Extreme Risks, Vulnerabilities and Community- Based Adaptation in India (EVA)

A PILOT STUDY

Final Report on WP4
Participatory assessment of adaptation and risk management options for the drought-prone drylands of Jalna District, Maharashtra, India

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Abstract

Climate change will increase the vulnerability of societies around the world. Changes in the frequency and magnitude of extreme events, such as droughts and floods require measures to reduce the vulnerability of communities in developing countries. However, there is a need to better understand the perspectives and responses of local communities and decision-makers to plan for such changes.

Within the research project 'Extreme risks, vulnerabilities and community-based adaptation in India (EVA): a pilot study', the impacts of and responses to extreme events on agriculture and water resources are assessed in nine villages in the drought prone drylands of Jalna District, Maharashtra, India.

In this report, we describe a prioritization approach based on multi-criteria analysis with a participatory focus which we applied to assess how local communities and local officers assess adaptation options in response to climate change.

On the basis of consultations with drought-affected communities and district-level officers in Jalna District, a long list of 26 adaptation options pertaining to agriculture, water and social development was identified. During workshops with block-level officers and at village cluster level, participants were asked to rank criteria and score these adaptation options. At the village cluster level, the scoring was done separately by different groups of stakeholders—farmers affiliated with village-level committees, other farmers, landless labourers, women and youth.

This approach helped us understand the diversity of adaptation priorities across scales and different stakeholder groups within a community. Results indicate considerable agreement about some adaptation options like construction of water conservation structures and educating youth, but sharp differences with respect to others. Some options like integrated farming system received high scores from officers, but were relatively unfamiliar to farmers; conversely, farmers appreciated the need for measures like groundwater regulation and water budgeting, while officers deemed them unfeasible. Women were less aware of policy-type options, but gave high scores to good practices like water conservation, drip irrigation and to social options like women's capacity building and strengthening of self-help groups (SHGs) for credit.

Acknowledgements

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We thank district-level and block-level officials of various departments who generously shared their knowledge and time with us. We are extremely grateful to officials of the Krishi Vigyan Kendra, Kharpudi, for their time and cooperation in facilitating our consultations in Jalna. Our utmost appreciation is to the communities of Asarkheda, Nivdunga, Dongaon, Kadegaon, Malegaon, Warudi, Palaskheda Pimple, Thote Pimpalgaon and Barav Pimpalgaon, who welcomed us and shared their concerns and aspirations with us during several workshops and interviews.

1 Introduction

In this report we present and discuss the outcomes of Work Package 4 (WP4) 'Participatory assessment of adaptation and risk management options', under the Extreme Risks, Vulnerabilities and Community-Based Adaptation in India (EVA): a pilot project. The overall project has assessed the impacts of and responses to extreme events on agriculture and water resources in nine villages in the drought-prone drylands of Jalna District, Maharashtra, India.

1.1 EVA

The Marathwada region is just coming out of the worst drought in 40 years. The Jalna District has provided an opportunity to explore the impacts of climate change and extreme weather on water and agricultural resources and the responses at community and district levels. The Jalna District is a central district in the state of Maharashtra in western India, see Figure 1.

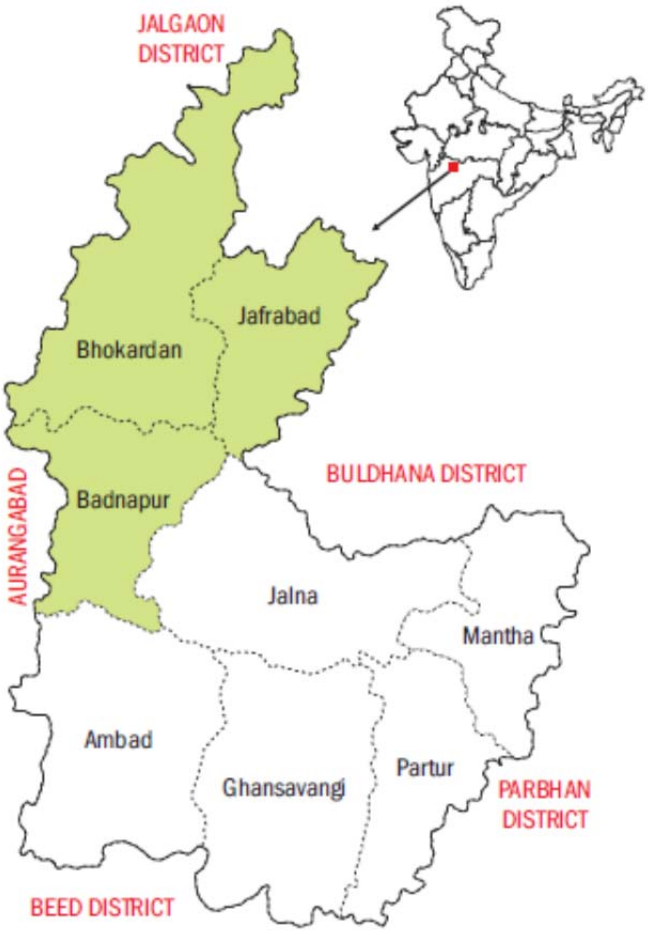


Figure 1. Jalna District in Maharashtra state, India
Source: Modified from http://jalna.nic.in/picture/jlnmap.jpg

The EVA project is based on a mixed-method approach, combining analysis of climate risks with participatory assessments of human and natural vulnerability. It uses multi-criteria analysis to rank and prioritize adaptation options and combines a livelihoods framework with institutional and governance analysis of adaptive responses and opportunities at local and district levels. The project involves extensive field work at village and district levels, semi-structured interviews, household surveys, policy and institutional analysis and participatory workshops. Field work has

been carried out in three blocks in Jalna District, which was severely affected by the 2012 drought. A cluster of three villages was surveyed in Badnapur, Bhokardan and Jaffrabad block; they are highlighted green in Figure 1. The nine villages selected in the three blocks are Asarkheda, Nivdunga, Dongaon, Kadegaon, Malegaon, Warudi, Palaskheda Pimple, Thote Pimpalgaon and Barav Pimpalgaon.

1.2 Climate change

Climate change will increase the vulnerability of societies around the world. Changes in the frequency and magnitude of extreme events, such as droughts and floods require measures to reduce the vulnerability of communities in developing countries. However, there is a need to better understand the perspectives and responses of local communities and decision makers to plan for such changes.

The normal annual rainfall in Marathwada is low, and it is characterized as a frequently drought prone area, where drought[1] can be expected every six to ten years (Shewale and Kumar 2005).During the years 1875–2004, it has experienced drought 18 times, including two years of successive drought in 1984 and 1985.

Rainfall data for Jalna shows great year-to-year variability (EVA WP1 report 2014). The 30-year period from the early 1940s had few droughts until the extreme drought of 1972, during which the state Employment Guarantee Scheme (a precursor of the National Rural Employment Guarantee Scheme) was introduced as a drought response measure. In recent years, however, there appears to have been a decline in rainfall, culminating in the extreme drought of 2012. Moreover, according to data recorded at the Badnapur Research Station, June rainfall has declined while September–October rainfall has increased over the period 1984–85 to 2010–11. This has important implications for farmers in terms of sowing dates and irrigation.

Climate change is expected to bring an increase in rainfall in Jalna. However, an increase in average rainfall may be accompanied by large variations from year to year and within a season. More uncertain and erratic rainfall could have important impacts on water resources and agricultural livelihoods in Jalna. The proportion of rainfall from extreme rainfall events is also likely to increase. However, much of this excess rainfall may be lost to runoff and many not help recharge groundwater aquifers. Moreover, it may worsen existing problems of soil erosion. Unless this rainfall is stored for irrigation and drinking water, climate change could pose an added stress on farmers in Jalna, who are already dealing with falling groundwater levels, rising input prices, poor soil fertility and changing market prices.

1.3 Adaptation to extreme events

The special IPCC report on managing the risks of extreme events and disasters to advance climate change adaptation defines adaptation as:

> 'Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate human or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate' (IPCC 2012).

[1] The IMD defines drought in any area when the rainfall deficiency in that area is 26 per cent or more of its long-term normal/average.

When defining Community-based Adaptation (CBA) to extreme events it is important to clearly describe the different elements of CBA, this is relevant when specifying the adaptation options that have been identified by the participants of the different participatory assessment workshops.

Adaptation: We follow the definition from the IPCC SREX report (IPCC 2012) and the most recent IPCC AR5-WGII (IPCC 2014) report. In the context of CBA, Schipper et al. (2014), also argue that CBA should be adaptation that focuses on first-order climate change impacts and that a CBA activity should include 'scientific and local knowledge contributing to a understanding of whether the risks of climate change impacts are likely to increase or not' (ibid.).

Based on: This relates to a wide set of important characteristics of CBA, stated by Ayers and Forsyth (2009); Magee (2012); Schipper et al. (2014); and IPCC (2012), where CBA:

- operates at the local level, the intervention is visible on the ground
- strengthens the capacity of local people to adapt
- centres around the priorities and processes chosen by the community
- options are generated through participatory processes involving local stakeholders
- no independence of the wider policy context

Community: IPCC (2012) indicates that through CBA, community members are empowered to take control of the process involved. Schipper et al. (2014) strongly emphasize that it is very important to ask the question 'Who do we mean by "the community?" '. It is relevant to identify who will, will not or should benefit from CBA initiatives in a community.

1.4 Participatory assessment

Understanding present adaptive capacity

There are a number of participatory methods for understanding present patterns of community-level adaptation to drought, determinants of and barriers to adaptive capacity (see Table 1 for an overview).

Time-related (e.g., seasonal diagram) and space-related (e.g., mobility map) methods can be used to identify agricultural practices adopted to deal with rainfall uncertainty or deficit; household options for income smoothing (ex ante) and consumption smoothing (ex post); measures adopted by men and by women. Relational methods can be used to identify collective coping strategies (village-level; beyond village-level) and to assess who would play a decisive/controlling role in their adoption.

Table 1. Classification of participatory methods

Space-related	Time-related	Relational
Transects Resource maps Social maps Mobility maps Service and opportunities maps	Time line Trend analysis Daily activity schedule Seasonal diagram	Venn diagram Force field analysis (drivers and constraints) Cause–effect diagram Problem ranking/scoring Wealth/well-being ranking

Source: Mikkelsen (2005)

Participatory stakeholder analysis is a useful tool to identify the relevant individuals and institutions. When a research team is not familiar with the local context, tools such as the importance-and-influence matrix or Venn diagram (e.g., Figure 2 and Figure 3) ensure that we do not neglect influential but less visible stakeholders or uninfluential but directly affected stakeholders. The social capital assessment tool can be used for understanding less tangible forces

influencing adaptive capacity. These approaches have been used during field work, and the process and outcomes are described in EVA WP3.1 Report.

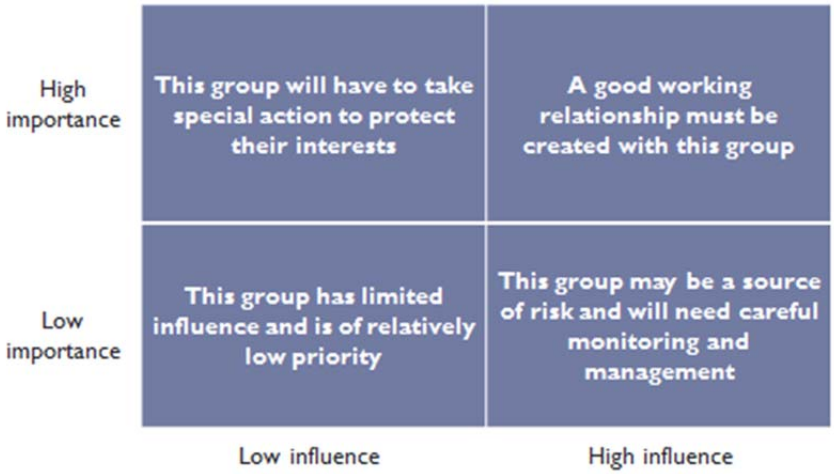


Figure 2. Importance-and-influence matrix for participatory stakeholder analysis
Source: Evans et al. (2006)

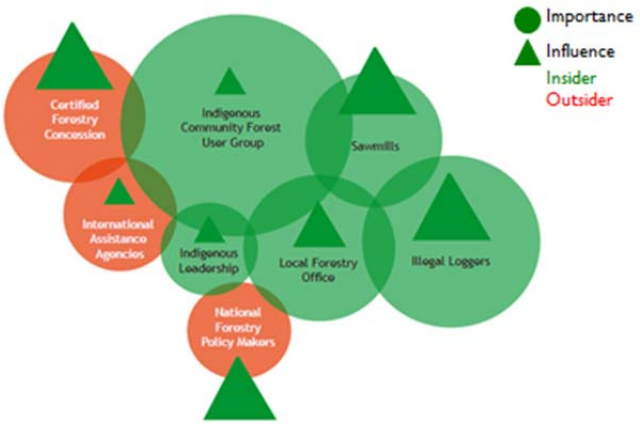


Figure 3. Example of Venn diagram exercise for participatory stakeholder analysis
Source: Evans et al. (2006)

Discussing future strategies

Evans et al. (2006) describes four participatory methods for discussing the future with natural resource-dependent communities. This includes scenarios, projections, visioning and pathways. Where *scenarios* are 'plausible futures, each an example of what might happen under particular assumptions' (MEA 2005). They are logically consistent and realistic stories about the future. Scenario exercises involve community-level group discussions to build a historical timeline, identify the forces that drove observed changes, elicit concerns about the future and draw out creative answers to 'what if' questions. Different starting points can be used to create narratives, to analyse possible impacts and discuss how the community can prepare for opportunities and threats. *Projections* are defined as 'forecasts of the future based on current trends'. *Visioning* is an exercise by which a group of people can imagine a common ideal future. It starts by deciding a timeframe for the vision, discussing today's concerns, and then developing a vision of the future. Drawing or collage exercises can be used to discuss aspirations (Banerjee and Duflo 2011) and build visions for the future (Kasemir et al. 2003). *Pathways* are follow-up exercises to Visioning or Scenarios to devise specific actions to attain the desired future. Such exercises help the

community to identify what they are lacking, to develop strategies (with action points, timetables, and responsibilities), including partnerships that can be built within and outside the community. To move away from an overly negative approach of identifying problems and gaps, the appreciate inquiry approach starts instead by discussing local strengths and achievements.

Learning from other communities

Chaudhury et al. (2012) describes the use of climate analogue methods, which use examples and site visits to see farmer adaptation in worse off analogue sites. They point out that 'people prefer to learn from successes than failures, and expressed a desire to see situations where local communities are successfully dealing with their potential climate, rather than suffering from it'. The EVA project conducted a community-level workshop in July 2013 where farmers from the EVA study villages and farmers from other villages (mainly Kadwanchi and Shivani) in Jalna attended. The purpose of the workshop was to expose farmers from the EVA study villages to best practices (i.e. in agriculture, cropping practices, watershed development, rainwater harvesting, water use efficiency, water budgeting etc.) adopted by farmers in other villages that have done well even during the extreme drought of 2012–2013. A full report of this workshop can be found in the field visit report.

1.5 Assessing adaptation options

There are different assessment methods to prioritize adaptation options, such as Cost-Effectiveness Analysis, Cost-Benefit Analysis and Multi-Criteria Analysis. Niang-Diop and Bosch (2005) have developed a flowchart to summarize the choice of method (see Figure 4).

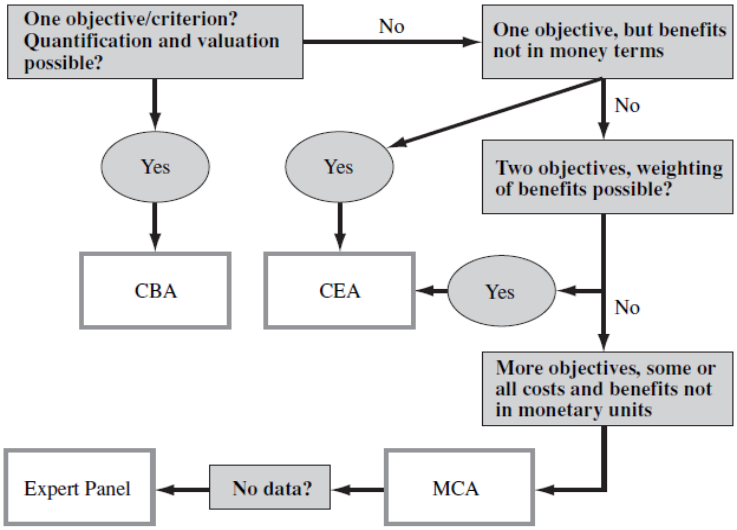


Figure 4. Flowchart choice of method for prioritizing adaptation options
Source: Niang-Diop and Bosch (2005)

The flowchart provides an intuitive way to choose an appropriate method for assessing adaptation options. When additional objectives are considered and not all costs and benefits of adaptation options are quantified, Multi-Criteria Analysis (MCA) is a suitable method to prioritize options.

Given the multiple qualitative objectives involved in the EVA project, we choose MCA for WP4 and provide in Chapter 2.2, in further detail, the approach we have taken to use MCA in the participatory assessment of adaptation options.

1.6 Objective of WP4

The objective of WP4 is to develop adaptation strategies for enhanced risks of extreme events in water and land systems for local, state, regional and national authorities, emphasizing the coordination of strategies between different parties and levels of decision making. The work package seeks to evaluate different adaptation options related to local barriers and to clarify the objectives of initiating adaptation by different agents and various levels of decision making involved in developing adaptation strategies.

To achieve this objective the team organized:

- Future thinking sessions at three village cluster level workshops and one district-level workshop in February and March 2013. Introduction to global changes and projections for future climate change were presented and participants were asked to identify adaptation options after discussing the impacts of climate change.
- A workshop on 10 July 2013 with block-level officers and extension agents. Participants were asked to rank criteria and prioritize the long list of adaptation options identified during previous rounds of field work. The barriers to implementing such measures were discussed.
- Three village cluster level workshops during 21–23 October 2013 to prioritize the long list of adaptation options identified during previous rounds of field work. The prioritization of adaptation exercise was done separately by different groups of stakeholders—farmers affiliated with village-level committees, other farmers, landless laboureres, women and youth. The structured interviews conducted as a part of policy and governance framework also provided information about the adaptation strategies.

The results of the prioritization exercise conducted are analysed and compared to identify scale mismatches and opportunities for coordination. A long list of adaptation options has been constructed where the options are further defined and evaluated for several categories, such as key actors, effect of adaptation option, actions to apply adaptation option, barriers. This final report on WP4 presents and discusses the conducted participatory vulnerability analysis and identified adaptation options at the community and district level.

1.7 Outline of the report

After the introduction to the EVA project, the objectives of WP4 and the participatory assessment of adaptation options, we continue with a more in-depth introduction to the selected methodology in Chapter 2, with a literature review on the assessment of adaptation options and details about the Multi-Criteria Analysis. Chapter 3 provides an outline of the identification of adaptation options done in the different workshops and the resulting long list of adaptation options. The prioritization of adaptation options is presented in Chapter 4, with details of the criteria used and ranking of options done at both the block-level and cluster-level, followed by the analysis of the top 5 prioritized options. Chapter 5 discusses barriers to adaptation, in general and in more detail for a few adaptation options that have been ranking high. Chapter 6 continues with a more in-depth evaluation of the identified and prioritized adaptation options, including indicators of adaptation options and using a metrics approach. The report provides a summary of the assessment of the options and recommendations for further research and policy makers in the concluding Chapter 7.

2 Methodology

2.1 Literature review

2.1.1 Overview of adaptation process

Adaptation to climate change has become inevitable in the light of the impacts being manifested in different forms such as changing frequency of extreme events. Adaptation is a challenging process, especially in regions where development needs itself have not been addressed appropriately. However, it also provides the opportunity to integrate climate change concerns while targeting the development needs of the region. The process of adaptation starts from understanding the vulnerabilities in the system and identification of adaptation needs. There can be several methods for identifying adaptation needs such as expert consultation, impact projection and impact detection and attribution. Based on the adaptation needs, the next step is identifying adaptation options, followed by appraising adaptation options (Noble et al., 2014; PROVIA, 2013; Bhadwal et al., 2013). These background steps help in planning and implementation of adaptation options followed by monitoring and evaluation of adaptation. Figure 5 shows an example of an adaptation learning cycle developed by PROVIA (2013), which highlights the cyclical process of adaptation learning.

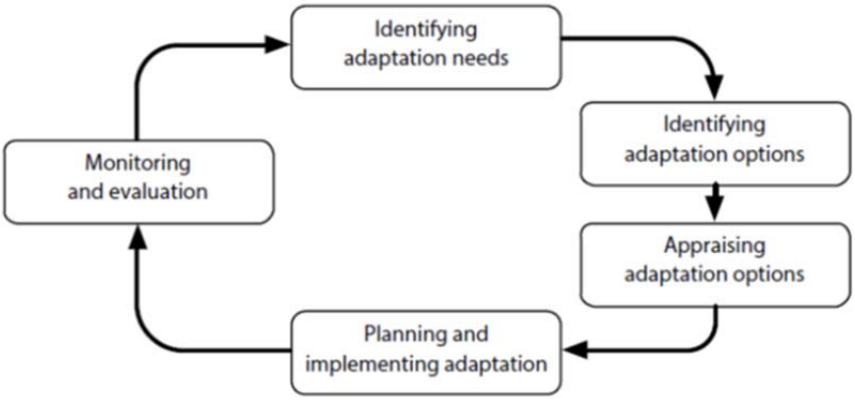


Figure 5. Adaptation learning cycle
Source: PROVIA (2013)

In a developing county context, it also becomes important to integrate this adaptation cycle in the existing development programmes. USAID has suggested a design process integrating the V&A approach (assessing vulnerability and identifying and implementing climate change adaptation) in the general development project cycle (Figure 6). Identification of adaptation options, conducting analysis and subsequently deciding on the course of action form the key steps of this project design phase for climate change adaptation (USAID 2007). While the adaptation learning cycle suggested by PROVIA focuses on each of the steps involved in adaptation process, the USAID approach helps in understanding how these basic steps can be integrated in the development projects.

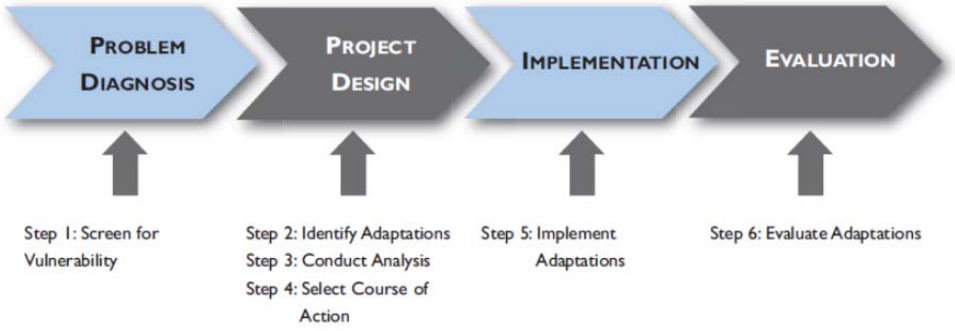


Figure 6. Project cycle which integrates VA approach
Source: USAID (2007)

2.1.2 Approaches for identification of adaptation options

Identifying suitable adaptation options is a critical step in the process of adaptation as there are a number of uncertainties involved regarding the understanding of the kind of expected impacts of climate change. One of the approaches to address this uncertainty is generation and analysis of climate information. This includes understanding the historical climate trends, current climate variability and also the future projections. Subsequently, assessment of impacts of climate variability on the sectors in consideration can be carried out. Based on this information, identification and analysis of possible adaptation options can be done taking into consideration uncertainty and different types of adaptation (PROVIA, 2013). This identification of the theoretical range of adaptation options can be done on the basis of scientific literature and also in consultation with the relevant stakeholders who have the appropriate knowledge of the local context (Hisali et al. 2011; Bhadwal et al. 2013). Adaptation measures can be categorized into no-regret, low-regret and high regret investments with increased complexity, costs and risks depending on the impacts of uncertainty of the climate information being used. Choosing no-regret and low regret options can be a 'win-win' option which can contribute in enhancing the adaptive capacity of the communities.

2.1.3 Approaches for prioritization of adaptation options

After the identification of adaptation options, prioritization of adaptation options is the next step in the adaptation process. There can be various methods and approaches for ranking and prioritization of adaptation options. Some of the commonly used tools include cost-benefit analysis and multi-criteria analysis which allows the assessment of different adaptation options against a number of criteria with each criterion having a weight (FCCC 2012). The Highnoon study for Ganges basin followed a participatory approach for identification and prioritization of adaptation options using a pairwise ranking method with the communities and analytical hierarchy process tool with researchers (Bhadwal et al. 2013). Similar approach was used by Ebi and Burton (2008) for prioritization of adaptation options to reduce health risks. Haque et al. 2012 did a study on participatory integrated assessment of flood protection measures for climate adaptation in Dhaka. The method used for assessment of adaptation options was MCA. After selection of adaptation options through consultation and literature, the evaluation criteria for prioritization was identified and selected in a participatory manner through Focus Group Discussions with stakeholders. Weights were given to the criteria and scoring of adaptation options was done in consultation with stakeholders. De Bruin et al. (2009) did a study on the identification of adaptation options and ranking of alternatives for the Netherlands. After identification of adaptation options based on literature review and consultation of stakeholders, a qualitative assessment of characteristics of the options was done. A set of criteria were selected based on expert judgement. The scores of the options on various criteria were done by the experts. The combined weights for ranking of options were done using MCA.

2.1.4 Approaches for evaluation of adaptation options

Assessment and evaluation of adaptation options is an integral part of the adaptation process, required to ensure more effective and efficient implementation process. The latest IPCC report (WG II) mentions three roles of evaluation as suggested by Preston et al. (2011): (1) ensuring reduction in societal and ecological vulnerability, (2) facilitating learning and adaptive management, and (3) providing accountability for adaptation investments (Noble et. al. 2014). Having a clear understanding of the adaptation process and evaluating its effectiveness also becomes indispensable due to the limited resources available to address the complex, uncertain challenges of climate change (Doria et al., 2009). Moreover, due to the uncertainties related to climate change impacts, evaluation is also important to avoid maladaptation. Evaluation of adaptation options primarily tries to assess their effectiveness in reducing the vulnerability towards climate change. There can be a series of objectives and outputs desired from the adaptation options and these needs are to be evaluated. For instance, a very important factor when considering adaptation is distribution of benefits across different social and economic groups. Also, unlike mitigation, adaptation is context specific and there are many local factors governing the success of adaptation practices. For this purpose, monitoring and evaluation can help in improving the understanding of adaptation.

Rosenzweig and Tubiello (2006) have mentioned three economic approaches for evaluating impacts and adaptation measures—cost-benefit analysis, cost-effectiveness analysis and multi-criteria analysis. While cost-benefit analysis looks at the overall costs involved in implementation and maintenance of adaptation options and the benefits of the option both in short and long term, cost-effectiveness analysis involves estimating the least expensive option to achieve the objectives and is useful in the adaptation process when it is difficult to quantify the benefits of adaptation options. Apart from prioritization of adaptation options (as discussed earlier), multi-criteria analysis can also be used for evaluation of adaptation options taking into account a wide range of criteria apart from costs and using multiple evaluation methods. Using an MCA approach provides the advantage of evaluating the options with respect to more than one criteria and also getting the results in the form of a single index value for each of the adaptation options for evaluation. Since this method can involve stakeholder participation it can help in understanding the overall effectiveness of adaptation on the ground.

Besides these there are other approaches used for evaluation of adaptation. An analysis of monitoring and evaluation processes of adaptation projects across six development agencies done by OECD revealed that Results Based Management and Logical Framework were the most common approaches used by the agencies similar to the approaches used in normal development projects (Lamhauge et al. 2012). One of the approaches widely used for evaluation of adaptation is the use of metrics. Metrics involving indicators can be used for measuring the effectiveness of adaptation options. Other approaches used for evaluation include methods such as simulation models, GIS-based methods and expert elicitation using empirical (e.g., probit models) or non-empirical approaches (e.g., workshops) (Prabhakar et al. 2011).

In this study under the EVA project, we used Multi-Criteria Analysis for the participatory assessment of adaptation options. As indicated by the review of literature, MCA has been widely used in several studies to prioritize adaptation options as it provides scope of assessment at a wider scale including more than one criterion. The next section (2.2) explains in detail the steps which were followed using MCA under the EVA study.

2.2 Multi-Criteria Analysis

The broad steps followed in MCA are:

1. Define the problem
2. Define the goal of adaptation intervention
3. Define the criteria to assess the effects of adaptation options
4. Identify the alternative adaptation options
5. Estimate the effects of the adaptation options
6. Give weights to the different criteria
7. Rank adaptation options

In ranking preferences between adaptation options, care should be taken to apply all criteria in the same direction (e.g., if simplicity is preferred, then lower cost should be preferred). With quantitative information, negative signs can be used to ensure uni-directionality, as in Example 1 below (Table 2). In Example 1, the options are given in rows, and the criteria are listed in columns. The quantitative data in Example 1 can be normalized by applying the following formula to each column: (option–minimum)/(maximum–minimum). The average score for each option is then calculated as a weighted or un-weighted average along each row, see Table 2.

Table 2. Example 1 - MCA with quantitative data

	Impact on agricultural production (million hectare days)	Impact on health (million DALYs)	Damage to buildings and environment (million $)	Cost of adaptation option (million $)
Install pumps	1000	10	-70	-700
Improve drainage infrastructure	800	8	-10	-800
Organize manual labour on large scale	300	3	-10	-900
Do nothing / bear losses	0	0	-50	0

Source: Niang-Diop and Bosch (2005)

2.2.1 Pair-wise comparisons of criteria

The method for pair-wise comparisons of criteria is described below, following the explanation by Dodgson et al. (2009). If there are three criteria, A, B, and C, the following matrix is drawn and the question is asked for each pair of criteria: 'How important is criterion A relative to criterion B?'

	A	B	C
A	-		
B		-	
C			-

Dodgson et al. (2009) explain that responses can be collected and codified using for example a 9-point intensity scale, see Table 3.

Table 3. Code and scale for pair-wise comparison

How important is A relative to B?	Preference index assigned
Equally important	1
Moderately more important	3
Strongly more important	5
Very strongly more important	7
Overwhelmingly more important	9

Source: Dodgson et al. (2009)

If the finding is that B is more important than A, then the reciprocal of the relevant index value is assigned. Table 4 shows a typical matrix for defining the relative importance of three criteria.

Table 4. Matrix defining relative importance of criteria

	A	B	C
A	1	5	9
B	1/5	1	3
C	1/9	1/3	1

Source: Dodgson et al. (2009)

The next step is to estimate the set of weights that are most consistent with the relative preferences expressed in the matrix shown above. A straightforward method presented by Dodgson et al. (2009) is to: calculate the geometric mean of each row in the matrix; total the geometric means, and normalize each of the geometric means by dividing by the total just computed. The weights should sum to one, see Table 5.

Table 5. Estimation of a set of weights

Geometric mean			Weight
Criterion 1	$(1 \times 5 \times 9)^{1/3}$	3.5568	0.751
Criterion 2	$(1/5 \times 1 \times 3)^{1/3}$	0.8434	0.178
Criterion 3	$(1/9 \times 1/3 \times 1)^{1/3}$	0.3333	0.070
Sum		4.7335	(=1.00)

Source: Dodgson et al. (2009)

2.2.2 Pair-wise comparisons of adaptation options

Similarly, the adaptation options can also be compared in pairs to elicit relative preferences. This exercise is done with respect to each criterion, i.e., if there are M options and N criteria, then N separate M x M matrices must be created (Dodgson et al 2009). A simple hypothetical example is outlined below.

Which option is better with respect to criterion A?

	Change crops	Drip irrigation	Insurance	Education	Processing
Change crops	-				
Drip irrigation		-			
Insurance			-		
Education				-	
Processing					-

Which option is better with respect to criterion B?

	Change crops	Drip irrigation	Insurance	Education	Processing
Change crops	-				
Drip irrigation		-			
Insurance			-		
Education				-	
Processing					-

As the number of adaptation options increases to N, the number of pair-wise comparisons increases to [N(N-1)]/2 (We do not repeat reverse matches of pairs assuming that preferences are symmetric, i.e., if, while going down the first column, 'drip irrigation' is preferred to 'change crops', we do not again ask about the same pair of options while going down the second column) i.e., if there are 20 options, we will have to perform 190 comparisons for each criterion.

2.2.3 Matrix ranking and scoring

In this approach, the criteria are arranged along one axis of the matrix, while the adaptation options are arranged along the other axis (as in the example below in Table 6). Now going by one criterion at a time, the various options are ranked on an ordinal scale with respect to that criterion. The guiding questions can start with: which option is best for this criterion? Which is worst?

Table 6. Example of matrix ranking

Elements	Judging criteria				
	Cost	Frequency	Availability	Energy	Time
Walk	1	1	1	5	5
Car	5	4	5	1	1
Bus	4	5	4	2	2
Bicycle	2	2	3	4	3
Cart	3	3	2	3	4

Source: Davis (2001)

However, as argued by ICRA (2004) since ranking follows an ordinal scale (first, second, third, etc.) it does not show the magnitude of the relative differences (e.g., the alternatives ranked first and second might both be considerably better than that ranked third). For this reason, matrix scoring may be a preferred approach.

ICRA (2004) presents the following steps matrix scoring of a set of options:

1. Determine the options and criteria.
2. Arrange the options at the head of the columns in the first row of the matrix, and the criteria at the beginning of each row.
3. Use symbols or items to denote the options and criteria, where possible, to facilitate visualization.
4. Determine the scores. Decide on the range of scores to be used (e.g., 1–10). Ask the individual or group to place objects (stones, beans, etc.) in each cell of the table according to their perception of the value of the option according to the criteria.
5. If weighting is to be applied to the criteria afterwards (e.g., by ranking or scoring the criteria themselves), a fixed number of stones/beans (e.g., 10) should be distributed across each row (i.e., across the options).

(Alternatively, a fixed number of stones/beans (e.g., 50) can be distributed throughout the whole table: this automatically gives a weighting for each criteria, but may be more difficult for the group to manage.)

Examples of participatory matrix scoring exercises conducted in rural settings are given in Figure 7 and Figure 8. Here the criteria are listed in the first column, and the options are listed in the top row. The figures provide examples of a preference ranking matrix of income-generating activities in India and matric scoring and ranking of vegetables grown in Gambia.

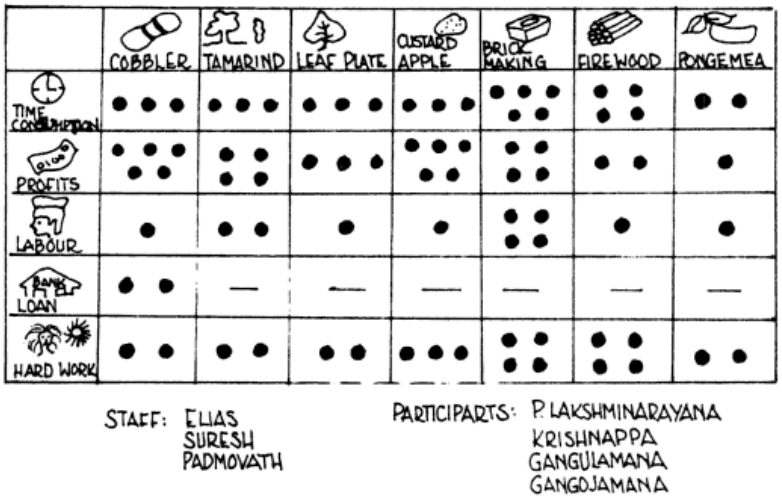


Figure 7. Example of matrix ranking and scoring of different income-generating activities
Source: Rietbergen-McCracken and Narayan (1998: 153)

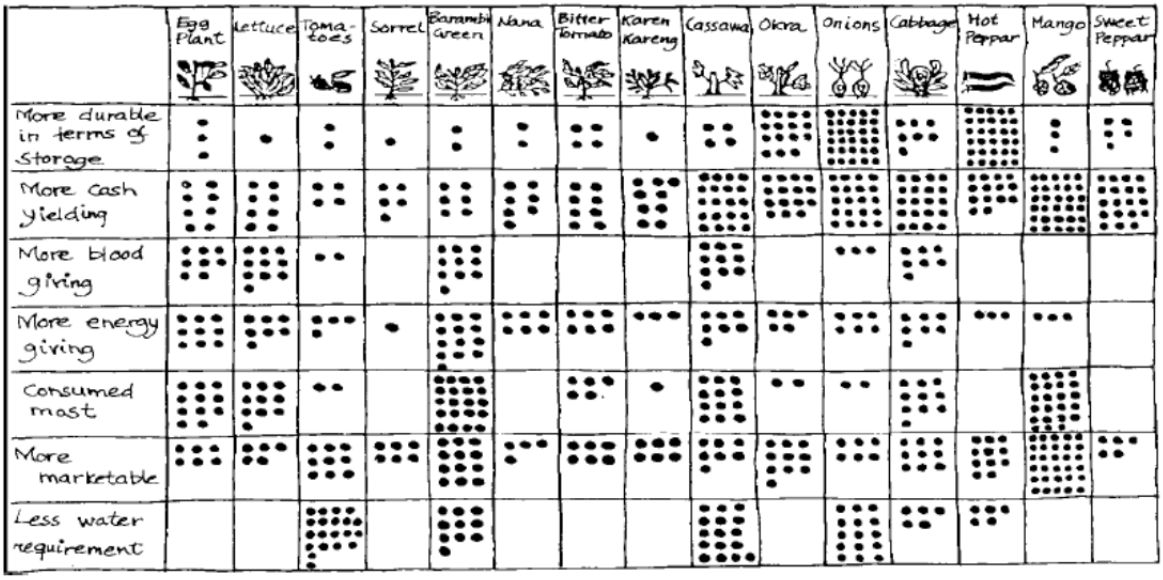


Figure 8. Example of matrix ranking and scoring of different vegetables
Source: *After* Guijt et al. (1992) *in* Mikkelsen (2005: 101)

2.2.4 Aggregation and prioritization

Moving from the scoring to a ranked list of options requires weighting and aggregation. There are several options for this step, which are discussed below.

Option 1 – Using equal weights for criteria
In the following example (see Figure 9), participants scored production problems according to three criteria (ICRA 2004):

1. how many farmers were affected

2. how important is the crop affected
3. how serious is the production problem (in terms of percentage of the crop affected and how frequent is the production problem).

They used a simple score of 1–3 (symbolized by x, xx and xxx, respectively, in the table below) to score each problem according to each criterion. The resulting scores were then added to rank the overall production problems, without weighting the different problem criteria.

Problem	Distribution of the problem	Importance of the crop	Importance of the problem	Problem Score
Nitrogen deficiency in maize	Most producers xxx	Maize xxx	xxx	1
Moisture stress in maize at flowering	Only N. Zone xx	Maize xxx	xxx	2=
High cost of weeding in maize	Most producers xxx	Maize xxx	xx	2=
Anthracnose in beans	Most producers xxx	Beans xx	xx	4=
Low plant population in beans	Most producers xx	Beans xx	xxx	4=
Nitrogen deficiency in tobacco	Few farmers x	Tobacco xx	xxx	6

Figure 9. Example of scoring of production problems
Source: ICRA (2004)

Option 2 – Overall ranking
Rather than average a ranking (which is not valid because of the ordinal scale), the respondents conducting the ranking exercise can be asked to give an overall rank, based on all the criteria considered together.

Option 3 – Weighting of criteria
Pair-wise comparisons (described earlier) can be used to develop weights for the criteria in a participatory manner.

Irrespective of the choice of weights and ranking method, the goal of the prioritization exercise is not to reach a final consensus or a 'best' list of adaptation options, but to go through a discussion and mutual learning among the participants and researchers, thereby gaining valuable insights into adaptation needs and their implementation (Antunes et al. 2011, ICRA 2004, Garmendia and Gamboa 2012).

2.3 Applied assessment framework

The steps introduced in Section 2.2 to conduct a participatory MCA are detailed for WP4 in the following way:

1. Define the problem: In case of Jalna, the main problem identified was climate extremes such as drought
2. Define the goal of adaptation intervention: The identified goal in this case was reduction of impacts of drought
3. Define the criteria to assess the effects of adaptation options: Two main criteria were identified to assess the effects of adaptation options based on literature. These were 'no regrets' and 'administrative feasibility'. Flexibility was kept to add a third criterion based on the responses from the participants. (Refer section 4.1)

4. Identify the alternative adaptation options: A long list of adaptation options was identified based on consultation with the communities using a 'what if scenarios' as well as literature. (Refer Chapter 3 for the process of identifying the options and the long list of adaptation options.)
5. Estimate the effects of the adaptation options: See specification of adaptation options in Section 3.6
6. Give weights to the different criteria: Weighing of the identified criteria was done through participatory process during the workshops. A sensitivity analysis of the different weights is provided in Section 4.4.
7. Scoring of adaptation options: This was done using a participatory process during different workshops conducted as part of the study. The options were given scores with respect to each of the criteria identified.

The project team detailed an assessment framework based on the ingredients discussed earlier, following the steps detailed in Table 7 below.

Table 7. Assessment framework

Step		**Process**
1	Develop 'What-if' scenarios	Based on results from WP1
2	Stock-taking of existing knowledge of present practices, potential adaptation options, barriers	Literature review and interviews with experts
3	Identification and selection of options	Workshop session with presentation of 'what-if' scenarios and discussion about adaptation options
4	Prioritizing of adaptation options by stakeholders	Selection and definition of criteria Scoring of options based on criteria Weighting of criteria Ranking of options
5	Evaluation of adaptation options	Sensitivity analysis Metrics approach Barriers

Interviews:

- Consultation with government officials was done to understand the barriers related to the implementation of top prioritized adaptation options. This included interaction with officials from agriculture and micro-irrigation department, Zila Parishad, Jalna.

Workshops:

- Future thinking sessions at three village cluster-level workshops and one district-level workshop in February and March 2013. Introduction to global changes and projections for future climate change were presented and participants were asked to identify adaptation options after discussing the impacts of climate change.
- A workshop was conducted on 10 July 2013 with block-level officers and extension officers. Participants were asked to rank criteria and prioritize the long list of adaptation options identified during previous rounds of field work. The barriers to implementing such measures were discussed.
- Three village cluster-level workshops were done during 21–23 October 2013 to prioritize the long list of adaptation options identified during previous rounds of field work. The prioritization of adaptation exercise was done separately by different groups of stakeholders: farmers affiliated with village-level committees, other farmers, landless labourers, women and youth. The structured interviews conducted as a part of policy and governance framework also provided information about the adaptation strategies.

Note that the workshops were conducted at different administrative levels (district, block and village) to capture the perspectives of different stakeholders. The district level is the top most level comprising different blocks. Each block has a number of villages and towns within them. The ranking exercises were well attended and had a good mix of farmers by age, landholding size, gender, and institutional connectedness. Annex A.1 provides an overview of the participants that attended the different workshops organized under WP4.

3 Identification of adaptation options

3.1 What-if scenarios

Climate change modelling for the Maharashtra region indicates a warmer climate with an extreme rainfall regime (EVA WP1 report 2014). This is because a warmer climate has greater capacity to hold moisture, and hence, there may be longer spells before rainfall is precipitated, and when it does, it may be heavier than usual. Hence, climate change may produce a different rainfall pattern than the past—one of heavy rainfall events interspersed with dry spells. According to climate model projections, the mean temperature increase for future time slices is in the range of 1.2°C to 2.9°C with the 2070s period showing the highest increase. The percentage change in rainfall relative to 1970–2000 baseline also shows an increase for the future time periods with the 2070s showing the highest increase of around 25.5%. Extremes in rainfall and temperature are also projected to increase with extreme wet days' index, warm nights' index and heat index showing an increase for the future time periods (EVA WP1 report 2014). The combination of these projected changes may lead to greater evaporation losses from water bodies, higher evapotranspiration rates and increased runoff loss (in the absence of storage structures).

These model projections were presented to farmers from the EVA case study villages in workshops in February 2014, and led to discussions on potential impacts and desirable adaptation strategies.

Future climate change trends:

- Temperature increase
- Rainfall days
- Frequency of droughts

Scenarios:

1. Increase in temperature
    - Increased irrigation requirement for Kharif crop
    - Decrease in rabbi crop yield
    - Introduction of new pests or increased pest attacks
    - Adverse impact on orchards
    - Scarcity of fodder and water for livestock and fall in milk production
    - Decrease in comfort level and impact on health of labourers
2. Increase in rainfall intensity
    - Soil erosion
    - High runoff
    - Increased damage by pests
    - Crop failure or fall in agricultural production
    - Adverse impact on health
3. Increase in drought frequency
    - Decrease in food production
    - Reduction in savings
    - Increased need for borrowing/loans
    - Unemployment
    - Reduction in farming activities and income

3.2 Identification of options

The 'What-if' scenarios are used to discuss with the participants, both at the village and district levels, the foreseen impacts of the scenarios and the adaptation options that can mitigate the impacts of future climate change trends. In the subsequent sections we specify how the activities have taken place in each workshop, the listed impacts and identified adaptation options.

3.3 Cluster-level workshops (February 2013)

3.3.1 Activity 'Future thinking'

The cluster-level workshop consisted of three activities: (1) general introduction, (2) participatory mapping and (3) future thinking. The aim of the participatory mapping activity was to bring back the resource maps that were made during the September 2012 field work and ground truth the resources that were then mapped by the participants. The community drought maps are input into the mapping activities of the project under WP2. After mapping of current resources and identification of different drought zones, the activity 'future thinking' aims in a participatory manner to stimulate future thinking and identify current community-based adaptation options for dealing with droughts. This will provide input for the overall project aim to prioritize community-based adaptation (CBA) options and a detail about the barriers of implementation of such options.

The activity consisted of three steps:

1. Introduction
   - Link future thinking with the mapping activity just done
   - There will be a short talk about trends on future climate change
   - Discussion aimed to list options to deal with future climate change
2. Climate change
   - Global change and future climate change; presentation based on TERI's work on the state of Maharashtra
3. 'What-if' scenarios
   - Discussion about the impact of the scenario on the community and the responses to adapt to such a situation

3.3.2 Jaffrabad Cluster

Around 50 participants from Asarkheda, Nivdunga and Dongaon were present at the workshop, and participated in the discussion about the identification of adaptation options. As the Introduction and Mapping activity extended further in time than expected, the Future Thinking activity was restricted in only covering the first scenario and partly the second scenario.

Scenario 1: Increase in temperatures

I. Climate change impacts

The participants indicated that they are currently observing a definite decrease in rainfall and a late onset of the monsoon. In terms of changes, as 1°C–2°C rise in temperature, the participants listed the following impacts:

a. Crops like wheat, jowar grown in the Rabi season will be affected.
b. Water requirement of cotton crop will also increase
c. Health—public health will be highly impacted due to rising temperatures
d. Labour—such changes would drive the labour community (landless laboureres) out of work

e. Orchards wilting—most of the orchards require less temperature for optimum growth. Increase in temperature may result in wilting of the flowers due to low water availability
f. Livestock—less water available for their consumption

II. Adaptation options
The participants identified the following adaptation options:

a. Increasing the number of watershed structures in order to increase the storage capacity. Additionally, wise utilization also needs to be followed. Over the years, the farmers have increased their uptake of groundwater due to factors such as increased use of chemical fertilizers. The number of wells have increased so much that currently, there are almost 3 wells in 1 acre of land.
b. Increasing returns on agriculture production
c. Undertaking soil and water conservation
d. Afforestation
e. Increase in the fodder production
f. Alternative livelihood options
g. Subsidizing the cost of renewable energy applications so that more and more farmers could implement it
h. Shade net but need to ease the procedural methods such as reduce pre-installation investment, agents/ middlemen involved,
i. Self Help Groups can ease the burden in times of drought
j. Cluster farming
k. Seed bank/fodder bank

Scenario 2: Increase in rainfall

The participants identified the following adaptation options to cope with the impacts on increase in rainfall:

a. Increase watershed structures
b. Cultivation of short duration crops on large scale
c. Increase in allied activities
d. Cultivation of fruits which have less water requirements
e. Water conservation
f. Increased dissemination of technology
g. Decrease dependency on Non-Timber Forest Produce (NTFP)

Photo 1. Future thinking activity – Jaffrabad Cluster

3.3.3 Badnapur cluster

Around 30 participants from Malegaon, Warudi and Kadegaon were present at the workshop, and participated in the discussion about the identification of adaptation options. First, the three scenarios were discussed with respect to the excepted impacts, followed by a discussion of adaptation options.

Scenario 1: Increase in temperatures

Climate change impacts

a. Decrease in comfort level
b. Increased water requirements
c. Introduction of new pests
d. Impacts on orchards owing to high temperature
e. Public health
f. Cropping pattern changed
g. Less milk production

Scenario 2: Increase in rainfall

Climate change impacts

a. Soil erosion
b. Crop failure
c. Less agriculture production
d. High runoff
e. Livestock health
f. Public health
g. Increased frequency of floods
h. Increased damage by pests
i. Impact on livelihood – owing to recurring droughts, the community loses its capacity to recover from the losses of the earlier drought. (Note: This year, they could survive since they had stored and saved from last year, as last year had good rainfall)

Scenario 3: Increase in frequency of drought

Climate change impacts

a. Decreased supply in food production
b. Decreased savings
c. Increased borrowing/ loans
d. Education
e. Health
f. Unemployment
g. Decreased farming activities

Adaptation options

In consideration of the 'what-if' scenarios, the participants identified a list of adaptation options, which were categorized in three levels, viz., personal, community and village/gram panchayat, see Table 8.

Table 8. Adaptation options identified at Badnapur cluster workshop

Personal	Community	Village/ Gram Panchayat
Afforestation	Afforestation	Renovation of river/nalla
Watershed structures	Grading, processing, packing, sale	Dissemination of technology (seeds which can withstand extreme drought conditions)
Wise utilization of water resources. Similarly undertaking more of drip/sprinkler irrigation	Cluster farming. This also needs to be supported with developing farm ponds, organic farming, finance options (but not grants/funds)	Training for drip/sprinkler irrigation (this can also be undertaken with the help of NGOs)
Controlled farming (Shade nets)		Concretization of farm ponds/ water storage structures
Tree plantation along the borders of the field		Individual water supply connections
Income diversification option such as poultry farming, goat farming		
Training for skilled labor work		
Processing of agricultural produce		

Source: own research

Photo 2. Future thinking activity – Badnapur Cluster

3.3.4 Impacts and options

Overall the participants of the village-cluster workshops listed expected impacts of the presented climate change scenarios, such as:

- Decrease in rabi yield
- Increase in irrigation requirement of kharif crop
- Decline in agricultural labour opportunities/wages
- Adverse impact on orchards
- Increase in pest attacks
- Scarcity of fodder and water for livestock

Based on the village-cluster workshops and literature review, the adaptation options listed out were, viz.:

- Changing cropping practices; switching over to fodder crops and introducing short duration crops
- Water harvesting; establishing farm ponds, KT weirs
- Water conservation and efficiency; introducing drip and sprinkler irrigation

- Soil conservation and enrichment through farm bunds
- Afforestation/reforestation (including on farm bunds)
- Technology, such as shading net/greenhouse, R&D and training on tolerant varieties and finance and credit for adoption of new technologies
- Income diversification (livelihoods that are less impacted by drought)
- Value-added enterprises (and training)
- Employment opportunities—labour schemes

3.4 District-level workshop (February 2013)

The district-level workshop was held at the Jalna District Collectorate Office, where the project team discussed the EVA project with over 10 participants from the District Collectorate Office, the District Collector, NABARD, and two farmers from Kadegaon and Asarkheda. The workshop consisted of three sessions, where session 1 provided a brief introduction to climate change and climate change projects for Maharashtra and Jalna. Session 2 discussed vulnerability to extreme events in Jalna based on EVA field work in the three village clusters. Issues discussed during this session were:

- Spatial variations in vulnerability due to soil quality, soil depth and access to irrigation.
- Severe impact of drought on livestock
- Large variation in institutional connectedness
- Gender issues related to women facing great burden of collecting drinking water.

Session 3 focused on adapting to extreme events, through presentation of "what-if" scenarios and the list of adaptation options that were identified in the village cluster-level workshops. The participants the list of options and added additional options, which resulted in the long list of adaptation options as presented in Table 9.

3.5 Long list of adaptation options

With input from the village-level cluster workshops, district-level workshop and literature review a long list of 26 adaptation options were identified. The project team categorized the long list of options in three sectors, viz., agriculture, water and society, which resulted in 13 adaptation options focused on agriculture, 6 adaptation options for the water sector and 7 options with a societal focus, see Table 9. In Annex A.2 the long list of adaptation options in Marathi is provided (see Table 34).

Table 9. Long list of adaptation options, per sector agricultural, water and social development

Nr.	Sector	Adaptation option
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)
3	Agriculture	Provide weather advisories/early warning system for drought to the farmers
4	Agriculture	Soil conservation and enrichment through construction of farm bunds
5	Agriculture	Promote better soil management
6	Agriculture	Promote organic farming (such as vermicomposting, mulching)
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops
8	Agriculture	Set up credit schemes to promote adoption of new technologies
9	Agriculture	Crop insurance (strengthening of insurance mechanisms especially in drought years)

Nr.	Sector	Adaptation option
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information), including for dairy, vegetables, millets
11	Agriculture	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy-based derived products)
12	Agriculture	Promote adoption an integrated farming system model
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs
15	Water	Promote greater awareness about the benefits of watershed development
16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies
17	Water	Promote water budgeting/planning management
18	Water	Promote protective irrigation and use of efficient irrigation technologies (drip and sprinkler)
19	Water	Afforestation and reforestation
20	Society	Women-focused capacity building
21	Society	Introduce innovative couple farmers forums
22	Society	Strengthening of local institutions such as Gram Sabha
23	Society	Education and mobilizing of youth
24	Society	Set up Self- Help Groups and train them to implement drought resilient livelihoods options
25	Society	Provide pensions or safety nets for elderly
26	Society	Strengthening of local level committees such as watershed committees and disaster management committee/formation of other local-level institutions such as user groups or farmer clubs

4 Prioritization of adaptation options

4.1 Criteria for scoring adaptation options

The adaptation options have been given scores with respect to the following criteria: (1) no-regret characteristics of the option, (2) administrative feasibility, and (3) public support and financial benefits.

No-regret options are options that are good to implement irrespectively of climate change. The United Kingdom Climate Impacts Programme (Willows and Connell, 2003) has defined no-regret adaptation options (or measures) as: 'options (or measures) that would be justified under all plausible future scenarios, including the absence of human-induced climate change'. *Feasibility* in the phase of implementation relates to the institutional and administrative complexity of realizing the option, whether or not radical institutional changes and adjustments are required. *Public support and financial benefits* emerged as an important criteria from block-level officials because they strongly felt that the effective implementation of any adaptation option requires the participation of people, who in turn will look for direct private gains in addition to the larger environmental or social benefits of the adaptation option.

4.2 Ranking of adaptation options

The scoring of the adaptation options to rank the adaptation options is done both at the block level and village level. This provides insight into the perspectives and responses of local communities and decision makers to plan for adaptation, both across scales and within communities. Scores were attached for each of the options and for each of the criteria, ranging from 1–5, with a detailed indication of what a low versus high score imply, see Table 10.

Table 10. Clarification of low and high scores for criteria

	Low score (1)	**High score (5)**
No-regret	Low no-regret characteristics, the net benefits are very low irrespective of climate change	High no-regret characteristics, the net benefits are very high irrespective of climate change
Feasibility	Realizing the options require radical institutional changes and adjustments	Realizing the option requires hardly, if any, institutional changes and adjustments
Public support – *People's participation and economic benefit*	The option is perceived as creating little direct financial benefits for people and is hence less likely to get people's participation	The option is perceived as creating direct financial benefits for people and is hence likely to get people's participation

The process followed in the different workshops and the overview of ranked options is presented in the following sections.

4.2.1 Block-level workshop (July 2013)

Criteria selection and Pair-wise ranking of criteria

A block-level workshop was organized on 10 July 2013 at KVK Kharpudi, Jalna. The participants mainly consisted of cluster and village-level agricultural officers and also some gram-sevaks from the three clusters of Jalna District. The project team introduced the criteria ('nikash') of no-regrets and interpreted it as 'robust in a range of climate scenarios' or even more simply in Marathi as 'appropriate in different situations' i.e., good rainfall years or bad rainfall years. Then a second criteria—'administrative feasibility'—was introduced. They felt that it is important to have a defined agency in charge of a scheme and to have clear administrative responsibilities. In addition, the project team asked if the participants wanted to add any other criteria. The participants indicated that people's participation (*lokasahbhag*), people's support, people's mindset (*manseekta*), financial benefits (*arthikphayda*), personal gain (*vyaiktiklabh*) are important criteria for prioritizing adaptation options. This lead to the consensus of adding a third criteria on financial benefits and people's support, see Table 11 for the details of the defined criteria used for scoring the adaptation options.

Table 11. Criteria for scoring adaptation options

Name of criteria ('nikash')	Interpretation	Marathi terms used
No-regrets	Appropriate under different scenarios	Veg-*veglyaparisthiteetyogya*
Administrative feasibility	Administrative simplicity/ease	*Prashasakeeyasulabhata*
People's support and financial benefits		*Aarthikphaydaaanilokasahbhag*

Later participants voted for the important criteria on which the long list of adaptation options would be rated. The results of the voting were as follows:

1. No regret criteria is more preferable (by 5X) to administrative feasibility
2. No regret criteria is more preferable (by 5X) to people's participation.
3. Administrative feasibility is more preferable to (by 5X) to people's participation.

It should be noted that all the officers strongly correlated the criteria of people's participation with that of financial returns that would be generated for the beneficiaries. The reason behind this correlation was that, according to them, people will participate in any development scheme only if such a scheme ensures some kind of short-term financial returns for them. At the same time, this participation is essential for the success of any scheme or programme of agricultural development.

All participants spoke strongly about the crucial importance of people's participation, but then deferred to our criteria of no-regrets and administrative feasibility when it came to pair-wise ranking of criteria. Even when the project team tried to flip the comparisons, they remained with their relative ranking. The facilitations noted that the discussion was dominated by 1–2 persons though they tried their best to get everyone to speak. The criteria weights given were 5 or 1. The participants conducted a pair-wise ranking of criteria, indicating which criteria was more important that the other, see Table 12 for the results of the pair-wise ranking of criteria, with the criteria weights for the three criteria 'no-regrets', 'administrative feasibility' and 'public support and financial benefit'.

Table 12. Pair-wise ranking of criteria

	No-regrets	Administrative feasibility	Public support and financial benefit	Geometric means	Criteria weights
No-regrets	1.00	5.00	5.00	2.92	0.69
Administrative feasibility	0.20	1.00	5.00	1.00	0.23
Public support and financial benefit	0.20	0.20	1.00	0.34	0.08

Scoring of adaptation options

In four break-out groups the participants were asked to score the adaptation options with respect the defined criteria. Each group received a matrix of a sub-set of adaptation options and the identified criteria and coins to score the options. Participants place objects in each cell of the matrix according to their perception of the value of the option according to the criteria, ranging from 1–5.

Group 1 - Agriculture 1

While discussing the short-listed adaptation options, one of the participants highlighted that one of the key reasons for soil erosion is lack of afforested area on the farm boundaries. Introduction of carbon credits for afforestation initiatives can encourage the farmers to undertake more of afforestation. Simultaneously, pockets of open land need to be identified for afforestation as no land is available for such initiatives.

The officers felt that there are two most important requirements for any project/scheme to be implemented efficiently, viz., community participation and financial security. Without community participation, neither can the programme be implemented efficiently nor will the community have any ownership towards it. Community participation also ensures better maintenance of the watershed structures, thus making it sustainable for a longer period.

Consequent to water and watershed management, soil management shares a larger role in agricultural security. Large benefits can be reaped if soil conservation is achieved and appropriate measures are taken for its overall management. But soil management also involves several administrative difficulties. Different departments are involved for different processes and hence the task becomes cumbersome.

Contrary to the preferences of the community members (farmers), the block-level officers felt that weather advisories are not useful and hence less important. The officers felt that during catastrophic events such as erratic rainfall or hailstorms, even though early warning forecast are disseminated, few steps can be taken to protect the crops in short time. Small farm holders, who are financial secured, can use techniques such as covering their harvest with shade nets, but for large farmers it is difficult.

Though crop insurance is considered as a safety net, the process of availing crop insurance needs to be simplified. Farmers lack belief in this system as they need to spend lot of time in procedural complications and few of them receive the insurance. In case of weather-based crop insurance, since the benchmark for rainfall or other weather-related events are considered for the block, individual farmers face difficulties in receiving the compensation.

The block-level officers also felt that strengthening the gram sabha would not serve in building the capacity of the community, as the heads of the gram sabha would then misuse the power entrusted to them. This would also lead to more conflicts in the village. The group discussed specially option 5 'Promote better soil management', with regard to soil testing.

Group 2 - Agriculture 2

Prioritization with respect to no-regret criteria

For the first criteria of 'no regrets', the least ranking of 1 was given to credit schemes. It should be noted that here the criticism of the participants was not on the credit/loan facilitations/schemes but on the usual government policies of waivers on loans as a response to drought.

All the rest options were ranked high (4–5) because those were perceived to be beneficial for farmers irrespective of the climatic constraints.

Prioritization with respect to administrative feasibility

For the next criteria of administrative feasibility, credit systems and marketing facilities were deemed with least ranking (of 2, in both cases). Whereas, livelihood diversity received highest ranking 5, as the participants thought that it was not really an administrative responsibility but an individual strategy to diversify one's livelihood options.

Prioritization with respect to people's participation and economic benefits

For the last criteria, participants were of the opinion that people's participation would be highest for (with ranking 5) for credit schemes, marketing facilitation, integrated farming and integrated pest management and moderate for crop insurance and livelihood diversification. They did not really provide any rationale for these rankings.

It was observed that participants' decisions were influenced by not only their identities as agriculture officers and a part of state governance but also as individual farmers. Most of them had their own lands in their native villages and their personal experiences influenced their notions, especially in the administrative feasibility for credit and crop insurance institutions.

Group 3 - Water

Prioritization with respect to no-regret criteria

With respect to no-regret criteria, the participants gave maximum points to the adaptation option of promoting greater awareness about benefits of watershed development since they felt that awareness is a key driver for public participation and subsequently facilitates implementation of water conservation structures. For this reason, construction of watershed structures was given four points. Soil and water conservation treatment also becomes easier due to public participation. Afforestation was given less points since they found it less relevant for the area. Majority of the land is agricultural land and there is very less waste land. So, there is not much area available for afforestation.Water budgeting was also given less score since according to them budgeting can be done only once water conservation structures are in place. Right now only some farmers do budgeting at the individual level, only those who have their own farm ponds. Regulatory framework for groundwater was given fewer points as the respondents believed that it will not work in this place as the farmers will not follow any such regulation.

Prioritization with respect to administrative feasibility

With respect to this criterion, construction of water harvesting structures was given five points since it is easier to get sanctioned by the authorities and implement. Efficient irrigation option was given four points (the barrier in wider application of this option is from the farmers who are asking for more subsidy). To promote the idea, 70%–90% subsidy will be provided on drip

irrigation to all farmers to adopt this option. Groundwater regulatory framework was given 3 points with respect to administrative feasibility. Awareness on water conservation, afforestation and water budgeting were given less points with respect to this criterion.

Prioritization with respect to people's participation and economic benefits
Awareness on water conservation was considered as the most important adaptation option with respect to this criterion and was given 5 points as the participants felt that it is the key for cooperation from the communities in the implementation of any scheme. Awareness leads to more participation by the communities. Drip and sprinkler irrigation was given 4 points. Afforestation was also given 3 points as it would require participation of the communities. Construction of soil and water conservation structures was given fewer points because the participants felt that although people readily participate in implementation of such measures, these structures don't really give economic benefits to people.

Group 4 - Society
Prioritization with respect to no-regret criteria
Women's capacity building and drought-resilient livelihood options for SHGs were given 5 points each with respect to no-regrets criteria. They felt that SHG savings are important. It was felt that giving priority to such capacity building would yield benefits in difficult years. One example was training women to make and sell sweets (*pedhe*) from milk. They should be trained on income earning options (*jod-dhande*) and on bank linkages. However, this would also break down in drought years unless fodder security is ensured.

Agricultural training for women and youth were also given high points as it would improve yields. One example was use of shade nets. They said that the young generation is of great importance. Youth should be given agricultural science and vocational training, which would help reduce unemployment. Those youth who are dependent on agriculture cannot do anything else. They lose out on education. Agricultural training for women is very important but the problem that they acknowledged is that society is very male dominated. Unless agricultural training is made more widespread, know-how tends to be limited to a few large farmers who are well travelled and better informed.

Strengthening local committees was considered useful as they can guide farmers in different situations/scenarios. Strengthening of local institutions would be beneficial only if they are given training. Otherwise people fight and nothing changes.

Pension for elderly was considered least important. They asked, how much will the government give Rs 500–600? They felt instead that children should take care of their elders.

Prioritization with respect to administrative feasibility
Although pensions had not been given high points under no-regrets, they did give it high points under administrative feasibility. They said that though it is currently not very simple, but it is feasible. They felt that village-level surveys should be done by government representatives for this purpose (and to find alternatives?).

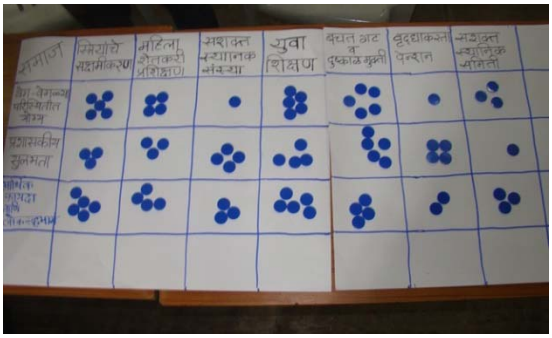
Women and child development department already exists and has schemes. But they gave it only 3 points under administrative feasibility.

They gave strengthening of local committees only 1 point. They said no one asks local committees (i.e., they do not have any say or power). Local village committees depend on block-level or district-level institutions (e.g., Zilla Parishad). They can do good work but their working

procedures (*karyapranali*) are not good. But they felt that empowerment of local institutions is very important. Strengthening of local institutions, which had not been given high points under no-regrets, got high points for administrative feasibility as they thought these institutions could get training and funds from the government.

Prioritization with respect to financial benefits/public support
Again, pensions for elderly were given low scores: they felt that spending on elderly cannot be justified as they do not contribute to work. Women's capacity building was given high points as it would elicit women's participation and economic benefits.

Participants of social adaptation group



Scoring of social adaptation options

Photo 3. Scoring of social adaptation options at block-level workshop

Prioritization of options

The ranking is based on a weighted summation of the scores on the criteria (1) no-regret characteristics of the option (weight 69%), (2) administrative feasibility (weight 23%), and (3) public support and financial benefits (weight 8%), combine the output from the four groups. See Table 13 for a detailed overview of the scored adaptation options and weighted sum.

From the ranking, the following adaptation options have the highest priority:

- Soil conservation and enrichment through construction of farm bunds (nr. 4)
- Promote better soil management (nr. 5)
- Set up Self Help Groups and train them to implement drought resilient livelihoods options (nr. 24)
- Promote adoption integrated farming system (nr. 12)
- Education and mobilizing of youth (nr. 23)

Options that score low on all criteria and are ranked low are:

- Strengthening of local institutions such as Gram Sabha (nr. 22)
- Provide pensions or safety nets for elderly (nr. 25)
- Set up credit schemes to promote adoption of new technologies (nr. 8)
- Afforestation and reforestation (nr. 19)
- Provide weather advisories/early warning system for drought to the farmers (nr. 3)

These options have a low weighted sum due to low scores for the 'no-regret' criteria as this criteria receives a very high weight in the weighted summation of the scores across the three criteria.

Table 13. Ranking with criteria weighting (Block-level workshop)

Nr.	Sector	Adaptation option	No-regrets (69%)	Administrative feasibility (23%)	Public support & Financial benefit (8%)	Weighted sum
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)	5	2	5	4,3
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	4	3	3	3,7
3	Agriculture	Provide weather advisories/early warning system for drought to the farmers	1	1	1	1
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	5	5	4	4,9
5	Agriculture	Promote better soil management	5	5	4	4,9
6	Agriculture	Promote organic farming (such as vermicomposting, mulching)	2	3	3	2,3
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops	2	1	3	1,9
8	Agriculture	Set up credit schemes to promote adoption of new technologies	1	2	5	1,6
9	Agriculture	Crop insurance (strengthening of insurance mechanisms especially in drought years)	5	4	3	4,6
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information) including for dairy, vegetables, millets	5	2	5	4,3
11	Agriculture	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy-based derived products)	4	5	3	4,2
12	Agriculture	Promote adoption an integrated farming system model	5	4	5	4,8
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management	4	3	5	3,9
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	4	5	2	4,1
15	Water	Promote greater awareness about the benefits of watershed development	5	1	5	4,1
16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies	2	3	2	2,2
17	Water	Promote water budgeting/planning management	2	2	2	2
18	Water	Promote protective irrigation and use of efficient irrigation technologies (drip and sprinkler)	3	4	4	3,3

Nr.	Sector	Adaptation option	No-regrets (69%)	Administrative feasibility (23%)	Public support & Financial benefit (8%)	Weighted sum
19	Water	Afforestation and reforestation	1	2	3	1,4
20	Society	Women-focused capacity building	5	3	5	4,5
21	Society	Introduce innovative couple farmers forums	4	3	4	3,8
22	Society	Strengthening of local institutions such as Gram Sabha	1	4	3	1,9
23	Society	Education and mobilizing of youth	5	4	5	4,8
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	5	5	4	4,9
25	Society	Provide pensions or safety nets for elderly	1	4	2	1,8
26	Society	Strengthening of local-level committees such as watershed committees and disaster management committee/formation of other local-level institutions such as user groups or farmer clubs	3	1	3	2,5

4.2.2 Cluster-level workshops (October 2013)

Following the workshops with block-level officers to conduct the multi-criteria analysis (MCA), similar workshops were conducted with the villagers at cluster level to understand their preferences for each of the select adaptation options.

Each of the workshops started with the EVA team explaining the objective and the course of the project until the field visits as well as the outputs that the team have obtained. Based on the outputs, a list of adaptation options were selected to carry out the MCA. The rationale to undertake MCA was to understand which options the villagers think would help them in adapting to the changing climate and its anomalies. The options were segregated into three categories depending on their relevance, viz., agriculture, water and social. The participants were required to rank the criteria under which the options would be easily implemented and adopted by the villagers.

The ranking was done in the following order.
1 – Least important
2 – Relatively less important
3 – Important
4 – Relatively more important
5 – Most important

The criteria, no-regrets and administrative feasibility, were listed based on literature study and the participants were free to add any criteria which they deemed significant. In the block-level workshop, the participants who were mainly from different government departments could easily grasp the context and added one more combined criteria, viz., public support and financial

benefit. Since these were added by the block-level participants, these options were not initially added in the cluster-level workshop, but could be added as per requirement.

The following break-out groups were established to score the options:

1. Farmers with institutional affiliations or village leaders (Gram Panchayat, watershed development committee, water supply and sanitation committee, Tanta Mukti committee, men's SHG leaders)
2. Farmers with no-institutional affiliation
3. Women
4. Landless labourers

As sessions started and the options were explained to the participants, it was observed that the participants, who had some affiliation with government currently or in the past, were able to rank the options quickly. The other groups, viz., farmers with no institutional affiliation, women (including members of local self-help groups), landless labourers or youth found it difficult to rank the options into different criteria. For these groups, the criteria of administrative feasibility did not seem significant as according to them, ideally administrative feasibility should be ensured irrespective of the situation. The following sections describe each of the workshops in details.

Badnapur cluster (Warudi, Malegaon, Kadegaon)

The workshop started with welcome speeches from EVA team as well as the sarpanch of Malegaon as they hosted this workshop. The EVA team explained in brief the objectives and the results obtained so far in this project.

General discussion

Farmers noted that in the last few years, duration of first phase of monsoon has decreased while the second phase has been extending longer than usual. However, they still have set periods of farming operations as before, thus with varying rainfall patterns, crops do get affected sometimes. EVA finding were presented from WP1 and WP2, and a discussion followed with the farmers on how impacts of drought are felt differentially even in a same village. Farmers shared how depending on the soil quality, the availability of the water differs in different seasons and accordingly give different productivity. For example, once the first rainfall is received, the coarse brown soil has enough water to grow orchards, but the soil quality is such that water is drained away and would not be available after three months to sustain the entire crop season of kharif. On the other hand, the rich black soil takes a long time for water percolation, hence seems dry in early months but retains the seeped in water for longer and is useful for crops like cotton.


Photo 4. Impression of scoring of adaptation options – Badnapur cluster

The participants were separated into four groups, viz., farmers with institutional affiliation, farmers without institutional affiliation, landless and youth. The group consisting of youth was formed, considering that there were large numbers of young participants and it was not possible to form a women's group. Women and landless labourers were largely absent from the group discussions, partly due to the fact that the workshop started around late morning and most women left for their household and later farm chores. On the other hand, the landless labourers started their day early and had already departed for their daily work.

Group I: Farmers with institutional affiliation

A total of nine participants joined this group, including Taluka Pramukh of political party Shivsena, ex-member Panchayat Samiti, member of the Farmers Cooperative Society, Gram Panchayat, Sarpanch, Deputy Sarpanch and Chairman of the Farmers Cooperative Society of the three villages (Warudi, Malegaon, Kadegaon) which are part of the Badnapur cluster.

Scoring the adaptation options as per their significance in 'no-regret' strategies:

- Given the latest concern, this ranking took place mostly on the criterion of significance of a particular option for drought resilience.
- While changing the cropping patterns was considered significant theoretically, farmers also felt that taking such decisions practically is not always easy. Since cotton is among the most valued crop in their villages (as it fetches more financial returns) most farmers are unwilling to experiment with other crops.
- Agricultural research was considered of utmost importance. Once again, farmers related it with cotton and cited how the research such as BT-cotton species has benefitted them.
- The advisory and information on weather updates was thought to be of general significance. However, farmers debated on its weightage over drought resilience. The first issue was of non-specificity of weather predictions. Presently available resources give information on weather for a larger area such as state, which does not enable farmers to take any decisive actions. The second issue was that of general uncertainty associated with weather. Farmers felt 'If the weather changes suddenly, or an unforeseen calamity strikes, we cannot change the crops that have already been standing in our farms. So how exactly having information on weather matter?'
- Soil conservation through area treatments were again considered important towards drought resilience. However, almost all the participants, especially who have been local leaders noted that generating the collective action for such initiatives is difficult. Farmers are usually unwilling to part with their land to construct the farm bunds and other area treatment structures.
- Soil management (through enrichment) was given the highest ranking because without the good quality top soil layer, there would be no agriculture.
- This group of farmers gave the one of the least weightage to organic farming, because they could not see how it will help them to face drought. Even if farming practices are organic, it would still need water.
- In this particular area, use of shade nets is not very prevalent. None of the participants had it installed on their farms. Shade nets are anyway used frequently by the vegetable growers, whereas this cluster depends heavily upon cotton. Their perceptions about shade nets were that it is quite expensive to get involved; moreover growing vegetable/seeds require lot of management efforts.
- The next adaptation option was of credit schemes for adoption of new technologies. However, most farmers of the group construed it as general credit schemes and unanimously counted it as one of the most significant adaptation options, for it gives the chance not only to start new initiatives in farming but also to survive during the difficult times such as droughts. Most farmers also noted that the informal credit sources (such as Savkar/Sahukar) are still quite abundant, and even inevitable in this region.

- Crop insurance was important but farmers are still not very aware of its importance and tend to miss the required premiums. On the other hand, the process of selection of which crop would get the insurance cover is also quite limiting.
- Market feasibility is important from the point of view of agricultural development. Participants recognized that getting good returns (via market feasibility) on non-drought years would increase farmers' capability to tide over the drought years.
- Participants found it difficult to decide over livelihood diversification as an adaptation option for towards drought resilience. It seems that in the present circumstances, the local agro-ecological system has already reached a station where very few farming households practice other so-called traditional means of traditional livelihood diversification such as animal husbandry. Therefore to integrate it once again, farmers felt that maybe some initial support might be needed. While no one argued upon the benefits of additional income sources which would provide a buffering during drought, they seemed unsure of whether the costs were higher than the benefits.
- Many participants were not convinced that integrated farming practices would help. They shared their experience of how planting cotton with alternate rows of other crops sometimes lead to increase in pests and also require more water.
- Integrated pest management requires a collective effort, therefore in spite of its significance, this adaptation options may not be always easy to adopt.

Scoring the adaptation options as per administrative feasibility:

- Credit schemes are available but its process is often bureaucratic. However, the channels are available.
- Access to latest agricultural research is mostly facilitated by the private companies, but not much by the governmental agencies.
- There is dearth of information on specific and accurate weather predictions.
- No resources to facilitate organic farming.
- There is some guidance on soil enrichment and management from KVK, but not from the agricultural departments.
- Constructing soil conservation measures like farm ponds need financial resources, which are not always available.
- Marketing feasibility that is presently available for cotton should be extended even to other crops.
- There is no facilitation for integrated farming by the government.
- Since KVK ran a special programme on integrated pest management in the area, the external support is available for that, but the required collective action is presently not achieved in this area.
- People do not support afforestation for the fear of losing fractions of already fragmented small land-holdings.
- There is very low level of awareness among people to adopt the measures for conservation of soil and water.
- While the groundwater usage should be regulated, how it could be regulated, given the nature of the resource and the widespread dependence on it.
- There should be more subsidies to adopt micro-irrigation practices.
- While the social measures such as empowerment of women, youth and supporting the landless, destitute elderly population are significant, there are not many means to looks after it. The women members among the participants here put in very strong emphasis on the empowering the young women and girls, by providing them vocational training (which would help their families to diversify their incomes) but lamented how none of the other participants (who were very much vocal till that point) are talking about it.

While the agricultural systems run very much on the labour of women, there are no support systems for them.

Group II: Youth

The seven participants of the youth group ranged from age 19 to 24, their occupation ranged from studying, to farming and or working in Jalna at a company or petrol pump. As the discussion started, it was noticed that since the participants were young, they were quite enthusiastic and were quite proactive in the discussion. But since some of them were studying and others were still fresher and budding farmers, they took time in responding to the ranking activity. They could easily grasp the context, but in terms of ranking, they felt that all the listed options were equally important in terms of adapting the changing climate. Hence they ranked most of the options within the range of 3–5. Though no additional criteria were added, the participants were asked to rank the options for both the criteria. The outcome of this activity is illustrated in the image below indicating the ranking order of the options.

As it is seen from Table 15, most of the options were ranked below 3, except for use of shade net option under the administrative feasibility criteria. With each option, the participants were asked why they give each option the respective rank, which they felt, as mentioned earlier, were equally significant but some of the them according to their past experiences, proved them to be useful. For some options like adopting organic farming, the participants had a difference of opinion, but for long term, future benefits and especially in terms of changing climate, some of the participants felt that such options need to be adopted urgently. When asked about strengthening the local institutions such as gram sabha, the respondents mentioned that they barely have gram sabha meetings and even if they have only the influential members of the village participate in it. Specifically for using shade net, the farmers felt it involves huge investment, risky in terms of the output/produce and is not favourable for large landholders. Moreover, though it is favourable for small landholders, they cannot afford to make large investments. These were some of the highlighting issues of the discussion.

Group III: Farmers without institutional affiliation

The ten participants in the group 'farmer without institutional affiliation' were asked to specify land ownership, main crops grown and if they have other sources of income, see Table 14.

Table 14. Details 'Farmers without institutional affiliation' – Badnapur Cluster

Farmer from	Land ownership	Main crops grown	Other sources of income
Malegaon	1 acre	Cotton, tur	Agricultural labour
Malegaon	25 acres	Cotton, bajra, tur, moog, jowar	Agricultural labour
Kadegaon	6 acres(no well)	Cotton, bajra, jowar	His son owns a shop
Kusali	6 acres	bajra, cotton, tur	Agricultural labour
Malegaon	3 acres	Cotton, bajra	Agricultural labour
Malegaon	6 acres	Cotton, bajra	Agricultural labour
Wakulni	8 acres	Used to have mausumbi orchard	Teacher in Malegaon
Kadegaon	5.5 acres(has farm pond)	Tur, cotton, bajra	
Malegaon	10-12 acres(adopted drip)		Son has company job + milk dairy business
Malegaon	4 acres		

The participants hesitated to choose the options; the moderator had to motivate them to answer. They were relying on other participants to rank the option. They were only saying all the options are important. According to the participants, soil conservation and management is most useful

and activities should be carried out in their fields. They said weather forecast systems are useful but not accurate; there should be perfect weather forecast so that it will help from losses which we have suffered. Participants agreed among themselves about organic farming but were not convinced to adapt it as it will take a long time. Training to women was appreciated by the farmers and said women should be trained because they only work in the farms. Participants told that for a common farmer it is difficult to install shade net as getting funds is not easy. Only farmers with contacts get easy access to these schemes.

Discussion on adaptation options:

- Crop research: There should be changes in crops. There are already changes in cropping patterns going by changes in the weather. But can have new varieties to reduce input costs. Earlier Tur would die if there was too much rain. Now, after research, all are using a new variety of tur (Khadki variety). Crop research is useful. But it does not reach the farmers well because: (a) Scientists put results in the newspaper (Agro or Sakal) but farmers can't read; (b) Corruption; (c) The KrushiAdhikari/Krushi Mitra/Agricultural Assistant meet only a few people in the village. The concerned department should take the responsibility of reaching all farmers instead of meeting only one or two farmers and claiming that the village is covered. Everybody should be gathered in the Gram Sabha to disseminate such information.
- Weather advisories: The teacher in our group gets SMS on the number 144—a crop-wise weather advisory. The Krishi Vibhag (Agriculture Department) gave a SIM card, the Panchayat Samiti gave a Krushi Card. Those with this card get messages every 2-3 days. They have to pay Rs 107 per month for this service. But others in our breakout group do not get these SMS messages. RML (Reuters Market Light) charges Rs 180 for six months as a one-time registration fee. Elder people assess the weather from their own experience.
- Soil conservation is important.
- Soil management: Soil testing is important but they have not done it. Before planting orchards, they have to do soil testing and water testing to get subsidies, but the officials just put a tick mark on the form without doing any actual test, and they charge a fee of Rs 250. Soil testing is very important because they can apply fertilizer accordingly, but they do not have access to it.
- Organic farming: They do not know much about it.
- Shade nets: Useful but they do not have the money. It helps people with small plots.
- Change in cropping pattern: Farmers change cropping pattern reactively, not in anticipation. Some get subsidized seeds, others do not e.g., last year, jowar seeds were distributed as fodder crop. Again issues of corruption arise. The timely availability of farm labour is a constraint, it is difficult to change crops.
- Credit: They take credit both from the moneylender (*sahukar*) and the government.
- Insurance: Many have taken insurance. Many have not. But do not benefit from insurance. Though they appreciated the principle of insurance.
- Marketing: Very important, especially warehousing. But do not get pricing information. The rate is not uniform for everyone. Agents and middlemen bargain because they know that the farmers are price-takers, they cannot take their goods back.
- Integrated farming system: They do not have any information about integrated farming system.
- Water conservation: One farmer in our group (Kathru Bakal) has a farm pond. It is very important to raise awareness about rainwater harvesting.
- Water budgeting: They do not have any idea about water budgeting.
- Drip irrigation: One farmer (Mhachindranath Kole) thought that drip is important but it needs water to be available in the first place. So it should get only 3 points. Another

farmer (Mhachinder Khule) thought drip was very important to conserve water so it should get as many as 6 points.
- Social options: No Gram Sabha meetings have been held in Malegaon. In Kadegaon, Gram Sabha meeting was held twice last year. New village societies are formed but they exist only on paper—they do not do much. Old-age pension sounds like a good idea.

Group IV: Landless

The Group exercise started with a round of introduction, the moderator briefed the group about the options and MCA ranking process. Six landless people participated in the activity.

General observations:

- Loan: The group ranked 3 points to no-regret as the schemes of loan are very important for the landless as there is no other option from where they can opt for finance. 2 points for feasibility because the access to loan is difficult and with no other option they have to go to private moneylenders.
- Livelihood option: The group ranked 4 points to no-regret and 1 point to feasibility
- Water harvesting: The group ranked 5 Points to no-regret and 2 points for feasibility, according to the group if water harvesting structures are constructed in drought-like situation, employment is provided to the labours.
- Women empowerment: The group ranked 3 points to no-regret and 2 points for feasibility. According to the group women's development it is important they add that all girls get education and women empowerment as already started.
- Strength local committees: The group ranked 5 points to no-regret and 3 points to feasibility. Gram panchayat should be strengthened schemes related to welfare of landless and labours should be direct via gram panchayat. Members from economically backward sections should be included in various committees.
- Youth: The group scored 2 points to no- regret and 1 point to feasibility; education is important but technical education, trainings are more important which are not provided to the youth.
- SHG: The concept of SHG is not clear to the group, they ranked 2 points to no-regret and 3 points to feasibility, however they were saying SHGs are useful they can get money from the SHG when they require.
- Pension: According to the group they should get pensions that would be very useful in their old age when they can't work. But they were doubtful whether they will get pension or not. They ranked 3 points to no-regret and 1 point to feasibility.

Scoring Badnapur cluster

Table 15 below shows the scoring done by the different groups. The empty cells indicate that the specific group has not scored an option for the provided criteria, either due to time constraints, decision to skip the options by the participants, or the selection made by the group facilitator.

Table 15. Scoring of adaptation options from Badnapur cluster workshop

Badnapur Cluster			Farmers with institutional affiliation		Farmers with no institutional affiliation		Youth		Landless labourers	
Nr.	Sector	Adaptation option	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)	3	1	3	3	4	5		
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	4	1	5	1	5	5		
3	Agriculture	Provide weather advisories / early warning system for drought to the farmers	5	1	3	1	5	5		
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	2	1	4	2	5	4		
5	Agriculture	Promote better soil management	5	2	5	1	4	4		
6	Agriculture	Promote organic farming (such as vermicomposting, mulching)	1	1	2	1	5	3		
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops	1	1	1		3	2		
8	Agriculture	Set up credit schemes to promote adoption of new technologies	5	3	3	2	4	4	3	2
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)	5	4	4	2	5	5		
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information), including for dairy, vegetables, millets	4	2	4		5	4		
11	Agriculture	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy-based derived products)	4	1	5		3	4	4	1
12	Agriculture	Promote adoption an integrated farming system model	1	1			5	3		
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management	5	2	4		5	3		
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	4	2	5		5	5	5	2
15	Water	Promote greater awareness about the benefits of watershed development	5	1	6		5	5	5	2
16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies	4	1			4	4	5	2
17	Water	Promote water budgeting/planning management	3	1			5	5	5	2
18	Water	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)	5	3	5	3	5	5		
19	Water	Afforestation and reforestation	5	1	4		5	5		
20	Society	Women-focused capacity building	5	1	5		4	4	3	2
21	Society	Introduce innovative couple farmers forums	5	1	6		4	5		

Badnapur Cluster			Farmers with institutional affiliation		Farmers with no institutional affiliation		Youth		Landless labourers	
Nr.	Sector	Adaptation option	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility
22	Society	Strengthening of local institutions such as Gram Sabha	5	1	1		3	3	5	3
23	Society	Education and Mobilizing of youth	5	1	4		5	5	2	1
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	5	2	4		3	3	2	3
25	Society	Provide pensions or safety nets for elderly	5	1	5		4	3	3	1
26	Society	Strengthening of local level committees such as watershed committees and disaster management committee/formation of other local level institutions such as user groups or farmer clubs	5	1			5	5		

Bhokardan cluster (Pimpalgaon Barav, Palaskheda Pimple, Thote Pimpalgaon)

Before the start of the workshop, there was a discussion with women from the local SHGs. The group consists of 12 women who contribute Rs 25 per week for a revolving chit fund. It is a group of 12 women who contribute Rs 25/week for a revolving chit fund. Presently, there is a provision to extend loans to member women up to Rs 1000 which is expected to be recovered within a month. There are five such SHGs in village which were started about eight months ago as a part of National Rural Livelihood Mission. Their five principles of operation are (1) save; (2) account keeping; (3) regular meetings; (4) abiding by the rules and (5) loan and loan recovery.


Photo 5. Impression of scoring of adaptation options – Bhokardan cluster

Group I: Farmers with institutional affiliation
A total of 17 participants joined this group, including the ex-president of the Tantamukti Committee, Gramsevak, president of a SHG, SHG member, secretary of SHG, sarpanch, Rojgarsevak, Gram Panchayat, ex-Taluka Adhyaksha of Nationalist Congress Party, president of Tanta-MuktaSamiti, ex-sarpanch, ex-president of Village Education Committee, president of

Water Supply, Health and Sanitation Committee and Chairman of Famers Cooperative Society of the three villages that are part of the Bhokardan cluster.

Ranking the adaptation options as per their significance in 'no-regret' strategies:

- Soil and water conservation measures, agricultural research and market feasibility were the adaptation options, which participants considered to be of importance without much debate.
- However, participants were not very sure about the importance of technologies or practices that are not practices widely in this sector, such as organic farming, shade nets. The general reaction was how to adopt such technologies when you do not have enough money to install it.
- IPM was once practiced in Bhokardan under IPM programme of KVK. However, with the advent of BT-cotton farmers' interest in taking efforts on IPM activities significantly decreased.

Ranking the adaptation options as per administrative feasibility:

- Soil conservation measures require regular investment of money, technologies which are not easy to procure.
- For organic farming there are no sources of technical information. Moreover, implementing those practices could be costly.
- For shade net, one requires the support of subsidies and loans which again are not easily accessible.
- There is an institutional structure for crop insurance, but more often than not, they are not very useful for farmers. For example, hybrid/BT/improved strains rarely get the insurance covers. The present system of crop insurance is not able to provide the required safety to farmers. There should be provision of personal insurance (like the one for animals) for crops, where agricultural produces is considered as an asset.

Group II: Farmers with no institutional affiliation

In this particular group, the participants included farmers without institutional affiliation, 13 farmers joined the group. Landholding size of the farmers ranged from 8 farmers with land between 2.5–6 acres, to farmers with 10, 14, 15, 20 and 30 acres. They ranked most of the options among 3–5 range. The only option which they ranked 2 was for changing cropping pattern under the criteria of administrative feasibility.

Discussion:

- The discussion initiated on the backdrop of the drought/severe water scarcity experienced during last summer. The group gave high importance to the crop insurance under such adverse climatic conditions but at the same time they expressed disappointment on the methodology and criteria adapted for remittance.
- From farmers' viewpoint they gave utmost importance to development of research and technology along with pest control. They needed short-term, water-efficient and pest-resistant crops for sustainable agriculture.
- For sustainable agriculture, need for water conservation and management was felt by all the members.
- It was bit difficult to for the group to understand livelihood options beyond agriculture as they belonged to farming community. They obviously emphasized agriculture development.
- The group was sensitive towards the exploitation of groundwater and suggested for special enactment for controlling the use of groundwater.

- Regarding institutions close/important to the farmers, they said village panchayat as most close and seemed less informed about the panchayat raj system.
- They expressed importance of local committees meant for many issues but seemed less intimate due to the internal politics affecting their performance towards the entrusted objectives.
- The group expressed the issues like provision of pension facility, women and youth development as very important.
- The participants felt that changing cropping patterns is a significant option but difficult to implement on large farms and thus could lead to large losses
- The SMS service for weather advisories was mainly used by well-to-do elite group of farmers and cannot be used by small landholding farmers.
- Organic farming though is an ideal option, it is unreliable and the benefits cannot be quantified immediately.
- One of the farmers who had set up a shade net on his farm shared his experiences. But the other farmers, though agreeing to the benefits from it, argued that it is difficult to implement on all farms as the mechanism which can support its wide use are absent. Moreover, it also requires large capital and investment.
- Credit schemes are highly significant, without which farmers find it difficult to implement new technologies on their farms.
- Though crop insurance is highly rated as seen in the Image No. 2, it is not much beneficial as in the past farmers have not received compensation equal to the principal amount they invested. With proper administrative support, this is an important safety net for the farmers.
- In terms of facilitating robust market linkages, the farmers were given an example of the Agricultural Produce Marketing Committee. To this the farmers expressed that though such marketing prototypes would help them eliminate the middlemen, the constantly changing market prices also contribute to their losses.
- Livelihood diversification was not a favoured option because according to the farmers, it required additional investment, labour and time too.
- While discussing integrated farming system model, the farmers felt the need to practice cluster farming, which can help them in harvesting the produce in shorter time and thus reap good profits and share it among themselves.
- Similarly greater awareness watershed development is required as the work done 5 years back helped retain water in the water bodies this year, when the region received good rainfall. On a personal level, all the participants seemed aware of the need of watershed development, as it has been widely promoted and implemented to a small extent this Bhokardan Taluka. One of the participants mentioned that since there is no major river in Jalna, huge watershed structures cannot be developed. Consequently, the emphasis on local watershed structures.
- Water budgeting activity is not undertaken in this taluka, but is an urgent need as currently there is no account of water usage and in this year 2013, most of the water used during the summer months was bought from other regions. Besides that, uncontrolled groundwater usage and exploitation of aquifers and groundwater resources is disturbing the soil composition.
- One of the participants was of the view that instead of planting new trees and new afforestation projects, it will be useful if we conserve the existing plants. The government have introduced schemes for afforestation and dedicated a budget for it, but the local government authorities misuse these funds. Another participant suggested that such species should be planted whose products could be further used/sold, thus provide additional income and dual benefits.

- Women focussed capacity building was regarded as highly important as currently the situation is such that only men are aware of the exact procedures for on-farm activities such drip irrigation, applications of fertilizers and pesticides, and so on. Consequently, if the men have to leave the farm for their routine work in cities or attend some workshops, then they are unable to do so as they need to stay back on farm to complete these activities. If the women in the family are educated about the on-farm activities, then men will be able to venture out to learn about new technologies.
- For the participants, only Gram Panchayat (GP) rather than Panchayat Samiti (PS) or Zilla Parishad (ZP) due to their proximity and frequency of interaction with GP. One of the elder farmers felt that GP was less important than PS or ZP as the GP acted as per the instructions from PS or ZP. Thus it was observed that there were lot of differences among the participants about the significance of these institutions and hence rated it with three points.
- SHGs too were deemed significant as they helped the farmer families to raise their own money and not get trapped in the debts from money lenders.
- The participants pointed out that the local-level committees do exist but they need to be strengthened for effective implementation of their objectives.
- Lastly, the discussion on administrative feasibility mainly revolved around how the options were significant but their execution/implementation was difficult and hence the need to strengthen administrative support. It was observed that the participants found it difficult to comprehend the significance of the options and thus ranked it similar. Overall, the participants expressed discontent towards administrative authorities.

Group III: Landless labourers
Ten people were present for discussion most of them were from Palaskheda pimple. The facilitator explained the scoring and criteria and explained the options to the participants. Discussion and scoring was carried with 6 options which the facilitator decided were most relevant for the group.

Options discussed:
- Loan: Schemes of loan are not easily available to landless and labours as they don't have any assets such as land to keep or show as a guarantee to the bank. But according to the group, loans are important as they ranked 4 points no-regret and feasibility 3 points. There is no scheme from the department of social welfare. The system has problems, when the father had access to a scheme, after he passes away, the scheme is not transferred to the son. Feasibility 3 – easier to get then livelihood option
- Livelihood option: To start any business we need capital, which we don't have and when we go for various schemes in zilla udhogya kendra, money is required for processing the file. The group ranked 5 points no-regret and 2 points for feasibility. Different entrepreneur problems with bank loans, administration, government schemes. No-regret 5 (very important); Feasibility 2 – (difficult to get loan because they are landless and have not property to get a mortgage)
- Water harvesting: Even if the group was landless and labours they ranked 3 points to no-regret and 4 points to feasibility, during drought like situations they get work (NREGA) for constructing water harvesting structures and when there is good rainfall it helps farmers to increase their production and thus the demand of farm labourers are increased. If no access to livelihood options/loan – they have to go to farmers for work. The farmers have to deal with the changing climate. When the rainfall is average, the farmers have work (hours, wage). Water harvesting is good, used in drought conditions resulting in very efficient water use. During a drought the labourers work on the construction of

the water harvesting installation. Now farmers change crop, labourers can work on farms. No-regret 3; Feasibility 4 – easy to get scheme for water harvesting

- SHG: The group ranked 3 points to no-regret and 4 points to feasibility, according to the group the SHG are important as they gets access to various loan schemes. No-regret 3 – important; Feasibility 4 – strong links between banks and SHG (the wife of one of the men attending is a member of a SHG)
- Pension scheme: the current pension criteria is for the age of 60 years, but the group expressed that the age to receive pension should be reduced to 50–55 years as they do lot of physical work, the wear and tear of body is more and they are not able to work after 50-55 years. They ranked 4 points to n-o regret and 2 points to feasibility. When you are over 60 years, the state government provides a scheme for pensions; the participants would like that the age of pension goes down to 50–55 years because landless work a lot, health goes down. No-regret 4 (important); Feasibility 2 – administration difficult, have to go to different levels
- Strength local committees: According to the group local committees should be strengthen, equality should be followed. They have 3 points to no-regret and 2 points to feasibility. No-regret 3 – important; Feasibility 2 – hard to implement

Group IV: Women

Six participants were present. The scoring of options did not happened as the women in the group did not have any idea about many of the options, did not really have much information about others, and said that they found it difficult to gauge the importance of the options. Mangesh tried to explain the prioritization exercise by saying that though water and air are both essential to survive, we can say that air is *more* important than water.

- The women in the group did not know about organic farming. They knew about shade nets. They did not really know about crop insurance. We explained integrated farming system and integrated pest management to them.
- Only 10–15 households have drip irrigation in their village. The main constraint is cost. Drip irrigation will mean less work for women, because men will just have to turn on the system. Also it helps save water, and is hence, an important option.
- Percolation tanks, check dams, reservoirs are important because they help raise the water level in wells.
- They could not explain why they gave a lower score to afforestation and reforestation.
- They thought credit was an important issue. They are not able to save enough. They think of insurance as credit waivers during drought.
- Vidya told everyone that women's education is very important because all women in the village are uneducated.
- They felt that women's SHGs were an important issue. They did not participate in Gram Sabha meetings because the main barrier is the timing of the meeting. They do not have time to spare from their household/farm chores to attend the meetings in the day time.

The important options for the participants were:

- Scientific research
- Credit
- Water conservation structures
- Drip/sprinkler
- Women's education
- SHGs

They want training related to water.

Vrishali shared her experience in Kadvanchi, particularly highlighting; the role of women; how Kadvanchi gets very little rain, but even that water was conserved and recycled; how farm ponds were built even by farmers with as little as 2 acres land, who were then able to grow high value fruit crops.

Scoring Bhokardan cluster

Table 16 below shows the scoring done by the different groups during the workshop. The empty cells indicate that the specific group has not scored an option for the provided criteria, either due to time constraints, decision to skip the options by the participants or the selection made by the group facilitator.

Table 16. Scoring of adaptation options from Bhokardan cluster workshop

Bhokardan Cluster			Farmers with institutional affiliation		Farmers with no institutional affiliation		Women		Landless laboureres	
Nr.	Sector	Adaptation option	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)	2	3	3	2				
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	4	3	5	4	4			
3	Agriculture	Provide weather advisories / early warning system for drought to the farmers	3	3	5	5				
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	4	1	5	3				
5	Agriculture	Promote better soil management	4	1	5	3				
6	Agriculture	Promote organic farming (such as vermicomposting, mulching)	2	1	3	3				
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops	3	1	5	4				
8	Agriculture	Set up credit schemes to promote adoption of new technologies	4	1	4	5	4		4	3
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)	4	1	5	5				
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information) - including for dairy, vegetables, millets	4	1	5	5				
11	Agriculture	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy based derived products)	3	1	3	4			5	2
12	Agriculture	Promote adoption an integrated farming system model	3	1	4	3				
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management	2	1	5	5				
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	4	1	5	5	5		3	4
15	Water	Promote greater awareness about the	4	3	5	5			3	4

Bhokardan Cluster			Farmers with institutional affiliation		Farmers with no institutional affiliation		Women		Landless labourers	
Nr.	Sector	Adaptation option	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility
		benefits of watershed development								
16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies	4	1	5	4			3	4
17	Water	Promote water budgeting/planning management	4	2	4	3			3	4
18	Water	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)	5	3	5	4	4		3	4
19	Water	Afforestation and reforestation	4	3	4	3				
20	Society	Women-focused capacity building	4	2	5	5	5			
21	Society	Introduce innovative couple farmers forums	4	1	5	5				
22	Society	Strengthening of local institutions such as Gram Sabha	4	1	3	4				
23	Society	Education and mobilizing of youth	4	1	5	5				
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	4	2	4	3	4		3	4
25	Society	Provide pensions or safety nets for elderly	4	2	5	5			4	2
26	Society	Strengthening of local level committees such as watershed committees and disaster management committee/formation of other local level institutions such as user groups or farmer clubs	4	1	5	5			3	2

Jaffrabad cluster (Dongaon, Nivdunga, Asarkheda)

Group I: Farmers with institutional affiliation
A total of 15 participants joined this group, including the ex-President of the Tantammukti Samiti, members of the different Gram Panchayat, member of the local youth group, Sarpanch, Deputy Sarpanch, NCP Block President, VWC Chairman, member of the Village Education Committee, ex-member of the Gram Panchayat, President of the Village Education Committee and VWC and NCP Block President of the three villages that are part of the Jaffrabad Cluster.

Ranking the adaptation options as per their significance in 'no-regret' strategies:

- Cropping pattern, agricultural research, weather updates, soil conservation measures and soil management were considered very important by the participants. Among these, soil management was considered to be of utmost significance and was given highest ranking, because the agricultural productivity is dependent eventually only on the health and quality of soil.
- Organic farming, while important in general, is not very helpful for the building better resilience to natural calamities like droughts.
- On the other hand technologies like shade net were considered of importance because of its water efficiency.

- Credit schemes are used by farmers only to survive during the droughts, not exactly to adapt to it, so they are of least importance as an adaptation option.
- Crop insurance could be of importance for drought resilience because it provides the necessary safety cover to farmers.
- Market feasibility too, although of general importance for agriculture was not believed to be of much assistance during drought.
- If the diversification of livelihoods is based on agriculture, it is bound to get affected along with agriculture during drought, and therefore is not very significant.
- The group strongly acknowledged women's significance and contribution in agriculture and was in general supportive of their empowerment but ranked it with lower weightage because they could not comprehend how that would help in mitigating the drought. However, one participant Mr Bodakhe (Sarpanch of Asarkheda) mentioned that women were among the most affected groups during drought. However, at the same time participants were unequivocal about their support for training of women in latest agro-based technologies, as women's contribution to farming is 90%. A member noted that they can participate in this and other such programme, only because their women are attending to the farms right now.
- Empowering institutions of Panchayati Raj (PRI) was considered to be crucial because, according to the participants, if those are responsible, the development or other assistance initiatives (such as drought relief measures) are effectively administered in village. An example was cited by Asarkheda villagers, where in recent drought, the timely intervention by local sarpanch, with respect to undisciplined service by tanker deliveries, ensured that village received water supply timely.

Ranking the adaptation options as per administrative feasibility:

- The guidance that is required to make suitable changes in cropping patterns is available, to certain extent, by KVK. However, agriculture department has been quite disappointing in facilitating any information. According to the participants, the agricultural assistants assigned for these villages are non-functional.
- The information and availability of new agricultural technologies is mainly facilitated by the private sectors such as seed companies or other agro-tech enterprises.
- For a farmer, mid-range weather reports are of importance, which are currently not available.
- For soil conservation measures, villages can employ the integrated programmes of watershed development. However, on a cautionary note some farmers shared their experience of getting hindered due to faulty and insufficient cash-flow under certain programmes of watershed development (In case of Nivdunga, planned watershed development activities could not be completed under Drought-Prone Area Programme (DPAP). Now they are trying to finish the area treatments under the scheme of Integrated Watershed Management Program (IWMP).
- Integrated farming methods, integrated pest management (IPM) and organic farming participants thought that most farmers can adopt and employ by themselves without much financial assistance, if provided with proper information, and thus were most feasible for administration.
- On the other hand, technologies such as shade nets are expensive and are dependent on support of subsidies and credits to be adopted.
- In its present form (especially the criteria for reimbursement), crop insurance schemes are not being very helpful to the farmers.
- Regarding water-efficient adaptation options such as watershed development, use of micro-irrigation techniques, participants noted that the success of such measures mainly

depends on the collective action and individual willingness. They expressed strong need for information and guidance on water budgeting measures, with which they are not familiar yet.

- Irrespective of their significance for making a drought-resilient community, most social adaptations measures do not have the necessary institutional support from the government. Most PRI struggle with low funding. In case of elderly destitute men and women, the only recourse offered by government is Sanjay Gandhi NiradharYojana. However, with its present criteria, very few people stand eligible for help. Similarly, while functional SHG of women have proven to provide much valued support to women and their families during drought, those have not flourished as they should have been and need to be focused upon.

Group II: Farmers with no institutional affiliation

In this particular group, the participants included farmers without institutional affiliation, 12 farmers joined the group. Landholding size of the farmers ranged from 7 farmers with land between 2–6 acres, to farmers with 11, 12, 13 and 20 acres.

Discussion:

- Generally, the participants felt that all the options presented were important and hence they could quickly rank the options as compared to participants from other workshops.
- In terms of requirement of research on risk proof agriculture, the participants felt it was highly significant since they have benefitted from the use of varieties such as 'BT cotton' which is a result of research for farmers to better cope in drought situations.
- The current early warning systems and forecast methods were not useful at all as most of the time they were incorrect. The farmers felt that their traditional forecasting methods are more precise and reliable.
- Regarding soil conservation and management, the participants cited examples of events in the past when the soil conservation structures have been destroyed due to heavy rainfall events and in some cases, which were built adjacent to farms, were damaged due cattle movement. Farmers from Asarkheda mentioned that absence of a large river/lake/pond in their village results in lack of water for irrigation. Since the village is bestowed with hills, the surface run-off from rainfall could be channelized to store water in some large structures, which could support them in irrigating their fields. The participants felt that such soil and water conservation activities/initiatives need to be started afresh.
- It was observed that the farmers currently do not follow any systematic pattern of applying fertilizers to the soil. Hence felt the need to integrate soil testing facilities in the routine farm activities and thus help them practice better soil management.
- One of the participants mentioned that organic farming has become the need of the hour so much so that it is more important than regularly carrying out soil quality test. Soil quality test can give an estimate of the level of nutrients in the soil, but to balance the nutritional levels of the soil, the farmers are currently using chemical fertilizers. This is gradually degrading the fertility of the soil and with changing climate; it could reduce their agricultural produce significantly.
- The participants felt that the current mechanism for availing funds for shade nets is complicated and inconvenient. But shade nets would prove as an important adaptation option, if these constraints were overcame.
- Similar to shade nets, other options such as credit schemes to implement new technologies and crop insurance were also rated high but these mechanisms need to be strengthened in order to help the farmers cope with the changing climate.
- Decrease in the rainfall was an attribute of deforestation according to the participants.

- Though women from their village have already ventured into the traditionally male-dominated sectors, it is necessary to impart training to the women so that they learn the correct methodology about new technology.

Group III: Landless labourers
A group of about eight participants scored the adaptation options. The landless members were working in vivid areas, viz., agriculture labour, transporter, fruit seller, cobbler, carpenter, blacksmith, forest labour, etc.

General discussion:
- Cropping pattern change in view of the drought: the group felt as moderately affected on their occupation. However, agriculture labours that are dependent on agriculture affected due to less/lack of employment.
- The fruit seller and transporter are also affected in the case of less/no agricultural production. Therefore, they supported agriculture development through resource management and other relevant measures.
- The new methods like shade net farming was favoured by them because it is labour intensive and provides employment for landless.
- The participants agreed for watershed development work if carried out by the labours.
- The drought situation less affected on the persons like cobbler, blacksmith, forest worker.
- As far as groundwater utilization is concerned few opined for drinking purpose only.
- They also gave importance to women and youth development and the role of village panchayats.

Agriculture options:
- Cotton changed – short-term crops create more labour in the fields
- Research leads to more mechanization, less labour required, laboureres see this as a problem
- Forecasting is as important to the labourer as the farmer
- Does the earning of a labourer increases if a farmer moves to organic farming?
- More credit for shading nets – farmers will use this, thus more work for labourers
- Farmers get assistance via credit, normal farming intensity reduces if there is no access to credit meaning that labourers have less work

Water options:
- Mechanization not good—no work for landless labourers
- High no-regret scores for options that give work for the labourers, irrespective of climate change occurring or the exact magnitude
- Drinking water options focus more on individual use
- Water budgeting—from the farmers' points of view it is good if it generates more labour for them, it is important for drinking water
- Irrigation - maybe not direct benefit, but if the community saves more water, that is a good thing. Do not care about drip irrigation system, when less water needed, this is good for farmers
- Afforestation/reforestation—participant from the forestry department indicates multiple benefits of afforestation (plantation) irrespective of climate change; provides labour, conserves water and soil, and provides fodder

Social options:

- Women empower to cope with drought—good to get knowledge; also for daily farming activities irrespective of climate change
- Gram Sabha—important accessibility, economic backward schemes are important to go via Gram Sabha. Give no-regret score 4; why not 5? Also do something self, not only the Gram Sabha
- Youth—important, should go beyond only academic education, also training
- Pension—important, survive independently
- Water supply committee—during drought, should make sure that all people in village get drinking water

Group IV: Women

All the women had gone for cotton pollination, which has to be done in a small critical window of time and is a very labour intensive operation. So the women in our group were mainly those who were presently not engaged in day-to-day farming. As in the Palaskheda Pimple women's breakout group, the women here also did not know much about many of the options, and found it difficult to do relative scoring. The one exception was a lady who used to regularly attend KVK programmes and was very well informed. We asked them to discuss options that they thought were important, and they spoke from their own experiences. An elderly landless labourer reminisced about getting part of the wages in kind (i.e., food) in the past and pointed out that commercial cotton monoculture and wages solely in cash have made landless labourers vulnerable to food price inflation. One participant worked as a health centre nurse in Asarkheda and she highlighted the health impacts of drought. One young lady did not speak much but could relate to drip irrigation and thought it important for conservation of water. The lady who regularly attended KVK programmes spoke about her experiences and having learnt about vermicomposting and crop rotation. See Table 17 for details of the women group session.

Table 17. Details Women group – Jaffrabad Cluster

Name	Age	Caste	Land ownership	
Geetabai Raghunath Kailkar	About 70	Nath Jogi	Landless	Has sons and a daughter in the village but lives alone, has to beg for food
Sonabai Dagadu Lokhande	About 65-70	Mang caste (those who ask for food)	Landless	Stays with her daughter who is a widow and works as a labourer
Anunda Bhimrao Sonavane	About 40		2.5 acres (poor soil – khadakmaati)	Husband is a carpenter
Kavita Gajendra Sonavane	About 25		4 acres (Bhurkimaati – brown soil)	
Sangeeta Madhav Bhodke	About 25		3 acres	
Sunita Arun Sonavane	About 25		2.5 acres	Husband works as an electrician and she sells coconuts
Mandakini Dnyaneshwar Koravade	About 40		5 acres (black soil, rainwater runoff flows through her land by dug drainage channels)	She is SHG head Goes for KVK training every month Used to go regularly till last year when she became Anganwadi teacher
Jyoti Suryavanshi	About 25-30			Works as nurse in Asarkheda

- Regarding change in cropping pattern, we asked who decides which crop to grow. They said women advise, discuss and decide along with the men. They choose crops that are

more profitable. For example, cotton gives cash, maize is good for fodder and to sell, bajra for food and to sell, wheat for food and fodder.

- For the landless, none of the options related to agriculture are important. In drought, there is no work, they need work to fill their stomachs.
- They suggested giving more time to change in crop choice because 'it is for eating'.
- They get information about crop varieties on TV. Other sources of information are the Krishi Sahayak (agriculture assistant from KVK) and private seed companies, e.g., the Mahyco people come and give information for only their chosen vegetables. Men don't attend training at KVK. One woman does attend the KVK training. Women can come for training, provided the training is provided in the village, it is difficult for them to travel.
- They get weather information on TV, and do find it credible.
- They get information on pesticides from people who sell it.
- Regarding soil management, they said that they themselves decide the amount of fertilizer to apply: a pinch when the plant is small, a handful when the plant is large.
- In the context of growing legumes for soil fertility, an elderly landless labourer spoke passionately about the monoculture of cotton. Why is it just cotton everywhere? Earlier farmers used to grow various food crops, and the landless labourers would get part of their wages in kind. Now all farmers are just growing cotton for cash. The labourers are also paid their wages in cash and have to buy food from the market, making them vulnerable to food price inflation.
- One participant applies the training she has received from KVK and interchanges maize and cotton on her lands. She was unusual in having travelled to other villages and having contacts with women leaders (e.g., SHG heads or committee members) in other villages. She had gone to Kadvanchi with a group of people from Asarkheda on an awareness visit organized by the KVK and was friends with the chairwoman of an SHG in Kadvanchi. She pointed out that Kadvanchi's case was special because they had water, but another participant complimented Kadvanchi's success in saving water.
- A mother-in-law and a daughter-in-law pointed out the secondary impacts of drought on households that do not earn their livelihood from farming: if farmers don't earn well, they cut costs on other things, e.g., don't build houses, the demand for electrical work declines. They demand for agricultural implements goes down reducing the demand for carpentry work. Thus the drought affected them even though they have non-agricultural sources of income.
- The nurse said that compared to the drought year, there have been more health problems this year because more mosquitoes bred in the stagnant rainwater.
- The participants had not heard about organic farming, though one lady had heard about some aspects of it in KVK training. The moderator from AFPRO told the group about organic farming.
- They had not heard of crop insurance, though all had taken life insurance. The moderator from AFPRO told the group about crop insurance.
- The elderly landless labourer said that she is too old to work in NREGA but begs for food. One participant said that she has not been getting old-age pension for many months, though she has a bank account.
- Everything depends on water—rainwater harvesting and farm ponds are the most important adaptation option. Asarkheda has perhaps one farm pond. The women did not know much about watershed development activities in Asarkheda. They knew that contour bunding has been done, check dams built on nalas, farm bunds made, channels/trenches on the hill and tree planting done.

- Women's education is important. One young lady participant said that because of education she was able to become an *anganwadikarya karmika* (worker).
- Women work more in the field (they do sowing, irrigation, pesticide spray). Only women can do that work. So it is useful if they get training. But even though the KVK calls them for training, women do not go because of work.
- The KVK training programmes can be held in the evening. Women cannot come for the whole day. Also, they can be held after key agricultural operations (which often take only a few days) are over.
- In discussing social options, they gave the example of LPG connections, which came through the KVK. There were 25 connections: one participant (the same who attended KVK trainings) got an LPG connection, but the other did not. They are finding it difficult to get fuel wood. They will have to go to the hill to fetch it.
- Regarding SHGs, they said they save Rs 50 per month. Members are given loans at 3% per month. They have not taken loans from the bank because they have not yet accumulated enough savings. It's like a chit fund. No one comes to train them. An NGO sent by KVK Kharpudi had come to tell them to start a group 8–10 years ago. They had suggested going for small businesses/livelihood options like dal machine, buffalo, but they do not have enough savings to take a bank loan. The SHG has been going on for the last 10 years. There are 5–6 SHG groups in Asarkheda. These women did not think that those SHGs have taken loans for income earning activities either.
- The nurse said that women's capacity building is most important.
- They don't get to know about Gram Sabha meetings and do not have the time to attend them. Even women sarpanches do not get the time because of household work.


Photo 6. Impression of scoring of adaptation options – Jaffrabad cluster

Scoring Jaffrabad cluster

Table 18 below shows the scoring done by the different groups during the workshop. The empty cells indicate that the specific group has not scored an option for the provided criteria, either due to time constraints, decision to skip the options by the participants or the selection made by the group facilitator.

Table 18. Scoring of adaptation options from Jaffrabad cluster workshop

Jaffrabad Cluster			Farmers with institutional affiliation		Farmers with no institutional affiliation		Women		Landless labourers	
Nr.	Sector	Adaptation option	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)	4	1	4		6		3	1
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	4	2	5				3	5
3	Agriculture	Provide weather advisories / early warning system for drought to the farmers	3	1	1		4		3	3
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	4	1	5		6		5	
5	Agriculture	Promote better soil management	5	4	4				5	
6	Agriculture	Promote organic farming (such as vermicomposting, mulching)	1	4	5				4	4
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops	4	1	5				5	5
8	Agriculture	Set up credit schemes to promote adoption of new technologies	1	1	5					3
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)	4	1	4					
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information) - including for dairy, vegetables, millets	2	3	5				2	2
11	Agriculture	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy based derived products)	1	1	4				3	
12	Agriculture	Promote adoption an integrated farming system model	2	4	5		6			
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management	3	4	5				4	3
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	5	1	5		6		1	
15	Water	Promote greater awareness about the benefits of watershed development	4	1	5				5	
16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies	4	4	5				4	
17	Water	Promote water budgeting/planning management	3	1	5				4	
18	Water	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)	4	2	5		5		3	
19	Water	Afforestation and reforestation	4	4	5				4	
20	Society	Women-focused capacity building	2	1	5		5		5	
21	Society	Introduce innovative couple farmers forums	5	1	4		5		3	
22	Society	Strengthening of local institutions	4	1	4				4	

Jaffrabad Cluster			Farmers with institutional affiliation		Farmers with no institutional affiliation		Women		Landless labourers	
Nr.	Sector	Adaptation option	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility	No-regrets	Administrative feasibility
		such as Gram Sabha								
23	Society	Education and Mobilizing of youth	4	1	4				5	
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	4	3	4		6		4	
25	Society	Provide pensions or safety nets for elderly	5	1	5				4	
26	Society	Strengthening of local level committees such as Watershed committees and disaster management committee/ Formation of other local level institutions such as user groups or farmer clubs	4	1	5				4	

Expert interviews

Expert interviews were conducted regarding the long list of adaptation options and barriers with regard to specific options, interviews were conducted at:

- Agriculture Department, Zilla Parishad Office, Jalna
- Micro-irrigation Department, Zilla Parishad Office Jalna - percolation tanks, KT weirs
- Micro-irrigation Department, Zilla Parishad Office Jalna - rural water supply

A discussion about barriers, based on these interviews, is presented in Chapter 5.

4.3 Analysis

Block-level workshop

The top five adaptation options from block-level workshop have been determined following the weights selected during the workshop. The weights are: no-regret (69%), administrative feasibility (23%) and public support and financial benefit (8%). Table 19 provides the top five options, including the weighted sum for these weights. The options ranked highest are:

- Soil conservation and enrichment through construction of farm bunds (nr. 4)
- Promote better soil management (nr. 5)
- Set up SHGs and train them to implement drought resilient livelihoods options (nr. 24)
- Promote adoption integrated farming system model (nr. 12)
- Education and mobilizing of youth (nr. 23).

The options are scored high (4 and 5 scores) on all three criteria, resulting in a high weighted sum. When considering equal weights (all three weights 33,3%), see Table 20, the top five remains the same. There is slight change in the order of the options, due to increased weight put on the criteria 'public support and financial benefit' and 'administrative feasibility'.

Table 19. Top 5 options Block-level workshop with weights 69%-23%-8%

Nr.	Sector	Adaptation option	No-regrets (69%)	Administrative feasibility (23%)	Public support & Financial benefit (8%)	Weighted sum
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	5	5	4	4,9
5	Agriculture	Promote better soil management	5	5	4	4,9
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	5	5	4	4,9
12	Agriculture	Promote adoption an integrated farming system model	5	4	5	4,8
23	Society	Education and Mobilizing of youth	5	4	5	4,8

Table 20. Top 5 options Block-level workshop with equal weights (33.3%-33.3%-33.3%)

Nr.	Sector	Adaptation option	No-regrets (33.3%)	Administrative feasibility (33.3%)	Public support & Financial benefit (33.3%)	Weighted sum
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	5	5	4	4,7
5	Agriculture	Promote better soil management	5	5	4	4,7
12	Agriculture	Promote adoption an integrated farming system model	5	4	5	4,7
23	Society	Education and Mobilizing of youth	5	4	5	4,7
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	5	5	4	4,7

Cluster-level workshops

We have used two different approaches to rank the adaptation options scores during the cluster level workshops, viz., approach 1 using average scores and approach 2 using composite score.

Under Approach 2, with the composite score using unit weighted method, we give each score an equal weight, which is similar to calculating the weighted sum using equal weights under approach 1. The difference between the two approaches is how approach 2 with the composite score deals with options that have not been scored for both criteria, which occurs in several of the groups. The approach assumes that the missing score for criteria 2 is equal to the score given for criteria 1 and then takes equal weights to derive the composite score, or that the weights change between the options (equal weights (50-50 to 100-0)). This would imply that an option that has been scored with a high mark for only one criteria may end up higher in the ranked list based on the composite score.

Approach 1 – Average score

For the Cluster workshop results we aim to find the top five adaptation options across the different groups in one cluster and then across the cluster as to able to analyse these results together with the top five outcomes of the block-level workshop.

In each cluster we have calculated per option the average score across the different groups (farmers with institutional affiliations, farmers without institutional affiliations, landless labourers, women and youth. That means that if only two groups have given scores for the no-regrets criteria, the sum of the scores is divided by two. This results in a list of average scores per option/per criteria, with distinction between the groups. Table 21 provides an overview of the average scores per cluster. Based on these scores, for each cluster, the top five highest ranked options can be determined through calculating the weighted sum with different weights for each criteria.

Two types of ranking are applied to analyse the sensitivity of the results—ordered criteria and criteria weighting. By ordering the criteria, we select that the ordering gives priority to options that score highest on 'no-regret' followed by 'administrative feasibility'. Thus with the ordered, criteria 1–2, meaning that criteria 1 is most important, follow by criteria 2. With respect to criteria weighting; as at the cluster-workshops the participants have not been asked to determine weights for each of the criteria, we have ranked the options based on equal weights between the criteria (50%–50%).The analysis based on the different ranking methods and the results of for the different clusters is discussed below.

Table 21. Average scores across clusters, per option/per criteria

			Badnapur Cluster		**Bhokardan Cluster**		**Jaffrabad Cluster**	
Nr.	**Sector**	**Adaptation option**	No-regrets - average	Administrative feasibility - average	No-regrets - average	Administrative feasibility - average	No-regrets- average	Administrative feasibility - average
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)	3	3	3	3	5	2
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	5	2	4	4	4	4
3	Agriculture	Provide weather advisories / early warning system for drought to the farmers	4	2	4	4	3	2
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	4	2	5	2	5	1
5	Agriculture	Promote better soil management	5	2	5	2	5	4
6	Agriculture	Promote organic farming (such as vermicomposting, mulching)	3	2	3	2	3	4
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops	2	2	4	3	5	3
8	Agriculture	Set up credit schemes to promote adoption of new technologies	4	3	4	3	3	2
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)	5	4	5	3	4	1

Nr.	Sector	Adaptation option	Badnapur Cluster		Bhokardan Cluster		Jaffrabad Cluster	
			No-regrets - average	Administrative feasibility - average	No-regrets - average	Administrative feasibility - average	No-regrets- average	Administrative feasibility - average
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information) - including for dairy, vegetables, millets	4	3	5	3	3	3
11	Agriculture	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy based derived products)	4	2	4	2	3	1
12	Agriculture	Promote adoption an integrated farming system model	3	2	4	2	4	4
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management	5	3	4	3	4	4
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	5	3	4	3	4	1
15	Water	Promote greater awareness about the benefits of watershed development	5	3	4	4	5	1
16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies	4	2	4	3	4	4
17	Water	Promote water budgeting/planning management	4	3	4	3	4	1
18	Water	Promote protective irrigation and use of efficient irrigation technologies (drip and sprinkler)	5	4	4	4	4	2
19	Water	Afforestation and reforestation	5	3	4	3	4	4
20	Society	Women-focused capacity building	4	2	5	4	4	1
21	Society	Introduce innovative couple farmers forums	5	3	5	3	4	1
22	Society	Strengthening of local institutions such as Gram Sabha	4	2	4	3	4	1
23	Society	Education and Mobilizing of youth	4	2	5	3	4	1
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	4	3	4	3	5	3
25	Society	Provide pensions or safety nets for elderly	4	2	4	3	5	1
26	Society	Strengthening of local level committees such as Watershed committees and disaster management committee/ Formation of other local level institutions such as user groups or farmer clubs	3	3	4	3	4	1

Per cluster the top five options is determined, using (1) ordered criteria 1–2, and (2)equal weights between the two criteria (50% and 50%). The results are discussed below for each cluster and the differences between the clusters.

Badnapur Cluster

For the Badnapur cluster, ranking the options using ordered criteria and equal weights shows agricultural and water options receive the highest priority, see Table 22 and Table 23. This includes Crop insurance (nr. 9) and Promotion of integrated pest management (nr. 13) for options from the agricultural sector and promotion of protective irrigation (nr. 18), Construction and maintenance of water conservation structures (nr. 14), as well as the promotion of greater awareness about the benefits of watershed development (nr. 15). The results are similar for both approaches as the top options were scored high for both criteria.

Table 22. Badnapur Cluster – options with highest priority – Ordered criteria 1-2

Nr.	Sector	Adaptation option
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)
18	Water	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs
15	Water	Promote greater awareness about the benefits of watershed development
19	Water	Afforestation and reforestation
21	Society	Introduce innovative couple farmers forums
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)
5	Agriculture	Promote better soil management
8	Agriculture	Set up credit schemes to promote adoption of new technologies

Table 23. Badnapur Cluster – options with highest priority – Equal weights (50%-50%)

Nr.	Sector	Adaptation option
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)
18	Water	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs
15	Water	Promote greater awareness about the benefits of watershed development
19	Water	Afforestation and reforestation
21	Society	Introduce innovative couple farmers forums
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)
5	Agriculture	Promote better soil management
8	Agriculture	Set up credit schemes to promote adoption of new technologies

Bhokardan Cluster

For the Bhokardan cluster, the ranking of options shows that society and agriculture options receive a high priority, see Table 24 and Table 25.Specifically the options—women-focused capacity building (nr. 20), crop insurance (nr. 9) and facilitation of robust market linkages (nr. 10) rank high in this cluster. The two approaches do show a different order of prioritized options and one different option. This difference in order is due to the scores given to both criteria, and the emphasis in the criteria ranking. With equal weights, the weighted sum of the options that score high for both no-regret and feasibility criteria end up high on the list of priority options. With

ordered criteria, the options with high scores for the no-regret criteria end up high on the priority list, irrespective of the scores given to the feasibility criteria.

Table 24. Bhokardan Cluster – options with highest priority – Ordered criteria 1-2

Nr.	Sector	Adaptation option
20	Society	Women-focused capacity building
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information) - including for dairy, vegetables, millets
21	Society	Introduce innovative couple farmers forums
23	Society	Education and Mobilizing of youth
4	Agriculture	Soil conservation and enrichment through construction of farm bunds
5	Agriculture	Promote better soil management
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)
3	Agriculture	Provide weather advisories / early warning system for drought to the farmers
15	Water	Promote greater awareness about the benefits of watershed development

Table 25. Bhokardan Cluster – options with highest priority – Equal weights (50%-50%)

Nr.	Sector	Adaptation option
20	Society	Women-focused capacity building
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)
3	Agriculture	Provide weather advisories / early warning system for drought to the farmers
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information) - including for dairy, vegetables, millets
15	Water	Promote greater awareness about the benefits of watershed development
18	Water	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)
21	Society	Introduce innovative couple farmers forums
23	Society	Education and Mobilizing of youth
4	Agriculture	Soil conservation and enrichment through construction of farm bunds

Jaffrabad Cluster

For the Jaffrabad cluster, the ranking of options shows that mainly agricultural options receive a high priority, see Table 26 and Table 27. Promotion of better soil management (nr. 5) and promotion of the use of shading nets and greenhouses to grow crops (nr. 7) rank highest.
The two approaches show a different order of prioritized options and several different options. This difference in order is due to the scores given to both criteria and the emphasis in the criteria ranking. See a more detailed explanation about this above at the Bhokardan cluster. The different options in the ranked lists using ordered criteria and equal weights results from the ordered criteria ranking putting high priority on options that score high on the no-regret option (5), irrespectively what score is given for the other criteria, possibly even scored 1. With weighted criteria, the feasibility criteria receives more weight with ranking the options and thus puts more weight on lower scores, resulting on a lower weighted sum and these options receive a lower ranking.

Table 26. Jaffrabad Cluster – options with highest priority – Ordered criteria 1-2

Nr.	Sector	Adaptation option
5	Agriculture	Promote better soil management
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)
4	Agriculture	Soil conservation and enrichment through construction of farm bunds
15	Water	Promote greater awareness about the benefits of watershed development
25	Society	Provide pensions or safety nets for elderly
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)
12	Agriculture	Promote adoption an integrated farming system model
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management

Table 27. Jaffrabad Cluster – options with highest priority – Equal weights (50%-50%)

Nr.	Sector	Adaptation option
5	Agriculture	Promote better soil management
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops
12	Agriculture	Promote adoption an integrated farming system model
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management
16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies
19	Water	Afforestation and reforestation
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)
6	Agriculture	Promote organic farming (such as vermicomposting, mulching)

When we compare the results of the three clusters, i.e., the options that receive a high priority, we notice that for the Badnapur cluster more water options are ranked high, with 4 out of 10 options coming from the water sector as compared to the other clusters, with only 1–2 out of 10 options. For the Bhokardan , the top 10 priority list contains slightly more social options than the other clusters and these are also ranked relatively higher, with the option 'Women-focused capacity building (nr. 20)' ranked highest. The prioritized list of options for the Jaffrabad cluster show that more agricultural options are ranked high compared to the other clusters, with also slightly more agricultural options in the top 10, being 7 out of 10 options, compared to 5–6 options.

Common options across clusters

Based on the tables presented earlier, containing the ranked options for the different clusters, we have identified common options across the clusters, with equal weights and ordered criteria. With common options, we mean, options that occur more than ones, in the list of high ranked options (ordered criteria: all options scored with 5 for no-regret criteria; weighted criteria: weighted sum equal to or higher than 4).

Common options across clusters with ordered criteria:

- Research on risk proof agriculture (nr. 2)
- Promote better soil management (nr. 5)
- Soil conservation and enrichment through construction of farm bunds (nr. 4)
- Crop insurance (nr. 9)
- Promote greater awareness about the benefits of watershed development (nr. 15)

Common options across clusters with weighted criteria:

- Research on risk proof agriculture (nr. 2)
- Crop insurance (nr. 9)
- Promote integrated pest management technologies and nutrient management (nr. 13)
- Promote greater awareness about the benefits of watershed development (nr. 15)
- Promote protective irrigation and use of efficient irrigation technologies (nr. 18)
- Afforestation and reforestation (nr. 19)
- Introduce innovative couple farmers forums (nr. 21)

Approach 2 – Composite score

An alternative approach for determining the top-ranked options for the clusters is an approach, where a composite score is calculated for each option, the following steps are taken:

- Calculate a composite score for each option taking equal weights average if the option had been scored on two criteria
- List the top 4–5 top options for each group; if a lot of options got the same high score, I included all of them.
- For each group (i.e., separately for institutional farmers, normal farmers, landless and women), the common top options across three or two villages are identified.

Table 28 provides a summary of the top common options for the different groups.

4.4 Block-level and cluster-level results

As the workshops at block-level and cluster-level have used a slightly different approach in scoring the adaptation options, we need to be careful with comparing the top adaptation options. The difference between the approaches used relate to:

- an additional criteria identified by the participants of the block-level workshop (three instead of two criteria)
- the block-level workshop random groups being asked to score a selective list of options for the three criteria.
- the cluster-level workshop, where the participants were defined in specific groups and asked to score the entire long list of adaptation options against the two criteria.

In addition, the two types of ranking are applied to analyse the sensitivity of the results; ordered criteria and criteria weighting.

From the cluster-level workshop, the most common options are based on sensitivity analysis with two different ways of ranking options:

- Research on risk proof agriculture (nr. 2)
- Crop insurance (nr. 9)
- Promote greater awareness about the benefits of watershed development (nr. 15)

For the block-level workshop, the most common options are based on sensitivity analysis with two different weights:

- Soil conservation and enrichment through construction of farm bunds (nr. 4)
- Promote better soil management (nr. 5)
- Promote adoption of an integrated farming system model (nr. 12)
- Education and mobilizing of youth (nr. 23)

- Setting up of SHGs and training them to implement drought resilient livelihoods options (nr. 24)

Table 28. Top common options for cluster-level following composite score approach

Farmers with institutional affiliation		Farmers with no institutional affiliation		Landless labourers		Women	
18 (W)	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)	14 (W)	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	15 (W)	Promote greater awareness about the benefits of watershed development	14 (W)	Construction and maintenance of water conservation structures such as farm ponds and KT weirs
5 (A)	Promote better soil management	15 (W)	Promote greater awareness about the benefits of watershed development	14 (W)	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	24 (S)	Set up Self Help Groups and train them to implement drought resilient livelihoods options
13 (A)	Promote IPM (Integrated Pest Management) technologies and nutrient management	20 (S)	Women-focused capacity building	16 (W)	Introduce regulatory framework for groundwater use and promote aquifer management policies		
19 (W)	Afforestation and reforestation	25 (S)	Provide pensions or safety nets for elderly	17 (W)	Promote water budgeting/planning management		
24 (S)	Set up Self Help Groups and train them to implement drought resilient livelihoods - options						

5 Barriers

Barriers to adaptation

While identification and prioritization exercise of adaptation options can help in selecting the right set of potential adaptation options, however, their actual implementation might face a number of limits and barriers. The Fourth Assessment Report of IPCC has categorized the limits and barriers to adaptation into physical and ecological limits, technological limits, financial barriers, informational and cognitive barriers and social and cultural barriers (Adger et al. 2007). According to Jones (2010) from ODI, different types of barriers to adaptation can be grouped into three broad classes—natural, human and informational and social, see Figure 10.

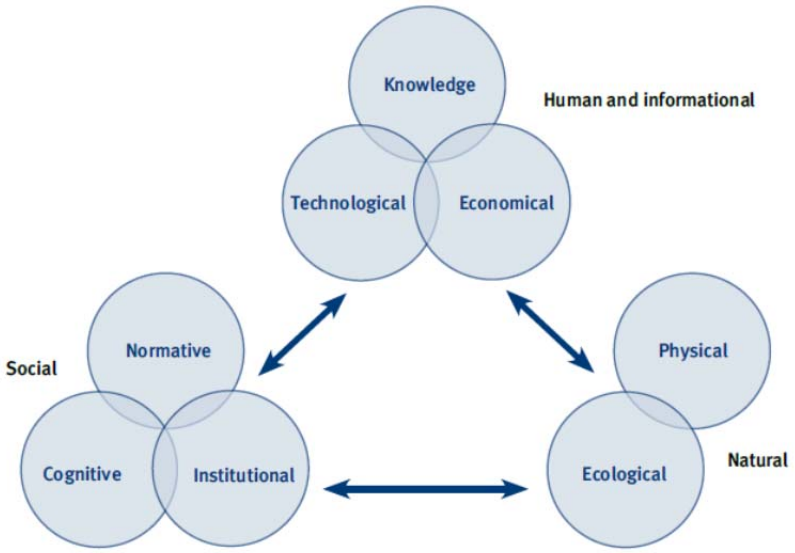


Figure 10. Conceptual grouping of limits and barriers to adaptation
Source: Jones 2010

Limitations arising from the natural environment including thresholds of the ecosystem or geographical and geological limitations can be grouped as ecological or physical barriers. Uncertainties related to spatial and temporal aspects, low level of awareness and financial constraints fall under human and informational barriers. Social and cultural barriers are the processes that govern how people react to climate variability and change. According to IPCC, these barriers to adaptation are not well researched and there is less understanding on what kind of barriers might be faced while actually implementing adaptation (Adger et al. 2007; Jones, 2010). In the context of Jalna, we did the identification and prioritization of adaptation options but it becomes inevitable to understand the likely limits and barriers to the implementation of these options.

Based on interviews we collected information on barriers to adaptation in the region for the top prioritized adaptation options at block level. Note that barriers mentioned are with respect to the top adaptation options identified through the different workshops and are only based on interviews conducted with government officials at district level. The listed barriers are not exhaustive and are only based on the perspectives of one set of stakeholders. These adaptation options might have more barriers depending on the perceptions of different stakeholders, who were not interviewed, such as the local communities. The barriers can be categorized based on sectors for specific adaptation options, i.e. water, agriculture and social.

1. Water

Construction of water conservation structures such as KT weirs and ponds
The primary barrier in implementing schemes and programmes related to construction of water conservation structures is lack of funds. The local government officials specified that there are a large number of incomplete works and new planned structures which are pending only because of lack of sufficient funds. Based on these constraints, the relevant departments have not undertaken any new work in the last two years. The government has also instructed these departments not to take up any new work and finish the incomplete works. The officials indicated that there is an urgent need for funds which can streamline the current incomplete structures and enable them to plan for implementing the planned structures.

Second barrier is that the farmers and other landholders are apprehensive about selling their land to the department. As the land prices are too high, the department is not able to give the appropriate compensation to the landholders due to lack of funds.

Third barrier is that the people from government do not receive any support from the Water User Associations (WUA) while implementing the maintenance and repair work. The WUAs are formed after the structures are formed so that the maintenance and repair work can be taken care of by them. Though the life of these structures is 60 years, minor repair work is required after 10 years. The WUAs feel that they should get all the funds from the government for the repair and maintenance work. The government officials felt trapped as the government did not release any money for these works and nor did they receive any support from the local bodies.

2. Agriculture

Soil conservation through construction of farm bunds:
Construction of farm bunds mainly faces three types of barriers—social, technological and financial. According to interviews conducted with local government officers, defining farm boundary for construction of farm bunds becomes one of the barriers as it is very difficult to get agreement from all the farmers for such constructions. The awareness on benefits of watershed development and soil conservation is still less amongst the farmers. Although some people want to have these farm bunds, many people don't agree for such constructions as they don't want any kind of bunds constructed in their fields. Settlement of disputes becomes an issue as there are lots of boundary disputes with respect to construction of bunds. There are also technical problems related to stabilization of bunds due to damage caused by bullock carts and people walking on the boundary. People while constructing don't make outlets in bunds. Ideally, there should be an outlet constructed in the bund at the level of 30–35 cm but that is not made due to which the bunds break after sometime. This reflects the lack of proper technical guidance and knowledge while constructing farm bunds. Financial barriers are also major constraints in the construction of bunds as there are not sufficient funds available to the relevant department. Since their mandate is limited to making bunds in areas where bunds are not currently present, the limited funds are used only for construction and no maintenance of bunds is done by the government department. The interviews with government officials also revealed that earlier, there were funds available for construction of bunds under different watershed programmes, but now the departments have to depend on employment schemes such as MNREGA for such activities. This kind of approach creates challenges for long-term planning and execution of watershed structures.

Integrated farming system model

The main barriers in implementing or following integrated farming system model are in the form of perception and willingness of people to adopt such a technology. According to the information from interviews with local government people, usually all family members of a household are not involved in agriculture as they are not willing to invest too much hard work. Only 1-2 members of the family are involved in farming activities. Livestock population has also reduced since people feel that it is very tedious to maintain animals and the benefit obtained is also less. This has reduced the use of farm yard manure and farmers use more chemical fertilizers. The farmers feel that it is better to buy mechanical machinery which involves less of manual labour. Also, the choices in farming depends on situation, for instance, if there is sufficient water and money available then they invest in horticulture or anything else rather than investing in livestock. In such a scenario, getting widespread adoption of an integrated farming system model can be very challenging.

Change in cropping pattern

One of the key barriers in encouraging changes in cropping pattern is the influence of market-based factors. Discussions with local officials show that cropping decisions by farmers are never based on environmental factors solely. There are market factors dominating changes in cropping pattern. For example, crop decision is never made only on basis of rainfall. After last years' drought, this year the farmers grew soya bean which is a short duration crop. However, in October when field was vacant and there was sufficient water available, the farmers grew sugarcane, a water-intensive crop which can fetch more money. Thus, the farmers take chances while making decisions about cropping pattern. Another barrier is about the criteria for changing the cropping pattern. Discussions with farmers indicated that non-specificity, uncertainty and spatial low resolution of weather predictions, prevents them from taking any decisive action regarding cropping pattern.

3. Social

Setting up SHGs and training them to implement drought resilient livelihoods.

SHGs can be a key coping mechanism for the communities in case of droughts. During the drought of 2012 also, savings from SHGs helped the communities in providing some financial resources. However, discussions in some of the villages such as Warudi indicated that many SHGs did not work as the savings were very less. Women in Malegaon felt that it is difficult to save money as it gets spent on medical and other expenses. This shows that the potential of SHGs in building resilience of communities towards extreme events such as droughts has not been tapped appropriately. SHGs can play a useful role in this respect. But there is a need for SHGs to be advised on options for entrepreneurial ventures and income-earning activities that can build drought resilience and aid in drought recovery.

6 Evaluation of adaptation options

As stated in section 2.1.4, evaluation of adaptation options is an integral part of the adaptation process, required to ensure more effective and efficient implementation of adaptation options. The chosen participatory MCA approach has provided the advantage of evaluation the adaptation options with respect to more than one criteria. In addition, in this chapter we further detail the indicators of the long list of adaptation options and detail a metrics approach to evaluate several highly ranked adaptation options. Furthermore, we describe additional evaluation approaches that are appropriate for evaluating options. The latter will be done in a descriptive manner, as data constraints restrict us in applying a thorough analysis.

6.1 Detailed long list of adaptation options

The long list of the 26 adaptation options, relating to agriculture, water and social development has been further specified for different indicators, to detail the specifications of each of the identified options. The details per option and indicator are based on observations from the field work, the WP4 team's and colleague's expertise, and literature sources. Several project members have reviewed different indicators. Table 29 and Table 30 give details of the top most common options identified from the block-level and cluster-level workshops, in numerical order. The extended long list with all 26 adaptation options can be found in Annex A.3, Table 35 and Table 36. Each of the indicators and generalised outcomes will be discussed in the next section.

Table 29. Detailed top adaptation options (part 1)

Nr.	Adaptation option	Category	Key actors	Implementing agency/actor:	Effects of adaptation option	Actions to apply adaptation option	Community-based adaptation?
2 (A)	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	Crop management and input technology	Agricultural Universities, Agricultural research institutions and stations	Research groups with interest and funding to conduct the research Eventually group of farmers	Change in agricultural practices, farmers to become less vulnerable to the impacts of droughts	Funding needed for research; research priority on risk proof agriculture; dissemination of results to Agricultural extension offices and eventually farmers	Indirectly
4 (A)	Soil conservation and enrichment through construction of farm bunds	Soil and water conservation	Farmers, government	Farmers and Government	Soil conservation and enrichment	Define locations where to construct farm bunds; Purchase material needed for construction	Yes
5 (A)	Promote better soil management	Soil and water conservation	Agricultural research stations, Agricultural extension offices, farmers	Farmers who have attended training to promote better soil management	Better soil management to mitigate impacts of drought	Conduct soil testing and application of fertilizers accordingly; awareness raising and training to promote better soil management	Indirectly
9 (A)	Crop insurance (Strengthening of insurance mechanisms	Credit and finance	Bank, Government, Farmers	Banks and government	Strengthened insurance mechanism especially in drought years	Set up insurance scheme, or strengthen existing ones with a focus on crop insurance with the aim to	Indirectly

Nr.	Adaptation option	Category	Key actors	Implementing agency/actor:	Effects of adaptation option	Actions to apply adaptation option	Community-based adaptation?
	especially in drought years)					improve the recovery of impacts of drought	
12 (A)	Promote adoption an integrated farming system model	Integrated solutions	Agricultural extension offices, Farmers	Promotion: Agricultural extension offices Implementation: farmer	Improved livelihoods, less impacted by droughts	Awareness raising and training to promote adoption of integrated farming system	Indirectly
15 (W)	Promote greater awareness about the benefits of watershed development	Soil and water conservation	Government, Agricultural research stations, Agricultural extension offices, Community based organizations	government	Lesser resistance towards such watershed development activates; Improved water conservation and harvesting to mitigate the impacts of drought	Awareness raising to promote the benefits of watershed development through training sessions, workshops for local communities, dissemination of easy to read manuals	Indirectly
23 (S)	Education and Mobilizing of youth	Capacity building/ Governance - youth	Government	Government	Youth have farming-related education to make better decisions and earn higher returns from agriculture; Also, youth have enhanced skills for non-agricultural livelihoods particularly in light of the fragmentation of landholdings; Reduced unemployment / disguised unemployment and waste of productive working years	Organise educational sessions to sensitise the youth to the impacts of climate change and their possible contributions to mitigate the impacts; Provide scholarships for vocational training programmes	Indirectly
24 (S)	Set up Self Help Groups and train them to implement drought resilient livelihoods options	Capacity building/ Governance - Institutional	Government	Government / NABARD / National Rural Livelihood Mission	Savings of Self Help Groups can ease the burden in times of drought; The investment of SHG savings into climate-resilient livelihoods can provide additional robust sources of income during drought or savings to cope with drought impacts	Set-up Self Help Groups and provide regular guidance and training on how to deal with the impacts of droughts, for example how to use their savings to implement resilient livelihood options	Indirectly

Table 30. Detailed top adaptation options (part 2)

Nr.	Adaptation option	Institutional aspects	Benefits (Individual /community level /spill over)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives
2 (A)	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	No institutional change required – can be carried out through existing research institutions (agriculture universities, research stations, CSIR labs, IARI), though funding may need to be increased	Community, results of research can be disseminated across villages, regions.	Funding required to conduct the research ($$), High costs involved for development of the suitable varieties ($$$)	Lack of funding to conduct the research	New varieties/practices may increase women's work burden e.g.by requiring more weeding, or requiring precision application of fertilizers which may be more time consuming. Further, new varieties may reduce women's autonomy with respect to managing seeds or managing household nutrition security. Transferring research to practice should be done in a way that women are engaged. More efficient irrigation technologies will have a positive effect directly and indirectly - no increase in work, saving of a scarce resource, financial savings. There should be greater involvement of women in field trials.
4 (A)	Soil conservation and enrichment through construction of farm bunds	No major institutional change required	Individual: implementation leads to soil conservation and enrichment	Material required to construct farm bunds ($$)	Financial constraint to purchase material for construction, Availability of adequate technical information	
5 (A)	Promote better soil management	No major institutional change required	Individual farmer who implements better soil management	Costs related to achieving better soil management (soil tests, purchase of fertilizer) - Training ($), Material ($$)	Individual farmers: no access to training, or opportunities to purchase soil testing, fertilizer	
9 (A)	Crop insurance (Strengthening of insurance mechanisms especially in drought years)	Institutional support for extending reach of crop insurance schemes and timely pay-outs	Individual farmers able to access crop insurance	Strengthening of existing mechanism ($$$), costs for individual farmers such as a premium ($$-$$$)	Availability and accessibility of crop insurance, and affordability of the premium	An FAO report points out: "Traditional coping methods include finding work on neighbouring farms (to supplement income for food) and borrowing from family and friends. But when everyone in a geographical area has been affected in the same way, these safety nets are often compromised as well. While government-based crop insurance schemes are available, most smallholder farmers are unable to meet their eligibility requirements. Women, in particular, face challenges in access to credit, collateral, and financial services." But if the household is able to get

Nr.	Adaptation option	Institutional aspects	Benefits (Individual /community level /spill over)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives
						insurance, it will definitely improve their resilience to drought. But awareness, access, and penetration of crop insurance, particularly weather-indexed insurance, needs to be drastically increased by public and private insurance providers.
12 (A)	Promote adoption an integrated farming system model	No institutional change required – can be facilitated through existing KVK and extension network	Farmers become less vulnerable to impacts of drought	Training and awareness activities for farmers ($)	Interest of farmers to learn about benefit of integrated farming system model, what it means in practice	Design of integrated farming system promoted in any area should take into consideration gender-specific preferences. While horticulture/aquaculture/dairy etc. will definitely enhance hh food security and diversify livelihoods, it is very likely that the additional work burden of these activities will fall on women as they are perceived as homestead activities (e.g. women interviews in Badnapur cluster showed that women did all the fodder collection and milking early in the morning - men only sold the milk.) (Though a project in Bengal found that "The proximity of the farming system to the house ensure that the women are able to transfer the extra time available from managing the house and children into an income generating activity and the ability to integrate the organic output from house and different farming activities into an integrated farming system".) As with IPM or new crop varieties, the training programmes should encourage the participation of more women, be held at a convenient time and venue for women, and could be conducted by women trainers.
15 (W)	Promote greater awareness about the benefits of watershed development	Linkages with ongoing watershed programmes	Greater awareness on watershed development leading to more initiatives being taken by the communities	Conducting awareness campaigns and training sessions for the farmers ($)	Land issues (such as prices) might undermine the motivation to give up land for construction purposes	Due to the hydrogeological profile in Jalna, collective watershed development may not result in collective benefits. So there is resistance to giving up private lands. Awareness raising activities could be targeted at both men and women. But to what extent do women have a say in such decisions within the household? How many women are members of village watershed committees and what are their roles? The watershed committees should have representation of women farmers even if they do not own land. Female committee members need to be given specific responsibilities and made signatories to the bank account for the project.

Nr.	Adaptation option	Institutional aspects	Benefits (Individual /community level /spill over)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives
23 (S)	Education and Mobilizing of youth	No major institutional change required	Individual	Needs to be designed in a focussed way with extensive reach, possibly set up new institutions ($$)	education (school / college) system does not provide practical skills; changing the system will be slow	Positive gender effect if young women are trained
24 (S)	Set up Self Help Groups and train them to implement drought resilient livelihoods options	No major institutional change required, linkages with National Rural Livelihood Mission	Individual	Extend ongoing activities to ensure regular guidance and training, may need to increase manpower ($$)	none	Positive gender effect if women's SHGs become more robust and resilient to drought. An assessment of livelihood options for women should also focus on access and control of private and common resources (land, water, fuel, fodder) and on those resources which provide livelihood options to women (e.g. basket weaving, pottery etc.)

6.2 Indicators of adaptation options

Sector and Category

The long list of adaptation options have been categorized in three sectors, viz., agriculture, water and society. Within these sectors we have detailed each of the options further into the following categories, see Table 31.

Table 31. Sectors and categories for long list adaptation options

Sector	Further detailed category
Agriculture (13)	Crop management (3) Soil and water conservation (3) Input technology (1) Credit and finance (3) Alternative livelihoods (1) Integrated solutions (2)
Water (6)	Soil and water conservation (3) Water management (2) Input technology (1)
Society (7)	Capacity building/governance - Women (2) - Institutional (3) - Youth (1) - Elderly (1)

Key actors and implementing agency

For each of the adaptation options, the key actors involved and specifically the implementing agency were specified. The key actors defined as the actors are part of planning, performing research, etc. They are part of the chain of providers of the adaptation option before it involves the implementing agency and end-user. For agricultural options, the important key actors across options are the agricultural research stations and extension offices, with farmers being the end-users. Banks and government are important implementing actors for options focused on credit

and finance, such as strengthening of insurance mechanisms. For water options, the government is a key actor in the implementation options aimed at promoting greater awareness towards water budgeting, use of efficient irrigation technologies, introducing regulator frameworks. Also for the social options, the key actor for implementing these options is the government, as these options focus on capacity building of different groups and institutions.

Effects of adaptation option

Most of the options are a response to counter the negative effects of climate change, specifically focused on reducing the impacts of droughts, making farmers less vulnerable to these impacts. For agricultural and water options, this implies improved soil, water conservation and harvesting, and crop management to mitigate impacts of droughts. Social options aim to increase awareness of the impacts of drought, and specific groups, such as women, youth and elderly are less vulnerable to the impacts of drought.

Actions needed to apply/implement adaptation option

For each of the options, the required actions needed to apply and/ or implement the identified options are provided in detail in Table 35 and Table 36 in Annex A.3. Research, training and awareness raising are needed to implement an adaptation option. This relates more specifically to for example conducting research on risk proof agriculture, training of farmers, and promoting better soil management, etc. In addition, several options required setting up schemes and frameworks, such as safety net schemes for the elderly, credit and insurance schemes, water budgeting and planning management, and regulatory framework for groundwater use.

Community-based adaptation

Following the definition of Community-based adaptation (CBA) as provided in Chapter 1, overall the identified options focus on adaptation to direct impacts of climate change, using scientific knowledge from WP1 and local knowledge through the participatory mapping workshops under WP2. The workshops to identify, discuss priorities and score options were conducted in a participatory way. The assessment in WP4 aims to provide insight in the setting of the options in the wider policy context, through highlighting institutional aspects and barriers for the planning and implementation of the identified options. An important characteristic of CBA relates to whether the adaptation options are being operated at the local level. In the further specification of the long list of adaptation options, we define whether or not an option is defined as CBA when the implementing agency is based at the local level and an option is not defined as CBA when the implementing agency is outside the village community.

The level of measurement of answering if the identified adaptation option is considered CBA is specified with:

- Yes: the implementing agency is based at the local village level and there is a clear participation by local community and focus on adaptation to climate change
- No: the implementing agency is based outside the village community

We have added the possibility of 'indirectly' as to indicate when the implementing agency that starts the implementation of the adaptation option is based outside the village community; however, the final implementor(s) is/are based at the local village level. Twenty of the options are considered indirect CBA options, as the agency which starts the implementation of the options is based outside the village community, however, the actual implementation is done at the local community level. For the agricultural options, the farmers are considered the final implementers of options to improve crop management and soil and water conservation to reduce the impacts

of a drought. Five out of 26 options are CBA, and one option out of 26 options is not considered CBA, viz., provision of pensions or safety nets for the elderly (nr. 25), where the implementing agency if based outside the village community.

Institutional aspects

Institutional aspects that are needed to create enabling conditions for implementation of the options are identified, which includes:

- Need for creating user interface that connects the providers to the end-users of the weather advise and early warning systems (nr. 3)
- Institutional approval that support agricultural research stations and extension offices to promote better soil management (nr. 5)
- Institutional arrangement of subsidy schemes to promote the use of shading nets and greenhouses (nr. 7) and to promote protective irrigation and use of efficient irrigation technology (nr. 18)
- Institutional arrangement of credit schemes to promote adoption of new technologies (nr. 8)
- Institutional support for establishing crop insurance (nr. 9)
- Consensus from both government and communities required to facilitate implementation of water conservation structures (nr. 14)
- Integration of regulatory framework for groundwater use into the existing institutional regime (nr. 16)

The feasibility of achieving institutional approval/support and setting up of institutional arrangements is considered complex as this requires adjustment of local institutions, existing procedures, schemes and arrangements, and cooperation between different institutional domains, such as the environment and agricultural department.

Benefits (Individual/Community level)

The level of benefits resulting from the implemented of the adaptation options have been defined for the individual farmer or household and/or the community level. For agricultural options, individual farmers benefit as their soils and crops will be less affected by drought, maintaining or even increasing productivity under drought conditions. The options will result in ancillary benefits for the individual framers and the community in non-climatic change-related droughts and temperature extremes, making the communities less vulnerable to the impacts of drought. The water options will benefit the individual farmers as well as the community through, for example, afforestation and reforestation leading to improvement of the soil and water retention capacity of the land. The society options benefit individual households by improving the adaptive capacity of households to face climate extremes, through women-focused capacity building, innovative couple farmers forums and setting of SHGs. The community benefits through options that focus on strengthening of local institutions and local level committees that are able to deal with the impacts of droughts.

Costs of implementing adaptation option

The costs of implementing the adaptation options have been evaluated using an ordinal level of measurement defined as ranging from $-$$-$$$, where $ indicates that low level of costs are required to implement the option, $$ indicates medium costs and $$$ high level of costs. Note that for each option, different actors bear the cost of implementing the options; this can be society, the government or an individual farmer. Table 32 provides an overview of the anticipated costs for implementing the adaptation options, based on expert judgements. For several options, different costs are specified such as the costs of conducting training to promote better soil

management, and the material costs needed to achieve better soil management, such as soil tests and purchases of fertilizer.

For agricultural options, the costs range from low ($) to high ($$$). Training and awareness activities to promote better soil management, organic farming, livelihood diversification, integrated farming system model and integrated pest management are expected to be achieved with low costs. Options that involve the purchase of materials, such as different crops, shading nets, etc., and the construction of farm bunds setting up credit schemes, however, require medium to high costs. For water options the costs also range from low ($) to high ($$$), with the implementation of training session and awareness campaigns at low costs and the purchase of equipment and construction of structures, such as farm ponds and protective irrigation at medium to high costs. For the social options the costs range from low to medium. This includes the need to add or reorganize budgetary resources to implement capacity building for specific groups and strengthen local-level institutions and committees.

Table 32. Costs of implementing adaptation options

Nr.	Adaptation option	Costs of implementing adaptation option ($-$$-$$$)
1 (A)	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)	Costs of purchasing different crops ($$-$$$; depends on type of crop and costs related to growing the crop)
2 (A)	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	Funding required to conduct the research ($$), High costs involved for development of the suitable varieties ($$$)
3 (A)	Provide weather advisories/early warning system for drought to the farmers	Setting up a system that provides information from the providers to the end-users ($$$)
4 (A)	Soil conservation and enrichment through construction of farm bunds	Material required to construct farm bunds ($$)
5 (A)	Promote better soil management	Costs related to achieving better soil management (soil tests, purchase of fertilizer) - Training ($), Material ($$)
6 (A)	Promote organic farming (such as vermicomposting, mulching)	Costs related to achieving better soil management, water usage, crop management - Training ($), Material ($$)
7 (A)	Promote the use of shading nets and greenhouses to grow crops	Purchase cost of shading nets ($$) and greenhouses ($$$)
8 (A)	Set up credit schemes to promote adoption of new technologies	Cost of credit (level of interest rate, repayment) - set of scheme ($$$), costs for individual farmer ($$-$$$)
9 (A)	Crop insurance (Strengthening of insurance mechanisms especially in drought years)	Strengthening of existing mechanism ($$$), costs for individual farmers such as a premium ($$-$$$)
10 (A)	Facilitate robust market linkages (road access, transport, storage, price information) - including for dairy, vegetables, millets	Construction of roads, affordable transportation and storage, set up of information system to provide market information ($$-$$$)
11 (A)	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy based derived products)	Training and awareness activities in communities ($)
12 (A)	Promote adoption an integrated farming system model	Training and awareness activities for farmers ($)
13 (A)	Promote IPM (Integrated Pest Management) technologies and nutrient management	Costs related to achieving better pest management - promotion ($), implementation ($$)
14 (W)	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	Construction costs ($$$), compensation for land procurement for such construction ($$), maintenance cost ($$)
15 (W)	Promote greater awareness about the benefits of watershed development	Conducting awareness campaigns and training sessions for the farmers ($)
16 (W)	Introduce regulatory framework for groundwater use and promote aquifer management policies	Set up of new policy regulation ($$)
17 (W)	Promote water budgeting/planning	Training for promotion of water budgeting ($)

Nr.	Adaptation option	Costs of implementing adaptation option ($-$$-$$$)
	management	
18 (W)	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)	Purchase of equipment ($$$)
19 (W)	Afforestation and reforestation	Afforestation ($$), reforestation ($)
20 (S)	Women-focused capacity building	Reorganization of existing budgets ($)
21 (S)	Introduce innovative couple farmers forums	Rescheduling of existing programmes with existing resources ($)
22 (S)	Strengthening of local institutions such as Gram Sabha	Extension of ongoing programmes ($$)
23 (S)	Education and Mobilizing of youth	Needs to be designed in a focussed way with extensive reach, possibly set up of new institutions ($$)
24 (S)	Set up Self Help Groups and train them to implement drought resilient livelihoods options	Extend ongoing activities to ensure regular guidance and training, may need to increase manpower ($$)
25 (S)	Provide pensions or safety nets for elderly	Add budgetary resources but also improve reach and accessibility of existing schemes ($$)
26 (S)	Strengthening of local level committees such as watershed committees and disaster management committee/formation of other local level institutions such as user groups or farmer clubs	Need to design creative approaches, possibly transfer more budgets to panchayat level ($$)

Barriers

The barriers to the implementation of the adaptation options have been evaluated, providing a brief description for each option. Chapter 5 provides more in-depth details of barriers to adaptation for five adaptation options. The overview shows that the potential barriers for the implementation of the agricultural options are:

- Market conditions need to be conducive enough to promote growing fodder crops
- Lack of funding to conduct research
- No existing user interface to provide weather advisories and early warnings to farmers
- Financial constraints to purchase materials, construction of roads, transportation and storage
- Individual restriction of farmers to access training concerning achieving better soil management, using shading nets, etc.
- Availability and accessibility to credit and crop insurance

Water options barriers relate to:

- Willingness of farmers and communities to accept regulatory frameworks for groundwater use and support water budgeting
- Land issues related to the construction of water conservation structures, watershed development structures and afforestation
- Long-term maintenance of water conservation structures

Social options barriers relate to:

- Lack of full devolution of powers at the village level to strengthen local institutions and committees as to improve awareness of and ability to respond to the impacts of drought
- Capacity building regarded as a marginalized issue

Gender perspectives

For each of the options we have evaluated the gender perspectives of the identified adaptation options. Table 35 and Table 36 in Annex A.3 provide a detailed description for each option. The issues highlighted are:

- The roles and responsibilities of women farmers; who makes within the household the decision about crop choices?
- New crop varieties and practices, such as organic farming, may increase women's work burden
- Accessibility of women to mobile phone-based weather advisory, credit, collateral and financial services
- Membership of village committees, such as the watershed and disaster management committee
- Women focused capacity building will help women become more independent and self-sufficient but capacity building activities should not increase their burden of work

Who will benefit, be unaffected, be negatively affected by the implementation of the option?

Each option has been evaluated to specify who will benefit, be unaffected and be negatively affected by the implementation of the adaptation option.

For the agricultural options, innovative group of farmers who have financial possibilities, or access to them will benefit as they are able to access training, make changes in their farming system and purchase materials. Farmers with restricted financial possibilities will be negatively affected by the implementation of the options, as they may not be able to change their crops, making it more difficult to sell their current crops on the market. In addition, landless labourers might benefit be negatively affected if the implementation of the options leads to less work for the laboureres.

For water options, for example, the construction and maintenance of water conservation structures such as farm bonds and KT weirs, farmers living in close proximity to the constructions and drawing water from the same aquifer which is recharged will benefit from the implementation of the option. Farmers and villages might be negatively affected when cross-territorial disputes related to water exist and these disputes increase when decisions are made about where to construct the water conservation structures.

For social options, such as the strengthening of local level institutions and committees, if limited resources are available for such options, other villages who are competing for a finite pool of resources might be negatively affected as they lose out on the possibility of receiving funding for such initiatives.

6.3 Evaluation of adaptation options using metrics approach

As discussed in earlier sections, monitoring and evaluation of adaptation is an emerging area of research required to ensure that the adaptation strategies being implemented are able to achieve the overall objectives of the project. Since one of the outcomes of the activities under this work package of EVA project is the long list of identified adaptation options and their prioritization, it becomes critical to evaluate these adaptation options for future applicability. However, as these are only options and not the implemented adaptation strategies, thus what can be evaluated is only the potential of implementation and potential effectiveness of a particular adaptation option.

For this purpose, we used the Metrics approach involving the use of indicators for evaluation of adaptation. This kind of approach has been used for monitoring and evaluation of several adaptation projects (Bours et al. 2013). One of the examples is the research project on 'Identification of win-win adaptation options for adaptation metrics and integrated adaptation decision making' focused on identifying local level indicators for assessing effectiveness of adaptation options and accordingly devising a tool for decision making (IGES 2013).
This project was conceptualized with the main objective of developing a methodology for measuring effectiveness of adaptation in agriculture and water sector through adaptation metrics which is applicable at the local level. For this purpose, the Global adaptation Index (GaIn) was adopted which can calculate the effectiveness of adaptation action in terms of change in the index value after the implementation of the practice (Figure 10). However, as this methodology is applicable at a macro scale, there was a need to identify additional indicators which represent the local conditions. Thus, a set of additional **local indicators** for testing the effectiveness of adaptation options were identified and developed. The set of additional indicators were identified using both top-down and bottom-up approaches (Figure 11). The methodology involved identifying the indicators to assess effectiveness of a particular adaptation action under three broad categories, ranking these indicators and identifying the criteria of ranking these indicators.Figure 11 illustrates the approach for measuring progress in adaptation using the Metrics approach as suggested in the IGES study.

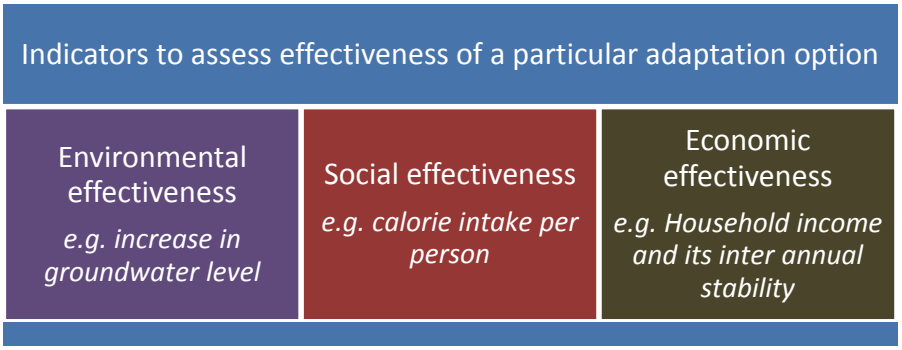


Figure 11. Illustration of indicators of Metrics approach

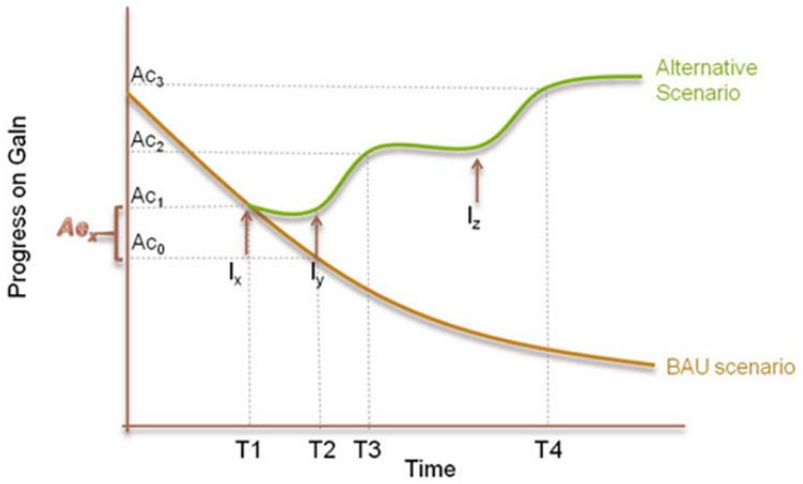


Figure 12. Measuring progress in adaptation
Source: Adopted from the Adaptation Metrics study

This approach involves measuring progress in adaptation by quantifying the indicators and measuring them at different points of time to understand the effectiveness.

Progress in adaptation is defined by $Ae_x = Ac_1 - Ac_0$

Where,
Ae_x: Effectiveness of adaptation action x; **Ac_0, Ac_1:** GaIn value at times T1 and T2; **Ix, Iy, Iz:** Interventions x, y, z
A0 would be the GaIn value of BAU scenario and Ac1 would be the GaIn value for each proposed adaptation action for implementation. The difference between these two GaIn values would give the estimate on the effectiveness of the action/practice implemented at T2.

Adopting the Metrics approach under EVA study

We tried applying the Metrics approach for evaluation of potential adaptation options under the EVA study. For the top-priority adaptation options in the water sector, some key indicators were identified to understand their effectiveness in helping the communities to cope with climate extremes such as droughts. The selection of indicators was done on the basis of the probability and extent of their measurability and quantification. Availability of data for two time frames (before and after implementation of the adaptation action) was also a criterion to choose the indicators. The evaluation process was carried out to demonstrate such an approach for adaptation process. The data used for evaluation was derived from the household survey done as part of this project. The household survey was done in each of the 9 EVA study villages covering 50 households in each. Random sampling was done to select the households on the basis of landholding.

Adaptation option in Water sector: *Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler) (nr. 18).* For this purpose, data for farmers using drip and farmers not using drip was used for doing a comparative analysis on the basis of selected indicators.

Finding indicators from HH questionnaire; Table 33 provides information from the household questionnaire on the number of households where drip irrigation is, or is not available, in each of the EVA study villages.

Table 33. Number of hhs with and without drip irrigation in each of the villages

	Is drip irrigation available?(in numbers)		
Village	No	Yes	Not applicable/ no answer
1 - Kadegaon	24	26	
2 - Malegaon	19	11	
3 - Warudi	33	16	
4 - Asarkheda	39	6	5
5 - Dongaon	37	7	4
6 - Nivdunga	18	27	4
7 - Palaskheda Pimple	25	18	
8 - PimpalgaonThote	35	12	1
9 - Barav Pimpalgaon	30	13	5

Looking at the data of farmers with and without drip irrigation as comparison for the following indicators shows:

- ***Yield (Average production per acre of land):*** We chose yield of cotton crop as an indicator to understand any difference or impact of using drip irrigation. Average decrease in yield of cotton crop in a drought year (2012–13) vis-à-vis a normal year (2011–12) was

calculated separately for farmers using drip irrigation and for the rest of the farmers depending on conventional methods of irrigation. The analysis shows that there is only a slight difference between average decrease in cotton yield of drip vis-à-vis non-drip using farmers. In Badnapur cluster, both Kadegaon and Warudi villages show a slightly more decrease in cotton yield for farmers not using drip irrigation while Malegaon village shows a different picture with more decrease in yield in case of farmers using drip irrigation. There is hardly any variation seen in the two categories in case of Jaffrabad cluster. In Bhokardan cluster, a remarkable difference can be seen in Palaskheda Pimple village with substantially more decrease in cotton yield for farmers not using drip irrigation and a slight difference in Barav Pimpalgaon village. Pimpalgaon Thote, however, shows a different picture with more decrease in case of yield for farmers using drip irrigation although the difference between the two is very minute.Figure 13 shows the decrease in cotton yield in drought year as compared to a normal year for farmers using drip irrigation and for farmers using traditional irrigation sources. The data is derived from the Household Questionnaire conducted under the EV project.

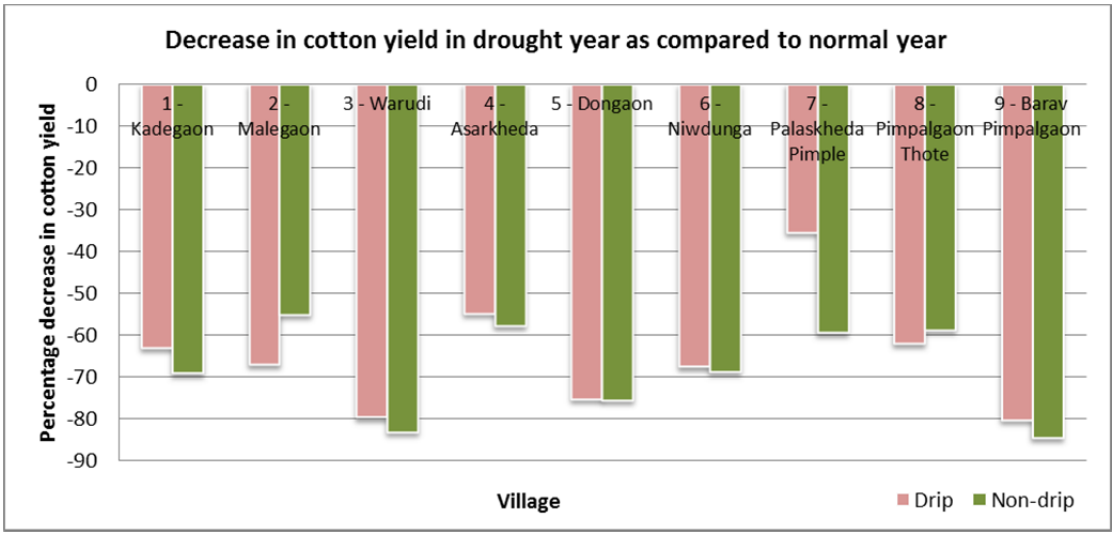


Figure 13. Cotton yield in drought year as compared to normal year

- ***Household income during drought*** vis-à-vis ***non-drought year:*** There is hardly any difference in percentage change of average monthly income from normal to drought year when comparing the two categories separately of drip vis-à-vis non-drip using farmers. However, when we compare the decrease in *average monthly income of households* ***per acre of land*** from normal to drought year then we see that the households having drip irrigation have had a comparatively lesser reduction in average income as compared to households not having drip irrigation in some of the villages.Figure 14 shows the decrease in average household income per acre of land from a normal to a drought year.

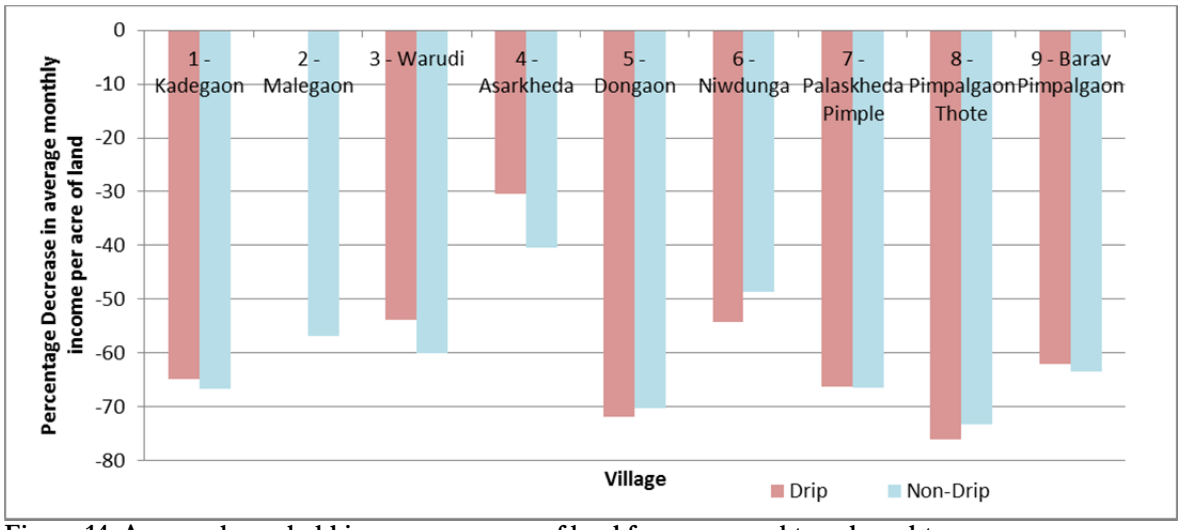


Figure 14. Average household income per acres of land from a normal to a drought year

In addition there can be other indicators for measuring effectiveness such as: selling assets, HHs member migrated out of the village, and taking up new loan/informal credit after failed monsoon

The data and the evaluation approach used in this case shows slight linkage of using drip irrigation with yield of cotton crops and average income per acre of land. The other indicators do not seem to be affected by the use of drip irrigation. It is important to note that these results are just indicative and the analysis has been mainly done to demonstrate an approach for evaluation of adaptation. Single indicators might not reflect or have direct correlation with the effectiveness of an adaptation options and it may have many underlying governing factors. Thus, it is important to firstly, understand the baseline, specific to the local context and the set of indicators which have correlation with the adaptation option.

6.4 Evaluation of adaptation options using participatory mapping

The evaluation of prioritized adaptation options can be done by using the maps that have been drawn during the cluster-level workshops conducted under Work Package 2. Here we describe how this evaluation can been done, because conducting the actual evaluation of the options based on this approach lies outside the scope of the EVA pilot study.

Cinderby et al. (2011) present an example of using a multi-scale Participatory Geographic Information Systems (PGIS) assessment to evaluated agricultural water management and livelihoods. PGIS entails community-focused public participating using GIS technology, where the issues assessed and mapped originate from and are controlled by the local community themselves (Cinderby et al. 2011 and Nelson et al. 2009). They applied a nested approach with two activities, viz., participatory mapping at the community scale, where the results were used as inputs to a second mapping activity undertaken by 'experts' at the watershed scale. This was followed by the development and mapping of scenarios of what might result from specific investments in water management which were discussed with the 'experts'.

For the evaluation of the prioritized adaptation, a similar approach is defined, with the following activities at the community and watershed scale:

1. Participatory mapping of resources and drought impacts
2. Participatory assessment of adaptation options; participatory approach based on multi-criteria analysis to assess how local communities and local officers identify and rank adaptation options in response to climate change

3. Development and mapping of scenarios of what might result from specific adaptation investments in the agricultural, water and social context to evaluate the effects of the adaptation options

7 Conclusion

This report presents the participatory assessment of adaptation and risk management options conducted under Work Package 4 of the EVA project 'Extreme Risks, Vulnerabilities and Community-Based Adaptation in India (EVA): a pilot project.' We describe a prioritization approach based on multi-criteria analysis with a participatory focus. We have explored and applied this approach to assess how local communities and local officers assess and evaluate adaptation options in response to climate change in the nine case villages of Jalna District.

We have identified adaptation options through consultation with communities and district-level officers, eliciting responses based on presenting 'what if scenarios' about future climate change trends. The prioritization of identified adaptation options has been done through workshops with multi-stakeholders, where the options have been scored with respect to multi-criteria. This served as a way to capture variation in priorities within communities. A sensitivity analysis has been conducted of the ranked options and further evaluation of the options is done in order to identify potential barriers to effective and efficient implementation of options.

In more detail, through consultations with drought-affected communities and district-level officers in Jalna District, a long list of 26 adaptation options pertaining to agriculture, water and social development was identified. During workshops with block-level officers and at village cluster level, participants were asked to rank criteria and score these adaptation options. At the village cluster level, the scoring was done separately by different groups of stakeholders: farmers affiliated with village-level committees, other farmers, landless labourers, women and youth.

This approach helped us understand the diversity of adaptation priorities across scales, and across different stakeholder groups within a community. Results indicate considerable agreement about some adaptation options, like construction of water conservation structures and educating youth, but sharp differences with respect to others. Some options, like integrated farming system received high scores from officers, but were relatively unfamiliar to farmers; conversely, farmers appreciated the need for measures like groundwater regulation and water budgeting, while officers deemed them unfeasible. Women were less aware of policy-type options, but gave high scores to good practices like water conservation, drip irrigation, and to social options like women's capacity building and strengthening of SHGs for credit.

These findings under WP4 indicate a possible mismatch between top–down government policy and local needs, and also reflect the gap between policy and implementation. For example, the state government's focus on building irrigation infrastructure has been accompanied by maladaptive choices (diverting water to water-intensive crops and industries), rather than by strengthening efforts to improve the technical quality of and increase people's participation in watershed development programmes.

Furthermore, effective implementation of adaptation options requires several key considerations, such as:

- Adaptation priorities vary across scales
- Adaptation priorities vary within a community
- Gender focus is key to successful adaptation
- Gap between policy and implementation needs to be bridged
- Monitoring and evaluation of adaptation options is important for ensuring successful adaptation

7.1 Reflection on the use of Participatory Multi-Criteria Analysis

Participatory Multi-Criteria Analysis is a good starting point for identifying and ranking adaptation options for climate change by providing a systematic method for assessing and scoring options against a range of decision criteria. Participatory MCA conducted under this work package has increased our understanding of the diversity of adaptation needs across scales, and across different stakeholder groups within a community. Key strengths, weaknesses and challenges are listed below, based on the experience under EVA and on Van Ierland et al. (2014) and De Bruin et al. (2009). Participatory MCA is relevant for adaptation to climate change as the approach provides information to address the data gaps in climate change adaptation and aids adaptation decision-making. In addition the approach is flexible, providing the possibility to include criteria that consider different aspects that are relevant for adaptation to climate change, especially aspects that are difficult to quantify, such as acceptability, feasibility, social performance, etc.

Strengths

- Decision-support tool to assess and rank adaptation options, which allows the consideration of both qualitative and quantitative data, especially when there is a lack of data on costs and benefits of adaptation options
- Transparent and simple method
- Involvement of stakeholders and experts helps to bridge the gap between top-down and bottom-up approaches to adaptation
- Conducting the ranking exercises in break-out groups for different types of farmers, can help ensure to some extent that the priorities of larger or better connected farmers do not outweigh the concerns of less vocal members of the community such as landless labourers or women farmers.
- Similarly, conducting the ranking exercises separately with officials and communities can provide useful insights into the gap between policy priorities and actual implementation on the ground.

Weaknesses

- Subjective scoring and weighting
- Restricted possibility to analyse climate change uncertainty

Challenges:

- Establish the criteria weights, to consider the aspects that are relevant for the assessment
- Reflect on how to score options and define the range of scores that should be applied
- Ability to add up the weighted scores, consider that all criteria should be formulated in positive or negative terms
- Standardized scores, as high and low levels of the scores need to represent the judgement about the performance of the option as precisely as possible
- Sensitivity of weights; assess equal weights, followed by a set of logical and plausible weights that express the values of various categories of stakeholders
- Transparency; assess various sets of weights on the ranking to create a transparent assessment where decision-makers can learn about the characteristics of the options and the ranking of the options for various sets of scores and weights.
- "What if" setting; where it is assumed that the selected future climate scenario represents the characteristics of climate change

- Assessment is done in a deterministic setting; the assumption is made that changes presented occur given the future climate scenario and the obtained ranking of options is solely relevant under the presented scenario.

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Annex

A.1 Workshop participants

Participants in village cluster workshops, February 2013

S.No.	Name	Village cluster
1	Jagannath Dattapant Jagtap	Nivdunga
2	Nanasaheb Gulabrao Jagtap	Nivdunga
3	Dnyaneshwar Vitthalrao Khandebharad	Nivdunga
4	Pandit Narayan Jagtap	Nivdunga
5	Shivaji DattaJagtap	Nivdunga
6	Bansilal Ganesh Dhamune	Nivdunga
7	Narayan DevraoJagtap	Nivdunga
8	Rajendra R. Jagtap	Nivdunga
9	Nivrutti N. Jagtap	Nivdunga
10	Baburao Vishwasrao Jagtap	Nivdunga
11	Janardhan Ashok Shinde	Warudi
12	Sudam Devrao Shinde	Warudi
13	Narayan Sukhdeo Shinde	Warudi
14	Bhaskar Nana Shinde	Warudi
15	Vishnu Bhalrao Shinde	Warudi
16	Kashinath Jadhav	Kadegaon
17	Bahure	Kadegaon
18	Ganesh Ghule	Kadegaon
19	Nimbalkar	Kadegaon
20	Shyam Katkar	Kadegaon
21	Narayan Kolhe	Kadegaon
22	Kailas Kardile	Kadegaon
23	Khotkar	Kadegaon
24	Gonaji Joshi	Kadegaon
25	Ramrao Kale	Kadegaon
26	Jagannath T. Thote	Bhokardan
27	Pralhad G. Sonawane	Bhokardan
28	Baban U. Sonawane	Bhokardan
29	Nathrao G. Thote	Bhokardan
30	Subhash L. Thote	Bhokardan
31	Ganesh G. Thote	Bhokardan
32	Sanjay V. Thote	Bhokardan
33	Sachin P. Thote	Bhokardan
34	Appasaheb U. Thote	Bhokardan
35	Atul N. Bavane	Bhokardan

Note: This is not a complete list.

Participants list of block-level workshop, July 2013

S.No	Name	Post	Village
1	N. L. Chaudhari	Gram Sevak	PimplegaonThote
2	M. B. Autte	Agriculture Supervisor	Dongoan
3	Dhage S.B	Agriculture Assistant	Asarkheda
4	B. R. Jaybhaya	Agriculture Assistant	Nivdunga
5	V. T. Korde	Gram Sevak	Palaskheda Pimple
6	S. J. Pawar	Gram Sevak	Asarkheda
7	P. A. Palwe	Agriculture Assistant	Palaskheda Pimple
8	D. S. Padhar	Agriculture Assistant	PimplegaonThote
9	K. R. Budhawan	Agriculture Assistant	PimplegaonBarav.
10	S. R. Ghodke	Gram Sevak	Warudi
11	S. S. Pawar	Agriculture Assistant	Kadegaon & Warudi
12	N. K. Shelke	Agriculture Assistant	Malegaon

13	Hanumant Patil	Talati	Mantha
14	Kishor Bhandarge	Agriculture Supervisor	Bhokardhan
15	P. V. Wasare	Agri Engineer	KVK
16	Dr H. M. Aage		KVK
17	G. N. Khaware	Agriculture Assistant	KVK
18	K. K. Rathod	Agriculture Supervisor	KVK
19	A. P. Pawar	Agriculture Supervisor	KVK
20	Sachin Khole	Agriculture Assistant	KVK
21	S. V. Sonune	Programme Coordinator	KVK

Participants in village cluster workshops, October 2013

S.No.	Name	Village
1	Geetabai Raghunath Kailkar	Asarkheda
2	Sonabai Dagadu Lokhande	Asarkheda
3	Anunda Bhimrao Sonavane	Asarkheda
4	Kavita Gajendra Sonavane	Asarkheda
5	Sangeeta Madhav Bhodke	Asarkheda
6	Sunita Arun Sonavane	Asarkheda
7	Mandakini Dnyaneshwar Koravade	Asarkheda
8	Jyoti Suryavanshi	Asarkheda
9	Rajeev Kakde	Asarkheda
10	Baliram Bodke	Asarkheda
11	Dyaneshwar Hiwale	Asarkheda
12	Devidas Sonawane	Asarkheda
13	Baburao Kakde	Asarkheda
14	Vitthal Kakde	Asarkheda
15	Ramesh	Asarkheda
16	Sunil Jadhav	Dongaon
17	Sheikh Salim	Dongaon
18	Maruti	Dongaon
19	Vitthal Jagtap	Nivdunga
20	Digambar Jagtap	Nivdunga
21	Sadashiv Anantrao Tope	Dongaon
22	Rajendra Zine	Dongaon
23	Vitthal Eknathrao Hiwale	Dongaon
24	Gangadhar Radhakisan Khrat	Dongaon
25	Sheshrao Mohanrao Hiwale	Dongaon
26	Shekh Jaabir,	Dongaon
27	Ashok Shankarrao Surashe	Dongaon
28	Ashok Shankarrao Surashe	Dongaon
29	Jagan Jagtap	Nivdunga
30	Vitthal Trymbak Jagtap	Nivdunga
31	Bhaskar Sonawane	Asarkheda
32	Bhimrao Sonawane	Asarkheda
33	Lakshman Bapurao Bansode	Asarkheda
34	Vishnu Somu Kakade	Asarkheda
35	Namdeo Devrao Hiwale	Asarkheda
36	Subhash Bodakhe	Asarkheda
37	Vidya Pimple	Palaskheda Pimple
38	Chhaya Pimple	Palaskheda Pimple
39	Shobha Appasaheb Jadhav	Palaskheda Pimple
40	Kantabai Janardhan Shinde	Palaskheda Pimple
41	Prayagbai Ashokrao Pimple	Palaskheda Pimple
42	Kachrabai Jadhav	Palaskheda Pimple
43	Chain Singh	Pimpalgaon Barav
44	Kayru	Pimpalgaon Barav
45	Atul Narayan Bavne	Thote Pimpalgaon
46	Purshottam	Thote Pimpalgaon
47	Aniruddha Thote	Thote Pimpalgaon

48	Dilip	Palaskheda Pimple
49	Prakash Jadhav	Palaskheda Pimple
50	Kudalik	Palaskheda Pimple
51	Sada Bhau	Palaskheda Pimple
52	Baburao Jadhav	Palaskheda Pimple
53	Bhausaheb Gawar	Palaskheda Pimple
54	K. R. Jadhav	Palaskheda Pimple
55	Ganesh Vadekar	Palaskheda Pimple
56	Vasant Asaram Pimpale	Pimpalgaon Barav
57	V. T. Korade	
58	Savita Jadhav	Palaskheda Pimpale
59	Mangalbai Dadarao Waghmare	Palaskheda Pimpale
60	Radha Aniruddha Pimpale	Palaskheda Pimpale
61	Vimal Babanrao Sonune	Thote Pimpalgaon
62	Radhabai Narayan Pawar	Thote Pimpalgaon
63	Shalanbai Sarjerao Bawane	Thote Pimpalgaon
64	Kashinath Ashok Pimpale	Palaskheda Pimpale
65	Dinesh Thote	Thote Pimpalgaon
66	AravindThote	Thote Pimpalgaon
67	Ashok Thote	Palaskheda Pimpale
68	Ramchandra Madhavrao Pimpale	Pimpalgaon Barav
69	Dnyaneshwar Sampatrao Thote	Thote Pimpalgaon
70	Vitthal Kaduba Ware	Pimpalgaon Barav
71	Sudhakar Kaduba Pimpale	Palaskheda Pimpale
72	Ramesh Pimpale	Palaskheda Pimpale
73	Subhash Ranganath Shingare	Malegaon
74	Radhakishan Eknathrao Dhotre	Malegaon
75	Mhachindranath Tukaram Kole	Kadegaon
76	Dadaram Nabaji Hakuwani	Kusali
77	Mhachinder Bhausaheb Khule	Malegaon
78	Dadarao Ranganath Mule	Malegaon
79	Appasaheb Kashinath Awaghad	Wakulni
80	Kathru Bakal	Kadegaon
81	Baban Asaram Dhotre	Malegaon
82	Baburao Vittoba Kature	Malegaon
83	Aakash Kharat	
84	Ramesh Shigale	
95	Mahindra Thombre	
86	Shivaji	
87	Rameshwar Nimbalkar	
88	Vasant	
89	Dyaneshwar	
90	Ankushrao Shinde	Warudi
91	Bhaskar Kondiba Shinde	Warudi
92	Narayan Kacharu Chaudhari	Malegaon
93	Shelar	Malegaon
94	Sarika Sanjay Katkar	Kadegaon
95	Sujata Digambar Jadhav	Kadegaon
96	Seetaram Bhanudas Gore	Malegaon
97	Baburao Kisanrao Godase	Malegaon
98	Nandu Baburao Dhotre	Malegaon

Note: This is not a complete list.

A.2 Long list of adaptation options in Marathi

Table 34. Marathi terms of long list of adaptation options

Nr.	Sector	Option	Marathi
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)	Peek-paddhateetbadal
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	Shetkisanshodhan
3	Agriculture	Provide weather advisories / early warning system for drought to the farmers	Havamansoochana
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	Mrudsandharan
5	Agriculture	Promote better soil management	Mrudvyavasthapan
6	Agriculture	Promote organic farming (such as vermicomposting, mulching)	Sendriyasheti
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops	Shade net
8	Agriculture	Set up credit schemes to promote adoption of new technologies	Karzyojana
9	Agriculture	Crop insurance (strengthening of insurance mechanisms especially in drought years)	Peek vima
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information) - including for dairy, vegetables, millets	Marketingchisulabhata
11	Agriculture	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy based derived products)	Upjeevikechivividhata
12	Agriculture	Promote adoption an integrated farming system model	Ekatmikkrushipaddhati
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management	Ekatmikkeedvyavasthapan
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	Jal sandharanbandhkaam
15	Water	Promote greater awareness about the benefits of watershed development	Panlotvikasjagruti
16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies	Bhoojalvaparchedhoran
17	Water	Promote water budgeting/planning management	Panyachataleband
18	Water	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)	Thivak / tusharsinchan
19	Water	Afforestation and reforestation	Vanikaran
20	Society	Women-focused capacity building	Striyanchesakshamikaran
21	Society	Introduce innovative couple farmers forums	Mahilashetkariprashikshan
22	Society	Strengthening of local institutions such as Gram Sabha	Sashaktsthanikswarajyasanstha
23	Society	Education and Mobilizing of youth	Yuvashikshanaanipreritkaran
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	Bachatgathvadushkaalmukti
25	Society	Provide pensions or safety nets for elderly	Vayovruddhankarta pension
26	Society	Strengthening of local level committees such as Watershed committees and disaster management committee/Formation of other local level institutions such as user groups or farmer clubs	Sashaktsthaniksamitya

A.3 Detailed long list of adaptation options

Table 35. Detailed long list of adaptation options (part 1)

Nr.	Sector	Adaptation option	Category	Key actors	Implementing agency/actor:	Effects of adaptation option	Actions to apply adaptation option	Community-based adaptation?
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)	Crop management	Farmers, Agricultural extension offices	Group of farmers	Changing cropping practices to result in increased fodder availability for livestock during drought period Changing cropping practices to ensure income and more tolerance towards drought	Training to farmers about the need for introducing change in cropping pattern	Yes
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	Crop management and input technology	Agricultural Universities, Agricultural research institutions and stations	Research groups with interest and funding to conduct the research Eventually group of farmers	Change in agricultural practices, farmers to become less vulnerable to the impacts of droughts	Funding needed for research; research priority on risk proof agriculture; dissemination of results to Agricultural extension offices and eventually farmers	Indirectly
3	Agriculture	Provide weather advisories / early warning system for drought to the farmers	Crop management	Disaster risk reduction departments (local, regional, national), Meteorological institute	Chain of providers to end-users (farmers)	Ability to change cropping patterns based on weather patterns	Set-up weather forecasts (already existing?); promote access to and use of weather advise; installation of early warning systems; orientation and awareness to community for using drought early warning system	Indirectly
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	Soil and water conservation	Farmers, government	Farmers and Government	Soil conservation and enrichment	Define locations where to construct farm bunds; Purchase material needed for construction	Yes
5	Agriculture	Promote better soil management	Soil and water conservation	Agricultural research stations, Agricultural extension offices, farmers	Farmers who have attended training to promote better soil management	Better soil management to mitigate impacts of drought	Conduct soil testing and application of fertilizers accordingly; awareness raising and training to promote better soil management	Indirectly

Nr.	Sector	Adaptation option	Category	Key actors	Implementing agency/actor:	Effects of adaptation option	Actions to apply adaptation option	Community-based adaptation?
6	Agriculture	Promote organic farming (such as vermicompostin g, mulching)	Soil and water conservation	Agricultural research stations, Agricultural extension offices, farmers	Farmers who have attended training to promote better soil management	Improved soil, water and crop management to mitigate impacts of droughts	Research, training and awareness raising to promote organic farming	Indirectly
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops	Input technology	Agricultural research stations, Agricultural extension offices, farmers	Farmers who have the financial opportunities to buy shading nets and greenhouses	Higher crop yields, conservation of water needed for crops	Awareness raising of benefits; create subsidies scheme to promote purchase of nets and greenhouses	Yes
8	Agriculture	Set up credit schemes to promote adoption of new technologies	Credit and finance	Bank, Farmers, Government	Banks and government	Increase access to new technologies	Setup credit scheme; increase awareness of and provide training on new agricultural technologies	Indirectly
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)	Credit and finance	Bank, Government, Farmers	Banks and government	Strengthened insurance mechanism especially in drought years	Set up insurance scheme, or strengthen existing ones with a focus on crop insurance with the aim to improve the recovery of impacts of drought	Indirectly
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information) - including for dairy, vegetables, millets	Credit and finance	Government, market-actors	Government: road access; Market entrepreneurs	Outputs of livelihood diversification, changing cropping patterns etc. to reduce the impacts of droughts can reach and be sold at the market to sustain farmers income	Improved road access, transportation and storage facilities, communication of market prices	Indirectly
11	Agriculture	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy based derived	Alternative livelihoods	Agricultural extension offices	Promotion: Agricultural extension offices Implementation: farmer	Livelihoods, such as dairy/poultry/goat rearing that are less impacted by droughts and also fetch income	Awareness raising and training to promote the benefits of livelihood diversification	Indirectly

Nr.	Sector	Adaptation option	Category	Key actors	Implementing agency/actor:	Effects of adaptation option	Actions to apply adaptation option	Community-based adaptation?
		products)						
12	Agriculture	Promote adoption an integrated farming system model	Integrated solutions	Agricultural extension offices, Farmers	Promotion: Agricultural extension offices Implementation: farmer	Improved livelihoods, less impacted by droughts	Awareness raising and training to promote adoption of integrated farming system	Indirectly
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management	Integrated solutions	Agricultural extension offices, Farmers	Promotion: Agricultural extension officesImplementation: farmer to have attended training	Improved crop yields, mitigate impacts of droughts	Awareness raising and training to promote technologies and management	Indirectly
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	Soil and water conservation	Farmers, local committees/user associations, local government agencies, Funding agencies, technical experts (government and non-government)	government, group of farmers/local committees/user associations	Improved conservation and harvesting of water by construction and maintenance of farm ponds	Plan for suitable locations to construct new farm ponds; Purchase maintenance and construction material, Technical assessment of existing structures for maintenance requirement	Yes
15	Water	Promote greater awareness about the benefits of watershed development	Soil and water conservation	Government, Agricultural research stations, Agricultural extension offices, Community based organizations	government	Lesser resistance towards such watershed development activates; Improved water conservation and harvesting to mitigate the impacts of drought	Awareness raising to promote the benefits of watershed development through training sessions, workshops for local communities, dissemination of easy to read manuals	Indirectly

Nr.	Sector	Adaptation option	Category	Key actors	Implementing agency/actor:	Effects of adaptation option	Actions to apply adaptation option	Community-based adaptation?
16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies	Water management	Government	government	Improved water conservation and harvesting to mitigate the impacts of drought; better distribution of groundwater resources	Set up regulatory framework; support implementation and upholding the framework	Indirectly
17	Water	Promote water budgeting/planning management	Water management	Government, Communities/Farmers	communities	Improved water conservation and harvesting to mitigate the impacts of drought, better management of water resources in the region.	Set up water budgeting and planning management; awareness raising to promote implementation and upholding of water management plans	Indirectly
18	Water	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)	Input technology	Agricultural extension offices, Farmers, Government	Government, farmers implementing irrigation technologies	Improved and more efficient water usage, to better deal with the impacts of drought	Awareness raising and training to promote the use of protective irrigation technologies	Indirectly
19	Water	Afforestation and reforestation	Soil and water conservation	Farmers, local government	Government, communities	Increased water conservation capacity, better soil conservation	Awareness of benefits, allocating more land for this purpose	Yes
20	Society	Women-focused capacity building	Capacity building/Governance - Women	Government	Government	Women become less vulnerable to the impacts of droughts - by diversifying their sources of income and savings	Budget for women in all depts / schemes instead of marginalized women's depts/schemes (Suggestion by Kadegaon Gram Sevika)	Indirectly
21	Society	Introduce innovative couple farmers forums	Capacity building/Governance - Women	Government, Agricultural extension offices	Government: Agriculture Universities, KVKs	Couples become jointly aware of adaptation options to mitigate the impacts of drought - important because it is not enough to train male farmers since women carry out many farming operations	Awareness raising and training for couple farmers to enhance their resilience to droughts; Need to schedule sessions so that women can attend: after key agricultural periods and in the evenings inside their own villages	Indirectly

Nr.	Sector	Adaptation option	Category	Key actors	Implementing agency/actor:	Effects of adaptation option	Actions to apply adaptation option	Community-based adaptation?
22	Society	Strengthening of local institutions such as Gram Sabha	Capacity building/Governance - Institutional	Government	Government, Village, YASHADA, Panchayati Raj Dept	Local institutions have improved awareness of the impacts of droughts and the possible measures that can be implemented to mitigate the impacts; Village better able to access government schemes relevant for adaptation; More participatory decision-making	Training of local officials to strengthen their capacity to deal with the impacts of droughts; Conducting regular Gram Sabha meetings in a manner (location, time) that women and lower castes can also attend	Indirectly
23	Society	Education and Mobilizing of youth	Capacity building/Governance - youth	Government	Government	Youth have farming-related education to make better decisions and earn higher returns from agriculture; Also, youth have enhanced skills for non-agricultural livelihoods particularly in light of the fragmentation of landholdings; Reduced unemployment / disguised unemployment and waste of productive working years	Organize educational sessions to sensitise the youth to the impacts of climate change and their possible contributions to mitigate the impacts; Provide scholarships for vocational training programmes	Indirectly
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	Capacity building/Governance - Institutional	Government	Government / NABARD / National Rural Livelihood Mission	Savings of Self Help Groups can ease the burden in times of drought; The investment of SHG savings into climate-resilient livelihoods can provide additional robust sources of income during drought or savings to cope with drought impacts	Set up Self Help Groups and provide regular guidance and training on how to deal with the impacts of droughts, for example how to use their savings to implement resilient livelihood options	Indirectly
25	Society	Provide pensions or safety nets for elderly	Governance - Elderly	Government	Government	Reduced impoverishment and vulnerability of elderly for the impacts of drought	Set-up pensions or other safety net schemes targeted to the elderly	No
26	Society	Strengthening of local level committees such as Watershed committees and disaster management committee/ Formation of other local level institutions such as user groups or farmer clubs	Capacity building/Governance - Institutional	Government	Government, Group of farmers / Village	Strengthened and creation of local institutions to better deal with the impacts of droughts; Collective decision-making (e.g. for water budgeting) made feasible; Village better able to access schemes relevant for adaptation	Awareness raising and training of local level committees to be better prepared to deal with impacts of droughts Set-up additional local-level organisations to collaborate on training and awareness raising on dealing with droughts	Indirectly

Table 36. Detailed long list of adaptation options (part 2)

Nr.	Sector	Adaptation option	Institutional aspects	Benefits (Individual / community level /spillover)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives	Who do we expect will benefit (B)/ be unaffected (U)/ be negatively affected (N) by the implementation of the option?
1	Agriculture	Change in cropping pattern (fodder crops/short duration crops/drought tolerant crop varieties)	No institutional change required – can be facilitated through existing KVK and extension network	Individual farmer who is able to change the cropping pattern will be less affected by drought. Ancillary benefits for individual and community: changed crop varieties raise productivity in non-climatic change related droughts and temperature extremes	Costs of purchasing different crops ($$-$$$; depends on type of crop and costs related to growing the crop)	Potential barriers: market conditions should be conducive enough to promote growing fodder crops + other grain crops in a beneficial manner	Who within the household makes the decision about crop choice? In our interviews in Jalna, women said that both husband and wife together decide or women advise their husbands. How can information about alternative crops reach farmers and how quickly can they combine this information with weather forecasts to change the cropping pattern? A Bioforsk study in Tamil Nadu found "change in cropping patterns due to climate changes is altering the roles and responsibilities of women farmers".	B - innovative group of farmers, that has the finances (or has access to), to make this change; U - non farmers; N - farmers that do not change their crops, more difficult to sell their crops on the market, lower prices; Landless/labourers might be affected if crops require less labour input, then less work for labourers
2	Agriculture	Research on risk proof agriculture (e.g., drought tolerant varieties, affordable efficient irrigation technologies)	No institutional change required – can be carried out through existing research institutions (agriculture universities, research stations, CSIR labs, IARI), though funding may need to be increased	Community, results of research can be disseminated across villages, regions.	Funding required to conduct the research ($$), High costs involved for development of the suitable varieties ($$$)	Lack of funding to conduct the research	New varieties/practices may increase women's work burden e.g.by requiring more weeding, or requiring precision application of fertilizers which may be more time consuming. Further, new varieties may reduce women's autonomy with respect to managing seeds or managing household nutrition security. Transferring research to practice should be done in a way that women are engaged. More efficient irrigation technologies will have a positive effect directly and indirectly - no increase in work, saving of a scarce resource, financial savings. There should be greater involvement of women in field trials.	B - researchers working on risk proof agriculture / farmers with access to knowledge developed at universities and research stations; U - non farmers; N - farmers with no access to work at agricultural research stations

Nr.	Sector	Adaptation option	Institutional aspects	Benefits (Individual / community level /spillover)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives	Who do we expect will benefit (B)/ be unaffected (U)/ be negatively affected (N) by the implementation of the option?
3	Agriculture	Provide weather advisories / early warning system for drought to the farmers	Need for creating user interface that connects the providers to the end-users of the weather advise and early warning systems	Individual: Access to information, increase flexibility of farmer to adjust his/her crop management to mitigate the impacts of a drought	Setting up a system that provides information from the providers to the end-users ($$$)	No existing user interface, information from the departments and met institutes does not reach the user of the information; Extent of reliability of information might be determining factor in its usage	Do women have access to mobile phone based weather advisories? What are the channels through which women can be provided this information? Women are unlikely to subscribe to such services at the KVK. An FAO study in Andhra found that women rely more on neighbours for weather information - how can such networks be tapped? TV was the most popular medium for both men and women, but weather information on tv is not local and advisories are not very customized. (Apart from farming, can advisories about health or water availability be made available to women?) (A study in Kenya found that women cite their husbands as a major source of such information and so the study recommends that weather advisories should be targeted to reach both men and women.)	B - farmers with access to information, and knowledge on how to use it with respect to crop decision-making; U - non farmers; N - farmers with no access to the information, or no understanding of how to use the information
4	Agriculture	Soil conservation and enrichment through construction of farm bunds	No major institutional change required	Individual: implementation leads to soil conservation and enrichment	Material required to construct farm bunds ($$)	Financial constraint to purchase material for construction, Availability of adequate technical information		B - farmers with financial possibilities to purchase material; U - non farmers; N - farmers with no financial possibilities
5	Agriculture	Promote better soil management	No major institutional change required	Individual farmer who implements better soil management	Costs related to achieving better soil management (soil tests, purchase of fertilizer) - Training ($),	Individual farmers: no access to training, or opportunities to purchase soil testing, fertilizer		B - farmers with possibility to access training, soil testing, fertilizer to improve their soil management; U - non farmers; N - farmers with no access to training and finances

Nr.	Sector	Adaptation option	Institutional aspects	Benefits (Individual / community level /spillover)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives	Who do we expect will benefit (B)/ be unaffected (U)/ be negatively affected (N) by the implementation of the option?
					Material ($$)			to purchase soil testing etc.
6	Agriculture	Promote organic farming (such as vermicompostin g, mulching)	The state government should adopt an organic farming policy	Individual farmers who implement organic farming to maintain productivity	Costs related to achieving better soil management, water usage, crop management - Training ($), Material ($$)	Individual farmers: no access to training, or opportunities to improve soil management, water usage and crop management, Lack of awareness on benefits of organic farming	Conventional "cash crop-focused farming is often more large scale, mono-cultural, mechanised and industrialised and therefore is often perceived to be closer to the male identity, but the advisors, traders and other external partners are also men, who mostly consider working exclusively with male farmers" But organic farming is work-intensive and involves smallholder women farmers - who need to be trained (Farnworth and Hutchings 2009, cited in Vaarst 2010). Experience from Thailand also shows that "adoption of organic farming significantly increases labour requirements compared to conventional farming. Women often shoulder the increased labour to a greater degree than men." (Eisses et al 2001)	B - farmers with possibility to access training, change soil, water and crop management; U - non farmers; N - farmers with no access to training and financial resources to change soil, water and crop management to achieve organic farming
7	Agriculture	Promote the use of shading nets and greenhouses to grow crops	Institutional arrangement for targeting and timely disbursement of subsidy schemes	Individual farmers who use shading nets and greenhouses to increase/maintain crop productivity under drought conditions	Purchase cost of shading nets ($$) and greenhouses ($$$)	Need better financial mechanisms such as more subsidies to promote use of shading nets. Access to markets to buy shading nets and greenhouses. Training to use shading nets and greenhouses		B - Farmers with access to subsidy schemes. Labourers benefit as farming with shading nets is more labour intensive and provides employment for landless; U - non farmers; N - farmers with no access to subsidy schemes and /or training

Nr.	Sector	Adaptation option	Institutional aspects	Benefits (Individual / community level /spillover)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives	Who do we expect will benefit (B)/ be unaffected (U)/ be negatively affected (N) by the implementation of the option?
8	Agriculture	Set up credit schemes to promote adoption of new technologies	Institutional arrangement for timely disbursement of credit, linkages with NABARD and rural cooperative banks	Individual farmers able to access credit	Cost of credit (level of interest rate, repayment) - set of scheme ($$$), costs for individual farmer ($$-$$$)	Availability and access to adequate, timely and affordable cost credit	FAO points out "Women, in particular, face challenges in access to credit, collateral, and financial services." Coppard (2001) notes a strong gender bias in bank lending against non-farm activities by women "Women receive fewer and smaller loans than men and also face higher transaction costs". Credit schemes can be targeted specifically at women and women's groups. "Credit components of projects may establish a separate line of credit for women's groups or earmark loans for women's crops and or activities, such as agro-processing. Adjusting extension messages to focus on activities that women control can facilitate their contact with male extensionists." However, "Programmes designed to reach both men and women are more effective. Getting men's support is critical to the success of gender-responsive projects."	B - Farmers with access to credit schemes, to use credit for adopting new farming/cropping technologies to mitigate the impacts of drought on crop productivity; U - non farmers; N - Farmers with no or little access to credit schemes
9	Agriculture	Crop insurance (Strengthening of insurance mechanisms especially in drought years)	Institutional support for extending reach of crop insurance schemes and timely payouts	Individual farmers able to access crop insurance	Strengthening of existing mechanism ($$$), costs for individual farmers such as a premium ($$-$$$)	Availability and accessibility of crop insurance, and affordability of the premium	An FAO report points out: "Traditional coping methods include finding work on neighboring farms (to supplement income for food) and borrowing from family and friends. But when everyone in a geographical area has been affected in the same way, these safety nets are often compromised as well. While government-based crop insurance schemes are available, most smallholder farmers are unable to meet their eligibility requirements. Women, in particular, face challenges in access to credit, collateral, and financial services." But if the household is able to get insurance, it will definitely improve their resilience to	B - farmers that can afford the premium required for accessing the insurance; U - non farmers; N - small holder farmers that cannot pay the premium

Nr.	Sector	Adaptation option	Institutional aspects	Benefits (Individual / community level /spillover)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives	Who do we expect will benefit (B)/ be unaffected (U)/ be negatively affected (N) by the implementation of the option?
							drought. But awareness, access, and penetration of crop insurance, particularly weather-indexed insurance, needs to be drastically increased by public and private insurance providers.	
10	Agriculture	Facilitate robust market linkages (road access, transport, storage, price information) - including for dairy, vegetables, millets	Linkages with Maharashtra State Agriculture Marketing Board (MSAMB)	Community will benefit from increased road access, individual farmers able to afford transportation, and storage facilities, and having access to market information	Construction of roads, affordable transportation and storage, set up of information system to provide market information ($$-$$$)	financial resources to construct road access, transportation and storage	To overcome gender-based agricultural marketing constraints, World Bank suggests consulting women's groups "to determine their demand for market infrastructure, feeder roads, market areas, stalls, and storage facilities". How can women take advantage of the new market opportunities created? Support the formation of women-owned enterprises or cooperatives but they need access to capital.	B - Communities with improved access, transport and storage; U - non farmers; N - Communities that remain having limited road access
11	Agriculture	Promote livelihood diversification (labour schemes, skilled labour, processing and sale of agriculture and dairy based derived products)	Linkages with National Rural Livelihood Mission	Communities become less vulnerable to the impacts of drought	Training and awareness activities in communities ($)	Interest of farmers to learn more about livelihood diversification, attending training	Livelihood diversification schemes will help reduce the dependence of households on 1-2 crops and hence reduce their vulnerability to drought. But in addition to imparting skills, this requires an entire market chain to be put in place. If the alternative livelihood is dependent only on local demand, it will not be robust in a widespread drought. Opportunities for acquiring new skills and obtaining credit support should not be focussed only on young men, but can be targeted at young women in senior school itself (e.g. computer, home science, vocational training). An FAO guide points out that even in new livelihoods, women may earn less than men ("Low-paid tasks in agro-processing are generally “feminized”, while men are more likely to have jobs that require training and earn higher wages") or they may have to be	B - Farmers attending training and having financial resources to diversify their livelihoods; U - non farmers; N - farmers not attending training and/or able to change their livelihoods

Nr.	Sector	Adaptation option	Institutional aspects	Benefits (Individual / community level /spillover)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives	Who do we expect will benefit (B)/ be unaffected (U)/ be negatively affected (N) by the implementation of the option?
							away from their homes for longer, that "that women can lose income and control as a product moves from the farm to the market", and also that men move into women's occupations when they become more profitable. Coppard (2001) argues that increase in non-farm activities may increase gender disparity due to (i) wage differentials (ii) differential access to job opportunities and (iii) strong gender bias in bank lending	
12	Agriculture	Promote adoption an integrated farming system model	No institutional change required – can be facilitated through existing KVK and extension network	Farmers become less vulnerable to impacts of drought	Training and awareness activities for farmers ($)	Interest of farmers to learn about benefit of integrated farming system model, what it means in practice	Design of integrated farming system promoted in any area should take into consideration gender-specific preferences. While horticulture/aquaculture/dairy etc will definitely enhance hh food security and diversify livelihoods, it is very likely that the additional work burden of these activities will fall on women as they are perceived as homestead activities (e.g. women interviews in Badnapur cluster showed that women did all the fodder collection and milking early in the morning - men only sold the milk.) (Though a project in Bengal found that "The proximity of the farming system to the house ensure that the women are able to transfer the extra time available from managing the house and children into an income generating activity and the ability to integrate the organic output from house and different farming activities into an integrated farming system".) As with IPM or new crop varieties, the training programmes should encourage the participation of more women, be held at a convenient time and venue for women, and could be conducted by women	B - Farmers attending training and having financial resources to implement an integrated farming system model; U - non farmers; N - farmers not attending training

Nr.	Sector	Adaptation option	Institutional aspects	Benefits (Individual / community level /spillover)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives	Who do we expect will benefit (B)/ be unaffected (U)/ be negatively affected (N) by the implementation of the option?
							trainers.	
13	Agriculture	Promote IPM (Integrated Pest Management) technologies and nutrient management	No institutional change required – can be facilitated through existing KVK and extension network	Individual farmer who implements integrated pest management	Costs related to achieving better pest management - promotion ($), implementation ($$)	Individual farmers: no access to training, or opportunities to purchase technology to test for pests and to apply nutrient management	Women tend to learn about IPM informally through social networks rather than being formally trained. Pesticide purchase and renting of sprayers may be decided by men, though actual application by hand is done by women ("pinch when plant is small, handful when it grows"). (Norton (2007) reports from one case in Ecuador that while men made the actual pesticide purchases, it was the women who decided how much the hh could afford to buy, particularly if the women were involved in pesticide application.) Women are concerned about storage, misuse, and health risks of handling pesticides. Need gender-sensitive training programmes and training of (women) trainers. If IPM and nutrient management leads to reduction of agrl expenses (input cost and indebtedness is a major concern in Indian agriculture), it will help women to balance the household budget and free up resources for nutrition, education, etc. It should also reduce the need for irrigation - reducing dependence on scarce water resources (Norton et al 2007)	B - farmers with possibility to access training, check for pests and apply nutrient management; U - non farmers; N - farmers with no access to training and finances to apply nutrient management

Nr.	Sector	Adaptation option	Institutional aspects	Benefits (Individual / community level /spillover)	Costs (descriptive AND/OR indicative $-$$-$$$)	Barriers	Gender perspectives	Who do we expect will benefit (B)/ be unaffected (U)/ be negatively affected (N) by the implementation of the option?
14	Water	Construction and maintenance of water conservation structures such as farm ponds and KT weirs	Consensus from both government and communities to facilitate implementation is required	Community: Better groundwater recharge in the region, reduced soil run-off Individual: Better productivity in both kharif as well as rabi season, better income	Construction costs ($$$), compensation for land procurement for such construction ($$), maintenance cost ($$)	Disputes due to boundary issues related to construction of structures, Lack of efficient technical knowledge while construction, Lack of attention & funds towards maintenance activities	Limited role of women in decision-making in relation to such activity. Seen as a technical male domain. How many women are members of village watershed committees and what are their roles? Women should be offered training in surveying methods or the construction of conservation structures or some training to hold supervisory positions	B - Farmers in close proximity/drawing water from the same aquifer which is recharged; U - Farmers in nearby lands where benefits of such structures will not reach; N - Cross - territorial disputes related to water
15	Water	Promote greater awareness about the benefits of watershed development	Linkages with ongoing watershed programmes	Greater awareness on watershed development leading to more initiatives being taken by the communities	Conducting awareness campaigns and training sessions for the farmers ($)	Land issues (such as prices) might undermine the motivation to give up land for construction purposes	Due to the hydrogeological profile in Jalna, collective watershed development may not result in collective benefits. So there is resistance to giving up private lands. Awareness raising activities could be targeted at both men and women. But to what extent do women have a say in such decisions within the household? How many women are members of village watershed committees and what are their roles? The watershed committees should have representation of women farmers even if they do not own land. Female committee members need to be given specific responsibilities and made signatories to the bank account for the project.	B - Farmers and other people in the community, use water resources more efficient, better able to cope with droughts; U - other villages; N - none

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16	Water	Introduce regulatory framework for groundwater use and promote aquifer management policies	Requires regulatory change, linkages with Maharashtra Water Resources Regulatory Authority	Communities can benefit from more equitable distribution of water, better management of water resource in the region	Set up of new policy regulation ($$)	People will not readily accept such a regulatory framework making it very difficult to implement	Ownership of land and of the technology to extract and use water determines access to water. Since women usually do not own land, men typically control access to water. The landless, regardless of gender, also lack access to water for their means of livelihood. Class and gender therefore intersect to mediate access to groundwater. Will regulatory framework for groundwater improve inter-household equity in use of groundwater? If there are aquifer management committees / associations, how will women participate?	B - communities that use water resources more efficient, able to better cope with droughts; U - other villages; N - none
17	Water	Promote water budgeting/planning management		Better management of water resources in the village by the community	Training for promotion of water budgeting ($)	People are not very open to the idea of water budgeting; Lack of support from the community might undermine the efforts	Community-level water budgeting should start with rainfall monitoring and well water level monitoring. Women should be engaged while initiating these activities (e.g. a school teacher or anganwadi worker could record rain gauge readings) instead of treating instruments as a male domain. The collective decision-making process on water use and crop choice should ideally allow women to participate in meetings and trainings and express their preferences. In general, effective water budgeting should improve household income and save scarce water resources.	B - communities that engage in water budgeting/ planning save water for farming and other purposes; U - other villages; N - none
18	Water	Promote protective irrigation & use of efficient irrigation technologies (drip and sprinkler)	Providing more subsidy to promote use of efficient irrigation technology	Individual: Secured income from crops, lesser requirement of water	Purchase of equipment ($$$)	Need electricity, Lesser subsidy provided by the government as compared to what communities expect	No increase in work burden for women, Saving of a scarce resource, which should also lead to money savings (e.g. not having to buy water) or enhanced returns (e.g. due to improved productivity if replacing rainfed cultivation)	B - communities that engage in protective irrigation and technologies save water for farming and other purposes U - other villages; N - none

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19	Water	Afforestation and reforestation	Allocation of common land for afforestation	Communities: Better green cover in the region, soil and water retention capacity of the land, additional income sources	Afforestation ($$), reforestation ($)	Communities might not be ready for giving land for afforestation	Women have to collect fodder and firewood, whose availability may improve through afforestation and reforestation programmes; Planting fruit tree species on farm bunds may improve household nutrition or add to income. Women and poorer sections of the community often prefer multispecies plantations including indigenous species because of their higher potential for providing a range of subsistence products.	B - communities that participate in afforestation/reforestation; U - communities that do not; N - none
20	Society	Women-focused capacity building	Requires institutional support, funding, and manpower	Individual households: Improved adaptive capacity of households to face climate extremes	Reorganization of existing budgets ($)	seen as a marginalized issue, People's perception about the need of such capacity building for women	Will help women become more independent and self-sufficient but capacity building activities should not increase their burden of work. Diversifying agriculture or rural livelihoods builds long-term resilience, but at the same time it might require new or different work input, and the control of new income is often gender specific.	B - women who benefit from schemes or programmes; N - none
21	Society	Introduce innovative couple farmers forums	Can be organized through existing KVK network	Individual households: Improved adaptive capacity of households to face climate extremes	Rescheduling of existing programmes with existing resources ($)	timing and venue of programmes; Required motivation to attend such programmes	training programmes should not increase women's burden of work; they need to be held in the village so that women don't need to travel and scheduled such that they are able to find the time to attend	B - households whose women participate in programmes; U - those who do not participate; N - none
22	Society	Strengthening of local institutions such as Gram Sabha	Can be addressed within existing policy framework (73rd and 74th Amendments to the Constitution)	Community	Extension of ongoing programmes ($$)	lack of full devolution of powers to village level	Positive gender effect if more women participate	B - communities / villages with stronger institutions; U - other villages; N - if other villages are competing for a finite pool of resources, they could possibly lose out

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23	Society	Education and Mobilizing of youth	No major institutional change required	Individual	Needs to be designed in a focussed way with extensive reach, possibly set up new institutions ($$)	education (school / college) system does not provide practical skills; changing the system will be slow	Positive gender effect if young women are trained	B - individuals or households who are engaged in programmes; U - those who are not; N - none
24	Society	Set up Self Help Groups and train them to implement drought resilient livelihoods options	No major institutional change required, linkages with National Rural Livelihood Mission	Individual	Extend ongoing activities to ensure regular guidance and training, may need to increase manpower ($$)	none	Positive gender effect if women's SHGs become more robust and resilient to drought. An assessment of livelihood options for women should also focus on access and control of private and common resources (land, water, fuel, fodder) and on those resources which provide livelihood options to women (e.g. basket weaving, pottery etc.)	B - women who participate in SHGs and receive advice / training; U - those who do not; N - none
25	Society	Provide pensions or safety nets for elderly	Requires budgetary allocation, policy change, and institutional support (e.g. for creation of bank accounts)	Individual	Add budgetary resources but also improve reach and accessibility of existing schemes ($$)	Lack of consideration of such needs for the elderly; Lack of effective channels for dissemination of benefits	Positive gender effect for especially for elderly landless widows	B - elderly who are eligible for and receive pension and their household members; U - all others; N - none

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26	Society	Strengthening of local level committees such as Watershed committees and disaster management committee/ Formation of other local level institutions such as user groups or farmer clubs	Can be addressed within existing policy framework (73rd and 74th Amendments to the Constitution)	Community	Need to design creative approaches, possibly transfer more budgets to panchayat level ($$)	lack of full devolution of powers to village level; lack of genuine participation of poor, lower castes, minorities, women	Positive gender effect if more women participate	B - communities / villages with stronger committees; U - other villages; N - if other villages are competing for a finite pool of resources, they could possibly lose out

About the Project

The EVA project focuses on the state of Maharashtra. More than 30 % of the state of Maharashtra falls under the rain shadow area and about 84 % of the total cultivated area is rainfed. Drylands in Maharashtra face the combined stress of human pressures and drought. Communities within these drylands are poor and face extreme conditions of water stress. This pilot project aims to assess the extreme risks and vulnerabilities to climatic extreme events in the drylands of Maharashtra and their impacts on agriculture and water resources, and the implications for community-based adaptation in response to these extreme events.

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