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Behavioral Biases in Disaster Decision-Making: Insights from Drought-Affected Individuals in Madhya Pradesh, India

Ashish Sharma[1*]

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Abstract This study examines how three behavioral biases (over-confidence, over-optimism, and herding) affect individuals' decision-making in the setting of droughts, which were characterised by complexity, uncertainty, and risk. Descriptive analysis approach is used to survey individuals in Madhya Pradesh, India, which include farmers, labourers, housewives, and small business owners. The study is limited to descriptive analysis due to qualitative nature of behavioral biases. The findings validate the behavioral shortcomings in decision-making when faced with the risk of drought, resulting in insufficient preparedness. These results have important implications for policymakers and government in developing effective policies for managing drought risks. It is essential to comprehend how individuals make decisions and include behavioral aspects in policymaking.

Keywords: droughts, risk management, behavioral biases, over-confidence, over-optimism, herding, decision-making

1. INTRODUCTION

The unpredictability of natural calamities such as droughts, floods, earthquakes, and cyclones are a genuine and increasing concern (IPCC, 2014). Although the potential harm to livelihoods, economy, and lives from these calamities is significant, individuals frequently neglect to take sufficient precautions (Gifford, 2011; Brooks et al., 2020). They deviate from logic (Palm & Hodgson, 1993), exhibit a propensity for risk-taking, and embrace a life of uncertainty (Botzen et al., 2021; Duijndam & Van Beukering, 2020). The available evidence

[1] Finance and Accounting, Indian Institute of Management Bodhgaya, India
* Corresponding author email: ashishsharma3062@gmail.com

suggests that certain behavioral biases[1] frequently impact behavior and decision-making, resulting in insufficient preparation for coping and adaptation (Aigbovo & Llaboya, 2019; Ballantyne, 2000; Grothmann & Reusswig, 2006; Paton & Johnston, 2001; Rüstemli & Karanci, 1999; Paton, 2019). Three commonly explored behavioral biases in catastrophe literature are over-confidence, over-optimism, and herding.

Over-confidence, which is marked by an emotional inclination, refers to individuals overestimating the accuracy of their information and their competence to perform effectively (Fischhoff et al., 1977; Camerer & Lovallo, 1999). Individuals tend to overrate their level of certainty based on previous favourable results and frequently recall their accomplishments more vividly than their disappointments. Ballantyne et al. (2000) show that being excessively confident affects the judgements made regarding preparedness by creating a belief in one's capability to remember and use relevant knowledge during disasters.

Conversely, over-optimism refers to the consistent tendency to overestimate the likelihood of a positive result, which is a cognitive mistake and underestimation of less favorable results (Shefrin, 2007). Paton and Johnston (2001) observe that individuals, due to their optimistic biases, may regard themselves as more capable of dealing with the consequences of hazards in comparison to others. Eiser et al. (2012), Meyer and Kunreuther (2017), Paton and Johnston (2001), and Royal and Walls (2019) similarly emphasise the substantial impact of over-optimism bias on individuals' judgements on readiness.

Herding refers to behavioral patterns correlated across individuals (Devenow & Welch, 1996). Kunreuther (2018) defines herding as “following of social norms instead of rational risk assessments”. It is a social phenomenon where people imitate the behavior of a bigger group, whether they are thinking logically. There is a prevailing perception that personal security is enhanced by engaging in cooperative behavior or emulating the activities of those whom one holds in high regard. The presence of herding bias frequently supersedes rational decision-making, resulting in less logical choices and a decrease in preparedness efforts (Kunreuther, 1984). Botzen et al. (2021), Kunreuther (2018), and Meyer and Kunreuther (2017) have highlighted that herding behavior has resulted in insufficient climate or mitigation actions. Similarly, Bubeck et al. (2013) and Fu (2021) observe that, amid fire threats, the tendency to engage in herding behavior (unreasonably following others during evacuation) frequently endangers lives, rather than making sensible decisions.

These identified behavioral biases (over-confidence, over-optimism, and herding), have been extensively studied in the context of fast-onset disasters like floods, earthquakes, storms, fires, and avalanches, primarily in European settings (Ballantyne, 2000; Meyer & Kunreuther, 2017; Paton & Johnston, 2001, among others). Nevertheless, there is a significant deficiency

[1] Behavioral biases are of two types: cognitive bias result from the inherent flaws in human reasoning. whereas emotional bias is an outcome of feelings or emotions rather facts, which affects decision-making (Brooks et al., 2018).

in the existing body of research about these prejudices in the specific context of gradual and prolonged calamities such as droughts, especially in developing nations such as India.

Droughts, due to their intricate nature and gradual onset, provide a well-known obstacle for individuals involved in agricultural endeavours. The repercussions of these events can vary in their scope, affecting either a specific area or a larger region. The timing of their occurrence, progression, and conclusion is unpredictable (Swain & Swain, 2011). In contrast to rapidly occurring calamities, droughts have both immediate and enduring secondary economic consequences (Dercon, 2004; Loayza et al., 2012; Panwar et al., 2021). These unique attributes might result in varying perceptions and reactions to risks, which can influence decision-making and preparedness.

With this backdrop, the present study focusses on droughts in Madhya Pradesh, an Indian state known for its susceptibility to droughts caused by unique geo-climatic conditions.

Notably, around 72% of the population resides in rural areas where agriculture is the primary occupation. According to the State Disaster Management Plan of 2012, droughts have had a severe impact on 7 districts of Madhya Pradesh during 1982-2012. In 2015-16, also a total of 46 districts, accounting for 90% of the districts, were officially recognised as being affected by drought.

Our study investigates the influence of over-confidence, over-optimism, and herding biases on decision-making and their resulting impacts on drought preparedness, using the case of some districts in Madhya Pradesh with distinct drought risk. These selected districts have consistently experienced different levels of drought during 2014 to 2017. The study employs primary data analysis techniques, namely descriptive analytic tools, to provide evidence within the context of a developing country experiencing drought.

The subsequent sections of the paper are organised in the following manner: The ‘Review of Literature’ section will introduce and analyse the theoretical framework and the fundamental behavioral principles, followed by a comprehensive assessment of the literature that consolidates significant investigations. Following that, we will proceed to present the research methodology of the study and its application in the study area, which will then lead to the analysis and presentation of the results. Finally, the ‘Conclusions’ section will provide a comprehensive summary of the study together with policy implications, limitations of the study, and recommendations for future research.

2. REVIEW OF LITERATURE

2.1 Theoretical Foundations

Theories of decision-making suggest that the situations of certainty, risk, and uncertainty involve distinct assumptions, resulting in notable differences in decision-making processes

and choices. In situations characterised by increased uncertainty and complexity, coupled with limited access to information, psychology frequently supersedes logical preferences as a result of modified risk perceptions and evaluations. In this section, we give fundamental notions that are crucial for examining the current investigation.

2.1.1 Risk and Certainty in Decision-Making

Decision-making at the individual level entails the process of choosing one choice from a given set of alternatives. At the outset, decision-makers acknowledge the necessity of deciding, then ascertain viable alternatives, and eventually select one. Greater certainty is achieved when decision-makers possess knowledge of several choices, their corresponding conditions, and can consistently evaluate and prioritise them based on their outcomes, typically derived from experiences. In the early investigations of decision-making under risk, Jeremy Bentham (1789) developed the notion of subjective utility. This concept was based on the notion of individuality and the difficulty in quantifying it. Subsequently, Pareto in the year 1896 & 1906 placed greater emphasis on the concepts of 'preference' and 'choice' as opposed to utility functions (Pareto, 1971). In contrast, Paul Samuelson (1948) introduced the ‘revealed preference theory' which is grounded in observed behavior rather than utility. Within the framework of these approaches, choices are commonly regarded as rational.

Conventional economic theories, such as the expected utility theory, were formulated based on rigid assumptions of rationality, which may not always be applicable in real-world situations, particularly in times of disasters. This microeconomic theory of expected utility maximisation, formulated by Von Neumann and Morgenstern in 1947, states that when individuals are presented with different outcomes and their corresponding probabilities, the most advantageous decision is the one that maximises the expected value of utility (satisfaction) obtained from the choice. The calculation of expected value involves summing the products of utilities and their corresponding probabilities. Individuals are anticipated to prioritise things or outcomes according to their personal preferences.

The theory of bounded rationality is also based on the assumption of rationality, perceives rationality as the process of optimisation (Simon, 1955, 1982). Although humans make reasonable decisions, their decision-making process may be influenced by cognitive limits, leading them to settle for choices that are deemed satisfactory, viable, and practical.

Nevertheless, numerous choice problems, particularly those pertaining to disaster risk, can be classified within the domains of risk and uncertainty. Therefore, the theories listed above have a restricted capacity for explanation. The decision-making process can be better understood by examining behavioral finance theories and their underlying principles, as explained in the next section.

2.1.2 Risk and Uncertainty in Decision-Making

When there is a lack of assurance about the results of a decision, the process of making decisions becomes more difficult. These scenarios usually occur when external factors have an impact on occurrences, resulting in a lack of data, doubt about the veracity of the data, and challenges in evaluating the interconnections between variables. In such situations, decision-making is frequently influenced by risk analysis methodologies (as elaborated upon later) and subjective factors. Hence, it is imperative to comprehend the way individuals perceive and navigate uncertain situations, such as disasters and more specifically droughts.

Prospect theory, introduced by Kahneman and Tversky in 1979, posits that enduring cognitive and psychological elements impact decision-making, departing from the assumption of rationality in situations of uncertainty. The theory of descriptive behavioral finance, which is grounded in the field of psychology, offers a novel viewpoint on the process of decision-making. Behavioral biases, which are integral to this theoretical framework, influence individuals' decision-making processes and elucidate the reasons behind occasional erroneous choices. The factors impacting decision-making can be better understood by analysing insights from prospect theory and behavioral biases (Ballantyne, 2000; Grothmann & Reusswig, 2006; Kunreuther, 2018; Paton & Johnston, 2001).

2.2 Behavioral Biases

There is substantial body of literature on behavioral biases, such as over-confidence, over-optimism, and herding on how individuals make decisions related to catastrophe preparedness and response.

Ballantyne (2000) demonstrates that the over-confidence bias can result in an over belief in one's ability to recall and apply practical knowledge during natural disasters. Ziegler et al. (2014) present an instance of excessive self-assurance exhibited during a flood event in Uttarakhand, India. After a catastrophic flood in 2003, a school situated near the Mandakani river was demolished. Following the flood, the overconfident local authorities chose to rebuild the school in the same location, even though the river had moved far closer to the structure. They argued that the probability of another flood of similar magnitude occurring soon was extremely low, relying on an assumption about low-risk, high intensity events that was not grounded in scientific evidence. This decision reflected a clear overestimation of their understanding, skills and knowledge. Such actions are indicative of overconfidence behavioral biases, where individuals or authorities overrate their judgment and downplay potential risks, leading to decisions that ignore crucial empirical data.

Yi-Xin (2014) examined the impact of over-confidence on decision-making after a disaster. The findings revealed that individuals who display overconfidence are more likely to make choices that include higher levels of risk. These individuals demonstrated a high level of confidence in their talents, and these positive emotions intensified their tendency to take risks.

Li (2010) noted that following a disaster, individuals tend to develop excessive confidence over time particularly when it comes to unlikely but highly impactful incidents. This observation was based on examining three disasters that occurred in China in 2008.

Further, Glöckner (2016) showed that the over-confidence bias can cause a distorted perception of risk, leading to an underestimation of important yet less attractive information. This, in turn, can result in insufficient readiness for disasters. Borpujari (2020) observed that over-confidence or excessive self-assurance in one's capabilities might result in a lack of action, such as unwillingness to evacuate during emergency situations, particularly if the person has never encountered a similar situation before.

Further, with reference to over-optimism, Paton and Johnston (2001) emphasised that optimistic biases can cause individuals to become excessively confident in their readiness for volcanic hazards, resulting in a lack of action when it comes to preparing for volcanic disasters. Meyer and Kunreuther (2017) highlighted that excessive optimism is a key driver of unpreparedness for disaster risks, as individuals face challenges in accurately assessing the likelihood of infrequent or unusual catastrophic events. Royal and Walls (2019) discovered that the probability of purchasing flood insurance was impacted by individuals' over-optimism, rather than their evaluation of its effectiveness. In addition, Trumbo et al. (2011) and Trumbo et al. (2014) conducted studies on over-optimism in the context of hurricane disaster risk. The findings showed that people felt more positive about their own safety than about the safety of others living in the same area.

In this context, Eiser et al. (2012) propose that optimistic biases, along with limited information exposure and insufficient decision-making competence, impede rational decision-making. Many people frequently display a lack of knowledge or awareness when it comes to reducing the impact of disasters, mistakenly thinking that they will not be affected by such events. Kinsey et al. (2019) highlighted the role of cognitive biases, specifically optimism, in decision-making during fire emergencies. They examined how the intuitive and reflective brain systems process and respond to uncertain situations, such as fires. Kishore et al. (2015) observed that over-optimism involved in a conditional cash transfer initiative in Bihar, India, designed to address drought-related issues, did not succeed in prompting farmers to modify their behavior.

With regard to herding bias, Lovreglio (2016) and Pan (2007) investigated how herding behavior affects the choices people make when faced with catastrophic events. Gersen (2001) provided empirical evidence that herding behavior can result in either optimal or sub-optimal outcomes. Lo (2013) analyzed that individual followed the adaptation norms seeing others thus significantly reducing flood risk. Herding leads to preventive behavior and is related to the social norms (Bavel et al., 2020). With reference to aid, donor displays herding behavior increasing the aid allocation yielding positive results (Frot & Santisco, 2009).

Conversely, Fahy (2009) discovered that in the event of a fire, people tend to imitate others and may opt for crowded evacuation routes instead of vacant yet right ones, indicating the

existence of a herding bias in decision-making during fire incidents. Similar findings are shown by Helbing et al. (2000) citing that individuals display mass behavior during emergency escape situations. Further, Kunreuther (1984) demonstrated the potential adverse impact of herding bias on individuals' decisions to buy insurance.

Furthermore, the literature indicates other behavioral issues too, concerning disaster risk decision-making which is contingent upon the specific circumstances and conditions. However, their scope in this study is limited. For example, Grothmann and Reusswig (2006) emphasised that only altering individuals' risk perceptions is not enough to bring about changes in their behavior. Insufficient awareness and education of the risks associated with natural disasters is a common issue. Even when information is available, the level of preparedness at both individual and communal levels is inadequate. There is an apparent discrepancy between the understanding of risk and the corresponding actions taken. Kerstholt et al. (2017) emphasised the significance of cognitive biases in disaster preparedness, as illogical behavioral strategies prevail in risk perceptions and management. In their study on the 2013 Uttarakhand flood in India, Lindell et al. (2019) discovered that the evacuation decision-making process was influenced by behavioral reactions, resulting in both delays and casualties.

To summarize, the literature review highlights the substantial impact of behavioral biases, such as over-confidence, over-optimism, and herding on how individuals make decisions related to disaster preparedness and response. These biases frequently result in less-than-optimal decisions and insufficient actions when confronted with disaster risk. Sharma and Sen (2021) in a review-based study also highlighted the sub-optimal outcomes are often due to behavioral weakness of individuals and institutions. Based on these observations, the current study assumes that decision-making of individuals impacted by drought in the study area of Madhya Pradesh, India may be influenced by behavioral biases such as over-confidence, over-optimism, and herding. The following part will provide a comprehensive explanation of our study structured to test this assumption.

3. RESEARCH METHODOLOGY

Our research is based on data gathered using structured questionnaire that were administered through face-to-face interviews with individual respondents (Refer to Annexure 2). The questionnaire is designed primarily to gather the information related to respondent’s behavioral biases during decision-making. In addition, their socio-economic status, drought and drought preparedness, awareness about access to government schemes were also captured. The questions were set up considering findings from the literature review. The questionnaire was initially written in English and subsequently translated into the local language, Hindi. The survey was done in two stages during the year 2018. The survey utilised a multi-stage random sampling methodology.

Before the main survey, a preliminary application was done to identify and rectify any shortcomings in the questionnaire.

The study sought to comprehend the behavioral aspects of individual respondents in the districts of Sagar and Vidisha in Madhya Pradesh, which were hit by droughts between 2014 and 2017. These districts experienced low rainfall according to data from the Indian Meteorological Department (IMD) and farmers' site (It contains the data of drought declared districts in Madhya Pradesh, please refer to "https://farmer.gov.in"). In addition, the Sagar district was classified as having a 'Severe' susceptibility to climate change, whereas Vidisha was classified as having a 'Moderate' vulnerability, according to the District Composite susceptibility Analysis conducted by the Environment Planning and Coordination Organisation of Madhya Pradesh. The water-intensive soybean and wheat are the main crops in these districts, therefore insufficient rainfall directly affects significantly the rural population that relies on agriculture for their livelihoods.

A few tehsils were selected from both districts. From these identified tehsils, a selection of towns and villages was made. Within these selected areas, respondents were randomly chosen to participate in the survey interview. The study involved 204 participants who successfully filled out the survey, with 161 residing in rural areas and 43 residing in urban areas. Given that droughts have a greater impact on rural economies, the sample involved a higher proportion of persons from rural areas. The respondents belonged to diverse groups including farmers, agricultural workers, non-agricultural workers, housewives, company owners, and salaried employees. All of them were affected, either directly or indirectly, by water scarcity and droughts as confirmed through survey question.

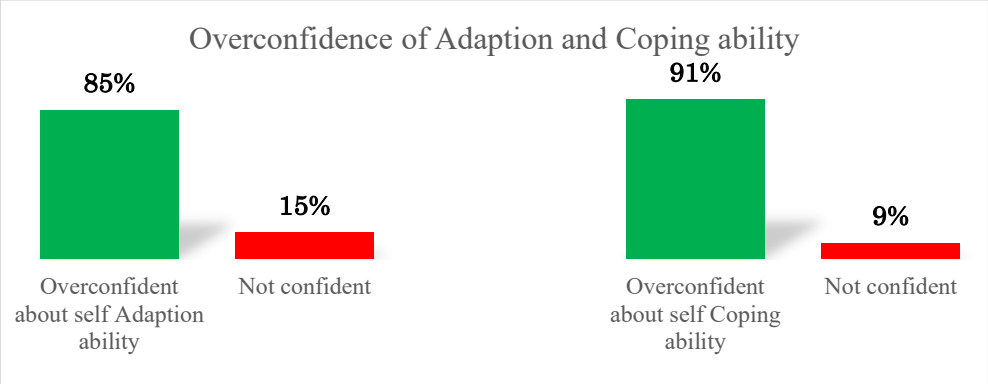
Information was gathered about three prevalent behavioral dimensions as documented in the disaster literature: over-confidence, over-optimism, and herding. Participants were classified as either 'prepared' or 'non-prepared' depending on their expressed preferences on readiness for drought. Out of the 204 participants, 65 individuals (31%) demonstrated readiness, while 139 individuals (69%) were insufficiently equipped to confront forthcoming droughts. The questions about respondents' confidence of future preparedness and coping ability, their optimism about adequate rainfall, good harvest, and relief disbursement were asked. In addition, the respondents' view regarding crop and livestock insurance purchase, and migration possibilities were also captured. Subsequently, the data were subjected to descriptive analysis techniques for analysis.

4. DESCRIPTIVE ANALYSIS AND DISCUSSION

Over-confidence: In response to a question (Q. No. 4.4) about the individuals' current preparedness, there were 65 respondents (out of 204) who believe that they were adequately prepared to deal with the droughts. When asked to such prepared respondents (Q. No. 8.1.2) about their ability to deal or adapt with such frequent as well as extreme events in coming

years, 55 out of 65 respondents (85%) answered that they will be able to manage/deal with future droughts easily (Figure 1). Within these prepared respondents (55), those having more than one earner in the family (diversified income sources), and access to more than 3 social welfare schemes (access to external aid via government schemes) were only 10 respondents (20%) The literature suggests that diversified income sources and adequate external aid (in terms of availability of bundle of social safety schemes) are important determinants of the adaptive capacity (Jarungrattanapong & Manasboonphempool, 2011; Mohmmed et al., 2018; Ndamani & Watanabe, 2016). In the absence of both these important determinants of adaptive capacity, the respondents believe about adequate preparedness is ambiguous. Therefore, 85% respondents' expression about enough future preparedness, indicate about the presence of over-confidence bias. Majority of these respondents were lacking the critical resources (income and social safety schemes) necessary for preparedness, however, their irrational belief on self-ability to adapt shows the presence of overconfidence bias.

Similar statistics were also noticed with reference to the short-term measures (coping). There were 80 out of 204 respondents (39%) who confirmed their coping abilities for ongoing drought conditions (Q. No. 4.5). When these respondents were asked about the probabilities (chances) of their future coping abilities (Q. No. 8.1.2), 73 out of 80 such respondents (91%) expressed confidence (rather over-confidence) on their own abilities to cope (Figure 1), which is a short-term measure. In lieu of critical resources (income and social safety schemes) necessary for even coping, 91% of respondents view that they may cope/manage the drought situation shows their overconfidence on their own ability and skills.

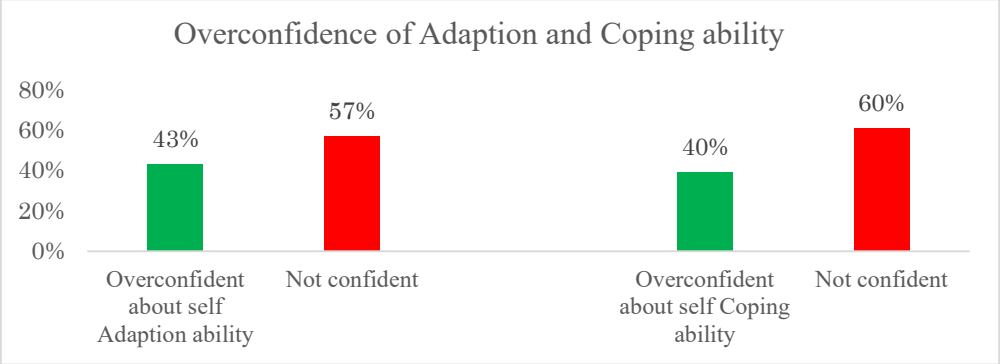


Source: Field Survey

Figure 1. Over-confidence of adaption and coping among prepared respondents

To further validate obtained findings about preparedness and coping abilities, we analyse the statistics for remaining respondents with no preparedness (139) or coping capacity (124). As a common rationale, it was a priori expected that these respondents will not be sure about their ability to deal with droughts in future also. However, the analysis shows somewhat different behavior. Around 60 (out of 139) and 50 (out of 124) non-prepared respondents (43% and 40% respectively) were much confident in their ability and knowledge to prepare and cope with future drought events respectively (Figure 2). These results are surprising and

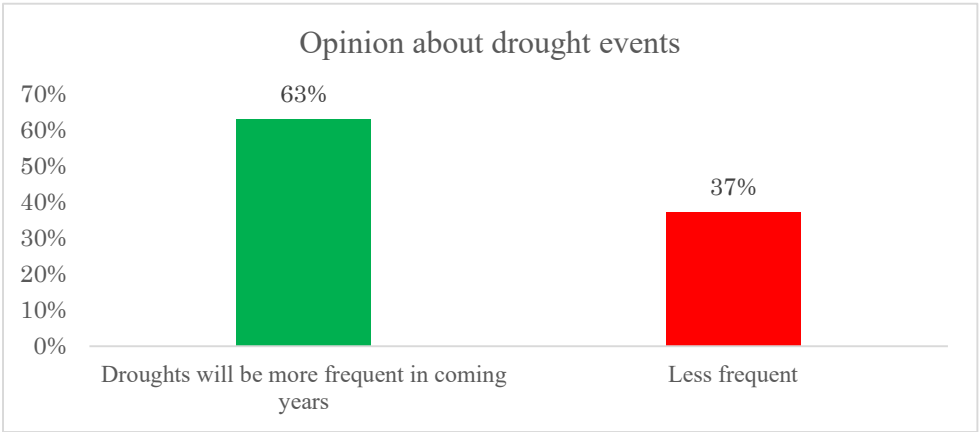
indicated an over-confident behavior. In view of respondents' vulnerability profile (such as average income[2], diversification of income sources[3], employment sources[4], irrigation infrastructure[5]) and rising external threats (increasing frequency and intensity of droughts), over-estimation of own capabilities for preparedness is not justified. Such surprising and inflated individuals' belief presents fair evidence of over-confidence bias. These findings are well supported by previous studies such as Gluckman and Bardsley (2021), Ziegler et al. (2014) and Glöckner (2016).



Source: Field Survey

Figure 2. Over-confidence of adaption and coping among non-prepared respondents

Over-optimism: In response to the Question. No. 8.2.1, around 63% respondents believed that rainfall scarcity that may lead to droughts will be frequent in coming years (Figure 3). In the absence of sufficient irrigation facility rainfall scarcity will be a threat to the crops and agricultural productivity.

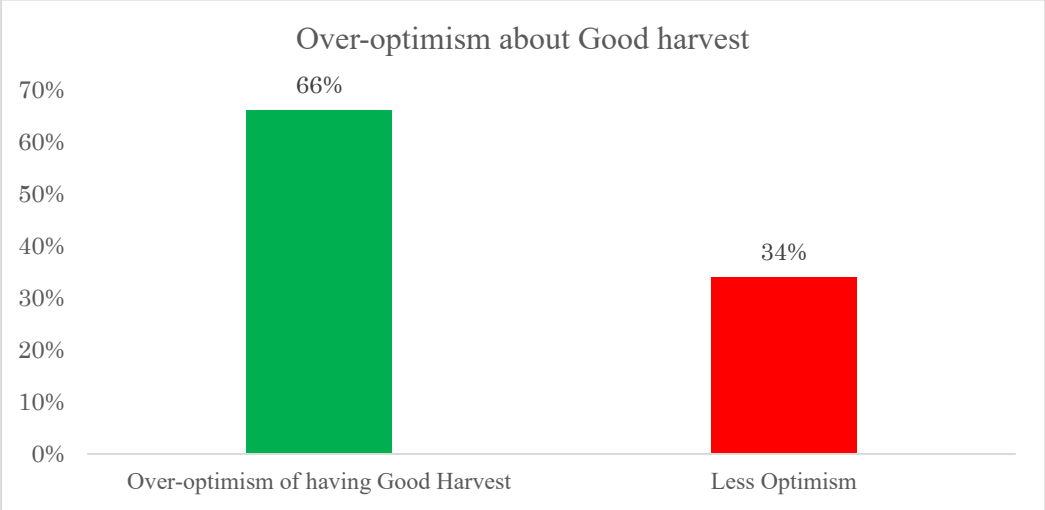


Source: Field Survey

Figure 3. Opinion about drought events

[2] We consider approximate total expenses as a proxy for the average total income, which was considerably low in the survey. 55% of respondents fall in the INR 5000 to 8000 bracket and 93% respondents' income lies within INR 11,000.
[3] Only 20% respondents have more than one sources of income.
[4] Around 62% of respondents don't have second earning member in the family.
[5] The respondents mostly depend on the natural water/rainfall for irrigation and don't have their own reliable irrigation facilities.

However, when questioned about the probabilities of having a good harvest in the coming years (Q. No. 8.2.2), 66% farmers (59 out of 90) expressed optimism and responded that they will have good harvests despite frequent droughts expectations (Figure 4). This paradox indicates over-optimism about their own farm production. If rainfall is expected to be less, how rainfall dependent crops may be good in absence of adequate irrigation infrastructure? In lieu of any logical elucidation, the explanation of such decision choices of respondents may be found in the behavioral finance theory and concepts (over-optimism bias). The underlying belief of respondents about good harvest (over-optimism) may be linked to a more systematic (cognitive) behavioral bias.



Source: Field Survey

Figure 4. Over-optimism about Good harvest

Further, the farmers were asked about the chances of getting the financial relief or loan waiver against crop losses by state government in case of future droughts (Q. No. 8.2.3). Notably, many respondents (farmers) have received (only once) the financial assistance by the state government in the last 3-4 drought years (Q. No. 5.2). Droughts were officially declared twice in last three to four years, but the financial relief was given only once and there was no loan waiver. In that sense, the probability of getting relief under similar policy regime in the future should be less than 50%, following a simple (proportional) rationale. Therefore, it was expected that most farmers in survey will register a probability of around 50% or less. However, the observed responses show otherwise. 83 out of 90 respondents (92%) were highly optimistic that they will get financial relief (with probabilities scoring from 60% to 100%) in case of crop losses due to drought events (Figure 5). Only 8% farmers assigned the probabilities which were 50% or less, although still higher than expected (around 33% or less). These results confirmed that farmers' expectations with respect to good harvest and financial relief disbursement were not rational but mere a wishful thinking (over-optimism). These results are inline with other studies such as Trumbo et al. (2011), Kinsey et al. (2019) and Royal and Walls (2019).

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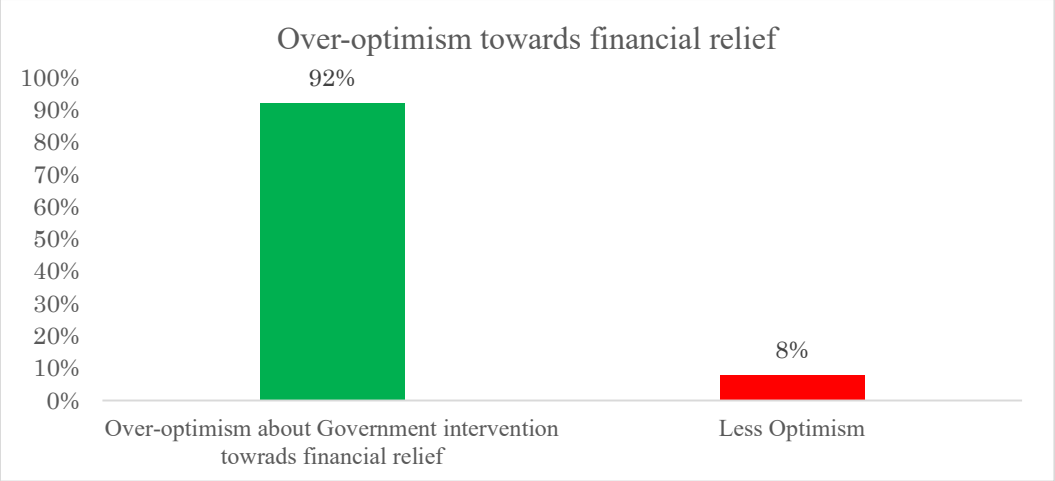
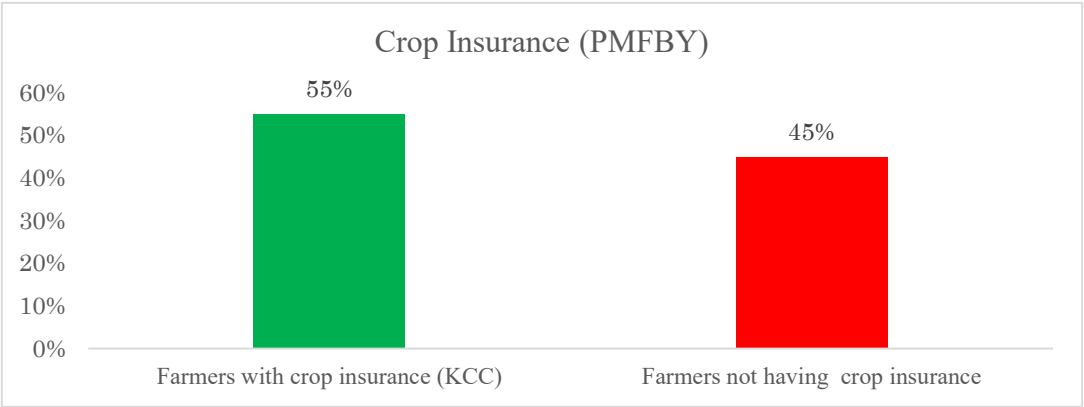


Source: Field Survey

Figure 5. Over-optimism towards financial relief

Herding: Out of 90 farmers (a sub-set of 204 total respondents), 50 were having Kisan Credit Card (KCC) (with attached crop insurance under PMFBY[6]) (Q. No. 8.3.1) while the remaining 40 farmers (45%) did not have KCC (therefore did not have crop insurance also) (Figure 6). The KCC offers a pre-defined credit limit to farmers at a discounted rate of interest by various banks in India. It also has a benefit of mandatory crop insurance as a risk management measure attached to it.

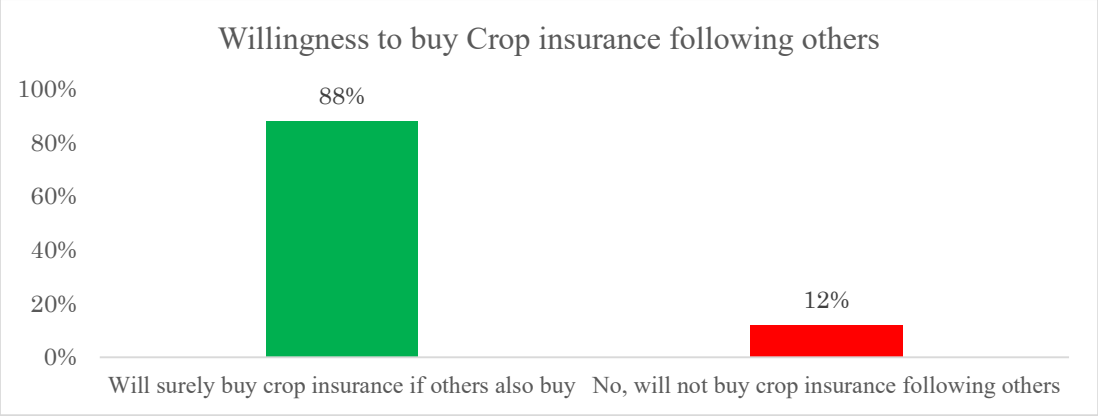


Source: Field Survey

Figure 6. Crop Insurance (PMFBY)

Notably, none of the non-insured farmers have been asking or have applied for insurance. The study explored the willingness of such uninsured farmers (Q. No. 8.3.2) to buy crop insurance if their uninsured friends or neighbours also buy (Figure 7) it. 88% (38 out of 43) showed willingness to buy insurance following others while the rest 12% respondents were still unwilling to buy insurance due to various reasons.

[6] PMFBY is a central government scheme to cover the crop loss against droughts and other natural disasters through an insurance cover and is attached as a benefit to KCC holders.



Source: Field Survey

Figure 7. Herding: Willingness to buy Crop insurance following others

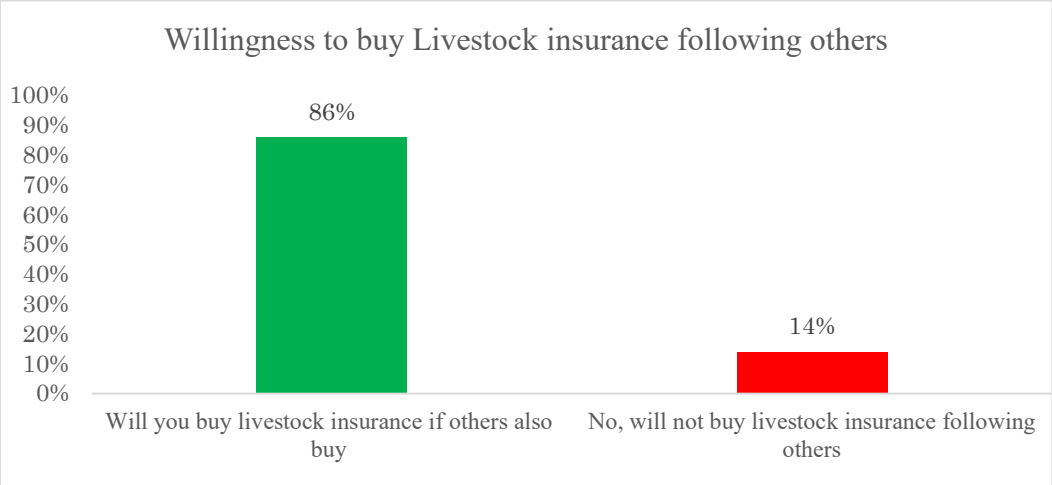
There were 38 livestock owners who don't have livestock insurance (Q. No. 8.3.3). However, the willingness to buy livestock insurance following others was questioned only to a sub-set of respondents (22 respondents), who own and lost some livestock/s in last 3 years due to droughts (Q. No. 4.3) and were non-prepared also (only 7 out of the 29 respondents were prepared for droughts, therefore excluded). Assuming that they act rationally, it is expected that those respondents would buy livestock insurance given that its utility (rationality assumption) is immense because the respondents were already vulnerable (had lost livestock earlier) and also lacked drought preparedness. However, the survey findings reveal that none of these respondents had insurance.

When inquired about their awareness of availability of livestock insurance in the local market, it was found that insurance was freely available and known to the respondents. The economic reasons for non-purchasing of the insurance were also minuscule (a concern to only 2 out of 29 respondents). Further, none of the respondents had experienced any negative experience in buying insurance (such as long administrative process, delay in getting insurance policy or inconvenience such as online policy purchase etc.) or previous experience of non-payment by insurance companies in the wake of livestock loss. The main reason cited by the respondents for not (currently) buying the livestock insurance is that their peers (friends, neighbours etc.) don't own it (herding behavior). Interestingly, 19 out of 22 (around 86%) such respondents showed their willingness to buy livestock insurance (Q. No. 8.3.4), if their friends or neighbours also buy (Figure 8)[7]. Responses of those respondents not having livestock insurance (as others don't own), and those willing to buy insurance if others also buy, firmly demonstrate the presence of herding bias (decision choices are solely made following others).

An alternate argument of such herding behavior (regarding crop and livestock insurance purchase) could be structured through the lenses of rationality. For example, the respondents

[7] In addition, out of all 38 respondents not having livestock (Q. No. 8.3.3), 35 respondents (approximately 87%) shown their willingness to buy insurance following others. These statistics are almost similar for those respondents who suffered livestock loss earlier, confirming that herding behavior was prevalent.

do not buy insurance because possibly others know something the respondents don't know (like the insurance do not pay out when claimed). Therefore, although it may seem irrational, it is unwise to disregard the action of others. However, this explanation is not plausible as respondents were aware about such insurance and associated benefits to them. Therefore, their decision choices are the outcome of behavioral weaknesses (herding bias) and may not be justified as rationale choices. These results broadly follow the findings of Kunreuther (1984) for insurance purchase, and Weinstein (1980), Fahy (2009), Lovreglio (2016) in principle.



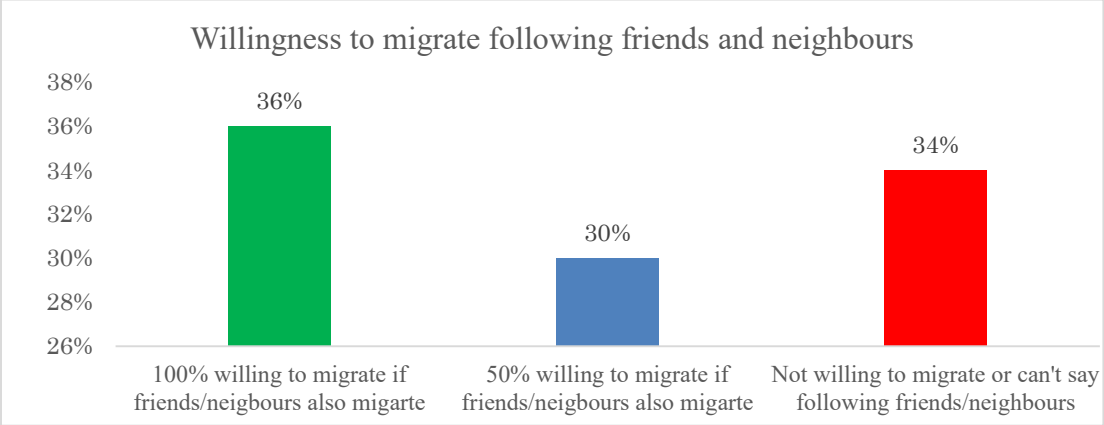
Source: Field Survey

Figure 8. Herding: Willingness to buy Livestock insurance following others

Further, in the full sample, there were 135 respondents who never migrated from their residential place for employment purpose (Q. No. 7.1). However, once asked to these 135 respondents (non-migrants) (Q. No. 8.3.5), 49 respondents (36%) were completely willing to migrate following others. 40 respondents (30%) assigned 50% probability of migration following their friends or neighbours (Figure 9). In totality, 66% respondents, who never migrated, were willingly ready to migrate (with the probability of 50% or more) following their friends and neighbours. Only 34% were either unwilling to migrate or could not decide due to various personal reasons. The results clearly show that for 66% respondents their decision choices are based on others decision. Therefore, it shows that herding bias are prevalent in the respondents' behavior.

An alternate argument regarding this reference could be that herding behavior is not only justified but also a rational behavior. For example, if all the neighbors are moving elsewhere, it is possible that they have a good understanding of the situation (as the theories of migration suggest that the migration may be due to pull reasons also such as better pay, good working conditions). In addition, social capital is often crucial for adapting to climate change by encouraging cooperation and collective action to lower the vulnerability (Adger, 2001; Smit & Wandel, 2006). Therefore, migration during disasters is a conscious adaptation strategy (Foresight, 2011). Herding behavior influences decision-making, as individuals tend to follow the proactive measures observed in their community, enhancing overall resilience

(Paul et al., 2016). The author however argues that the information asymmetry has little role to play here and a clear shift of choices following others (in response to herding questions) deeply indicates the behavioral weaknesses among respondents. Kniveton et al. (2011) also argue that individuals' decisions to migrate are often influenced by biases and perceptions. In real disaster situations, migration decisions may be primarily based on observing others' behavior rather than on rational analysis (Warner et al., 2012). In all, the findings with reference to over-confident, over-optimistic (McKay & Dennett, 2009) and herding behavior may have deep biological origins also (Raafat et al., 2009).



Source: Field Survey

Figure 9. Herding: Willingness to migrate following friends and neighbours

5. CONCLUSIONS

This comprehensive study thoroughly investigates the impact of three behavioral biases—over-confidence, over-optimism and herding- on individuals' decision-making in the challenging context of drought preparedness. It specifically evaluates the effects of drought on two districts, Sagar and Vidisha, in Madhya Pradesh, India. Our detailed analysis of survey data indicates that respondents in the drought-affected districts of Sagar and Vidisha in Madhya Pradesh, India, show a consistent deviation from rational decision-making. This includes both those who claim preparedness and those who do not, as they exhibit noticeable overconfidence in their ability to manage future droughts. They generally ignore existing conditions such as frequent droughts and fewer resources. The respondents' excessive self-assurance is also evident in their positive expectations for future harvests and their steadfast faith in receiving financial assistance if their crops fail. This demonstrates the widespread influence of over-optimism, a cognitive bias. Additionally, the study reveals occurrences of herding behavior, where individuals tend to imitate the choices of their peers, especially when it comes to insurance selections and migration plans. This suggests that social dynamics (herding) have a significant impact on individual decision-making. Such systematic departure

from rationality may lead to risky choices and outcomes. For example, it may lead to sub-optimal selections such as less investment in crop and livestock insurance, avoiding drought proofing measures such as investing in irrigation infrastructure, enhanced expenditure on consumption rather on developing the productive assets etc. Furthermore, it confirms prior discoveries with a significant number of participants. The study presents compelling evidence that behavioral factors significantly impact individuals' decision-making about disaster preparedness.

The inadequate preparedness despite drought-risk and prior exposure (experience) may have serious policy implications. Any efforts of government or institutions for risk communication may also be completely neglected or discounted by individuals. These findings highlight the necessity for policymakers to consider behavioral biases when developing effective disaster management policies. They also stress the crucial importance of comprehending and addressing these factors to improve the resilience of communities to droughts. This study has the potential to supplement government initiatives aimed at improving readiness in both agricultural and non-agricultural sectors to achieve the intended outcomes. Moreover, these findings have major implications for government budgeting. The government may be required to bear a substantial financial burden if individuals suffer financial losses because of illogical decision-making during droughts. Hence, policymakers ought to consider and integrate behavioral aspects into policy decisions to mitigate budgetary deficits or maintain them within manageable limits.

The present study paves the way to future research employing in-dept inferential analysis due to qualitative nature of behavioral biases, In addition, a longitudinal study in a disaster context may be advantageous to re-validate the findings of the present study. The study's significant contribution of novel field evidence within the Indian context extends its relevance to regions and economies globally grappling with droughts or water scarcity, offering a rich and promising avenue for future research exploration into the multifaceted impacts of behavioral biases across diverse disaster contexts and geographic settings. This investigation into the intricacies that underlie individual decision-making in disaster-prone regions holds the potential to enhance our comprehension and to provide valuable insights for developing more efficient approaches to disaster preparedness and response.

Conflict of Interest: The author states that there is no conflict of interest.

Funding Source: The study is self-funded.

Data Availability: The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

ADDENDUM

The present work is extended and developed out of the PhD thesis Chapter (Behavioural biases in decision making), as a MHRD Scholar for which the author duly acknowledges the motivation and support of the PhD supervisor and IIT Roorkee.

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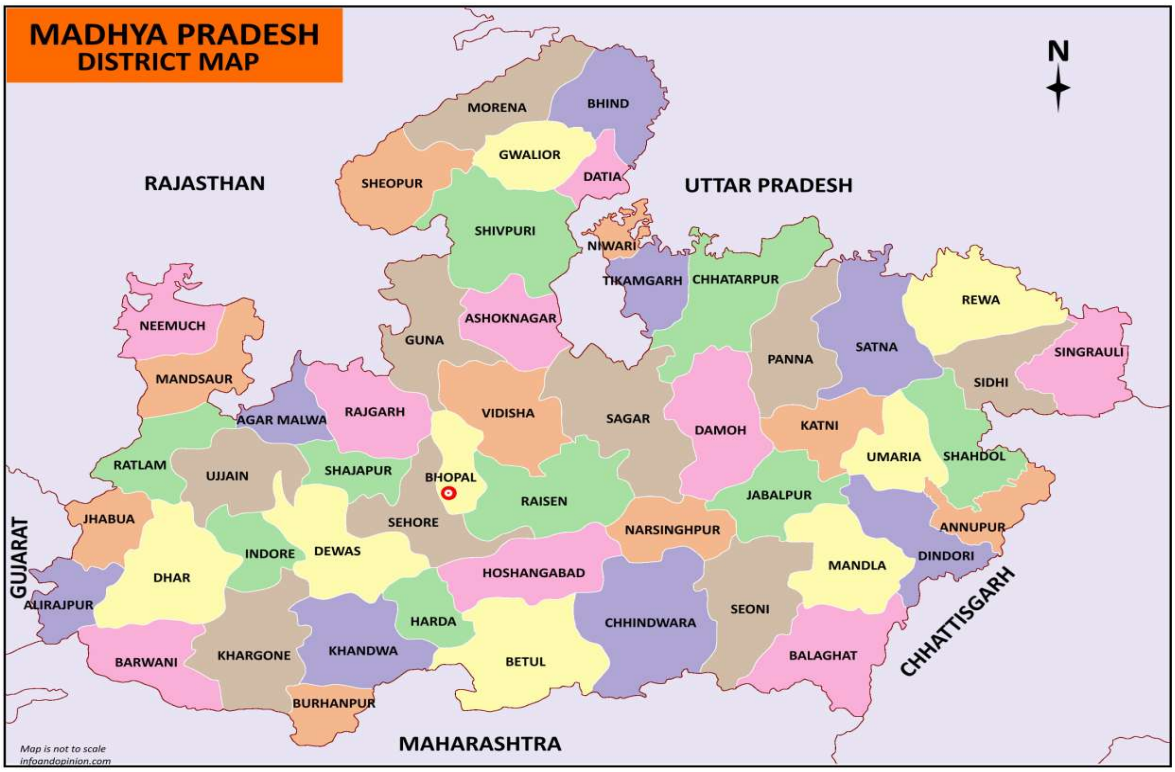
Annexure 1

Figure A1: Madhya Pradesh District Map



Source: Google Map (Infoandopinion.com)

Table 1: List of Blocks (Tehsils) surveyed for the study

S.No.	District	Block
1	Sagar	Sagar
2	Sagar	Jaisinagar
3	Sagar	Surkhi
4	Sagar	Mathone
5	Sagar	Rahatgarh
6	Vidisha	Teoda
7	Vidisha	Sironj
8	Vidisha	Tyonda

Source: author's own creation

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Annexure 2

QUESTIONNAIRE

Strictly Confidential
(For Research Purpose only)

To explore the selected individuals' behavioral biases in drought-affected districts of Madhya Pradesh

Date of Interview.....

Time (beginning)..... Ending.....

Name of Interviewer.....

District: ...…….

Block: ……

Name of the Village: ……Panchayat: …….

Location (1=Urban, 2=Rural) …….

Name of Respondent: ……

Respondent Code: ……

1. Respondent's details

1.1 Employment status: Principal……Secondary……..

1. Self-employed in agriculture
2. Self-employed in non-agriculture
3. Regular wage/salary earning
4. Casual labour in agriculture
5. Others

Q. No.	Details	Response
1.2	Economic status (1=APL, 2=BPL)	
1.3	Age (years)	
1.4	Gender (1=Female, 2= Male)	
1.5	Category (1=SC, 2=ST, 3=OBC, 4=GEN, 5=Unclear)	
1.6	Education (1=Illiterate, 2=Below High School, 3=High School, 4=Higher Secondary School, 5=Graduate, 6=Postgraduate, 7=Above Postgraduate)	
1.7	Are you the sole earner in the family? (1=Yes, 2=No)	
1.8	Number of dependents	

2. Approximate total expenses (INR): (Tick)……

Total income/month (INR)	Respondents Income	Family income
1. below 5000		
2. 5000-8000		
3. 8001-11000		
4. 11001-20000		
5. more than 20000		
6. do not know/no answer		

3. Source of Irrigation

Source of Irrigation	Bore well	Canal	Lake/pond	River	Rainfall	Others
Area of land irrigated (Acres)						
	1	2	3	4	5	6
Normal Years						
Drought Years						

4. Drought and Preparedness

4.1 Have you ever experienced drought in last 1-3 years? (1=Yes, 2=No)

4.2 Do you believe that the frequency of droughts has increased in the last decade?

1=Yes, 2=No, 3=don't know

4.3 If you maintain the livestock, have there been any losses (like, mortality) due to drought?
1=Yes, 2=No

4.4 Are you prepared enough to deal with the droughts? 1=Yes, 2=No

4.5 Are you also able to cope with the drought and water scarcity conditions? 1=Yes, 2=No

5. Drought Relief

Q.No.		Response
5.1	Are you aware of the drought relief programmes/schemes of Government? (1=Yes, 2=No)	
5.2	Did you receive post-drought relief by government? (1=Yes, 2=No)	
5.3	How much was the delay in receiving the financial relief from the date of sanction to disbursement? 1=one month, 2=two months, 3=three months, 4= more than three to six months, 5= more than six months, 6= no delay,	

6. Do you have awareness or access to the following government schemes?

PDS (Food Security) 1=Yes, 2=No

Mid-day meal 1=Yes, 2=No

Mudra loan 1=Yes, 2=No

MGNREGA (employment) 1=Yes, 2=No

PMFBY (Crop insurance) 1=Yes, 2=No

Bhavantar Yojna 1=Yes, 2=No

Nalkoop Khanan 1=Yes, 2=No

Micro-irrigation 1=Yes, 2=No

Early warning advisory for droughts 1=Yes, 2=No

Soil check-up 1=Yes, 2=No

Any other (Goat distribution etc.) 1=Yes, 2=No

7. Drought and Migration

7.1 Have you ever migrated because of drought from your village/town? (1=Yes, 2=No)

7.2 If migrated, why? 1=limited/no coping strategy; 2=livelihood loss (total loss)/ moving out to find some work; 3=unavailability of water to drink/cook/bath; 4=lack of insufficient government intervention, 5=any other(specify)…….

8. Behavioral Biases in Decision Making

Q.No. ***8.1***	***Over-confidence***	Response
8.1.2	Are you adequately prepared to deal (adapt) with future droughts? (1=Yes, 2=No)	
8.1.2	Do you feel that the coping measures will help you again? (1=Yes, 2=No)	
8.2	***Over-Optimism***	Response
8.2.1	Do you feel that rainfall will be normal or adequate in coming years/seasons? (1=Yes, 2=No)	
8.2.2	Are you of opinion (probabilities/chances) that the crops will be good in the coming years (1=Yes, 2=No)	
8.2.3	How sure you are that loan waiver/relief will be disbursed to you by government, if crops fail again? Not sure (0%)	

	Very less sure (20%) Somewhat sure (40%) Reasonably sure (60%) Highly sure (80%) Fully sure (100%)	
8.3	***Herding***	Response
8.3.1	If you are a farmer, do you have Kisan Credit Card (KCC) which covers crop insurance (Or do you have crop insurance at your own?) 1=Yes, 2=No	
8.3.2	If the crops are still uninsured, will you buy crop insurance if your friends, neighbours or relatives also buy it? 1=Yes, 2=No	
8.3.3	Do you have livestock insurance? (1=Yes, 2=No)	
8.3.4	If the livestock/s are still uninsured, will you buy insurance if your friends, neighbours or relatives also buy? 1= No (economic reasons), 2=Yes (following others), 3 = (don't know), 4 (bad experience during purchase or /non-payment by insurance companies in case of livestock loss previously)	
8.3.5	What are the chances of your migration to some other place to work/live if your neighbours/friends/relatives also migrate due to droughts? 1=100%, 2=50%, 3=0%, 4=can't predict	

Note: A part of the original (broader) questionnaire from the author's PhD thesis is adopted and presented here which is relevant and useful to explore the selected behavioral biases of individuals.