

# 1 Drought Adaptation Mapping in the Southern African 2 Development Community: a review

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22

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## 33 Abstract

34 Evidence on how people adapt to drought frequency and severity is expanding, yet remains  
35 fragmented and insufficiently informative for assessing progress, limits, equity, and key  
36 priorities. Previous global syntheses demonstrate that adaptation is occurring but provide limited  
37 insight into how, where, for whom, and with what risks. This scoping review addresses these  
38 gaps by mapping peer-reviewed evidence on drought adaptation in the 16 countries that make  
39 up the Southern African Development Community (SADC) region, one of the few regions  
40 globally that exhibits an observed downward trend in precipitation while encompassing many  
41 countries, making it a valuable case for examining diverse approaches to managing changing  
42 risk.

43 We review 141 studies published since 2020, documenting the geographic, sectoral, and  
44 thematic distribution of reported drought coping and adaptation strategies. We discuss the  
45 spectrum of adaptation strategies utilized in SADC, identify common enablers and barriers,  
46 assess conditions associated with success, and examine risks of maladaptation. We also  
47 analyze which approaches are described as “transformative” and the traits they share.

48 Results reveal that studies are concentrated in a small number of countries, primarily South  
49 Africa, Tanzania, and Zimbabwe, and of the seven broad sectors identified, only two feature  
50 prominently: 1) Agriculture, food, forestry, fibre, and fisheries and 2) Water. There are major  
51 gaps in documentation of ecosystem-based adaptation and private-sector responses.  
52 Adaptation actions are predominantly individual or community-level, while institutional and  
53 governance-focused strategies, though less common, are more frequently associated with  
54 transformative change. Governance and social capital consistently shape outcomes, while  
55 maladaptation risks often arise from short-term coping strategies that deepen inequality or  
56 erode long-term adaptive capacity.

57 By synthesizing what is known and not yet documented along with what is labeled  
58 transformative, this review provides a regionally grounded evidence base to support  
59 assessments of adaptation progress, limits, and pathways that avoid leaving vulnerable  
60 populations behind.

## 61 Introduction

62

63 Droughts are increasing in frequency, duration, and severity across many regions of the world,  
64 driven by rising temperatures, altered precipitation patterns, and growing climate variability.<sup>1</sup>  
65 These changes pose increasing risks to key socio-ecological sectors particularly in the global  
66 south, where exposure to climate hazards is high and adaptive capacity is often constrained.  
67 Rain-fed agriculture remains a central livelihood base for many people globally, especially in  
68 low- and middle-income countries, making drought a critical climate hazard with far-reaching  
69 social and economic consequences.<sup>2</sup> The Southern African Development Community (SADC)  
70 region is one such area, characterized by high dependence on climate-sensitive livelihoods,  
71 recurrent drought exposure, and persistent structural constraints related to poverty,  
72 infrastructure, and governance.

73 Effective and sustained adaptation to drought is therefore essential for reducing climate risk and  
74 advancing climate-resilient development. While drought response and adaptation have long  
75 been practiced by many communities and groups, with varying degrees of success, a growing  
76 body of evidence indicates that households, communities, and governments are changing their  
77 behaviors to account for increased drought risk. The Intergovernmental Panel on Climate  
78 Change (IPCC) has documented widespread implementation of adaptation across sectors,  
79 including agriculture, water, health, ecosystems, and human settlements, while emphasizing  
80 persistent limits and growing risks of maladaptation. These assessments highlight that  
81 adaptation is occurring, but often not at the scale or speed required to manage escalating  
82 drought risk.<sup>3</sup>

83 The Global Adaptation Mapping Initiative (GAMI) provides the most comprehensive synthesis of  
84 adaptation responses to date, mapping thousands of documented adaptation actions across  
85 regions, sectors, and hazards, inclusive of drought, through 2019.<sup>4</sup> GAMI demonstrates that  
86 adaptation is widespread, particularly in food and agriculture systems, while other relevant  
87 literature notes that documentation of adaptation is also increasing.<sup>5,6</sup> However, GAMI focuses  
88 on the presence and type of adaptation actions rather than their implementation, effectiveness,  
89 and enablers. As a result, important questions remain unanswered about how adaptation  
90 strategies work and how maladaptation unfolds over time, particularly in countries from the  
91 SADC region.

92 It is unclear which drought adaptation strategies are most commonly used and under which  
93 social and economic conditions these adaptations lead to reduced drought impacts. Additionally,  
94 while “transformative adaptation” is increasingly sought after, there is little clarity on which  
95 strategies are framed as transformative, how transformation is defined, or whether such claims  
96 are supported by empirical evidence. Finally while maladaptation is widely recognized as a risk,  
97 emerging maladaptive outcomes remain inconsistently documented.<sup>7</sup>

98 Without clearer evidence, it is difficult to assess progress toward climate-resilient development  
99 or to inform future climate risk management. An incomplete understanding of barriers and  
100 maladaptation risks may lead to overconfidence in short-term coping strategies that fail to build  
101 long-term resilience. This review addresses these gaps by synthesizing the recent literature on

102 drought adaptation across sectors. Building on previous global assessments while extending  
103 beyond them, we focus not only on what adaptations are reported, but also on the conditions  
104 that shape their adoption.

105 Specifically, within the SADC region, we aim to:

- 106 1. map reported drought adaptation strategies across sectors, including agriculture, water,  
107 livelihoods, health, ecosystems, and human settlements;
- 108 2. identify common barriers and enablers influencing adaptation adoption and  
109 effectiveness;
- 110 3. examine reported maladaptations and underexplored risks; and
- 111 4. explore how transformation is defined, operationalized, and evidenced in the drought  
112 adaptation literature.

113 By synthesizing this evidence, this review seeks to clarify where adaptation is implemented,  
114 where it is falling short, and where critical knowledge gaps remain.

## 115 Methods

116  
117 To address the aims of this review, we conduct a systematic synthesis of the peer-reviewed  
118 literature on drought adaptation in the SADC region. The review examines reported adaptation  
119 strategies, as well as the conditions influencing their implementation, documented  
120 maladaptations, and claims of transformation. We applied the following inclusion and exclusion  
121 criteria to define the scope of the literature included:  
122

123 Table 1. Inclusion and exclusion criteria for the review

Include	Exclude
<ol style="list-style-type: none"><li>1. The paper is drought related</li><li>2. The paper addresses human systems or human-assisted systems such as farming</li><li>3. Specific coping strategies or adaptations are mentioned to deal with drought</li><li>4. Published post-2019</li><li>5. The paper presents tangible responses (such as existing government initiatives, implemented strategies, etc)</li><li>6. White papers not listed in the exclusion criteria</li><li>7. Includes one or more countries in the SADC region, defined as: Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini / Swaziland, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia, Zimbabwe</li></ol>	<ol style="list-style-type: none"><li>1. The paper does not specifically mention drought or synonyms for drought</li><li>2. The paper addresses natural systems such as plants or animals</li><li>3. The research is solely a vulnerability assessment or impacts-focused</li><li>4. Published in or before 2019</li><li>5. The paper primarily involves planning, prioritizing, or proposing responses</li><li>6. Conference proceedings, media articles, book chapters, grey literature (anything not peer-reviewed)</li><li>7. Does not include a SADC member country</li></ol>

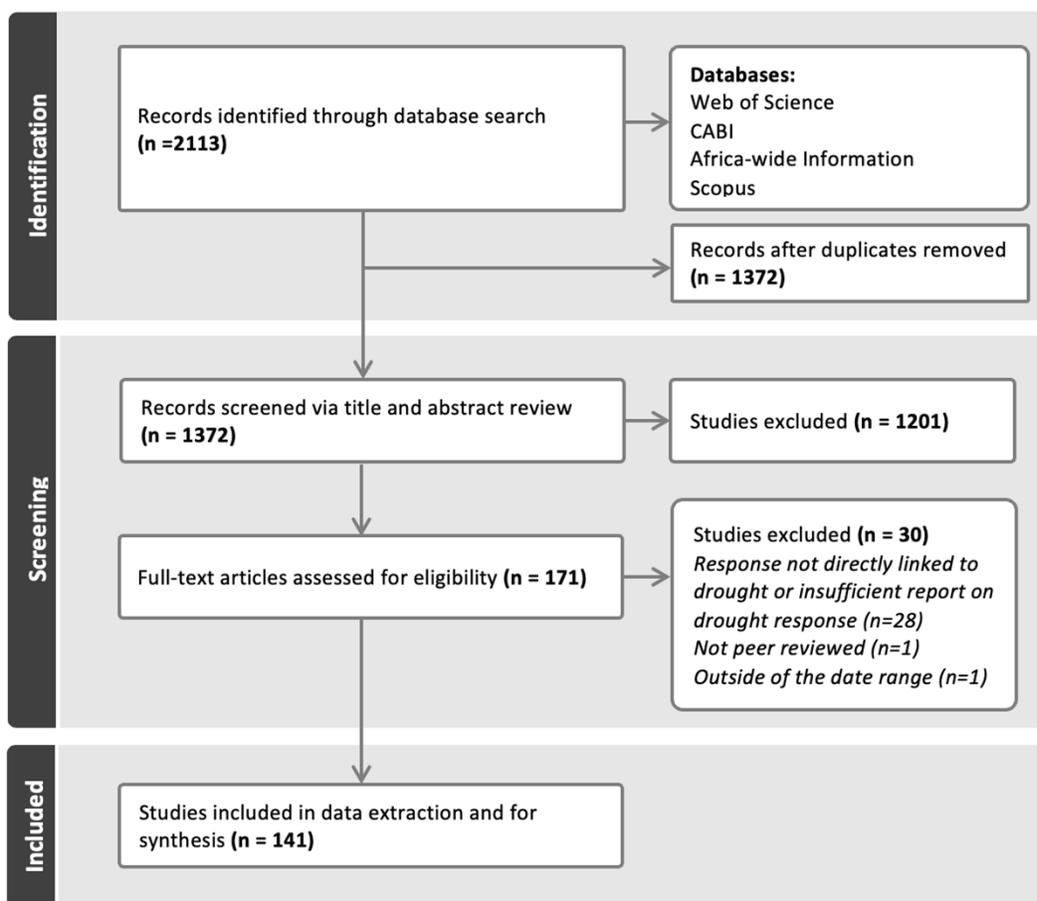
124

125 The search strategy queried peer reviewed studies published between January 2020-June  
126 2025. These dates were chosen because the Global Adaptation Mapping Initiative has already  
127 documented adaptation through 2019.

128 A three-step search strategy was utilized in this review. First an initial limited search of Web of  
129 Science was undertaken to identify key words relevant to our search, which were used to  
130 develop a full search strategy for Web of Science, CABI, Africa-Wide Information, Scopus, and  
131 Ovid Medline. The search strategy, including all identified keywords and index terms, was  
132 adapted for each database (*see SM2 for search terms for each database*). The reference list of  
133 all included sources of evidence was screened for additional studies. Only studies published in  
134 English were included, though a search was conducted to understand the number of papers  
135 excluded by this strategy by removing the English language requirement from the search  
136 strategy and the output was minimal (<10). Studies published after 2019 were included as the  
137 Global Adaptation Mapping Initiative has previously reviewed evidence prior to 2020.

138 Following the search, all identified citations were collated and uploaded into Endnote and  
139 duplicates removed. Following a pilot test, titles and abstracts were screened by two  
140 independent reviewers for assessment against the inclusion criteria for the review. Sources that  
141 met the inclusion criteria (table 1), were retrieved in full and the full article with citation details  
142 were distributed to reviewers for blinded data extraction, which was completed using a  
143 standardized excel spreadsheet. Any disagreements that arose between the reviewers at each  
144 stage of the screening and extraction process were resolved through a third reviewer. The  
145 results of the search and the study inclusion process are reported in Figure 1.

146 Figure 1. Prisma flow chart



147

148 Data was extracted from papers included in the scoping review by up to two independent  
 149 reviewers using a data extraction tool, which gathered information on adaptation activities and  
 150 sectoral relevance, barriers and enablers to adaptation, possibilities of maladaptation, and  
 151 evidence of transformation, each of which is defined in SM3.

152 A pilot was conducted for data extraction and after 10% of articles had been reviewed, the  
 153 authors met to discuss necessary clarifications. Revisions, including clarifying terms and  
 154 deleting frequently unanswerable questions, were made to the tool at this time and the initial  
 155 10% of data was revised accordingly. Table 2 presents a breakdown of the tool's sectoral  
 156 categories accompanied by a narrative summary.

157

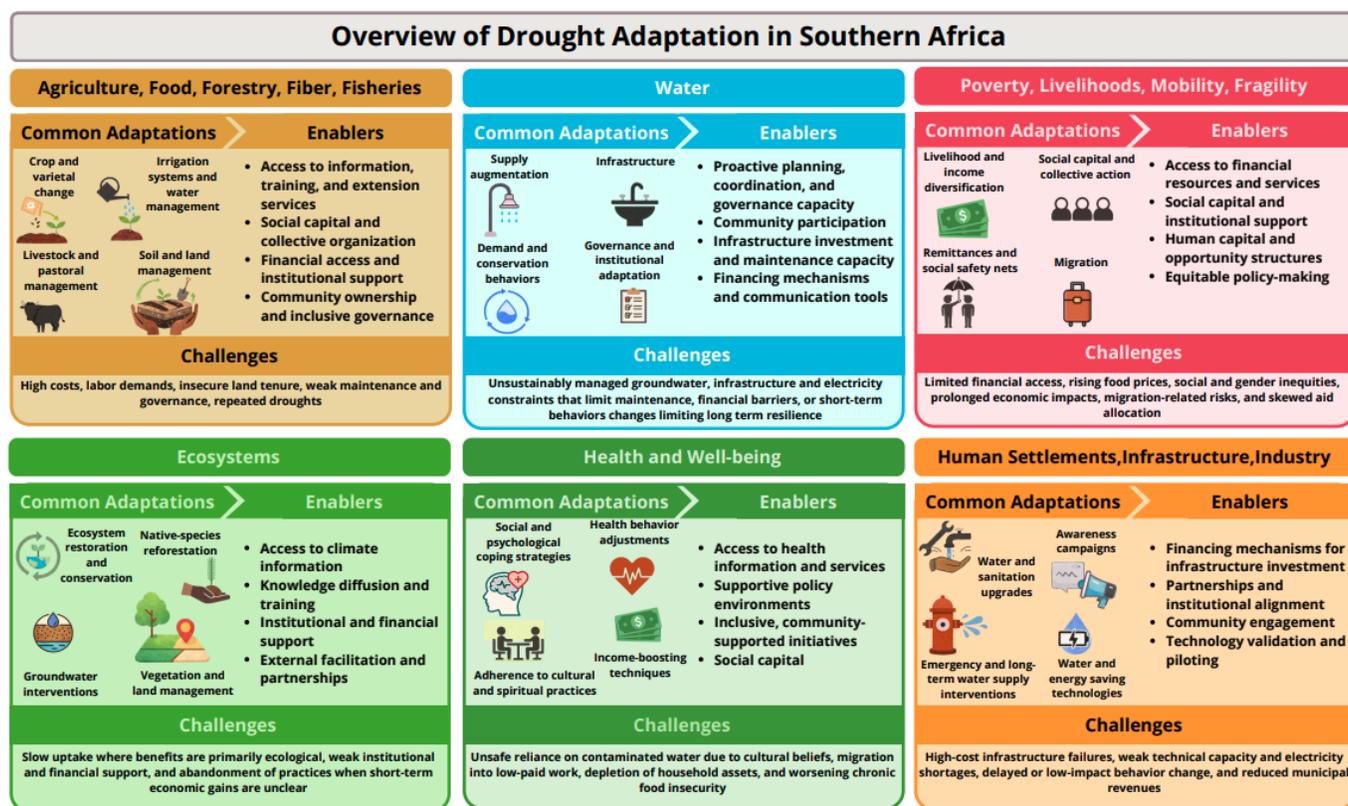
Table 2. Definitions of sectors included in results analysis

Sector	Scope of Adaptation
Agriculture, food, forestry, fibre and fisheries	Adaptations related to food systems, agricultural production, agroforestry, fisheries, and livelihood strategies that affect food security
Water	Adaptations involving water resources, including hydrology, droughts, floods, sanitation, water scarcity, and water management or allocation

Poverty, livelihoods, mobility and fragility	Adaptations linked to poverty, livelihood resilience, equity, mobility or displacement, and responses in fragile or conflict-affected context
Human settlements, infrastructure, and industry systems	Adaptations in urban and rural settlements, infrastructure, and industrial systems to enhance climate-resilient development
Health and well-being	Adaptations addressing physical or mental health, disease risks, health systems, and the social factors affecting well-being under climate stress
Terrestrial and freshwater ecosystems	Adaptations involving terrestrial habitats and freshwater environments such as forests, grasslands, rivers, wetlands, and lakes
Ocean and coastal ecosystems	Adaptations focused on marine and coastal systems, including oceans, reefs, estuaries, and mangroves

158 **Results and Discussion**

159 **Adaptation summary**



1

161 Thematic shading corresponds to the relevant sustainable development goal. Reference guide  
 162 provided in SM4.

# 163 Evidence mapping and gaps

## 164 Geographic representation

165

Table 3. Where is the evidence?

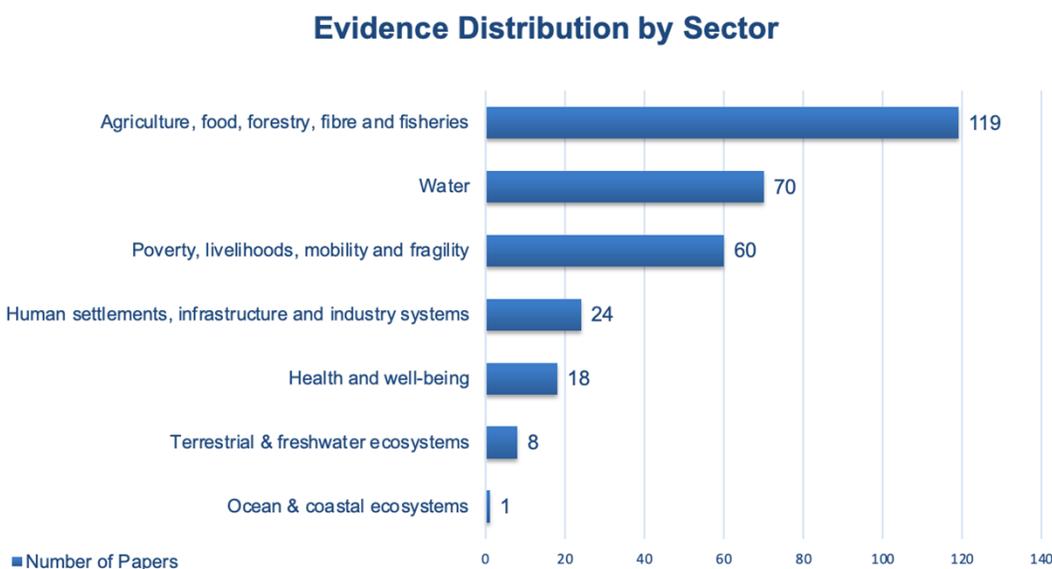
Country	# of papers	Map of distribution of papers	
South Africa	57	<p>Distribution of Evidence on Adaptation: SADC Region</p> <p>Number of papers 0 28.5 57</p>	
Tanzania	27		
Zimbabwe	22		
Malawi	11		
Zambia	6		
Namibia	5		
Multi-country	5		
Madagascar	2		
Botswana	2		
Democratic Republic of Congo	1		
Eswatini / Swaziland	1		5 studies that either addressed several countries within SADC or the SADC region as a whole which are not captured on this map.
Lesotho	1		
Mozambique	1		
Comoros	0		
Mauritius	0		
Seychelles	0		
Total	141		

166

167  
168 Country of origin was determined by the study area and/or where interventions took place. As  
169 noted in table 3, evidence is concentrated in South Africa, Tanzania, Zimbabwe, and, to a lesser  
170 extent, Malawi. Some possible explanations for this are the exposure of drought, strong  
171 research capacity, and highly agriculture-dependent economies making adaptation a priority.  
172 These countries have also been the focus of many major donor-supported adaptation programs  
173 and English is widely spoken. The three countries not represented in the evidence, Comoros,  
174 Mauritius, and Seychelles, are all island states with less or more niche agricultural activity and a  
175 lower vulnerability to drought. There is a notable scarcity of multi-country studies; further  
176 research of this kind is warranted, as drought risk transcends national boundaries.  
177  
178

## 179 Sectoral representation

180 Figure 2. Evidence distribution by sector



181  
182  
183 Sectoral relevance was decided by each reviewer using the definitions provided in table 2 and a  
184 “select all that apply” method. Most (n=87, 62%) papers cover more than one sector. Evidence  
185 is lacking for ecosystem-related adaptation and, to a lesser extent, in health and infrastructure.  
186 While there is significant amount of agriculture, food, forestry, fiber, fisheries and water  
187 evidence, much of this is concentrated in a few select countries. It is worth noting that some  
188 international groups and non-governmental organizations may be using reports to convey their  
189 work, which were excluded from this review.  
190

## 191 Agriculture, food, forestry, fiber, and fisheries

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193

Reference numbers for papers discussing agriculture, food, forestry, fiber, or fisheries*	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 57, 59, 60, 61, 62, 63, 65, 66, 67, 68, 70, 71, 73, 74, 75, 76, 77, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 104, 106, 107, 109, 110, 111, 112, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 128, 129, 131, 133, 134, 135, 139, 140
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194 \*Reference numbers correspond to the results table in SM1

## 195 What adaptations are being studied?

196 On the growing side, shifts in crop types, particularly the adoption of drought- and disease-  
197 resistant or early-maturing varieties, were among the most frequently reported strategies. These  
198 were often combined with crop diversification, planting crops with differing water or maturation  
199 requirements, intercropping, and crop rotation. Drought-tolerant varieties were consistently  
200 associated with higher yields relative to traditional varieties, though this was commonly only  
201 studied during drought years. Diversification of small grains allowed for some production under  
202 low-rainfall conditions when maize failed entirely. In several contexts, these strategies were also  
203 linked to improved food access and diet diversity.

204 Adjustments to planting practices, including shifting planting dates, staggered or sequential  
205 planting, and dry planting, were commonly reported. While these measures were often  
206 associated with improved short-term production outcomes, several studies emphasized  
207 temporal limits to drought recovery, noting that repeated shocks may constrain the longer-term  
208 effectiveness of planting adjustments alone.<sup>8–13</sup> Post-harvest adaptations, including improved  
209 food storage and seed banking, were described as contributing to more stable food availability  
210 across seasons and reduced vulnerability to post-harvest losses.

211 Soil and land management strategies frequently included no or low tillage, mulching, pit  
212 planting, and the use of organic waste and fertilizers, often framed as conservation agriculture  
213 or integrated soil fertility management. These practices were commonly associated with  
214 improved crop yields and soil quality indicators and in some cases contributed to improved food  
215 security and dietary diversity. However, several studies noted challenges to sustained adoption,  
216 emphasizing that continued use often declined after extension services or project support  
217 ended.<sup>13–19</sup> Agroforestry systems, including afforestation, woodlots, boundary trees, and fertilizer  
218 trees, were commonly perceived as positive with few drawbacks.

219 Agriculture-focused water management strategies included investments in irrigation  
220 infrastructure, water harvesting, and water storage. Irrigation was consistently associated with  
221 higher and more stable production, improved household food security, and increased income  
222 compared to rain-fed systems. At the same time, the sustainability of irrigation-based  
223 adaptations was frequently linked to maintenance requirements, institutional support, and  
224 farmers' technical capacity, with some studies noting that benefits diminish where systems are  
225 poorly maintained.<sup>15</sup>

226 Livestock and pastoral adaptations included destocking, use of adaptable breeds, fodder  
227 production and preservation, livestock mobility, herd splitting, setting aside land for grazing, and  
228 alternative land use. Evidence suggests that fodder preservation, improved livestock housing,

229 and improved access to drinking water reduced livestock mortality and disease incidence during  
 230 drought. Nonetheless, recovery following severe drought was often incomplete, with herd sizes  
 231 remaining depressed for multiple years in some contexts.

232 Many of the above strategies were discussed collectively under integrated frameworks such as  
 233 climate-smart agriculture, ecosystem-based adaptation, integrated pest management,  
 234 agroforestry, aquaculture, and integrated crop-livestock systems.

235 What barriers and enablers to success are described?

236

Barriers	Enablers
<ul style="list-style-type: none"> <li>● Labor constraints and natural resource limits further complicated by the legacy of apartheid and social inequality</li> <li>● Farmers who do not own their own land are less motivated to and often cannot invest in long term solutions since they do not own the land and have limited access to related finance services</li> <li>● Difficulties balancing resource consumption versus accumulation</li> <li>● Limits to accessing information</li> <li>● Timing challenges such as syncing adaptation techniques with seasonal calendars in a changing climate</li> <li>● Age and health limit labor-intensive adaptations, especially in an aging farmer population</li> <li>● Recurring droughts compound impacts</li> <li>● Impressions that governments are mishandling funds can be demotivating</li> <li>● Cultural perceptions of crops can inhibit willingness to diversify</li> <li>● Inadequate gender representation leaves women behind</li> <li>● Lack of financial support along with high adoption costs</li> <li>● Education and asset gaps widening the socioeconomic divide</li> </ul>	<ul style="list-style-type: none"> <li>● Access to training, extension services, and group membership strongly influence sustained adoption, especially when these rights are extended to women</li> <li>● Rolling out project activities fully understood and owned by the community strengthens sustainability</li> <li>● Membership in farmer groups, farmer field schools, cooperatives, or savings and loan groups, provide a platform where farmers can share information</li> <li>● Access to credit improving long term investment capacity</li> <li>● Flexible social safety nets that can be combined with disaster risk management</li> <li>● Indigenous knowledge and strong local government engagement</li> <li>● Increased government contracts for farmers, including non-farm livelihood opportunities</li> <li>● Government promotion of improved and affordable seed varieties that can withstand drought stress</li> <li>● Early warning systems and digital weather platforms improving access to weather information</li> <li>● Piloting technologies in local communities to build trust and demonstrate value</li> <li>● Access to markets</li> <li>● Facilitate knowledge sharing across generations</li> <li>● Large household sizes have access to more labor</li> <li>● Breeder-farmer collaborations which combine farmer experiences with scientific experts to develop, select, and test new crop varieties</li> <li>● Social capital</li> <li>● Planning at all levels</li> <li>● Use of radio broadcasts for information sharing and social media for mobilizing individual action</li> </ul>

237  
238

## 239 What are the risks of maladaptation?

240 Drought-tolerant seeds must be purchased at the start of each season rather than saved,  
241 increasing farmers' expenses. Early-maturing cultivars can produce lower yields even in  
242 favorable conditions due to their shorter growth duration, again putting farmers at risk for less  
243 income. Some conservation practices are very labor-intensive, particularly if not mechanized,  
244 requiring additional time, effort, and costs. Agroforestry can also negatively affect yields by  
245 reducing farm space on small plots, although this effect is mitigated when combined with  
246 livestock. Irrigation, while improving water efficiency, can reduce long-term drought resilience if  
247 gains are used to expand irrigated areas, leading to increased water withdrawals and depletion.  
248 Quality storage structures are crucial for keeping out pests and maintaining dryness, and the  
249 lack of such structures limits households' ability to stock grains for extended periods, reducing  
250 income potential during droughts. Finally, selling livestock has longer term income-related  
251 consequences alongside immediate food security concerns.

252

## 253 Water

254  
255

Reference numbers for papers discussing water*	2, 3, 4, 10, 11, 13, 19, 22, 25, 26, 29, 30, 31, 32, 36, 39, 40, 41, 42, 43, 45, 46, 47, 48, 50, 53, 54, 55, 56, 58, 59, 61, 62, 63, 64, 67, 68, 69, 70, 72, 73, 75, 76, 78, 81, 82, 83, 84, 88, 91, 93, 100, 103, 105, 108, 109, 110, 113, 122, 126, 127, 128, 132, 133, 135, 136, 137, 138, 139, 141
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256 *\*Reference numbers correspond to the results table in SM1*

## 257 What adaptations are being studied?

258

259 Rainwater harvesting and storage emerged as a widely adopted household-level strategy, with  
260 evidence that women and school-educated households have higher adoption rates. Saving  
261 water in tanks and constructing water canals on rooftops connected to storage containers are  
262 two documented examples. Infrastructure upgrades such as solar-powered boreholes are  
263 highlighted as relatively long-lasting interventions, while groundwater abstraction is increasingly  
264 used but accompanied by concerns about sustainability. Other water supply related responses  
265 include desalination, securing access to clean water through municipal taps, pumping drinking  
266 water, and diversifying water sources.

267 On the water demand side, studies document extensive use of water-saving behaviors and  
268 policies, including shorter showers, reduced laundry and cleaning, mandatory water use  
269 restrictions, water pressure management on taps, greywater reuse and recycling, and broader

270 water reduction policies. Evidence suggests these measures can reduce water use and costs in  
271 the short-term but may not result in lasting change.

272 At the community scale, water infrastructure investments such as pit latrines, water metering  
273 systems, leak prevention and repair, and installing tanks and boreholes were commonly  
274 documented and some papers mentioned that these strategies helped prevent disease  
275 outbreak. Small-scale drip, or bucket irrigation is reported to have long-term benefits for water  
276 efficiency and production, but present some maintenance challenges. Developing and reviewing  
277 farm water budgets and decentralized water resource management have been used to improve  
278 planning and allocation. Additionally, sand dams show evidence of effectiveness, with significant  
279 increases in the number of months water can be collected after construction.

280 Governance and institutional strategies include re-negotiating roles and responsibilities between  
281 private and public actors in water provisioning, which has been shown to lower aggregated  
282 municipal water demand and provide opportunities for more equitable participation in policy  
283 design. Municipal coordination on water scarcity policy plans, community contributions to paying  
284 for water delivery, and enforcement through water committees reflect shifts toward shared  
285 responsibility, with evidence that communities develop a stronger sense of ownership and  
286 inclination to conserve water when they have a voice. More transformative potential is noted  
287 where community-based water tenure underpins governance arrangements, suggesting that  
288 equity can enhance the sustainability and effectiveness of water interventions in the long term.<sup>20</sup>

289

290 What barriers and enablers to success are described?

291

<b>Barriers</b>	<b>Enablers</b>
<ul style="list-style-type: none"><li>● Communication issues</li><li>● Perceived unfairness related to restrictions, policies, and tariffs</li><li>● Propensity to revert back to old behaviors after awareness campaigns end</li><li>● Financial barriers to inclusive participation and decision-making</li><li>● Constraints on capacity, scale, and physical infrastructure</li><li>● Evolving regulatory environments</li><li>● Lack of community knowledge of ability to influence policy</li><li>● Electricity shortages</li></ul>	<ul style="list-style-type: none"><li>● Proactive water planning and investment</li><li>● Clear restrictions and targets</li><li>● Repurposing existing policies<sup>21</sup></li><li>● Improved collaboration and coordination along with broader stakeholder inclusion</li><li>● Improved infrastructure</li><li>● Water committees<sup>22</sup></li><li>● Use of social media to mobilize individual action<sup>15</sup></li><li>● Tariffs and other financing mechanisms</li><li>● Monitoring processes</li><li>● Identifying community members as stakeholders</li></ul>

292

293 What are the risks of maladaptation?

294 Groundwater abstraction raises sustainability concerns, with several papers noting the need to  
295 monitor aquifer levels and implement recharge measures.<sup>23,24</sup> Water-saving behaviors, such as  
296 shorter showers, reduced laundry, mandatory restrictions, and greywater reuse, often decline  
297 once droughts or campaigns end, suggesting that these campaigns should be ongoing if they  
298 hope to improve water supply in the long term. Small-scale irrigation methods, like drip or  
299 bucket systems, face challenges due to maintenance needs and farmers' capacity to manage  
300 them independently, indicating that projects that require upkeep may not be sustainable  
301 solutions.

302

## 303 Poverty, livelihoods, mobility, and fragility

304

Reference numbers for papers discussing poverty, livelihoods, mobility, or fragility*	2, 4, 5, 9, 11, 14, 15, 16, 13, 18, 21, 22, 24, 25, 26, 28, 36, 38, 40, 41, 42, 43, 44, 46, 47, 49, 50, 52, 54, 58, 59, 61, 63, 65, 67, 75, 76, 80, 81, 82, 84, 85, 87, 89, 90, 91, 95, 97, 98, 100, 103, 106, 109, 112, 116, 129, 133, 135, 137, 139
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305 *\*Reference numbers correspond to the results table in SM1*

306 What adaptations are being studied?

307

308 Diversifying income was the most commonly mentioned adaptation strategy used to address  
309 poverty and livelihoods. The means by which individuals diversified income ranged from sale of  
310 assets and belongings, off-farm employment, borrowing, selling livestock, using savings, and  
311 taking out loans, all of which demonstrated varying levels of success in improving outcomes or  
312 avoiding the worst impacts of the drought. Some studies even noted that these strategies were  
313 better suited for improving individual welfare during non-drought times. Dependence on  
314 remittance and social safety nets as well as leveraging social capital via collective labor, village  
315 savings and loan associations, livestock lending, borrowing food from neighbors or relatives,  
316 and communal granaries were also frequently mentioned strategies.

317

318 Migration was referenced in two forms: moving to urban areas for new work or to different rural  
319 areas with more rainfall for better grazing or farmland. Remittances were named as a motivating  
320 factor for the decision to migrate, where in many cases some family members would move and  
321 send cash or food assistance back to other family members who remained in their home village.  
322 In some cases, families were reunited once sufficient income was being made in the new place  
323 of residence.<sup>25</sup>

324

325 What barriers and enablers to success are described?

Barriers	Enablers
<ul style="list-style-type: none"> <li>● Socioeconomic factors, especially those linked to land ownership and availability of other financial resources</li> <li>● Financial impact of drought lasts beyond the return of rainfall, but not all resources do</li> <li>● Rising food prices</li> <li>● Lack of education or education opportunities</li> <li>● Lack of capital</li> <li>● Limited financial services</li> </ul>	<ul style="list-style-type: none"> <li>● Social capital</li> <li>● Expert consultations</li> <li>● Improving social safety nets</li> <li>● Policies promoting gender equality</li> <li>● Increased access to credit, loans, or skills</li> <li>● Higher wages</li> <li>● Knowledge of relevant determinants of poverty</li> <li>● Subsidies</li> <li>● Diversity of economic opportunities</li> </ul>

326

327 What are the risks of maladaptation?

328 Limited aid, credit, and livelihood support can be directed toward households most likely to  
 329 “succeed,” which can strengthen individual resilience while diverting scarce resources away  
 330 from the poorest, deepening overall poverty and inequality. Women are especially affected, as  
 331 discriminatory inheritance and land-ownership laws restrict their ability to accumulate wealth,  
 332 even when they take on economic responsibilities during drought.<sup>26</sup> Migration can lead to  
 333 unintended harm: people and livestock are at increased risk for encountering conflict or death  
 334 after moving into unfamiliar environments, families are separated, women are forced into  
 335 traditionally male roles under stressful conditions, and competition over land and water  
 336 increases conflict. Migrants often end up in poorly paid, unskilled work, meaning migration  
 337 reduces immediate drought risk but can lock households into long-term economic insecurity.

338 Human settlements, infrastructure, and industry  
 339 systems

340

341

Reference numbers for papers discussing human settlements, infrastructure, or industry systems*	3, 21, 25, 36, 39, 47, 49, 56, 63, 72, 78, 85, 88, 93, 98, 105, 113, 122, 128, 133, 135, 136, 137
-------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------

342 *\*Reference numbers correspond to the results table in SM1*

343 What adaptations are being studied?

344

345 Strategies frequently described as human settlements, infrastructure, and industry systems  
 346 include the use of pit latrines, drilling boreholes, and mandatory water use reductions. The use

347 of heterogeneous infrastructure configurations, such as combining indoor flush toilets with  
348 backyard latrines on a single plot has been used to help residents address intermittent water  
349 supply, economic constraints, and safety concerns associated with having to navigate long  
350 distances in the dark to use shared toilets.<sup>27</sup> Regarding tourism, the hotel industry utilized  
351 several water-saving strategies including water-saving technological and infrastructure  
352 upgrades as well as awareness-raising strategies, encouraging guests and employees to make  
353 behavioral changes that conserve water. The upgrades allowed hotels to remain operational  
354 during periods of extreme water scarcity. Evidence of decline in water consumption levels  
355 related to awareness campaigns was mixed.

356  
357 In Namibia, implementing emergency abstraction from the Windhoek Aquifer and pumping  
358 alternative drinking water sources from distances of up to 450km has been used to better serve  
359 rural communities. In urban areas, the #DontWashMeNAM campaign, where artists drew on  
360 dusty windshields to encourage water conservation is a unique strategy that led to an estimated  
361 15-40% reduction in water used by car washes during the campaign.<sup>24</sup> However, despite their  
362 eventual success, the impact of the campaign had an “unacceptably long lead time” and the  
363 overall impact was much lower than targeted.

364  
365 Several papers noted that infrastructure upgrades are long-lasting and continue to provide  
366 benefits even after the drought and help avoid future crises, emphasizing the need for long-term  
367 resilience policies and investment. Literature also discussed the importance of equitable  
368 investment in infrastructure.

369  
370 What barriers and enablers to success are described?

Barriers	Enablers
<ul style="list-style-type: none"><li>● Funding for infrastructure improvements</li><li>● Lack of assessments to inform investment needs</li><li>● High upfront adoption costs</li><li>● Weak institutional frameworks for technology validation</li><li>● Electricity shortages</li></ul>	<ul style="list-style-type: none"><li>● Community involvement in organizing and planning awareness campaigns and other interventions / treating local communities as relevant stakeholders</li><li>● Clear goals or targets</li><li>● Aligning programs with government development plans</li><li>● Strategic partnerships between governments, private sector, and communities</li><li>● Sources of financing such as grants, tariffs, and low/zero-interest loan options</li><li>● Piloting technology in local communities to build trust and demonstrate value</li></ul>

371

## 372 What are the risks of maladaptation?

373 Short-term emergency responses can move too quickly and result in high-cost, low-efficacy  
374 results. For example, an expensive borehole was drilled to provide water to a hospital only to  
375 discover that the subterranean water was too high in magnesium and could not be used.<sup>28</sup>  
376 Additionally, lack of pre-existing technical expertise without training can make investment  
377 projects unsustainable. In the case of conservation campaigns, there were reports of reduced  
378 municipal revenue due to lower water consumption, impacting local economies more broadly.  
379 There were hotels and guest houses that replaced lawn grass with stones or artificial grass,  
380 which led to reduced groundwater infiltration.<sup>29</sup>

## 381 Health and well-being

382

Reference numbers for papers focused on health and/or well-being*
----------------------------------------------------------------------

3, 15, 21, 25, 26, 28, 32, 36, 40, 44, 46, 48, 100, 109, 113, 133, 139
---------------------------------------------------------------------------

383 *\*Reference numbers correspond to the results table in SM1*

## 384 What adaptations are being studied?

385

386 Strategies mentioned as health and wellness adaptation include peer or family support,  
387 migration, social capital, altering food consumption patterns such as skipping meals or eating  
388 less preferred foods, relying on less food, engaging in faith-based practices, exercise, and  
389 traditional cultural practices such as rain rituals. Health-promotion strategies were vaguely  
390 mentioned without clarification on what types of strategies were being promoted. Social capital  
391 was frequently discussed, with one paper noting that these relationships are important for  
392 gaining access to resources, information, and influence.<sup>30</sup>

393

394 Regarding migration, people moved both to urban areas for new or to new rural areas with  
395 better farmland, but one study noted that the ability to send cash or food assistance back to  
396 their families was a significant motivating factor for the decision to migrate.<sup>31</sup> Authors also noted  
397 that while migration has been perceived as an often maladaptive short-term coping strategy, it  
398 can be a legitimate adaptation method due to its role in supporting various adaptive efforts. One  
399 indicator of positive outcomes for families who migrated was being able to send children back to  
400 school after previously being unenrolled.<sup>31</sup> Alternatively, one paper used the proxy variable of  
401 "thriving farmers" to indicate successful adaptation, which was defined as farmers who have not  
402 migrated due to drought and have sustained or improved their crop production and income. This  
403 study showed a positive and significant relationship between the adoption of on-farm adaptation  
404 strategies and "thriving" during drought, suggesting that those who adopted more strategies  
405 were more likely to report "thriving."<sup>16</sup>

406

407 What barriers and enablers to success are described?

Barriers	Enablers
<ul style="list-style-type: none"> <li>Peer-led initiatives, when unsupported or dismissed by the wider community, may not be sustainable</li> <li>Cost of health services and health prevention measures, such as water treatment tablets</li> </ul>	<ul style="list-style-type: none"> <li>Access to health information</li> <li>Community belonging and collective discussion on resource distribution</li> <li>Social capital</li> <li>Policies that encourage urban migration</li> <li>Roads to increase access to health prevention supplies and medical providers</li> </ul>

408

409 What are the risks of maladaptation?

410 Literature identified increased health risks when using water from contaminated sources that is  
 411 believed to be safe due to cultural rituals.<sup>32</sup> Despite some arguments that migration can have  
 412 positive benefits, studies noted that migration may make people more vulnerable, as they are  
 413 still paid very little, work in unskilled jobs, and lack the opportunity to learn new skills for higher-  
 414 paid income. Literature also highlights how increased reliance on coping strategies, such as  
 415 buying cheaper food, reducing meal sizes, or sending children elsewhere, could deplete  
 416 household assets and adaptive capacity, potentially leading to deeper vulnerability and chronic  
 417 food insecurity.

418

419

420 Terrestrial, freshwater, ocean, and coastal  
 421 Ecosystems

422

Reference numbers for papers discussing terrestrial or freshwater ecosystems*	25, 32, 60, 73, 81, 126, 133, 139
Reference number for the paper discussing ocean or coastal ecosystems*	139

423 *\*Reference numbers correspond to the results table in SM1*

424 What adaptations are being studied?

425 Ecosystem-focused adaptations noted include restoration and conservation of agro-  
 426 ecosystems, native-species reforestation, agroforestry practices that reshape forest structure,

427 borehole rehabilitation to stabilize groundwater-dependent ecosystems, coastal rehabilitation,  
428 and targeted vegetation management. The literature notes some ecological risks that are  
429 reduced or avoided by utilizing these strategies: biodiversity and carbon loss, forest  
430 degradation, soil erosion, habitat decline, invasive species spread, and watershed deterioration.  
431 Many of these adaptations provide co-benefits such as improved yields and more stable agro-  
432 ecosystems.

433 Progress and sustainability indicators within these adaptation efforts include evidence of  
434 changing attitudes towards conservation, increasing adoption rates of ecosystem-based  
435 practices, and some livelihood gains that help reinforce continued use. However, studies note  
436 that uptake can be slow, particularly where the benefits are ecological rather than immediately  
437 economic. This raises important questions: 1) Are strategies justified primarily as “doing it for  
438 the ecosystem” struggling to gain traction? 2) Can these strategies be reframed to increase  
439 uptake at the community level?

440 What barriers and enablers to success are described?

Barriers	Enablers
<ul style="list-style-type: none"><li>● Lack of institutional support, especially financially</li><li>● Lack of inclusion in climate action plans to encourage political will</li><li>● Access to climate information is identified as a crucial factor that makes farmers more likely to adopt ecosystem-based agriculture practices</li></ul>	<ul style="list-style-type: none"><li>● Membership in farmer field schools improves knowledge on how to use ecosystem-based agriculture practices</li><li>● Access to credit</li><li>● Diffusion of knowledge</li><li>● Some training in conservation practices</li><li>● Work done by third party organisations</li></ul>

441

442 What are the risks of maladaptation?

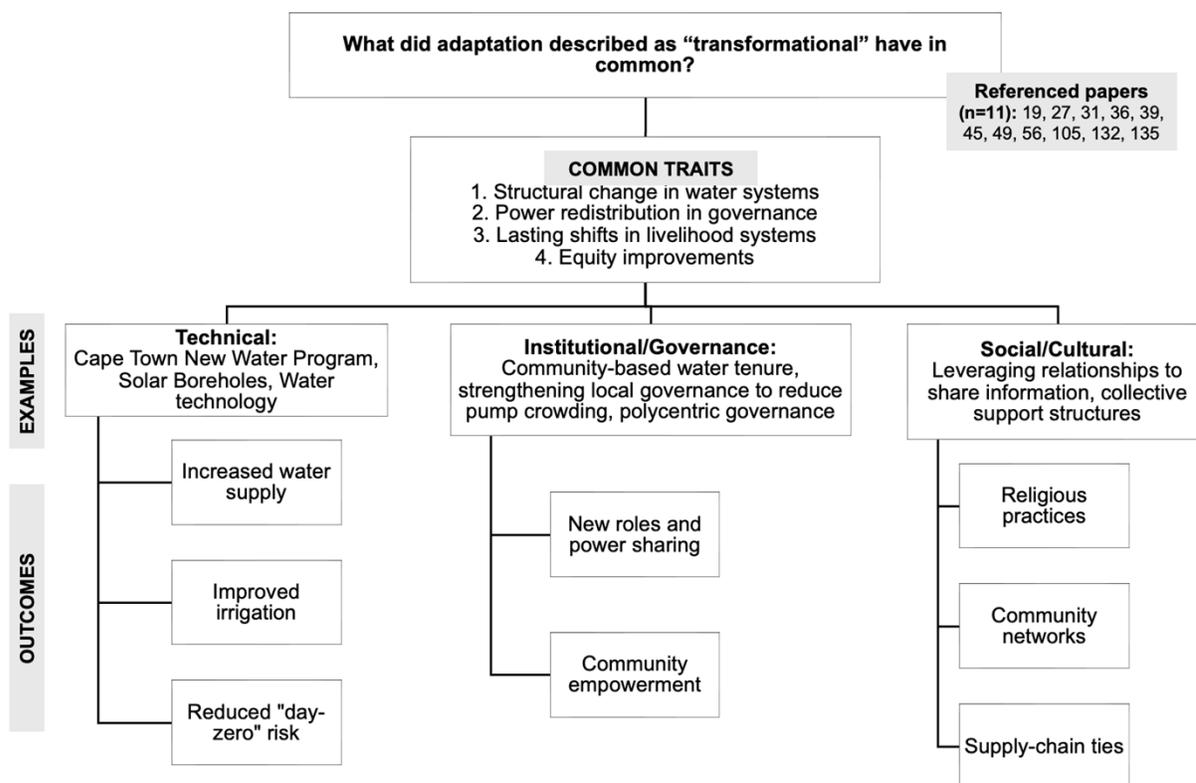
443 None explicitly mentioned for the ecosystems in the papers included in this review.

444

445

446 Which approaches are considered transformative?

447



448  
449

450 Transformational adaptation was defined as long-term, irreversible changes in system function  
451 or structure. Across the eleven papers that reviewers agreed indicated transformational change,  
452 all programs address drought through collective, institutional, or community-based strategies  
453 that attempt to increase resilience, emphasizing technology, governance, and/or social  
454 networks. The cases collectively highlight that transformational shifts rarely emerge from  
455 technology alone, as power and resource redistribution repeatedly shape outcomes. Examples  
456 of restructured authority and participation in water management include polycentric  
457 arrangements, decentralization, and community-based water tenure.

458 Many programs share a reliance on collective action and multi-actor coordination. Cape Town's  
459 New Water Program, for example, depended on widespread individual cooperation and  
460 coordinated shifts across public and private sectors.<sup>23</sup> Similarly, Zambia's solar-powered  
461 borehole system required strong community water governance.<sup>20</sup> These examples reinforce that  
462 climate adaptation is best positioned to succeed when it mobilizes multiple stakeholders in  
463 complementary ways. Collaboration also emerges in cases emphasizing social networks and  
464 community participation, where social ties help mobilize resources and information across  
465 scales.

466 Another common thread is the central importance of governance. Polycentric governance in  
467 Cape Town, decentralized water management in Namibia, and community-based water tenure  
468 in South Africa and Zambia demonstrate that who controls water, and how decisions are made,  
469 can matter more than the physical availability of water itself.<sup>20,21,33,34</sup> Water source  
470 diversification, such as investments in desalination and solar-powered boreholes, becomes

471 transformational primarily when paired with these governance shifts and equitable institutional  
472 arrangements.  
473

## 474 Limitations

475 This review is only a snapshot of peer-reviewed literature on adaptation since 2020, excluding  
476 other forms of adaptation documentation. Many studies provided poor documentation of  
477 methods, including incomplete information on sampling procedures, timing of data collection,  
478 and definitions of key terms. Purposive sampling was frequently used, sometimes targeting  
479 populations with extreme conditions such as farmers applying for emergency drought  
480 assistance (i.e. those with the least coping capacity). Several studies also lacked comparison  
481 groups when assessing the impact of promoted coping strategies. In some studies, data relied  
482 on long recall periods, raising concerns about accuracy of the information provided. Because of  
483 these limitations, we only report outcomes that are claimed or assumed and the findings of this  
484 review should be interpreted through that lens.

485 Additionally, synthesis of findings was complicated by overlaps in categorizations and the  
486 subjective nature of several key classifications, including sectoral categories. The authors'  
487 perspectives, varying between local and international viewpoints, may also have influenced  
488 interpretations.

489

## 490 Conclusion

491 In the reviewed literature, adaptation success strongly hinged on recovery time between shocks,  
492 meaning droughts spanning multiple seasons can undermine the effectiveness of many  
493 strategies. Implementation of adaptation is often contingent on a households' ability to rebuild  
494 assets before the next drought, which could explain why short-term coping strategies repeatedly  
495 fail to improve long-term resilience, aligning with findings from other contexts and hazards.<sup>35,36</sup>  
496 This highlights temporal limits to adaptation, indicating that technical advancements alone such  
497 as improved forecasts may not be enough to improve wellbeing.

498 Ecosystem-focused strategies are often framed as environmental protection rather than  
499 livelihood protection. Adaptations framed as "for the ecosystem" may require explicit pairing with  
500 tangible, short-term, human-centered benefits to be worth promoting under resource  
501 constraints. Local priorities seem to be rooted in the reality of today rather than the possibilities  
502 of tomorrow, echoing findings that climatic shifts and their estimated impacts do not provide  
503 sufficient evidence to fully inform practical decision-making.<sup>37-39</sup> Similarly, health-focused  
504 adaptations are also often indirect or via awareness raising which is motivationally inadequate.  
505 Previous research has found health behavior change to be mostly dependent on self-efficacy,  
506 motivational and behavioral skills, and supportive social and environmental contexts rather than  
507 information alone.<sup>40-43</sup>

508 Economic barriers dominate the literature. Some barriers are low-cost to address, but only if  
509 social and institutional contexts are considered. For example, information, awareness, and  
510 technology barriers often have relatively low-cost solutions, but these fail without trust and  
511 cultural alignment, a concern already noted by the IPCC AR6.<sup>3</sup> The prevalence of governance-,  
512 social-, and awareness-related barriers in the reviewed literature point to the importance of  
513 genuine partnerships over tokenistic engagement. There are no substitutions for physical  
514 barriers such as inadequate infrastructure which are often constrained by finance. In cases  
515 where financial resources are finite but necessary for infrastructure development, failure to  
516 consider equity and community perspectives in resource allocation risks systematically  
517 overlooking vulnerable households.

518 The literature identifies some risk of maladaptation, but we found little evidence on whether  
519 these maladaptations are realized within communities and how those will impact future risk.  
520 Future evaluations should consider long term outcomes and prioritize follow up on unintended  
521 consequences.

522 Transformative adaptation was rarely defined or operationalized by the studies in this review.  
523 The few examples of adaptations viewed as transformative shared common traits such as  
524 power shifts and a focus on long-term outcomes. While this is a start to understanding how  
525 adaptation can lead to long-term resilience, more evidence is needed to build criteria for  
526 “transformational change.” We are also left with several questions such as: *Does prioritizing*  
527 *transformation risk discouraging incremental but necessary action? How can incremental and*  
528 *transformative approaches coexist?* We suspect that true transformation may lie less in the  
529 novelty of practices and more in changes to recovery capacity, governance, and equity. For  
530 example, enabling recovery between shocks may be as transformative as introducing new  
531 technologies, given that short-term coping strategies frequently did not lead to improved  
532 resilience and recovery time between shocks was a common indicator of success. Regardless,  
533 transformation should be viewed as a trajectory, not a threshold.

534 Drought adaptation in SADC is widespread but uneven, often short-term, and constrained by  
535 structural factors; without attention to equity, governance, and recovery dynamics, adaptation  
536 risks stalling or becoming maladaptive. To address concerns around future adaptation, in  
537 addition to the questions already mentioned, we suggest that future research considers which  
538 strategies being implemented by local communities work well in combination and which are  
539 counter-productive or duplicative. Because drought doesn't stop at national boundaries, we  
540 recommend additional multi-country studies to help understand what aspects of adaptation are  
541 generalizable. Finally, adaptation evidence in the SADC region is heavily concentrated in food  
542 and agriculture, especially rain-fed crop production. Future research should explore other  
543 relevant sectors to maximize resilience.

544

545

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## 677 Supplemental Materials

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### SM1. Included paper references and relevance

Reference	Title	Source	What is the adaptation described in the document?
1	Ex-ante and ex-post coping strategies for climatic shocks and adaptation determinants in rural Malawi	Abid et al., 2020	Increasing manual work, intercropping, increasing seed rate, early planting, planting drought resistant varieties, planting disease-tolerant varieties, borrowing resources, changing eating habits, diversifying crops
2	Perception of resource-limited livestock farmers on adaptation management strategies in drought-prone rural areas in eastern Cape Province, South Africa	Akinmoladun et al., 2024	Livestock destocking, storing water, planning for supplementary feeding, breed diversification, use of adaptive breeds, forage conservation, off-farm employment, borrowing money, taking out loans, selling livestock
3	Sanitation configurations in Lilongwe: Everyday experiences on and off the grid	Alda-Vidal et al., 2024	Sanitary infrastructure diversification, use of pit latrines
4	Climate resilience in rural Zambia: evaluating farmers' response to El Niño-induced drought	Alfani et al., 2021	Sustainable land management, controlling soil erosion, diversifying livelihood
5	Yield effects of climate-smart agriculture aid investment in southern Malawi	Amadu et al., 2020	Implementing agroforestry and apiculture, restoring watershed to reduce erosion, increasing water retention, improving soil moisture with check dams, continuous contour trenches, stone bunds, marker ridges, vetiver grass, and water absorption trenches

6	Soil health and grain yield impacts of climate resilient agriculture projects: Evidence from southern Malawi	Amadu et al., 2021	Constructing check dams, trenches, and bunds for watershed restoration
7	Farming Under Drought: An Analysis of the Factors Influencing Farmers' Multiple Adoption of Water Conservation Practices to Mitigate Farm-Level Water Scarcity	Apio et al., 2023	Implementing Water Conservation Practices (WCPs) including irrigation, conservation tillage, cover cropping, intercropping, mulching, planting drought tolerant crops
8	Do ex-ante and ex-post strategies to manage drought differ at the farm household level? A case of sub-Saharan Africa	Aryal et al., 2023	Using drought-tolerant crop varieties, using sustainable land-management practices, replanting, seeking alternative employment, increasing savings, preserving food, reducing food consumption, borrowing
9	Adaptation Strategies and Farmer-led Agricultural Innovations to Climate Change in Mbire District of Zimbabwe	Asare-Nuamah et al., 2021	Planting drought-resistant crops, using mixed cropping, increasing livestock, using local ecological knowledge, diversifying income, using remittances/social safety net for support, reducing size and type of diet
10	Development of an integrated assessment framework for agroforestry technologies: assessing sustainability, barriers, and impacts in the semi-arid region of Dodoma, Tanzania	Awoke et al., 2023	Using agroforestry technologies including tree intercropping, tied ridges, contour planting, chololo pits, farmer-managed natural regeneration (FMNR), boundary trees, and woodlots
11	Exploring gender dynamics in climate-smart agriculture adoption: a study in semi-arid Dodoma, Tanzania	Awoke et al., 2025	Using Climate Smart Agriculture (CSA) including drought-tolerant seeds, intercropping, tied ridges, contour farming, chololo pits, manure application, and inorganic fertilizer
12	Determinants of Farmers' Adaptation Intent And Adoption of Adaptation Strategies To Climate Change And Variability in Mwanza District, Tanzania	Bagambilana et al., 2023	Implementing agroforestry, managing livestock feed, using organic fertilizer, intercropping, water harvesting and storage, improving irrigation systems, shifting planting schedule
13	The Impact of Agricultural Drought on Smallholder Livestock Farmers: Empirical Evidence Insights from Northern Cape, South Africa	Bahta et al., 2022	Using boreholes, canals and wells, transporting water from homes to farms, selling belongings

14	Adaptation, coping strategies and resilience of agricultural drought in South Africa: implication for the sustainability of livestock sector	Bahta et al., 2021	Selling livestock, using alternative land, storing food, asking for animal feed, additional employment, migrating, using drought-tolerant breeds, using relief grants as source of aid, using savings and investments, leasing farms
15	Nexus between Coping Strategies and Households' Agricultural Drought Resilience to Food Insecurity in South Africa	Bahta et al., 2022	Using alternative land, storing feed, using drought-resistant breeds
16	Diversity of Food Insecurity Coping Strategies among Livestock Farmers in Northern Cape Province of South Africa	Bahta et al., 2023	Selling livestock, changing land use, relying on food reserves and relatives for food, seeking alternative employment, migrating livestock production, using drought-tolerant breeds, receiving government grants, using savings and investments, leasing farm land
17	Smallholder livestock farmers coping and adaptation strategies to agricultural drought	Bahta et al., 2020	Buying or selling livestock, migrating, halting production, seeking credit, selling other assets, leasing part of the farm, seeking other employment
18	Climate change and hunter-gatherers in montane eastern DR Congo	Batumike et al., 2021	Growing new crop varieties, including disease-resistant varieties, growing near streams for irrigation, increasing farm size, incorporating livestock, diversifying income with off-farm activities
19	Geoethical issues around water security for the City of Cape Town (South Africa) and groundwater resilience in uncertain circumstances: development of the Atlantis, Cape Flats and Table Mountain Group Aquifers	Blake et al., 2023	Diversifying municipal water sources through desalination, water reuse, groundwater abstraction
20	Farmers' perception of climate change and variability in the North-East District of Botswana	Bosekeng et al., 2020	Planting drought-tolerant and early-maturing crop varieties, shifting planting dates, diversifying crops, providing supplementary livestock feeding, using conservation agriculture, diversifying income
21	Migration dynamics of smallholder farmers in semi-arid rural areas: harnessing coping and adaptation strategies for climate change effects in Tanzania	Chetto et al., 2025	Migrating to urban areas, improved rural farm sites, or other work locations, sending and receiving remittances

22	Household survival and resilience to food insecurity through the drip irrigation scheme in dry rural areas	Chidavaenzi et al., 2021	Using drip irrigation, trying to increase production for income, subsistence, and nutrition of households
23	Benefits of Herding on Communal Rangelands in Free State Province, South Africa	Conradie et al., 2024	Hiring paid herders for livestock holders
24	Understanding drought impacts on livelihoods and risk management strategies: South African smallholder farmers' perspectives	Danso-Abbea m et al., 2024	Using NGO social safety net intervention and government assistance, seeking new sources of food and employment, using food reserves, selling farmland and livestock, harvesting rainwater, maintaining flexibility, using crop insurance
25	Resilience building interventions to manage climate induced livestock poverty and deaths in Southern Zimbabwe	Defe et al., 2024	Reducing livestock poverty deaths through fodder production and preservation, improving livestock structures, constructing livestock drinking sites with borehole rehabilitation, using village savings and lendings, using NGOs and government resources
26	'A creeping phenomenon': the association between rainfall and household food insecurity in the district of iLembe, KwaZulu-Natal	Drysdale et al., 2021	Altering consumption patterns, relying on less expensive foods, changing resource management strategy
27	Vulnerability to resilience for smallholder, small grain farmers in Southern Zimbabwe: The case of semi-arid regions of Southern Zimbabwe	Dube-Takaza et al., 2024	Planting drought-resistant small grains and short season varieties, and practicing conservation agriculture, diversifying household income sources through field crops, vegetables, livestock, and gold mining
28	Agricultural technology adoption for smallholder small grain farmers in Zimbabwe. Implications for food system transformation and sustainability	Dube-Takaza et al., 2023	Implementing conservation agriculture

29	Social vulnerability of smallholder farmers to climate change in Zambia: the applicability of social vulnerability index	Dumenu et al., 2020	Planting drought-tolerant species, varying planting times, diversifying crops, relying on government assistance, pursuing non-farm jobs
30	Farmers' knowledge, attitudes, and perceptions for the adoption of in-field rainwater harvesting (IRWH) technique in Thaba Nchu, South Africa	Dzvene et al., 2021	Using rainwater harvesting technology
31	Emergent polycentric governance in response to drought: Motivations, transaction costs, and feedback in corporate and city collaboration	Eakin et al., 2025	Conserving municipal water through water tariffs, designating Water Service Intermediaries (WSI) to supply water through alternative sources
32	Collective Responses to the 2018 Water Shortage in Cape Town: An Explorative Qualitative Study	Eid et al., 2020	Implementing water-saving awareness and programming, such as student housing distributing buckets for grey water collection and reuse
33	Smallholder farmer coping and adaptation strategies during the 2015-18 drought in the Western Cape, South Africa	Fanadzo et al., 2021	Receiving support from public and private organizations, transporting water, sharing water rights among farmers, storing water in tanks and other conservation strategies, paying for municipal water, buying supplemental livestock feed
34	Diversity and determinants of traditional water conservation technologies in the Eastern Cape Province, South Africa	Fanteso et al., 2022	Using local knowledge to improve water system access
35	Do climate change adaptation strategies improve farmers' food security in Tanzania?	Gebre et al., 2023	Using drought-tolerant and early-maturing varieties, early planting, diversifying income, using precautionary savings, selling livestock

36	The importance of cross-scale social relationships for dealing with social-ecological change in agricultural supply chains	Gonzalez-Mon et al., 2024	Forming social ties to access resources, information, and influence
37	Too much, too soon? Early-maturing maize varieties as drought escape strategy in Malawi	Greuer et al., 2024	Adopting early-maturing varieties
38	Integrating local indigenous knowledge to enhance risk reduction and adaptation strategies to drought and climate variability: The plight of smallholder farmers in Chirumhanzu district, Zimbabwe	Grey et al., 2020	Stocking grain, building storage structures, planting early in combination with secondary planting at the end of the season, applying manure as fertilizer, using drought-tolerant seeds, growing small grain crops, saving seeds
39	Water innovation in South Africa: Mapping innovation successes and diffusion constraints	Habiyaremye et al., 2020	Developing new water purification technology
40	Growing Hope in Dry Lands: A Look at How Tanzania's Smallholder Farmers Thrive Despite Drought	Hagamu et al., 2024	Using drought-resistant crops, changing planting dates, irrigating crops, miscellaneous soil conservation strategies
41	Smallholder sheep farmers' perceived impact of water scarcity in the dry ecozones of South Africa: Determinants and response strategies	Halimani et al., 2021	Rotating water sources, supplementary livestock feeding, rearing adaptive sheep breeds, engaging with alternative markets

42	Validating a novel genetic technology for hybrid maize seed production under management practices associated with resource-poor farmers in Zimbabwe	Hamadziripi et al., 2025	Using new technologies to recycle hybrid seeds
43	Dietary and agricultural adaptations to drought among smallholder farmers in South Africa: A qualitative study	Hawkins et al., 2022	Shifting dietary patterns to replace vegetables with starches and decreasing animal-sourced food consumption
44	Opportunities and constraints in women's resource security amid climate change: A case study of arid-living Namibian agro-pastoralists	Hazel et al., 2021	Strengthening resource security for women by owning specific livestock breeds such as goats and sheep, cultivating garden crops
45	Local participation in decentralized water governance: insights from north-central Namibia	Hegga et al., 2020	Decentralizing water resource management
46	Water Scarcity and Water Quality: Identifying Potential Unintended Harms and Mitigation Strategies in the Implementation of the Biosand Filter in Rural Tanzania	Hovden et al., 2020	Engaging in traditional cultural practices such as physically separating water sources, boiling water, cloth filtration, and sterilizing with water treatment chemicals
47	No safety net in the face of climate change: The case of pastoralists in Kunene Region, Namibia	Inman et al., 2020	Using drought-resistant crops and livestock, migrating, changing planting time, changing or diversifying income sources, reducing food consumption
48	Climate change adaptation strategies and production efficiency: The case of citrus farmers in the Limpopo province, South Africa	Joseph et al., 2021	Planting drought-resistant and early-maturing varieties, harvesting rainwater, changing fertilizers, using drip irrigation, using Integrated Pest Management (IPM)
49	The role of community dynamics on child wellbeing in the context of climate change in the Mwanza Region, Tanzania	Joseph et al., 2024	Improving community participation and social networks

50	Determinants of farmers' choice of adaptation strategies against climate variability and change: Lessons from central Tanzania in Manyoni district	Kabote et al., 2024	Using drought-resistant and early-maturing crop varieties, keeping resistant livestock breeds, practicing conservation agriculture
51	Farmers' Perceptions on Drought, Low Soil Fertility, Coping Strategies and Preferred Traits of Beans in Balaka District of Malawi	Kachiguma et al., 2023	Planting high-yield legumes, practicing conservation agriculture, afforestation
52	Effects of Climate Change Adaptation Strategies on Maize Productivity among Smallholder Farmers in Dodoma, Tanzania	Kamuzora et al., 2024	Planting drought-tolerant and short duration maize varieties, adjusting planting dates, intercropping, minimizing tillage, using fertilizer and irrigation, diversifying income
53	Adaptive mechanisms to drought risk management in a KwaZulu-Natal community, South Africa	Khumalo et al., 2025	Borrowing from neighbors, using savings, sharecropping, seeking additional employment
54	Contributions of integrated soil fertility management (ISFM) to various sustainable intensification impact domains in Tanzania	Kihara et al., 2022	Using integrated soil fertility management (ISFM) practices including improved crop varieties, organic and inorganic fertilizer, and soil and water conservation (SWC) techniques
55	Determinants of small-scale farmers' choice and adaptive strategies in response to climatic shocks in Vhembe District, South Africa	Kom et al., 2022	Using drought-tolerant and shorter-cycle crop varieties, changing planting dates, diversifying crops, using irrigation, migrating to urban areas, engaging in small-scale business
56	Community-based water tenure in equitable and transformative drought resilience	Koppen et al., 2024	Sharing water with local and neighboring communities, using government-financed infrastructure including hand pumps and dams in combination with personal investments like wetland cultivation, scoopholes, wells, and groundwater pumps
57	Irrigation area, efficiency and water storage mediate the drought resilience of irrigated agriculture in a semi-arid catchment	Lankford et al., 2023	Improving irrigation efficiency and constructing water storage to reduce water depletion and maintain sustainable supply

58	Assessing sand dams for contributions to local water security and drought resilience in the semi-arid eastern Shashe catchment, Zimbabwe	Lazurko et al., 2024	Constructing sand dams
59	Climate Change Impacts and Challenges of Combating Food Insecurity in Rural Somkhele, KwaZulu-Natal, South Africa	Leonard et al., 2022	Storing water in tangs, digging water canals, extracting water from river ground, sourcing water from dams, buying water in bulk, buying food, producing more crops and storing surplus, reducing water use during drought, recycling greywater, using crop rotation and no-plow farming strategies, selling natural capital
60	Coping and adapting to drought in semi-arid Karoo rangelands: Key lessons from livestock farmers	Letsoalo et al., 2023	Destocking livestock, diversifying income, and evaluating grazeland post-drought for grazing strategy
61	The Impacts of Drought and the Adaptive Strategies of Small-Scale Farmers in uMsinga, KwaZulu-Natal, South Africa	Lottering et al., 2021	Using early-maturing and drought-tolerant crops, implementing mixed cropping, keeping land unsown following drought, changing irrigation practices, harvesting water
62	Climate change awareness and adaptation strategies by smallholder farmers in semi-arid areas of Zimbabwe	Madamombe et al., 2024	Diversifying crops, using improved varieties, early planting, planting trees, crop livestock integration, irrigation, soil water management
63	Drought-flood coexistence: Risk perception and adaptation of urban and rural households in Southwest Madagascar	Mahamba et al., 2024	Harvesting rainwater, purchasing water, using boreholes and wells, sourcing from municipal water
64	Stakeholders' Perceptions on the Formulation of Climate Change Adaptation Policy and Governance: A Case of the Water Sector in the Raymond Mhlaba and Ngqushwa Local Municipalities, South Africa	Majahana et al., 2025	Harvesting rainwater, drilling boreholes, and coordinating across the municipal level to develop water scarcity policy plans

65	Do Rainfall Shocks Prompt Commercial Input Purchases Amongst Smallholder Farmers in Diverse Regions and Environments in Malawi?	Makate et al., 2022	Investing in inputs such as agrochemicals, fertilizer, seeds, and labor
66	Living and Responding to Climatic Stresses: Perspectives from Smallholder Farmers in Hanang' District, Tanzania	Maliki et al., 2021	Diversifying crops, using drought-resistant and short-cycle crops
67	Indigenous knowledge systems and drought preparedness in rural Umzingwane in Zimbabwe	Mandiopera et al., 2023	Using Indigenous Knowledge Systems (IKS) strategies including natural observation, traditional storage, farming techniques, and rituals
68	Adoption of sustainable land and water management practices and their impact on crop productivity among smallholder farmers in sub-Saharan Africa	Mangole et al., 2025	Implementing sustainable land and water management (SLWM) practices such as terraces, sandbags, vetiver grass, tree belts, drainable ditches, water harvest bunds, stone bunds, water catchment, afforestation, organic fertilizer, and crop rotations
69	Exploring household water conservation methods in rural South Africa: a case of the Mbhashe and Mquma local municipalities	Mapuka et al., 2024	Storing water, harvesting rooftop rainwater, recycling greywater, limiting water usage, lifestyle changes, diversifying water sources
70	Adapting to changing climatic conditions: perspectives and experiences of women in rural KwaZulu-Natal, South Africa	Masinga et al., 2021	Seeking alternative livelihoods such such as selling forest trees, informal trading, precarious employment, obtaining grants from the government
71	Local knowledge of climate change adaptation strategies from the vhaVenda and baTonga communities living in the Limpopo and Zambezi River Basins, Southern Africa	Matandirotya et al., 2025	Borrowing from relatives, supplementing food with wild fruits, temporarily relocating livestock to greener pastures, selling livestock
72	Drought response impacts on household water use practices in Cape Town, South Africa	Matikinca et al., 2020	Recycling greywater and drastically reducing showering duration in response to city water restrictions

73	Linking Conservation, Community Knowledge, and Adaptation to Extreme Climatic Events: A Case Study in Gorongosa National Park, Mozambique	Matos et al., 2021	Sharing resources, gathering wild forest products for resources, livestock and crop diversification, farming on riverbank, seasonal and circular migration
74	Effectiveness of Pfumvudza as a resilient strategy against drought impacts in rural communities of Zimbabwe	Mavesere et al., 2023	Intensifying agricultural production
75	Factors Correlating with the Ability to Cope with Drought Conditions in the Greater Letaba Local Municipality, South Africa, 2014-2016	Mbombo-Dweba et al., 2024	Introducing supplementary livestock feed before and during drought peaks, altering livestock management practices to reduce costs, using municipal taps for clean water access
76	Impact of Climate Variability and Change Adaptation Strategies on Technical Efficiency of Sorghum Production in Manyoni District, Tanzania	Mbwambo et al., 2023	Planting drought-tolerant crops and early-maturing crops, practicing conservation agriculture, using small-scale irrigation, shifting from cropping to livestock rearing
77	Pathways to adoption and mitigation: A dynamic perspective on good agricultural practices in Rural Malawi	McCarthy et al., 2024	Increasing agricultural productivity through pit planting, water infiltration, organic manure, legume cover crops, compost, grass strips, contour ridges, bench terracing, drainage channels, fertilizer trees, and swales
78	Tackling Water and Waste Management Challenges Within the Tourism and Hospitality Industry: A Sustainable Development Goals Perspective	Mdoda et al., 2024	Water and waste reduction strategies in the hospitality sector including water reserve tanks, water purification, reusing greywater, planting desert plants for conservation-oriented landscaping
79	Adaptation Measures to Drought Risk Perceived by Smallholder Crop Farmers in the Eastern Cape Province, South Africa: Implications for Food and Nutrition Security	Mdoda et al., 2024	Changing planting dates, increasing agricultural inputs, using irrigation, rotating crops, intercropping, soil and water conservation
80	Farmer Preparedness for Building Resilient Agri-Food Systems: Lessons	Mkwambisi et al., 2021	Diversifying crops, integrating livestock into farms, diversifying income through off-farm occupations

	From the 2015/2016 El Niño Drought in Malawi		
81	Factors Influencing Adoption of Ecosystem-Based Adaptation Practices: The Case of Small-Scale Maize Farming in Morogoro Region, Tanzania	Mollel et al., 2024	Using Ecosystem-based Adaptation (Eba) including crop rotations, maize-legume intercropping, and improved seed varieties
82	Climate-smart agricultural practices among rural farmers in Masvingo district of Zimbabwe: perspectives on the mitigation strategies to drought and water scarcity for improved crop production	Mpala et al., 2024	Adopting Climate-Smart Agricultural (CSA) practices including optimal water utilization, early maturing and drought-resistant seeds, soil, potholing, water channelling, and nutrient management practices (NMP)
83	The Contribution of Climate-Smart Agriculture to Reducing Climate-Related Risks to Rain-Fed Maize Production: Insights from Tanzania's Semi-Arid and Sub-Humid Regions	Msongaleli et al., 2023	Diversifying crops, intercropping, changing planting dates
84	Evoking the epistemology of climate governance through indigenous knowledge systems for sustainable development in rural Zimbabwe	Mugambiwa et al., 2021	Using IKS-based irrigation including waterholes and solar boreholes, Indigenous resource management, relying on social networks

85	Adapting to Climate Change in Semi-Arid Rural Areas: A Case of the Limpopo Basin Part of Botswana	Mugari et al., 2020	Using drought-tolerant and early maturing crop varieties, timing cropping sequentially, diversifying with new crops, diversifying geographical areas for planting, supplementary livestock feeding, changing composition of livestock, obtaining grazing rights from authorities, destocking livestock, moving livestock to other geographic areas, purchasing new breeds, obtaining livestock through government or NGO assistance, starting animal rearing or feed lots, selecting improved planting land, increasing cultivated area, using irrigation, altering agrochemical use, relying on seasonal forecasts or drought early warning systems, seeking advice from extension services, harvesting rainwater, using drip irrigation, pumping from rivers, drilling boreholes, earth dams, rehabilitating water points, conserving water sources for dry seasons, started small businesses, hiring out grazing land, producing charcoal and firewood, migrate for other employment, forming committees to protect natural resources, investing in grain storage
86	Smallholder farmers' adaptation strategies to mitigate the effect of drought on maize production in OR Tambo District municipality	Muroyiwa et al., 2022	Shifting planting dates, reducing maize cultivated area, planting drought-resistant varieties, diversifying crops, intercropping
87	Rural Smallholder Maize Farmers' Adaptation and Coping Strategies to Climate Change in Thota-Moli, Maseru District, Lesotho	Muroyiwa et al., 2022	Planting short season crops, planting drought-tolerant maize varieties, shifting planting dates, intercropping, crop rotations, mulching, diversifying crops, diversifying livelihoods
88	Perception of climate change and coping strategies among smallholder irrigators in Zimbabwe	Mwadzingeni et al., 2023	Mulching and residue retention for soil moisture conservation, establishing small-scale reservoirs on farms, trading water, establishing water use priorities, early warning systems, using climate resilient and short season crop varieties
89	A case study of the Handeni District (Tanzania) examining drought coping strategies and risk management among pastoralists based on livestock	Mwakalonge et al., 2022	Migrating to find pastures and water sources, splitting herds

90	Sorghum Production Constraints, Trait Preferences, and Strategies to Combat Drought in Tanzania	Mwamahonje et al., 2021	Shifting planting schedule, planting early maturing sorghum, planting drought-tolerant varieties, contour farming, tied ridging, intercropping
91	A gendered approach to drought-coping mechanisms: A case of the Lubombo region, Eswatini	Myeni et al., 2021	Migration, water management, crop substitutions, selling livestock, seeking odd jobs, securing resources through government and partners
92	Vulnerability and Responses of Smallholder Farmers to Climate Change Effects in Semiarid Areas of Bahi and Kongwa Districts, Tanzania	Myeya et al., 2021	Planting drought-resistant varieties, changing planting dates, practicing intercropping, increasing farm size, out-migrating for labor, changing from cropping to livestock rearing
93	Indigenous Knowledge System and Agricultural Drought Adaptation in the uMkhanyakude District Municipality, KwaZulu-Natal	Mzimela et al., 2024	Harvesting rainwater, using hand-dug wells, recycling domestic water, using bucket irrigation and boreholes, mulching with manure, planting trees to increase soil moisture, diversifying crops, planting short season and drought-resistant varieties, shifting planting calendars, using low cost pest control such as ash and botanicals, livelihood diversification, migrating
94	Factoring water harvesting into climate change adaptation: Endogenous responses by smallholder farmers in Gwanda district, Zimbabwe	Ndlovu et al., 2020	Harvesting rainwater through pit planting, mulching in fields, deep tillage, dead level contours, ephemeral stream diversion, ridges and furrows, and hillside sheet runoff
95	Impact of climate change and variability on traditional farming systems: Farmers' perceptions from south-west, semi-arid Zimbabwe	Ndlovu et al., 2020	Diversifying livelihoods when traditional farming ability is reduced
96	The Occurrence of Drought in Mopani District Municipality, South Africa: Impacts, Vulnerability and Adaptation	Nembilwi et al., 2021	Destocking livestock, shifting from livestock to cropping, using drought-resistant crop varieties
97	Climate shocks, vulnerability, resilience and livelihoods in rural Zambia	Ngoma et al., 2024	Using climate-smart agriculture (CSA) techniques including minimum tillage, hybrid maize seed, and inorganic fertilizer

98	Climate shock response and resilience of smallholder farmers in the drylands of south-eastern Zimbabwe	Nkonya et al., 2023	Diversifying crops, raising livestock, growing short-term crops, intercropping, selling livestock, moving livestock, engaging in nonfarm activities, seeking aid from external sources
99	Climate change and variability perceptions and adaptations of pastoralists' communities in the Maasai Steppe, Tanzania	Nnko et al., 2021	Adapting diets, moving livestock seasonally, receiving livestock donations from family, conserving grazing land for dry season
100	Harnessing of Social Capital as a Determinant for Climate Change Adaptation in Mazungunye Communal Lands in Bikita, Zimbabwe	Nyahunda et al., 2021	Leverage community social capital through collective labor, chief-coordinated communal granaries, destocking or lending livestock
101	Climate-smart agricultural practices, productivity, and food-nutrition security in rural South Africa: A dataset of smallholder maize farmers	Omotoso et al., 2024	Adopting Climate-Smart Agricultural (CSA) practices including drought-tolerant maize varieties, mulching, mixed cropping, zero tillage, planting cover crops, and irrigation
102	Adoption of climate-smart agricultural practices and their influence on the technical efficiency of maize production under extreme weather events	Pangapanga-Phiri et al., 2021	Applying organic manure, combining organic and inorganic fertilizers, soil and water conservation (SWC), planting improved maize varieties, intercropping with legumes
103	Climate change and water insecurity in rural uMkhanyakude District Municipality: an assessment of coping strategies for rural South Africa	Patrick et al., 2021	Communal payment for water tanker delivery, purchasing diesel to power borehole machine in combination with manual labor, rationing water, following community code of conduct for water allocation, collective work on rivers and dams, purchasing water from vendors, using rooftop canals to collect rainwater, traveling longer distances on foot to source water, reusing water for non-drinking purposes

104	Smallholder farmer coping and adaptation strategies for agricultural water use during drought periods in the Overberg and West Coast Districts, Western Cape, South Africa	Pili et al., 2022	Storing fodder, installing water tanks to harvest rainwater, moving livestock to secure areas, reducing herd size, practicing conservation farming, drilling boreholes, clearing alien vegetation, reducing production of crops with high water demand
105	Resilient health systems in action: How actor relationships and organizational adaptation shaped the health sector's response to the 2015–2018 Western Cape drought	Quintana et al., 2025	Procuring water tanks, fixing hospital pipes, relying on strong relationships, good communication, and shared values among health workers and decision-makers during drought
106	Understanding climate-risk coping strategies among farm households: Evidence from five countries in Eastern and Southern Africa	Rahut et al., 2021	Changing farming practices, using savings, borrowing money, reducing consumption, seeking alternative employment
107	The impact of the 2014–2016 drought in Greater Letaba Local Municipality: How the farmers coped and factors that were significantly associated with loss of animals	Rakgwale et al., 2020	Reducing herd, buying supplementary livestock feed, drilling boreholes, using aid from government agencies
108	Towards Hazard-Resilience Cities: Comparative Research on Resilience-related Policies and Local Practices in Five Cities Worldwide	Ran et al., 2024	Investing in groundwater resources and wastewater recycling to supplement surface water resources, using multifunctional blue-green infrastructure, using digital tools, incorporating social-ecological values into investments, updating emergency disaster response protocols and protection, ecological restoration, environmental management, increasing disaster relief infrastructure
109	Climate change impacts on water resources in a rural community in Limpopo province, South Africa: a community-based adaptation to water insecurity	Rankoana et al., 2020	Restricting community water use, enforcing regulations through a water committee, collecting water from neighboring villages when local resources are insufficient

110	Food security under unreliable rainfall: the case study of a rural community in Limpopo Province, South Africa	Rankoana et al., 2020	Using geothermal hot spring water flow to improve subsistence crop production
111	Indigenous knowledge and innovative practices to cope with impacts of climate change on small-scale farming in Limpopo Province, South Africa	Rankoana et al., 2022	Using rainfall prediction techniques, fertilizing soil with biomass and char, changing planting season, increasing crop weeding, crop diversification.
112	“Burnt by the scorching sun”: climate-induced livelihood transformations, reproductive health, and fertility trajectories in drought-affected communities of Zambia	Rosen et al., 2021	Alternative income sources and employment, migration and relocation, planting early-maturing crops, tilling land quickly, planting immediately after rainfall, diversifying seeds
113	Neighbourhood responses to drought in the Western Cape	Rule et al., 2020	Reducing water use in households and businesses through shorter showering, grey water reuse, reducing laundry and cleaning, storing water, installing tanks or boreholes, using non-municipal water sources, restricting water at the municipal level, establishing distribution points, implementing tariffs, and disseminating information through awareness campaigns
114	Enabling acceptance and use of ecological intensification options through engaging smallholder farmers in semi-arid rural Limpopo and Eastern Cape, South Africa	Rusere et al., 2020	Ecological intensification strategies including intercropping, polycultures, crop rotations, field sanitation, planting extracts, predatory insects, land fallowing, planting legumes, fertilizing with manure and compost, mulching, harvesting rainwater and rooftop water, and agroforestry
115	The economic viability analysis on the Adopted Climate Change Adaptation Strategies among Maize Farmers in semi-arid of central Tanzania	Said et al., 2023	Intercropping and delaying planting schedule
116	Overcoming Namibia’s worst drought in the last 40 years: Ethnographic insights from Okakarara constituency	Schwieger et al., 2023	Purchasing inputs, collecting leaves and seeds in veld, relocating herds, using resources including state benefits and remittances, income diversification

117	Exploring the Adoption and Impact of Conservation Agriculture among Smallholder Farmers in Semi-Arid Areas: Evidence from Chamwino District, Tanzania	Selya et al., 2023	Using conservation agriculture technologies and practices (nonspecified)
118	Perceived Effective Adaptation Strategies against Climate Change Impacts: Perspectives of Maize Growers in the Southern Highlands of Tanzania	Shabani et al., 2022	Planting improved maize varieties, planting drought tolerant crops, changing planting dates, crop rotations
119	Enhancing the Resilience and Adaptive Capacity of Smallholder Farmers to Drought in the Limpopo Province, South Africa	Shikwamban a et al., 2022	Planting early-maturing and drought-resistant crops, changing planting dates, diversifying crops, using irrigation, pursuing non-farming activities
120	Assessing the Effectiveness of Resilience Strategies Adopted by Female-Headed Households During Drought-Induced Challenges in Zimbabwe	Siambale et al., 2025	Livelihood diversification through casual labor, small-scale trading, backyard gardening
121	Opportunities and Challenges Experienced by Smallholder Farmers in Using Climate Smart Agriculture to Adapt to Climate Variability and Change in Kilosa District, Tanzania	Silas et al., 2022	Implementing Climate Smart Agriculture (CSA) strategies including soil management, adoption of drought-resistant crops, improved water management, and crop management practices
122	Constraints Inhibiting Farmers' Adoption of Cattle Feedlots as a Climate-Smart Practice in Rural Communities of the Eastern Cape, South Africa: An In-Depth Examination	Slayi et al., 2023	Adopting cattle feedlots for resource efficiency in livestock farming
123	Drought coping strategies by smallholder cattle farmers in Zimbabwe	Soul et al., 2022	Destocking livestock, supplementary feeding, lease grazing
124	Farmers' perceptions of climate change and adaptation strategies in South Africa's Western Cape	Talanow et al., 2021	Changing planting and harvest time, crop rotations, implementing water conservation techniques

125	What explains the gender differences in the adoption of multiple maize varieties? Empirical evidence from Uganda and Tanzania	Teklewold et al., 2020	Integrating-drought tolerant maize varieties alongside consumer preferred varieties
126	Place-based perceptions, resilience and adaptation to climate change by smallholder farmers in rural South Africa	Tesfahuney et al., 2020	Changing planting dates, adopting short maturing and drought-tolerant cultivars, shifting to animal husbandry, building livestock shelter, increasing water storage
127	Understanding the relevance of indigenous knowledge on climate change adaptation among mixed farmers in the Ngono River Basin, Tanzania	Theobald Frank Theodory et al., 2021	Farming and grazing in wetlands during drought, planting drought-resistant crops, using local pesticides
128	Exploring farmers' perceptions and lessons learned from the 2015–2018 drought in the Western Cape, South Africa	Theron et al., 2022	Implementing irrigation, recycling water, planting improved crop varieties, practicing conservation agriculture, relying on weather forecasts and past experience of drought to prepare for the future
129	Agricultural resilience and adaptive capacity during severe drought in the Western Cape, South Africa	Theron et al., 2023	Developing farm water budgets, saving water with drip irrigation and nets, sourcing water with boreholes
130	Youth Resilience to Drought: Learning from a Group of South African Adolescents	Theron et al., 2020	Reducing water use, shutting taps off, sharing bathwater, storing water in drums or tanks, adjusting diet and exercise, relying on faith, peers, and family for support
131	What matters in adoption of small-scale rain water harvesting technologies at household level? Evidence from Charco-dam users in Nzega, Tanzania	Timothy et al., 2022	Adopting charco-dam technology

132	The interplay of Christianity and Ndau African traditional religion in shaping climate change adaptation in Zimbabwe: An Afrocentric analysis	Tirivangasi et al., 2024	Drawing from religious ceremonies and rituals to cope with effects of drought
133	Local Government and Climate Change: How Are Rural Local Municipalities in Limpopo Province Coping With the Effects of Climate Change?	Tshamano et al., 2021	Implementing climate change policy, Integrated Development Plans (IDPs), and environmental awareness campaigns
134	Analysis of adoption of conservation agriculture practices in southern Africa: mixed-methods approach	Tufa et al., 2023	Adoption of conservation agriculture (CA) practices including improved crop varieties, planting basins, zero tillage, mulching, crop rotations, intercropping, and hosting demonstration plots
135	Community-based water tenure in equitable and transformative drought resilience	van Koppen et al., 2024	Installing a solar-powered borehole, creating a local governmental framework for climate governance, establishing small water systems, building a megadam
136	An Assessment of the 2015–2017 Drought in Windhoek	van Rensburg et al., 2021	Pumping alternative sources of drinking water, using aquifer for emergency water supply, implementing mandatory water use reductions, social pressure and public campaigning against excessive water consumption
137	Guest Houses, Drought and Water Management Strategies in the Cape Winelands, South Africa	Visser et al., 2021	Posting water saving notices in guest houses to encourage tourists to reduce consumption, increasing municipal water tariffs to incentivize lower use, transporting water from neighboring farms to guest houses, drilling boreholes for non-potable water, recycling water
138	Saving water at Cape Town schools by using smart metering and behavioral change	Visser et al., 2021	Implementing behavioral interventions to encourage responsible water usage, restricting water to 50 litres per household per day, increasing water pricing, drilling boreholes, storing rainwater in tanks, managing water pressure of taps, preventing leaks, using water metering

139 Climate change risks and adaptation options for Madagascar Weiskopf et al., 2021 Collecting rainwater, managing planting schedules, using conservation agriculture and the System of Rice Intensification (SRI), afforestation with native species, promoting sustainable agriculture at the organizational level

140 Better Agronomic Management Increases Climate Resilience of Maize to Drought in Tanzania Xiong et al., 2020 Using improved crop varieties and adding fertilizer to production strategy

141 The role of indigenous knowledge and local knowledge in water sector adaptation to climate change in Africa: a structured assessment Zvobgo et al., 2022 Harvesting rainwater, using irrigation, implementing agroforestry

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686 SM2. Search strategy.

Population	Exposure	Comparison	Timeframe	Database
TS=(angola or botswana or eswatini or lesotho or malawi or mozambique or namibia or "south* africa*" or zambia or zimbabwe or swaziland or "Democratic Republic of Congo" or DRC or "DR Congo" or Madagascar or Tanzania or Comoros or Mauritius or Seychelles or "Southern African Development Community" or SADC)	((TS=(drought* or "dry spell*" or arid*)) OR TS=((low* or reduc* or minimal*) NEAR/2 rain*)) OR TS=(scarc* NEAR/2 (water* or rain*))	TS=((adapt* or adopt* or coping or cope* or respons* or intervent* or resil* or anticipat* or action* or alleviat* or mitigat* or strat*) NEAR/5 (drought* or "dry spell*" or arid* or water* or rain*))	(PY==( "2025" OR "2024" OR "2023" OR "2022" OR "2021" OR "2020") AND DT==( "ARTICLE" OR "EARLY ACCESS" OR "DATA PAPER"))	Web of Science

<p>(angola or botswana or eswatini or lesotho or malawi or mozambique or namibia or "south* africa*" or zambia or zimbabwe or swaziland or "Democratic Republic of Congo" or DR Congo" or Madagascar or Tanzania or Comoros or Mauritius or Seychelles or "Southern African Development Community" or SADC).ti,ab. or exp southern africa/ or exp sadc countries/</p>	<p>((drought* or "dry spell*" or arid*).ti,ab. or (drought/ or arid climate/ or dry conditions/ or dry season/) or (((low* or reduc* or minimal*) adj2 rain*) or (scarc* adj2 (water* or rain*))).ti,ab.</p>	<p>((adapt* or adopt* or coping or cope* or respons* or intervent* or resil* or anticipat* or action* or alleviat* or mitigat* or strat*) adj5 (drought* or "dry spell*" or arid* or water* or rain*).ti,ab. or (adaptation or adaptability or sustainability or coping strategies).sh.</p>	<p>(english language and yr="2020 - 2025")</p>	<p>CABI</p>
<p>TI ( angola or botswana or eswatini or lesotho or malawi or mozambique or namibia or "south* africa*" or zambia or zimbabwe or swaziland ) OR AB ( angola or botswana or eswatini or lesotho or malawi or mozambique or namibia or "south* africa*" or zambia or zimbabwe or swaziland ) OR TI ( "Democratic Republic of Congo" or DR Congo" or Madagascar or Tanzania or Comoros or Mauritius or Seychelles or "Southern African Development Community" or SADC ) OR AB ( "Democratic Republic of Congo" or DR Congo" or Madagascar or Tanzania or Comoros or Mauritius or Seychelles or "Southern African Development Community" or SADC )</p>	<p>TI ( drought* or "dry spell*" or arid* ) OR AB ( drought* or "dry spell*" or arid* ) OR TI ( (low* or reduc* or minimal*) N2 rain* ) OR AB ( (low* or reduc* or minimal*) N2 rain* ) OR TI ( scarc* N2 (water* or rain*) ) OR AB ( scarc* N2 (water* or rain*) )</p>	<p>TI ( (adapt* or adopt* or coping or cope* or respons* or intervent* or resil* or anticipat* or action* or alleviat* or mitigat* or strat*) N5 (drought* or "dry spell*" or arid* or water* or rain*) ) OR AB ( (adapt* or adopt* or coping or cope* or respons* or intervent* or resil* or anticipat* or action* or alleviat* or mitigat* or strat*) N5 (drought* or "dry spell*" or arid* or water* or rain*) )</p>	<p>Limiters - Publication Year: 2020-2025; Language: English</p>	<p>Africa-Wide Information</p>
<p>TITLE-ABS-KEY ( angola OR botswana OR eswatini OR lesotho OR malawi OR mozambique OR namibia OR "south*africa*" OR zambia OR zimbabwe OR swaziland OR "Democratic Republic of Congo" OR drc OR "DR Congo" OR madagascar OR tanzania OR comoros OR mauritius OR seychelles OR "Southern African Development Community" OR sadc )</p>	<p>(TITLE-ABS-KEY ( drought* OR "dry spell*" OR arid* ) OR TITLE-ABS-KEY ( ( low* OR reduc* OR minimal* ) W/2 rain* ) OR TITLE-ABS-KEY ( scarc* W/2 ( water* OR rain* ) ) )</p>	<p>TITLE-ABS-KEY (( adapt* OR adopt* OR coping OR cope* OR respons* OR intervent* OR resil* OR anticipat* OR action* OR alleviat* OR mitigat* OR strat* ) W/5 ( drought* OR "dry spell*" OR arid* OR water* OR rain* ) )</p>	<p>(LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "cp" ) OR LIMIT-TO ( DOCTYPE , "dp" ) ) AND ( LIMIT-TO ( PUBYEAR , 2020 ) OR LIMIT-TO ( PUBYEAR , 2021 ) OR LIMIT-TO ( PUBYEAR , 2022 ) OR LIMIT-TO ( PUBYEAR , 2023 ) OR LIMIT-TO ( PUBYEAR , 2024 ) OR LIMIT-TO ( PUBYEAR , 2025 ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )</p>	<p>Scopus</p>

(angola or botswana or eswatini or lesotho or malawi or mozambique or namibia or "south* africa*" or zambia or zimbabwe or swaziland or "Democratic Republic of Congo" or DRC or "DR Congo" or Madagascar or Tanzania or Comoros or Mauritius or Seychelles or "Southern African Development Community" or SADC).ti,ab. or exp Africa, Southern/	(drought* or "dry spell*" or arid* or ((low* or reduc* or minimal*) adj2 rain*) or (scarc* adj2 (water* or rain*))).ti,ab. or exp Droughts/ or exp Desert Climate/	((adapt* or adopt* or coping or cope* or respons* or intervent* or resil* or anticipat* or action* or alleviat* or mitigat* or strat*) adj5 (drought* or "dry spell*" or arid* or water* or rain*)).ti,ab. or exp "Conservation of Natural Resources"/	(english language and yr="2020 -Current")	Ovid MEDLINE(R) ALL
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Note: this search was completed in May 2025 and only includes papers up to that date.

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### SM3. Data extraction guidance

Question	Definitions and Clarifications
What is the adaptation described in the document?	Describe the component of the paper that empirically describes a response in human systems or human-assisted responses in natural systems
Which sectors or systems are relevant to this document?	See table 2.
Are any incentive mechanisms to motivate change at the household, community, or civil society-driven level described?	Look for any strategies that encourage or reward behavior change such as subsidies, recognition programs, or community competitions. These mechanisms should aim to motivate action on adaptation or resilience, particularly among households, communities, or civil society groups.
What aspects of transformational adaptation are present?	Shifts in values, worldviews, or adaptation goals: from economic growth to wellbeing, from control to co-existence with nature; Change in governance structures or decision-making processes: increased local agency, participatory planning, decentralization; Reconfiguration of institutions or rules: new land tenure systems, changes in resource rights or customary law; Changes in power dynamics or social relations: increased equity, empowerment of marginalized groups, reduced dependency; Structural or systemic changes: moving away from maladaptive development paths, large-scale relocation, alternative economies; Transformation of livelihoods or economic systems: diversification away from climate-sensitive livelihoods, regenerative agriculture; Innovation in knowledge systems or learning processes: integration of ILK and science, transdisciplinary collaboration, reflexive learning; Long-term, irreversible changes in system function or structure: ecosystem restoration with new ecological baselines, permanent land use changes); No aspects of transformation present
Is the duration or	Check whether the text discusses how long-lasting the adaptation is or whether its

sustainability of impact of the adaptation assessed?	realized benefits continue over time. This could include mention of long-term outcomes, maintenance plans, lasting behavior change, or institutional sustainability.
Is there any evidence (implicitly or explicitly) provided that demonstrates activities successfully reduced risk or vulnerability?	The change must be documented to respond 'yes' for this question. Anticipated or expected reduction is not sufficient for this question. Note that these don't need to be quantitative, but could involve theory of change, narrative justifications of change, or other.
Are indicators of progress or success identified either implicitly or explicitly?	Look for any measures, signs, or criteria used to show whether the adaptation is working or making progress—these could be explicit indicators or implied outcomes.
Are risks or maladaptations associated with the response considered (implicitly or explicitly)?	Look for any mention of risks, negative side effects, or maladaptations linked to the response—whether stated directly or implied.
Does the paper identify or describe constraints or limits to adaptation?	Constraints are defined as: “factors that make it harder to plan and implement adaptation actions.”
Is there evidence to indicate whether responses approach, challenge, or exceed constraints/limits?	Note whether the response approaches a constraint (gets close), challenges it (tries to overcome), or exceeds it (cannot adapt further).
Are specific barriers or enablers to overcoming limits identified?	Look for factors that help or hinder the ability to overcome adaptation limits. Barriers might include lack of funding, knowledge, coordination, or political will. Enablers could be strong institutions, community engagement, leadership, or external support.

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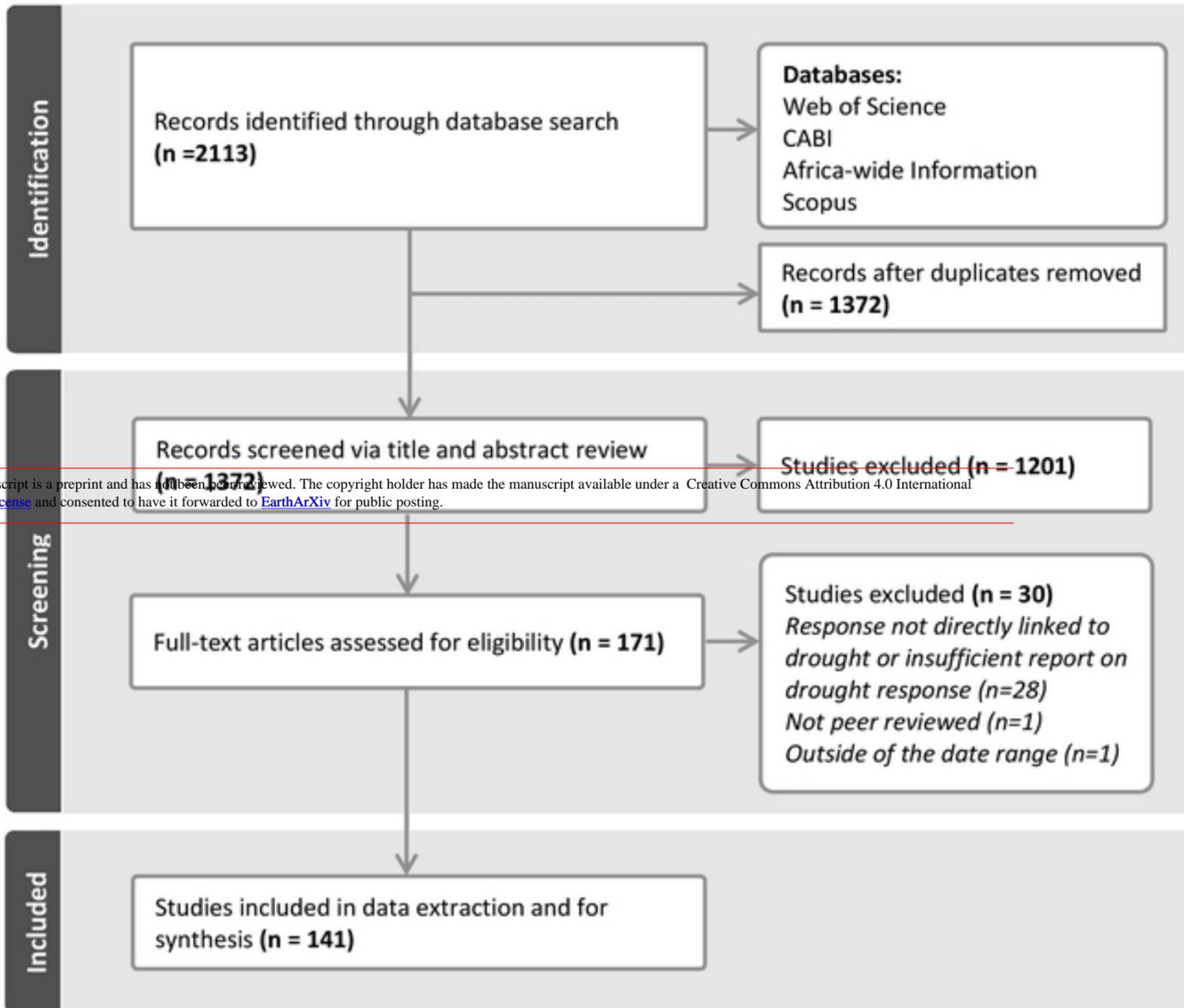
690 SM4. Shading template for overall graphic

Theme	Primary SDG Goal	Colour
Agriculture, Food, Forestry, Fiber, Fisheries	Zero Hunger	
Water	Clean Water and Sanitation	
Poverty, Livelihoods, Mobility, Fragility	No Poverty	
Human Settlements, Infrastructure, Industry	Sustainable Cities & Communities	
Health and Well-being	Good Health and Well-Being	
Ecosystems	Life on Land	



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Graphic by WorldShare



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Figure 1