Institutional adaptation to drought: The case of Fars Agricultural Organization

Article *in* Journal of Environmental Management · May 2013

DOI: 10.1016/j.jenvman.2013.04.032 · Source: PubMed

2 authors:

Marzieh Keshavarz
Payame Noor University
14 PUBLICATIONS **98** CITATIONS
SEE PROFILE

Ezatollah Karami
Shiraz University
60 PUBLICATIONS **604** CITATIONS
SEE PROFILE

Journal of Environmental Management 127 (2013) 61–68

Contents lists available at SciVerse ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Institutional adaptation to drought: The case of Fars Agricultural Organization

Marzieh Keshavarz*, Ezatollah Karami

College of Agriculture, Shiraz University, Shiraz, Iran

ARTICLE INFO

Article history:
Received 31 August 2012
Received in revised form
18 February 2013
Accepted 11 April 2013
Available online

Keywords:
Drought
Adaptation
Organizational capabilities
Organizational capacity
Performance
Iran

ABSTRACT

Recurrent droughts in arid and semi-arid regions are already rendering agricultural production, mainstay of subsistence livelihoods, uncertain. In order to mitigate the impact of drought, agricultural organizations must increase their capacity to adapt. Institutional adaptation refers to the creation of an effective, long-term government institution or set of institutions in charge of planning and policy, and its capacity to develop, revise, and execute drought policies. Using the Fars Agricultural Organization in Iran, as a case study, this paper explores the institutional capacities and capabilities, necessary to adapt to the drought conditions. The STAIR model was used as a conceptual tool, and the Bayesian network and Partial Least Squares (PLS) path modeling was applied to explain the mechanisms by which organizational capacities influence drought management. A survey of 309 randomly selected managers and specialists indicated serious weaknesses in the ability of the organization to apply adaptation strategies effectively. Analysis of the causal models illustrated that *organizational culture* and *resources and infrastructure* significantly influenced drought management performance. Moreover, managers and specialists perceived *human resources* and *strategy, goals, and action plan*, respectively, as the main drivers of institutional adaptation to drought conditions. Recommendations and implications for drought management policy are offered to increase organizational adaptation to drought and reduce the subsequent sufferings.

1. Introduction

Drought is occurring more frequently in arid and semi-arid regions of the world; global climate change is also increasing both its extent and intensity (IPCC, 2010). Critical features of drought and its impact on resource-dependent sectors, such as agriculture, raise concern about meeting the demands for water and food (Karami and Keshavarz, 2009). Appropriate drought management policies are needed to alleviate negative consequences (O'Brien et al., 2006) and increase the capacity of varying societies to adapt successfully (Næss et al., 2005). Rural communities and organizations, embedded in the natural environment (Starik and Rands, 1995), must learn how to increase their capacity to adapt to drought conditions. However, the covariate nature and frequency of droughts (Keshavarz et al., 2013) make efficient management difficult. Human suffering, natural resources degradation, and shortages of credit force organizations to act more responsibly in reducing the drought vulnerability, and managing the impact of the drought on rural societies. A comprehensive, adaptive system is therefore imperative (Comfort and Kapucu, 2004) to respond to the pressures and develop mechanisms for reducing negative consequences. Meeting such challenges requires increased and proactive organizational performance (Holbeche, 2006). Organizations must avoid focusing narrowly on drought management outputs and pay more attention to the operating processes (Wilbanks, 2002) at different levels.

This study examines the capacity and performance of the Fars Agricultural Organization in Iran, during drought and the variables that affected the organization performance. First, it explains the dynamic context of drought and its impact on organizations. After that, it addresses the need for proactive organizational adaptation and proposes a framework. The focus then shifts to the study design followed by an analysis of results and concluding remarks.

1.1. The changing context of drought and its impact on organizations

Since organizations are embedded within the global ecosystem, they are affected by changes in the natural environment (Winn and Kirchgeorg, 2005). Their survival depends on their compatibility in response to these changes (Druckman et al., 1997). Organizations that do not adapt adequately cannot perform effectively or maintain their legitimacy or the resources they need to survive.

* Corresponding author. Present address: Department of Agriculture, Payame Noor University, Iran. Tel.: +98 9177077446.
E-mail addresses: keshavarzmarzieh@pnu.ac.ir, keshavarzmarzieh@gmail.com (M. Keshavarz), ekarami@shirazu.ac.ir (E. Karami).

0301-4797/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.jenvman.2013.04.032

Unfortunately, mobilizing effectively in response to extreme events like drought is one of the least understood public management problems (Comfort and Kapucu, 2004). Adaptation to drought requires pre drought planning to anticipate the spread of risk through communities (Wilhite and Svoboda, 2000) and devise actions that will limit it (Comfort and Kapucu, 2004) but many governments apply a traditional, reactive approach that relies on crisis management (Wilhite and Vanyarkho, 2000).

For many years, policymakers and administrators assumed drought as an "act of God" (Quarantelli, 2005) or a rare occurrence that did not require preparation (Kartez and Kelly, 1988). However, managing drought as a crisis has resulted in decreases in surface and groundwater resources (Wilhite et al., 2007), loss of productivity (Riebsame et al., 1991) and increase of hunger (Speranza et al., 2008). It also has long-term environmental, socioeconomic, and health impacts on the population (Dey et al., 2011; Keshavarz et al., 2013). Recent changes in the natural environment increases the need for a comprehensive understanding of the magnitude, complexity (Wilhite and Pulwarty, 2005), and nonstructural nature of the drought (Campbell et al., 2010), which differ significantly from general organizational assumptions.

As many public organizations fail to respond to drought promptly and efficiently, rethinking on its management at all levels is essential. However, in the developing countries, more emphasis has been put at the national than the local level (Karami, 2009; Keshavarz, 2012). As drought impacts vary on both spatial and temporal scales (Wilhite et al., 2007), local ability to manage the recurring droughts differs (Keshavarz et al., 2010, 2013). The challenge facing the policymakers is how to design and support the regional and local government systems that can adapt to the drought complex operating conditions (Comfort and Kapucu, 2004).

1.2. Need for proactive organizational adaptation to drought

While various studies have documented the failure of organizations to act during drought (e.g., Salami et al., 2009; Wilhite and Vanyarkho, 2000), none systematically determines how to design organizations which perform efficiently under risk conditions (Comfort and Kapucu, 2004). Organizations can reduce vulnerability by acquiring knowledge about environmental hazards, adapting their structures and processes, and implementing adequate strategies. They must develop capabilities to proactively manage disruptions in the natural environment, but few studies have examined what these capabilities should be (Busch, 2011). To avoid the negative consequences of drought, some authors (e.g., Hijmans, 2003; Hosseini et al., 2009; Keshavarz et al., 2011; Salami et al., 2009) suggest investing more in water reservoir projects and water-saving technology, promoting drought-resistant crops, increasing insurance coverage, providing drought management information, and targeting governmental support. These sector-focused studies proposed various strategies to improve organizational capabilities for adapting to drought; chief among them is the steady functioning of the organizations. Achieving reliable functions is dependent on enhancing our understanding about the non-linear dependencies among sub-systems and the many ways they may self-organize and co-evolve in a constantly changing environment (e.g. Beer, 2009; Siemieniuch and Sinclair, 2008). Zeppou and Sotirakou (2004) argue that successful achievement of a determined mission depends on the organization's ability to consider strategy, targets, structure, processes, human resources, infrastructure, and their interconnections. Therefore, organizational adaptation to drought must not be limited to improving drought management strategies but the compatibility of sub-systems with the dynamic environment (Fig. 1) should also be enhanced. Based on this theory, the paper also derives a set of organizational capabilities for adapting to drought.

2. Materials and methods

2.1. Study area

The study was conducted in Fars province, southwest Iran, one of the country's leading agricultural regions, ranked first in wheat production. Fars has experienced several severe droughts between 2003 and 2011. In 2011, when the data for this study were collected, Fars was confronting groundwater degradation and water scarcity. Many internationally renowned lakes – *Kaftar*, *Bakhtegan*, *Arjan*, and *Tashk* – completely dried up, and in all other wetlands and rivers, water levels recessed to critical levels. Based on a report of the Fars Agricultural Organization (*Jihad-e-Keshavarzi*), drought has directly affected more than 9 million hectares of irrigated farms, rain-fed agriculture, and natural resources.

2.2. Sampling

The Fars Agricultural Organization was studied for two reasons. First, it plays a leading role during normal and drought conditions in addressing the rural people's needs and providing a range of highly diverse technical and nontechnical services to rural communities. Second, its drought budget revenue has risen 13-fold during the last five years.

Fig. 1. Drivers of organizational adaptation to drought.

Table 1
Study variables.

Variable	Definition	No. of items	Cronbach's alpha coefficient
Strategies, goals, and action plans	Strategies are actions and resource allocations necessary to carry out the previously determined basic long-term goals and objectives of an enterprise (Chandler, 1990). Goals are non-quantitative statements of general intent, aim, or desire; the endpoints toward which management directs its efforts and resources (Cartin, 1999). Action plans are tasks or steps in a sequence designed to achieve an objective or goal (Marquardt, 2002).	10	0.93
Environmental factors	Political, economic, legal, technological, and social dimensions that shape organizations' interactions with the environment by providing resources necessary to achieve objectives (Vasu et al., 1998).	12	0.94
Transformational leadership	Transformational leaders help followers grow and develop into leaders by responding to their individual needs, empowering them, and aligning the objectives and goals of the individual followers, the leader, the group, and the larger organization (Bass and Riggio, 2006).	16	0.97
Structure and process	Organizational structure determines how and to what extent roles, power, and responsibilities are delegated, controlled, and coordinated and how information flows among levels of management (Vasu et al., 1998). Process is the policies, procedures, and rules that define how things get done inside organizations - how plans are made, goals are set, priorities are established, funds are distributed, people are hired, products are developed, money is spent, communications take place, decisions are made, problems are solved, finances are managed, and people are rewarded (Marquardt, 2002).	17	0.95
Resources and infrastructure	Infrastructure is the people-side of the organization. It establishes roles, responsibilities, authority, focus, and controls and determines the level of innovation, creativity, responsiveness, or bureaucracy (Vasu et al., 1998).	13	0.94
Human resource management	Human resource management concerns the administrative aspects of acquiring, using, improving, and retaining the organization's employees (Nicholson et al., 1998).	12	0.94
Organizational culture	Organizational culture can be viewed as a pattern of shared values and beliefs that help members understand overall functioning and behavioral norms in the organization (Dwyer et al., 2003).	9	0.95
Drought management strategies	Technical and nontechnical strategies may be used to manage risks and alleviate negative consequences of this extreme hazard.	19	0.95

A multistage, stratified random sampling technique was used to select a sample of agricultural specialists and managers from Fars Agricultural Organization who had been involved in drought management for at least three years and had background knowledge concerning the province's planning and implementation duties. The sample size ($n = 309$) was determined based on a formula suggested by Scheaffer et al. (1979). Initially, the counties were classified into four strata (cold and arid, hot/moderate and arid, cold and semi-arid/humid, moderate and semi-arid) using a climatological map of Fars. A proportional sample was then randomly selected from each climatic strata. In each randomly selected county, a random sample of specialists and managers were chosen. The number of respondents in each county depended on the total number of officers who were often involved in drought management.

2.3. Survey instrument

A self-administered mail questionnaire was developed for the survey. Its face validity was approved by a panel of experts, and a pilot study, involving 30 agricultural specialists and managers who met all the selection criteria for the study sample, was conducted in Bushehr province to evaluate the instrument. No earlier attempts had been made to measure organizational capabilities for adaptation to drought; therefore, the study considered theories about Organizational Environment, Human Resources, Transformational Leadership (Bass and Riggio, 2006), and five competitive forces – rivals, customers, suppliers, potential entrants, and substitute products (Porter, 2008). Table 1 defines study variables and their Cronbach's alpha[1] reliability coefficient. For each measure of organizational capability, a five-point Likert-type scale, ranging from 0 = never use to 4 = always use, rated respondents' attitudes about applying the variable in drought management planning. How important they deemed different technical and nontechnical drought management strategies was measured by a five-point Likert-type scale ranging from 0 = of no importance, to 4 = very important.

2.4. Construction of an empirical model of institutional adaptation to drought

Organizations that are products and producers at the same time are complex (Le Coze, 2008), and the interrelated structures and processes of organizations embedded in the natural environment are subject to constant change. This complexity leads to unexpected, emerging patterns where causality is not easy to be determined. Moreover, lack of background knowledge and theory on drivers of adaptation to drought make determining causal directions difficult.

To solve these problems, the methodology proposed by Wu (2010) was adopted. This method links the Bayesian network and Partial Least Squares (PLS) path modeling for causal analysis. The Bayesian network is a causal map based on probability theory (Nadkarni and Shenoy, 2001). It represents a set of conditional independence constraints among a given number of variables and their related conditional probability distributions as a directed acyclic graph (DAG; Lauria and Duchessi, 2007). The PLS path modeling is one of main structural equation modeling (SEM) approaches for exposing the relationships between latent variables (Tenenhaus et al., 2005). In comparison to other SEM approaches, like Linear Structural RELations (LISREL), PLS path modeling is better suited to complex (Hulland, 1999) or exploratory models (Ranganathan and Sethi, 2002). Therefore, in the present study where no rigorous theoretical grounding existed, the PLS path modeling seemed to be more applicable.

In the first step, the 'WEKA[2]' software was used to obtain a DAG through Bayesian network classifier (Wu, 2010). To heuristically

[1] Cronbach's alpha is a measure of reliability. More specifically, alpha is a lower bound for the true reliability of the instrument, and its computation is based on the number of survey items and the ratio of the average inter-item covariance to the average item variance (Thompson, 2003).

[2] WEKA is a package which incorporates a large number of machine learning algorithms for data mining tasks.

search the Bayesian network space, it was necessary to employ a search method such as simulated annealing algorithm, genetic algorithm, or tree augmented Naïve Bayes (TAN). Among these algorithms, the TAN was adopted that produces a causal–effect graph in which the class attribute is treated as the supreme parent node. The class attribute is the *drought management* in our study that is located at the top in the DAG. As a result, the causal relationships diagram (Fig. 2) is obtained. From Fig. 2, it is apparent that *leadership* is the most important factor because it plays a core role, affecting *structures and processes* and *human resource management*. However, it does not directly affect *strategies, goals, and action plans*; *resources and infrastructure*, *organizational culture*, and *environmental factors*.

After setting up the causal diagram, the psychometric properties of the measures (consistency reliability, and convergent and discriminant validity) for the latent constructs were evaluated through confirmatory factor analysis (Chin, 1998). Because the independent and dependent attributes are measured, using one item, both the composite reliability and convergent validity values for each attribute were acceptable. The PLS path modeling was then implemented with the SmartPLS software. The PLS structural models were assessed by examining path coefficients and their significance levels. Chin's (1998) bootstrapping procedure – 1000 samples of the same size as the original, with replacement – was performed to obtain estimates of standard errors for testing the statistical significance of path coefficients using *t*-tests.

3. Results and discussion

3.1. Institutional adaptation to drought

Fars Agricultural Organization policymakers have developed very diverse strategies aimed at helping the rural communities to adapt to drought, but the current drought (2003–2011), the worst since 1981, presented unexpected challenges. Although the surveyed managers and specialists considered the strategies important, the study revealed significant weaknesses in the organization's ability to apply them effectively.

As Table 2 shows, adaptation policy is context-specific, i.e. the drought management policy particularly concerns strategies that are directly or indirectly related to water issues. Such strategies are technical support for irrigation plans including infrastructural modernization, incentives and information dissemination through extension systems in order to promote conservation, and leveling lands to use water properly and reduce the pressure on water resources. The policy also emphasizes drought relief programs and emergency response systems. However, governmental drought assistance was found to have serious administrative and logistic shortcomings in relation to provision of funds, due to problems associated with determining the eligibility of the affected individuals to receive subsidized low-interest loans.

On the other hand, managers and specialists who prefer to manage drought through structural adjustments such as promoting farm management technologies, changing crop patterns, consolidating land, and developing farm programs, are concerned that welfare programs developed in response to the negative consequences of drought undermine their objectives. They believe that conservation of critical resources and systems on which communities depend is not considered adequately and that greater attention should be paid to introducing proper risk-management techniques. This approach would balance prevention, mitigation, preparedness, response, and recovery. However, according to Table 2, the Fars Agricultural Organization does not have the capacity to provide information and support services to persuade people in taking actions to minimize the potential drought damages. It lacks a comprehensive drought management plan, including an effective early warning system and preparedness schemes; an efficient system for continuous assessment of drought impacts and dissemination of accurate information to reduce vulnerability; and while different drought assistance schemes are

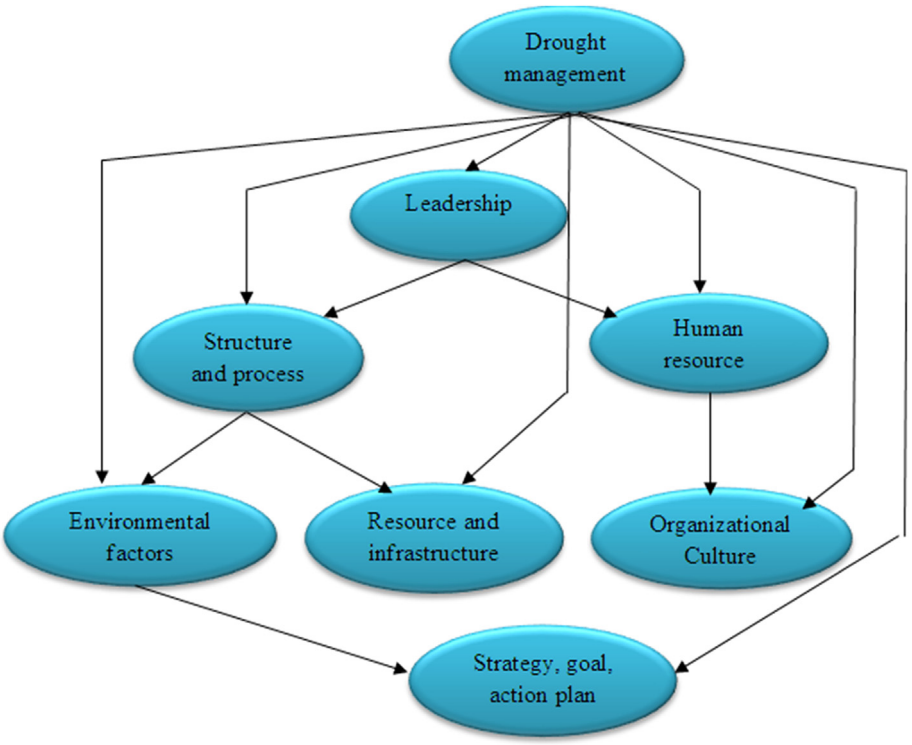

Fig. 2. Causal relationships among institutional drought management variables.

Table 2
Macro-level drought management strategies in Fars province.

Strategies	Mean importance[a]	The extent of use of DM strategies[b]			
		Managers' mean	Specialists' mean	*T*	Sig.
Conserving water resources	3.55	2.92	2.54	3.21	0.001
Conserving soil resources	3.44	2.33	2.12	1.58	0.114
Encouraging reduced public water consumption	3.23	1.51	1.32	1.34	0.181
Introducing proper farm management technologies	3.32	2.78	2.28	3.91	0.000
Establishing crop improvement programs	3.28	2.95	2.31	5.34	0.000
Introducing drought resistant varieties	3.38	2.73	2.33	2.95	0.003
Promoting land consolidation and farm development programs	3.40	2.60	2.09	3.31	0.001
Promoting land leveling programs	3.47	2.92	2.64	2.00	0.046
Promoting optimal crop patterns	3.34	2.35	1.85	3.58	0.000
Developing emergency response systems	3.32	2.86	2.62	1.57	0.116
Allocating drought relief funds	3.36	2.63	2.52	0.84	0.400
Providing technical support	3.55	3.04	2.80	1.86	0.064
Managing drought-induced conflicts	3.07	2.52	2.16	2.58	0.011
Implementing and improving early warning systems	3.13	1.83	1.40	2.74	0.006
Setting up a system of information management	3.25	2.38	1.84	3.63	0.000
Improving drought management information through extension systems	3.42	3.14	2.50	4.58	0.000
Establishing awareness-raising campaign to promote household economy	3.02	2.10	1.72	2.53	0.012
Leading education and awareness campaigns using media (TV and radio)	3.28	2.54	2.29	1.81	0.071
Encouraging local participation	3.29	2.46	2.11	2.61	0.010

[a] The mean relates to a five-point scale from 0 = of no importance to 4 = very important.
[b] The mean relates to a five-point scale from 1 = less than 30% to 5 = 91–100%.

implemented for affected rural communities, they are not sustained through awareness-raising approaches.

Table 2 also reveals a general tendency for managers to appraise organizational performance as better than their subordinates find it. This observation is consistent with "the good news syndrome" presented by Saunders et al. (1997), which holds that managers often like to show that everything is running smoothly. While Saunders et al. (1997) do not explain the reasons for this phenomenon, in our view, it is due to political and social pressures that force managers to see only positive performance, especially in the case of frequent and (or) severe drought. Managers and specialists also have different views on how to meet the needs of people who are vulnerable to drought. Specialists emphasize the ability to meet the basic needs, without considering organizational barriers and limitations while in the managers' view, institutional capabilities should be considered, too.

Another explanation is that delegating responsibility to subordinates may distance managers from drought-affected populations. To avoid misunderstandings, subordinates must communicate the problems clearly and promptly. Some executives tend to have an exaggerated belief in their own effectiveness. Unattended, these psychological tendencies can obfuscate how effectively the organization is performing during drought.

3.2. Organizational capacity for adaptation to drought

Because our analysis revealed significant differences between managers and specialists' perception of institutional adaptation to drought, two structural models were developed to address the issue.

3.2.1. Drivers of institutional adaptation to drought as perceived by managers

Fig. 3 summarizes the SEM findings on drivers of drought management as perceived by managers. They believe *human resources* have the largest significant effect on performance ($\beta = 0.39$, $p < 0.01$). This finding coincides with the human resource literature, which concludes that organizations with more human resources respond better to hazards. Managers also positively associated *resources and infrastructure* with drought management performance ($\beta = 0.31$, $p < 0.01$), consistent with the resource-based approach, arguing that an organization should obtain or develop core resources and capabilities to cope with the environmental threats (Barney, 1991). The findings also suggest that the attribute *strategy, goals, and action plan* has a significant effect on organizational performance ($\beta = 0.20$, $p < 0.05$). The more comprehensive, efficient, and adaptable they are, the better drought management will be.

Environmental factors were negatively associated with drought management performance ($\beta = -0.20$, $p < 0.05$). The literature is contradictory on this point. While some studies document a positive impact of environmental factors on performance (e.g., Galdeano-Gomez et al., 2008; Nakao et al., 2007; Wahba, 2008), others do not (e.g., Wagner, 2005; Watson et al., 2004). In our study, the mean value of environmental factors is 59.81[3]. Perhaps reactive organizational procedures, abstracted from crisis management (Karami, 2009), cause managers to disregard the environmental factors. In our study, the associations between drought management performance and *organizational culture*, *leadership*, and *structure and process* were not significant.

To confirm the mediating roles played by independent variables in linking some attributes to drought management performance, a series of hierarchical model tests were performed using PLS. Results show that, on the whole, *organizational culture* ($\beta = 0.43$, $p < 0.01$), *human resources* ($\beta = 0.41$, $p < 0.01$), and *resources and infrastructure* ($\beta = 0.37$, $p < 0.01$) have a significant effect on drought management performance. *Human resources* and *leadership* mediate the significant effect of *organizational culture* ($t = 2.88$, $p < 0.05$); which provides a framework through which employees internalize expectations about their roles and responsibilities in response to drought, serving as a control mechanism and enhancing performance. *Structure and process* mediates the significant effect of *resources and infrastructure* ($t = 2.79$, $p < 0.05$); organizational ability to establish effective structures and processes depends on acquiring certain resources, and when they are available, better performance can be expected. *Environmental factors* have a significant direct effect on drought management performance

[3] The scale ranged from 0 to 100.

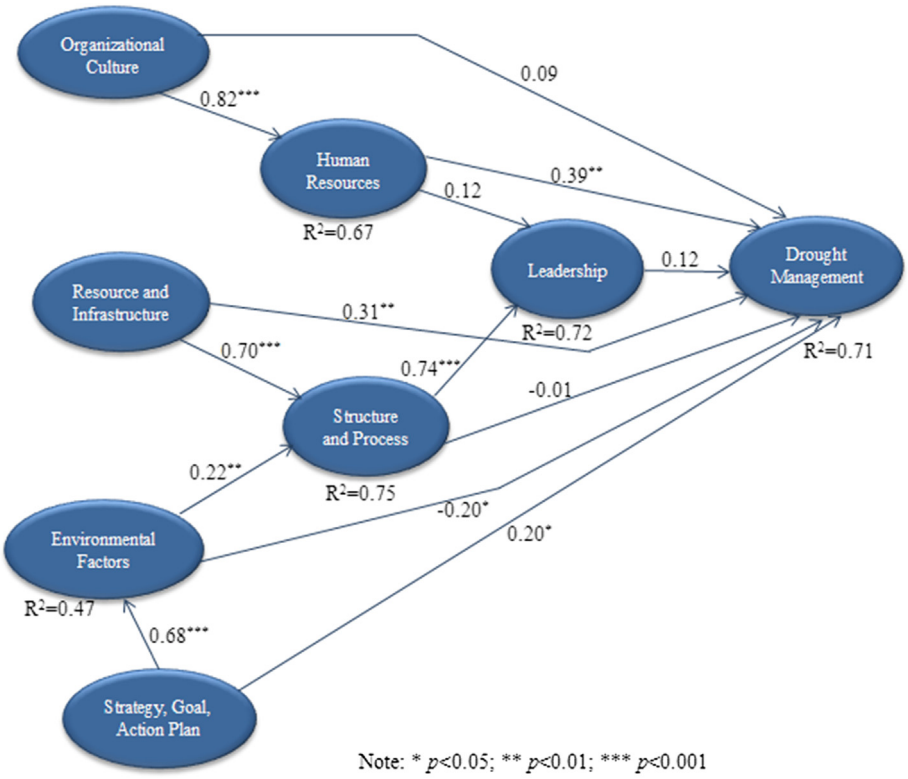

Fig. 3. Drivers of institutional adaptation to drought as perceived by managers.

($\beta = -0.20$, $p < 0.05$) until *structure and process* and *leadership* are added to the model ($t = 1.57$, n.s.). Similarly, the significant direct effect of *strategies, goals, and action plans* ($\beta = 0.20$, $p < 0.05$) becomes insignificant when *environmental factors* and *structures and process* are added ($t = 0.60$, n.s.). The model also explains substantial portion of variance in drought management performance ($R^2 = 0.71$).

3.2.2. Drivers of institutional adaptation to drought as perceived by specialists

Fig. 4 summarizes, based on the model, the specialists' perceptions of drought management drivers. They prioritized *strategy, goals, and action plan* ($\beta = 0.24$, $p < 0.01$), i.e. the Organization's planning capacity can promote drought management. The association with *organizational culture* is also significant ($\beta = 0.23$, $p < 0.01$); specialists believe it enhances performance. *Resources and infrastructure* were also positively associated with organizational performance during drought ($\beta = 0.21$, $p < 0.01$). The association between *human resources*, *leadership*, *structure and processes*, and *environmental factors* and drought management performance was not statistically significant.

Findings indicated that *human resources* mediate the effect of *organizational culture* on drought management performance ($t = 3.68$, $p < 0.001$). Overall, *organizational culture* ($\beta = 0.31$, $p < 0.01$), *resources and infrastructure* ($\beta = 0.20$, $p < 0.05$), and *strategy, goals, and action plan* ($\beta = 0.27$, $p < 0.01$) have a significant effect on drought management performance in the view of specialists. The model explained 48 percent of variance in drought management performance.

4. Conclusions and implications for drought adaptation

Recent natural disasters, such as extensive drought in various arid and semi-arid regions of the world, including southern Africa and Southeast Asia (Kranz et al., 2010), demonstrate three features: the change is dynamic, intensifying, and deeply disruptive, reducing the productivity and stability of residents who depend on natural resources (Busch, 2011). Organizations embedded in the natural environment must accept the reality of climate change (O'Brien et al., 2006), build capacity to adapt to a range of possible consequences (Kranz et al., 2010), and permeate their institutional structures with climate change risk assessment and management strategies.

Until now, few studies have investigated exactly how organizations can adapt their capabilities to the complex operating conditions of climate change. This paper addresses the gap. Although it focuses on Iran, we believe that Iran's institutional adaptation to drought does not differ significantly from that of other developing countries that rely on a crisis approach. The implications for drought adaptation policy arising from our research may be widely applied.

While climate change makes the need to integrate risk management into development interventions urgent (DFID, 2004), the current Fars Agricultural Organization's framework provides weak incentives for a proactive drought management. Our investigation of its performance confirms that the main response patterns during drought were technically and financially oriented to emergency schemes that relied on a crisis management approach. Instead, planning should include comprehensive risk-reduction strategies. Adapting to drought may involve very difficult policy choices. For instance, some radical changes to water consumption are likely to be required – restricted less-essential use, recharging groundwater with nonconventional water, and social acceptance of low-quality water. To implement such serious changes, provincial and national decision-making will require strong, accepted organizational structures and specialists and a rural society educated about the problems and alternatives solutions. The challenge is to find ways for risk-reduction solutions and organizational capabilities, evolving concurrently.

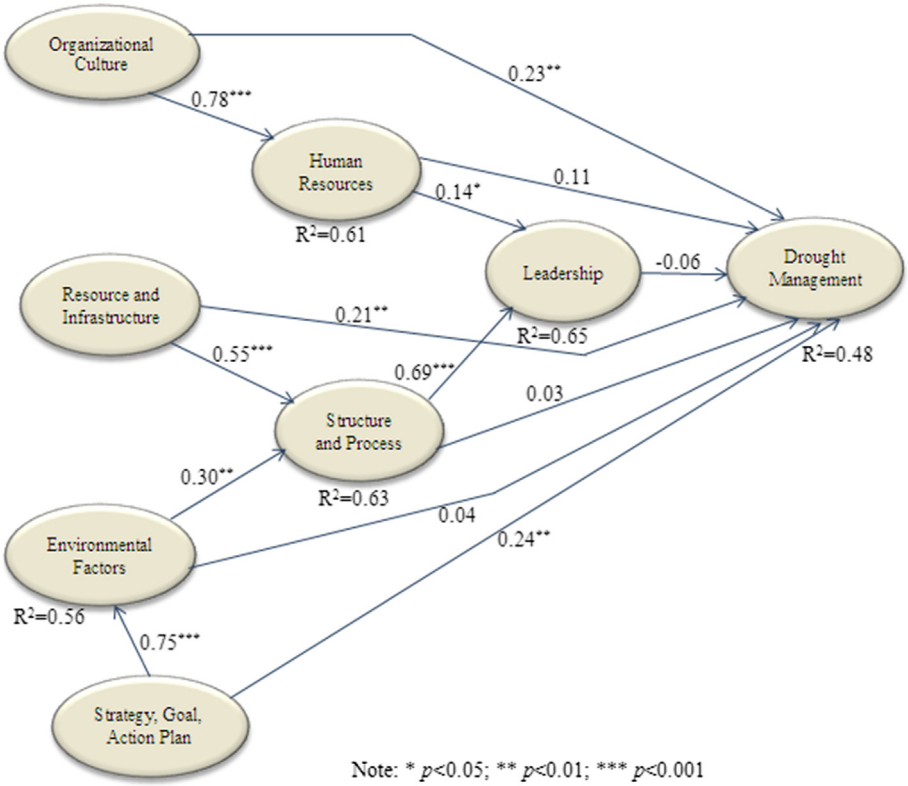

Fig. 4. Drivers of institutional adaptation to drought as perceived by specialists.

The significant differences in managers and specialists' viewpoints necessitate attention to human factors. Key clients and stakeholders must be involved in decision-making, and coordination between managers and their subordinates needs to be improved. Regardless of such differences, the empirical models explain the mechanisms by which organizational capacities influence their drought management. As indicated in the two models, organizational culture has considerable influence. Specifically, study results show that such cultural factors as focus on clients and customer services, contribution to the community, and performance and behavior standards strongly influence performance; and managers must emphasize them to enhance performance during drought.

Based on the models, drought management performance is significantly influenced by resources and infrastructure. Information on most processes and applied research on coping strategies must be provided pervasively. Other infrastructural aspects, requiring attention, are new materials, and facilities for employees. Defining the budget required to serve management structures and processes and planning to put them in place at the right time will enhance the organization's capacity to adapt to drought. The two models support two distinct pathways by which human resources significantly influence drought management performance. Changing the ways people work and are rewarded could increase the institutional adaptation to drought. Most development projects are said to fail because of insufficient attention to human factors; therefore, this step is essential. It will almost certainly include policies re-appraising the roles and jobs, and redistribution of responsibilities and authority between subordinates. As indicated in the specialist model, *strategy, goals, and action plans* specifically influence drought management performance. Organizations can adapt to drought by defining and articulating common outcomes; establishing mutually reinforcing or joint strategies to achieve them; establishing compatible policies, procedures, and other means of operation; and developing mechanisms for monitoring, evaluating, and reporting the outcome of drought management efforts. As represented in the manager model, *leadership* and *structure and process* indirectly influence drought management performance. Strategies must be developed to determine where proactive leadership will contribute most and least.

Acknowledgment

We acknowledge the constructive comments from Professor Javad Zamiri, Shiraz University. This research was funded by the Fars Research Center of Agriculture and Natural Resources.

References

Barney, J.B., 1991. Firm resources and sustained competitive advantage. Journal of Management 17 (1), 99–120.
Bass, B.M., Riggio, R.E., 2006. Transformational Leadership, second ed. Lawrence Erlbaum Association, Mahwah, NJ, USA.
Beer, M., 2009. High Commitment, High Performance: How to Build a Resilient Organization for Sustained Advantage. John Wiley & Sons Ltd., New York, USA.
Busch, T., 2011. Organizational adaptation to disruptions in the natural environment: the case of climate change. Scandinavian Journal of Management 27, 389–404.
Campbell, D., Barker, D., McGregor, D., 2010. Dealing with drought: small farmers and environmental hazards in southern St. Elizabeth, Jamaica. Applied Geography 31 (1), 146–158.
Cartin, T.J., 1999. Principles and Practices of Organizational Performance Excellence. ASQ Quality Press, Milwaukee, WI, USA.
Chandler, A.D., 1990. Strategy and Structure: Chapters in the History of the Industrial Enterprise. MIT Press, Cambridge, MA, USA.
Chin, W.W., 1998. The partial least squares approach to structural equation modeling. In: Marcoulides, G.A. (Ed.), Modern Methods for Business Research. Lawrence Erlbaum Associations, Mahwah, NJ, USA, pp. 295–336.
Comfort, L.K., Kapucu, N., 2004. Inter-organizational coordination in extreme events: the World Trade Center Attack, September 11, 2001. Natural Hazards 39, 309–327.

Le Coze, J.C., 2008. Disasters and organizations: from lessons learnt to theorising. Safety Science 46, 132–149.
Department for International Development (DFID), 2004. Adaptation to Climate Change: Making Development Disaster-Proof, Key Sheet 06. DFID, London.
Dey, N.C., Alam, M.S., Sajjan, A.K., Bhuiyan, M.A., Ghose, L., Ibaraki, Y., Karimi, F., 2011. Assessing environmental and health impact of drought in the northwest Bangladesh. Journal of Environmental Science and Natural Resources 4 (2), 89–97.
Druckman, D., Singer, J.E., Van Cott, H.P., 1997. Enhancing Organizational Performance. National Academies Press, Washington DC, USA.
Dwyer, S., Richard, O.C., Chadwick, K., 2003. Gender diversity in management and firm performance: the influence of growth orientation and organizational culture. Journal of Business Research 56, 1009–1019.
Galdeano-Gomez, E., Cespedes-Lorente, J., Martinez-del-Rio, J., 2008. Environmental performance and spillover effects on productivity: evidence from horticultural firms. Journal of Environmental Management 88, 1552–1561.
Hijmans, R.J., 2003. The effects of climate change on global potato production. American Journal of Potato Research 80, 271–279.
Holbeche, L., 2006. Understanding Change: Theory, Implementation and Success. Elsevier Science Ltd., Oxford, UK.
Hosseini, M., Sharifzadeh, A., Akbari, M., 2009. Causes, effects and management mechanisms of drought crisis in rural and nomadic communities in southeastern Iran as perceived by agricultural/rural managers and specialists. Journal of Human Ecology 27 (3), 189–200.
Hulland, J., 1999. Use of partial least squares (PLS) in strategic management research: a review of four recent studies. Strategic Management Journal 20 (2), 195–204.
Intergovernmental Panel on Climate Change (IPCC), 2010. World Climate Report on Global Drought Patterns. http://www.worldclimatereoprt.com/index.php/2010/02/24/update-on-global-droughtpatterns-ipcc (accessed 15.05.12.).
Karami, E., 2009. Drought management: Knowledge and Information System. National drought Seminar: Issues and Mitigation. Shiraz University, Shiraz, Iran, pp. 40–65, 13–14 May (in Farsi).
Karami, E., Keshavarz, M., 2009. Sociology of sustainable agriculture. In: Lichtfouse, E. (Ed.), Sustainable Agriculture Reviews vol. 3. Springer, France, pp. 19–40.
Kartez, J.D., Kelly, W.J., 1988. Research based disaster planning: conditions for implementation. In: Comfort, L.K. (Ed.), Managing Disaster: Strategies and Policy Perspectives. Duke University Press, Durham, N.C., USA, pp. 126–146.
Keshavarz, M., 2012. A Sociological Understanding of Drought in Fars Province, Iran. PhD Dissertation in Agricultural Extension and Education. Shiraz University, Shiraz, Iran (in Farsi).
Keshavarz, M., Karami, E., Kamgare-Haghighi, A., 2010. A typology of farmers' drought management. American-Eurasian Journal of Agriculture and Environmental Science 7 (4), 415–426.
Keshavarz, M., Karami, E., Zamani, G., 2011. Drought vulnerability of farm households: a case study. Iran Agricultural Extension and Education Journal 6 (2), 15–33 (in Farsi).
Keshavarz, M., Karami, E., Vanclay, F., 2013. The social experience of drought in rural Iran. Land Use Policy 30, 120–129.
Kranz, N., Menniken, T., Hinkel, J., 2010. Climate change adaptation strategies in the Mekong and Orange-Senqu basins: what determines the state-of-policy. Environmental Science & Policy 13, 648–659.
Lauria, E.J.M., Duchessi, P.J., 2007. A methodology for developing Bayesian networks: an application to information technology (IT) implementation. European Journal of Operational Research 179 (1), 234–252.
Marquardt, M.J., 2002. Building the Learning Organization: Mastering the 5 Elements for Corporate Learning. Davies-Black Publishing Inc., Mountain View, CA, USA.
Nadkarni, S., Shenoy, H.P., 2001. A Bayesian network approach to making inferences in causal maps. European Journal of Operational Research 128 (3), 479–498.
Nakao, Y., Amano, A., Matsumura, K., Genba, K., Nakano, M., 2007. Relationship between environmental performance and financial performance: an empirical analysis of Japanese corporations. Business Strategy and the Environment 16, 106–118.
Nicholson, N., Schuler, R., Van de Ven, A., 1998. The Blackwell Encyclopedic Dictionary of Organizational Behavior, second ed. Blackwell Publishers, Ltd, Malden, MA, USA.
Næss, L.O., Bang, G., Eriksen, S., Vevatne, J., 2005. Institutional adaptation to climate change: flood responses at the municipal level in Norway. Global Environmental Change 15, 125–138.
O'Brien, G., O'Keefe, P., Rose, J., Wisner, B., 2006. Climate change and disaster management. Disasters 30 (1), 64–80.
Porter, M.E., 2008. The five competitive forces that shape strategy. Harvard Business Review, 23–41. January.
Quarantelli, E.L., 2005. The Earliest Interest in Disasters and The Earliest Social Science Studies of Disasters: a Sociology of Knowledge Approach. University of Delaware, Disaster Research Center. Preliminary paper#349.
Ranganathan, C., Sethi, V., 2002. Rationality in strategic information technology decisions: the impact of shared domain knowledge and IT unit structure. Decision Sciences 33 (1), 59–86.
Riebsame, W.E., Changnon, S.A., Karl, T.R., 1991. Drought and Natural Resource Management in the United States: Impacts and Implications on the 1987–1989 Drought. Westview Press, Boulder, CO, USA.
Salami, H., Shahnooshi, N., Thomson, K.J., 2009. The economic impacts of drought on the economy of Iran: an integration of linear programming and macro econometric modeling approaches. Ecological Economics 68 (4), 1032–1039.
Saunders, M., Lewis, P., Thornhill, A., 1997. Research Methods for Business Students. Pitman Publishing, London, UK.
Scheaffer, R.L., Mendenhall, W., Ott, L., 1979. Elementary Survey Sampling, second ed. Duxbury Press, Pacific Grove, CA, USA.
Siemieniuch, C.E., Sinclair, M.A., 2008. Using corporate governance to enhance 'long-term situation awareness' and assist in the avoidance of organization-induced disasters. Applied Ergonomics 39, 229–240.
Speranza, C.I., Kiteme, B., Wiesmann, U., 2008. Droughts and famines: the underlying factors and the causal links among agro-pastoral households in semi-arid Makueni district, Kenya. Global Environmental Change 18 (1), 220–233.
Starik, M., Rands, G.P., 1995. Weaving an integrated web – multilevel and multisystem perspectives of ecologically sustainable organizations. Academy of Management Review 20 (4), 908–935.
Tenenhaus, M., Vinzi, V.E., Chatelin, Y.M., Lauro, C., 2005. PLS path modeling. Computational Statistics and Data Analysis 48 (1), 159–205.
Thompson, B., 2003. Score Reliability: Contemporary Thinking on Reliability Issues. Sage, Newbury Park, CA.
Vasu, M.L., Stewart, D.W., Garson, G.D., 1998. Organizational Behavior and Public Management, third ed. CRC Press, Boca Raton, FL, USA.
Wagner, M., 2005. How to reconcile environmental and economic performance to improve corporate sustainability: corporate environmental strategies in the European paper industry. Journal of Environmental Management 76, 105–118.
Wahba, H., 2008. Does the market value corporate environmental responsibility? an empirical examination. Corporate Social Responsibility and Environmental Management 15, 89–99.
Watson, K., Klingenberg, B., Polito, T., Geurts, T., 2004. Impact of environmental management system implementation on financial performance. Management of Environmental Quality 15, 622–628.
Wilbanks, T.J., 2002. Geographic scaling issues in integrated assessments of climate change. Integrated Assessment 3, 100–114.
Wilhite, D.A., Pulwarty, R.S., 2005. Drought and water crisis: lessons learned and the road ahead. In: Wilhite, D.A. (Ed.), Drought and Water Crisis: Science, Technology, and Management Issues. CRC Press, Boca Raton, FL, USA, pp. 389–398.
Wilhite, D.A., Svoboda, M.D., 2000. Drought early warning systems in the context of drought preparedness and mitigation. In: Wilhite, D.A., Sivakumar, M.V.K., Wood, D.A. (Eds.), Early Warning Systems for Drought Preparedness and Management, World Meteorological Organization. Switzerland, Geneva, CH, pp. 1–21.
Wilhite, D.A., Vanyarkho, O., 2000. Drought: pervasive impacts of a creeping phenomenon. In: Wilhite, D.A. (Ed.), Drought: a Global Assessment, Natural Hazards and Disasters Series. Routledge Publishers, London, UK, pp. 245–255.
Wilhite, D.A., Svoboda, M.D., Hayes, M.J., 2007. Understanding the complex impacts of drought: a key to enhancing drought mitigation and preparedness. Water Resources Management 21 (5), 763–774.
Winn, M.I., Kirchgeorg, M., 2005. The siesta is over: a rude awakening from sustainability myopia. In: Sharma, S., Starik, M. (Eds.), Research in Corporate Sustainability: Strategic Capabilities and Competitiveness. Elgar, MA, USA, pp. 232–258.
Wu, W.W., 2010. Linking Bayesian networks and PLS path modeling for causal analysis. Expert Systems with Applications 37, 134–139.
Zeppou, M., Sotirakou, T., 2004. The STAIR: a dual core model for changing public sector performance. In: Epstein, M.J., Manzoni, J.F. (Eds.), Performance Measurement and Management Control: Superior Organizational Performance. Elsevier Science, Ltd., Amsterdam, The Netherlands, pp. 375–406.