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Designing a model for integrated watershed management in Iran

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Abstract

This study, which designs a model for integrated watershed management in Iran, is based on qualitative research applying a grounded theory methodology. Interviewing was the main tool for gathering data. Using snowball sampling, we chose three categories of informants: (a) academics and experienced natural resource experts, (b) representatives of active environmental non-governmental organizations, and (c) local people. Integrated watershed management was constituted from contextual conditions (i.e., physical conditions of watersheds, infrastructure, and constructed facilities); causative conditions (i.e., management challenges, climatic–environmental factors, and local people's socio-cultural and economic conditions); and intervention conditions (i.e., extension and education, motivation, attitude, and professional ethics factors). Integrated watershed management paves the way for strategies involving holistic and systems thinking, improved credit and financial resources, coordinative and general policymaking, stakeholder participation, and integrated information systems. These strategies result in environmental, economic, and social outputs.

Keywords: Grounded theory; Integrated management; Model; Natural resource; Watershed

Introduction

For thousands of years, people have been exploiting natural resources, primarily through agricultural activities to produce food. Global population and economic growth, and natural resource scarcity, especially in developing countries, have raised serious concerns about the sustainability of accessible natural resources. The availability of fertile land for crop cultivation has decreased considerably over the last 20 years while, based on the UN's Millennium Development Goals regarding global hunger, food production must double by 2050 (Swanson, 2006). In the face of growing demand for food, soil nutrient depletion and desertification are developing in many countries. Water deficiency is also a serious problem endangering food security in many developing countries. Water resources

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development and management is imperative for sustainable agriculture in water-scarce areas (Bijani & Hayati, 2015).

It is obviously impossible to achieve sustainable development without protecting water, soil, forest, and rangeland resources and ensuring their optimal exploitation. Existing renewable natural resources are currently being exploited under the most undesirable conditions (Ghafouri & Sarreshtehdari, 2008), and Iran's natural resources, on which food production and human welfare depend, are dangerously vulnerable. Iran is a large country with an area of about 165 million hectares. There are six main river basins: Caspian Sea (174,618 km^2), Persian Gulf and Oman Sea (424,515 km^2), Urumia Lake (51,801 km^2), Central Plateau (824,356 km^2), Eastern Boundary (103,169 km^2), and Ghareh-Ghoum (44,165 km^2). These six basins are divided into 30 sub-basins and 609 study areas. These river basins are composed of forests, rangelands, deserts, etc.

Approximately 1.6 million rural and nomadic households use 90 million hectares of the country's forests and rangelands (Forest, Range and Watershed Management Organization of Iran, 2012). Rangelands are among Iran's most significant natural resources. In 1974, approximately 14 million hectares of Iran's summer pastures (15.6% of all pastures) were in good to very good condition with a production capacity of 290 kg per hectare of forage. By 2000, this total had declined to 9.3 hectares and 22.7% of the formerly average quality rangelands (66.7% of total rangelands) had declined to poor and very poor condition (Farahpour & Marshall, 2001; Badripour, 2004).

Unsustainable exploitation of the renewable natural resources that constitute much of Iran's natural environment has rapidly increased in recent decades due to increasing population and socio-economic issues. Every year, approximately 130,000 hectares of the country's pastures are degraded and changed, and forests shrink by approximately 48,000 hectares. Soil erosion by wind and water averages approximately 25–30 tonnes per hectare per year, three times the global average, while dam sedimentation in Iran is approximately 10 tonnes per hectare per year, versus the world level of under two tonnes per hectare per year. Overall, Iran is ranked 132nd in the world in terms of environmental sustainability, which suggests insufficient attention to the sustainable management of natural resources and the environment (Forest, Range and Watershed Management Organization of Iran, 2012). However, the importance of agriculture and natural resources in Iran, as a developing country, has been always emphasized by planners and policymakers as key to food security, job creation, employment, earnings, export growth, and improving the growth of other sectors. Despite government interventions, infrastructure weakness, and market inefficiency, the World Bank anticipates that the agriculture and natural resources sector of Iran should be able to supply food for 100 million people in 2020 (World Bank, 2007).

Formulating and implementing watershed management projects are important in order to overcome the current crisis and to preserve, restore, and develop Iran's forests and pastures. However, for many years, especially in the recent decade, plans addressing, for example, range management, the conversion of low-productivity dry land fields, forestry consolidation, livestock–pasture equilibrium, withdrawal of animals from forests, wetland protection, and biodiversity conservation, with a focus on farmer and villager participation, have been implemented at the national level.

No specific enforcement mechanism has been developed for natural resource management, despite numerous efforts to achieve institutionalized public participation in watershed management. The lack of villager participation reflects the failure of planners and decision-makers to incorporate active participation into these efforts. Rural rehabilitation has not happened and activities to identify problems, formulate and present solutions, and make decisions have stopped (Yavari *et al.*, 2007).

An international project for sustainable water resource management has been implemented in the Hablehrood watershed since 1997. Inter-sectoral coordination among various organizations to overcome issues such as the continuing degradation of soil and water resources, limited public participation in decision-making, inter-sectoral coordination of range management, the lack of a comprehensive, integrated approach to development planning, weakness in human resources and planning, and unsustainable water and soil resource management are the main reasons for implementing this project. The project was initiated under a joint plan between the country and the United Nations Development Programme (UNDP), applying an integrated understanding of the problems related to the sustainable management of soil and water resources in the Hablehrood watershed basin.

In the first phase, despite great efforts to engage local people and relevant coordination structures, the project failed to achieve the coordinating goals of the plan (Salmanimoghadam, 2007).

To meet the challenges of the plan for the sustainable management of the water and soil resources of Hablehrood, the Middle East and North Africa Regional Development (MENARID) international project is being implemented in four watersheds, including range ecosystems, forests, dry lands, and wetlands. MENARID is based on a 2008 resolution of the High Council of the Environment concerning development planning and regional cooperation and is conducted in partnership with the Global Environment Facility, the UNDP, and the Forest, Range and Watershed Management Organization of Iran. The main objective of the project is to resolve existing legal barriers to the integrated management of natural resources through developing and strengthening institutional knowledge, capacity building, improving inter-organizational coordination, and formulating sustainable practices for water and land management. However, due to the lack of attention to public participation, local institutions, and non-governmental organizations (NGOs) and to the absence of integrated watershed management, this project may suffer the same fate as previous plans. The implementation of an integrated watershed management approach is essential (Forest, Range and Watershed Management Organization of Iran, 2012).

An integrated watershed management approach would emphasize the socio-economic features of the region as a new paradigm of natural resource management supporting robust, sustainable livelihoods for the residents of the Iranian areas included in MENARID (McDuff *et al.*, 2008; Ghafouri & Sarreshtehdari, 2008). The general objective of the approach is to develop sustainable rural livelihoods through stakeholder participation based on integrated natural resource management (Galewski, 2010; Promburom, 2010). Stakeholder participation is the fundamental principle of integrated management (Mutekanga, 2012). Participation of a range of stakeholders entails interaction between bureaucrats, experts, and local people as well as fostering leadership, participatory planning, and an empowered populace (Ko, 2009).

Johnson *et al.* (2002) demonstrated that stakeholder participation has important consequences for sustainable watershed management and the improvement of organizational decision-making mechanisms. The assumption is that stakeholder participation, through describing problems, identifying priorities, mentoring, and evaluation, will improve project performance In this regard, public and local officials must consider stakeholders' rights and uphold norms such as legitimacy, responsiveness, and effective communication (Francis & Roberts, 2003; Ribot, 2004; Corbett & Lane, 2005). Generally, watershed management plans should belong to all stakeholders and should have long-term objectives for the whole watershed region (Kaplowitz & Witter, 2008). In the following, some studies addressing these principles are presented.

In a study entitled 'Integrated water resource management projects in developed and developing countries' (i.e., China, Hungary, India, Indonesia, Mexico, Southern Africa, Thailand, the United States, and Uganda), Ko (2009) evaluated that stakeholder participation was weak. In general, the framework of integrated management was only evident in developing countries.

According to Crook & Decker (2006), the success factors of natural resources management included the participation of local organizations, creating and protecting benefits for local people, local participation, and the non-intervention of and lack of dependence on the public sector. In contrast, ignoring these factors had caused the failure of natural resources management plans; in particular, government intervention and control gave rise to undesirable consequences (Hickey *et al*., 2012).

Manning & Seely (2005), in their research in Namibia, found that the government had transferred the integrated management of water and soil resources to local communities. To implement integrated management in the studied region, a committee was established in which all stakeholders were treated as members of a community entitled to similar benefits and pursuing the same objective, i.e., integrating natural resource and environmental protection to support sustainable livelihoods. Regarding the importance of local communities' participation, it was shown that community institutions' participation in forest conservation is essential to more effective reserves (Tucker, 2004).

Additionally, in Iran, Kazemi *et al*. (2006), in their study of the Hablehrood sustainable water and soil resource management project, showed that the following, i.e., empowering local communities for practical participation, supplying livelihoods and creating income for local communities, considering environmental protection (especially natural resource conservation), and designing and selecting coordinating mechanisms for executive institutions together with local communities, are all key policies in developing a model for sustainable, integrated watershed management. Interaction between stakeholders, policies, rules, regulations, institutions, and society needs to change considerably. These changes depend on the change on the watershed management approaches (Jusi, 2009).

Based on what was said above, the main purpose of this qualitative study was to design a model for integrated watershed management in Iran. The model can serve as a guide for decisions and actions regarding watershed management and, it is hoped, promote more sustainable watershed management in Iran. To achieve this aim, the objectives of the study were to:

- extract causal, contextual, and intervention conditions of integrated watershed management;
- extract strategies and general policies of integrated watershed management;
- extract the consequences for integrated watershed management of using identified strategies and policies;
- integrate the conditions, strategies, and consequences under a paradigm model to design a watershed management model.

Methodology

The study is based on a qualitative methodology in combination with a grounded theory approach. Interviews about integrated watershed management were carried out with academics in the fields of rangelands, watersheds, forestry, and the environment, experts from forest, rangeland, and watershed management organizations in Iran, representatives of watershed management NGOs, and local community informants. Theoretical sampling and purposeful sampling were conducted simultaneously and the

snowball method was used to select informants. Purposeful sampling was used to select the informants, while theoretical sampling was used to identify the research direction. Experienced experts, NGOs, and local communities were selected from those involved in implementing the sustainable management of the land and water resources project (SMLWR) within the Hablehrood watershed and the MENARID project for integrated natural resource management.

Model areas of the Hablehrood watershed and the MENARID projects include four different watershed ecosystem of rangelands, forests, irrigated and rain-fed lands, arid and semi-arid and dry sub-humid environments located in five provinces, which represent the vast expanses of the country as follows:

1. Hamoon site in Sistan and Baloochestan Province: 18,250 hectares.
2. Behabad site in Yazad Province:
   a. Behabad sub-watershed in the south-west of Behabad county (hilly terrain with mainly forest, range, and orchard land use): about 5,730 hectares;
   b. Behabad sub-watershed in the north of Behabad county (plain area with mainly agricultural land use): about 10,550 hectares.
3. Razin watershed in Kermanshah Province: about 14,700 hectares with four different agro-ecosystems (range, forest, rain-fed, and irrigated farming).
4. Hablehrood watershed in Tehran (Damavand and Firuzkooh counties; up-stream) and Semnan (Garmsar, Aradan, and Sorkheh counties; down-stream) Provinces: about 1,266,000 hectares; this site is just for software work, i.e., coordination, up-scaling, and multi-sectoral planning. In this watershed, the hardware works will be covered by the team of the UNDP-SMLWR project in coordination with the MENARID team (Forest, Range and Watershed Management Organization of Iran, 2012) (see Figure 1).

After initial interviews and preliminary data analysis, the data were analyzed and coded. Concepts identified and extracted from the data were then compared with each other, giving rise to categories among which links were established. Theoretical sampling was used to select additional informants. Finally, interviews with key informants continued until the informants gave repetitive answers and interviews produced no new information. Researchers achieved theoretical saturation by means of individual interviews with experts in the natural resource field (17 informants), experts from forest, rangeland, and watershed management organizations (16 informants), managers and members of natural resource NGOs (12 informants), and local people with experience of integrated watershed management (12 informants). Interviews combined with the study of written documentation were the main tools of data collection. Research validity and reliability were ensured by simultaneously using two data collection methods, creating a database, and using the interviewees' points of view when completing and revising the research report. Data were analyzed using a coding method based on open, axial, and selective coding.

Results

In this section, the data are analyzed according to grounded theory in three stages, i.e., open, axial, and selective coding. Concepts were first extracted from the main sentences of the interviews and each

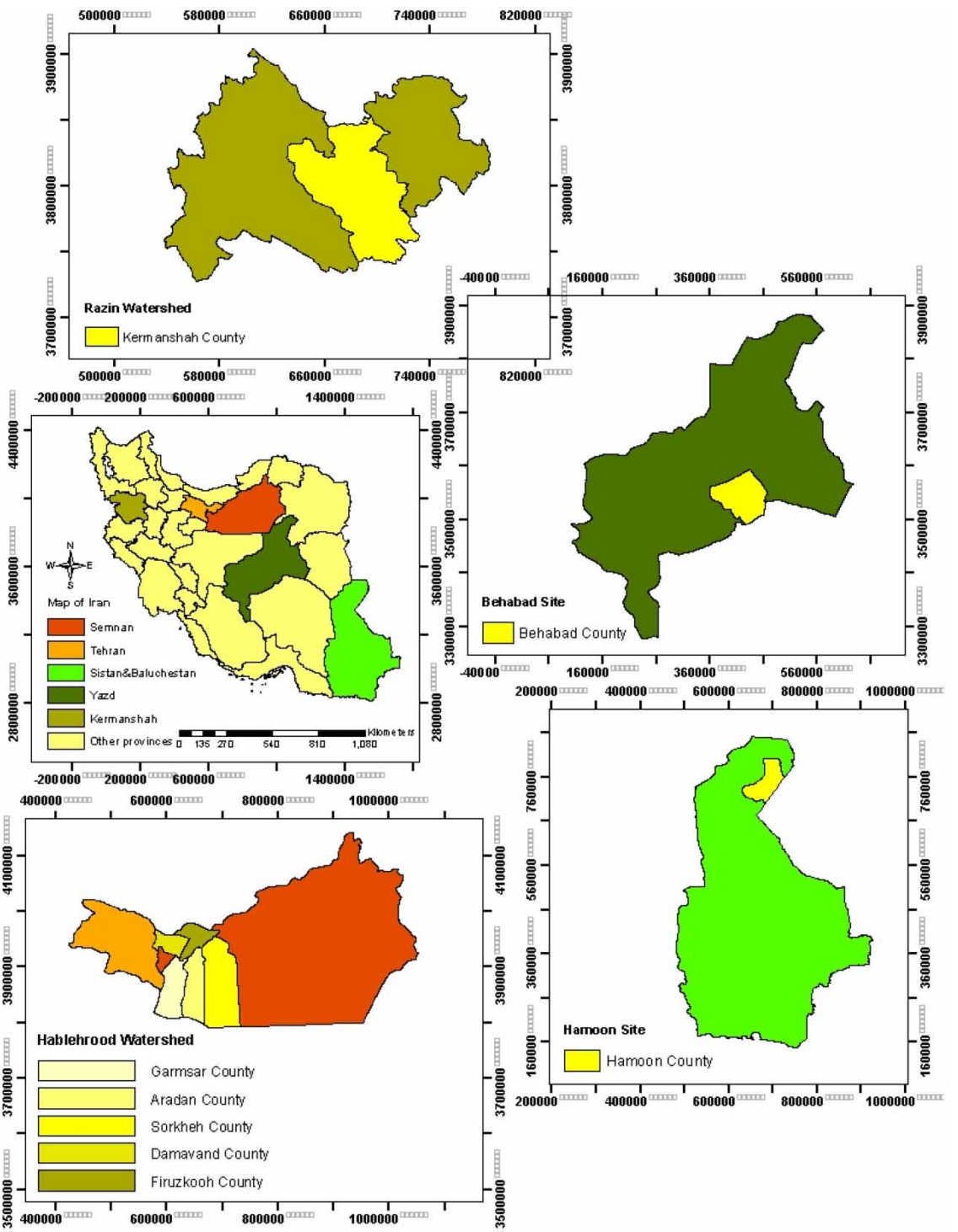

Fig. 1. Geographic location of the research area.

of them was coded, F, N, or L. E was given to concepts extracted from experts from forest, rangeland, and watershed management organizations, while F was given to concepts extracted from natural resource academics. N was given to concepts extracted from experienced NGO members and L was given to concepts extracted from local informants. After extracting the concepts, in the next step, similar concepts were classified in various categories. In total, 120 concepts and 20 categories were extracted from the data. The results are presented in Table 1.

In the next stage, axial coding was conducted. The extracted categories were classified as conditional, interactional-process, and consequential categories. Conditional categories that are model inputs include: management challenges, local people's socio-cultural conditions, local people's economic conditions, physical conditions of watershed, climatic–environmental factors, extension-educational factors, professional ethics, attitudinal factors, motivational factors, and infrastructure and constructed facilities.

Interactional-process factors included integrated information systems, improving credit and financial resources, integrity and systems thinking, research and development, integrative policymaking, participation of all stakeholders, and establishing councils and cooperative committees. Finally, the environmental, economic, and social consequences that are model outputs were treated as consequential categories. The conceptual research model was designed by combining categories from the previous analytical stages after identifying conditions, interactions, and consequences. In the next step, the researchers rechecked each of the categories thoroughly and then explored (or described) their interrelations. Finally, a paradigmatic model of integrated watershed management was formulated by considering the process of research and data analysis (Figure 2).

Causal conditions

The causal conditions that the sample population identified are the reasons for moving towards integrated watershed management. These conditions included existing management challenges, climatic–environmental factors, local people's socio-cultural conditions, and local people's economic conditions.

Many experts mentioned management challenges as the most important reason to establish integrated watershed management. For example, they said that organizations prefer to follow their organizational plans rather than developing communication and integration with other organizations and institutions to achieve joint objectives. If these isolated sectoral actions continue on separate paths and continue to be based on the specific policies of each organization, the process of natural resource destruction will continue.

Climatic–environmental factors are identified in the interviews as fundamental in shaping integrated watershed management. The probability of events such as droughts, floods, and fires has increased in the watersheds due to changes in the amount and variance of rainfall and in the climate. The essential point is that recent changes in climate and in the occurrence of unexpected events have been caused by people's irregular and unexamined interventions.

Local communities' socio-cultural and economic conditions are other effective causal conditions for integrated watershed management. One of the most important issues in relation to watershed management is the disregard of women's roles in local communities and natural resource management. Despite social, economic, and culturally enforced impediments, women play significant roles in many economic, productive, and service activities in Iran. Although their involvement in activities such as management and decision-making is limited, they can nevertheless play a key role in improving watershed management, both directly and indirectly.

Table 1. Categories resulting from analyzing extracted concepts (second stage of open coding).

Code	Concepts	Categories
E1	Considering details in public organizations	Management challenges
E2	Not obtaining expected results from implementing previous projects	
E3	Weaknesses of rules and existing policies	
E4	Lack of empathy, unity, and consistency between organizations and various sections of organizations	
E5	Limited credit and financial resources	
F14	Diverse stakeholder needs, expectations, and benefits	
N3	Violating local community laws of watershed management	Local people's socio-cultural conditions
L2	Disregarding the culture and customs of local communities regarding natural resource protection and exploitation	
F16	Low local community awareness of factors promoting the sustainability of natural resources	
F17	People leaving their villages	
E7	Insufficient consideration of women's roles in managing the local community and natural resources	
L1	Poverty of local people	Local people's economic conditions
E6	Relationship between livelihood activities of local communities and natural resources	
N4	Local people's ways of conducting activities such as agriculture, animal husbandry, and horticulture in the watershed	
F3	Topography of watershed (e.g., elevation and slope of watershed, unevenness of terrain)	Physical conditions of watershed
F4	Geomorphology of watershed (e.g., drainage, sedimentation, faults, and mines)	
E10	Natural diversity (e.g., of forest, range, water, and soil resources) and complex dynamics of the watershed	
F1	Limitations of natural resources	
E8	Occurrence of constant drought and aridity	Climatic–environmental factors
F2	Increased water and wind erosion in Iran	
N1	Drying up of wetlands and rivers	
E9	Destructive floods	
N2	Occurrence of fire	
N5	Condition of paths, accessible roads, and transportation facilities	Infrastructure and constructed facilities
F5	Appropriate construction of dam in watershed	
F6	Energy sources (e.g., fuel and electricity)	
F7	Networks and telecommunication services	
N6	Educational, welfare, and sanitary facilities	
F15	Making local people aware of plans and rules for the protection and exploiting of natural resources	Extension-educational factors
F18	Considering the role and position of indigenous knowledge in watershed management	
L5	Holding extension-education courses and educational workshops for local communities	
E11	Fitting educational content to stakeholder needs	
E12	Providing publications and promotional brochures	
E13	Suitable uses of religious doctrine in protecting natural resources	
E14	Continuing education for all natural resource managers and experts	

(*Continued.*)

Table 1. (*Continued.*)

Code	Concepts	Categories
L6	Change and transformation of stakeholder attitudes and thoughts regarding integrated management	
F19	Using related technologies	
F20	Community familiarity with the benefits and advantages of integrated management	
F25	Reforming existing rules and enacting suitable rules and regulations at the national level	Integrative policymaking
F26	Enacting directives and executive circular letters at the organizational level	
F27	Suitable enacting of higher-level documents	
E19	Executive enforcement of rules	
E20	Coordinating political sectors and officials	
F28	Aligning political boundaries with watershed borders	
N7	Considering traditional rules for managing and exploiting natural resources	
F30	Reducing governmental supervision and assigning roles and responsibilities to other stakeholders	
E15	Experts and bureaucrats are committed and accept responsibility	Professional ethics
E16	Honesty and effective communication in action	
F31	Organizational responses	
E17	Fairness and justice	
E18	Respect to subordinates and clients	
F21	Encouragement to manage forest, rangeland, water, and soil resources appropriately	Motivational factors
N10	Encouraging people to respect nature, not abuse it	
E21	Establishing policies to encourage individuals who are active in integrated management	
N11	Encouraging rural women to participate in watershed management	
F22	Paying attention to stakeholder viewpoints	
L3	Encouraging local communities to participate in watershed management projects and plans	
E22	Motivating experts and those in charge to implement integrated management	
E23	Suitable data bank	Integrated information systems
E24	Accessibility of statistics and information	
F8	Up-to-date and sufficient information	
F9	Meeting stakeholders' information needs	
E25	Suitable integration of new information	
F10	Exchanging information between all stakeholders	
F11	Development of information technology	
F12	Creating easily understood communications	
E26	Creating and developing communicative channels among stakeholders	
F13	Improving the relationship between research, education, and extension work	
F23	Belief in integrated management on the part of legislators, decision-makers, and those in charge	Attitudinal factors
N8	Stakeholder interests in integrated management	
N9	Confidence of NGOs in watershed management	
L4	Trust in local communities and public sectors	

(*Continued.*)

Table 1. (*Continued.*)

Code	Concepts	Categories
E27	Attitudes of stakeholders (e.g., local communities, public organizations, and NGOs) towards natural resources	
F24	Stakeholder perceptions and thoughts regarding watershed sustainability	
E28	Development of jobs not dependent on natural resources, to reduce the pressure on natural resources	Improving credit and financial resources
N14	Improving the capacity of the tourism industry to create sustainable livelihoods	
N15	Using suitable methods of agriculture and animal husbandry to increase local incomes	
L8	Establishment and development of small credit funds to support watershed projects	
E29	Using private sector and cooperative capital	
E30	Budgeting and suitable allocation of credit and financial resources	
F32	Developing a systemic view among stakeholders	Integrity and systems thinking
F33	Developing the culture of cooperation among all stakeholders	
E33	Organizing various stakeholder groups	
E34	Coordinating all organizations and related institutions	
F29	Long-term planning of watershed management	
N12	Integrated consideration of upper and lower regions of watersheds	
N13	Coordinating all projects and economic–constructive activities based on coordinated watershed management designs	
F35	Identifying elements of watershed sustainability	Research and development
E35	Identifying standard geographical units	
E36	Development of economic-social studies	
F36	Implementing spatial planning design	
E38	Implementing monitoring and evaluation systems to follow activities and implemented reforms and applied recommendations	
E31	Local community participation	Participation of all stakeholders
F34	Private sector participation	
E32	Using the abilities of NGOs	
L7	Establishing a local-level watershed council	Establishing councils and cooperative committees
E38	Creating a provincial-level coordinating council	
E39	Development of national-level strategic committees	
E40	Establishing technical committees, planning, and monitoring participation	
N16	Establishing integrated management think tank including the participation of local people's representatives	
F37	Empowering local people	Social consequences
E42	Reducing the migration of local people to cities	
L9	Increasing local communities' willingness to accept responsibility for protecting, renewing, and exploiting natural resources	
E43	Increasing the sense of natural resource ownership	
E44	Improving internal and external organizational coordination and consistency	
E42	Improving local people's livelihoods and reducing poverty	Economic consequences
N17	Improving economic welfare based on healthy environmental conditions	
F38	Preventing the waste of energy and resources	
N18	Reducing the dependence of projects on credit and government financial aid	
E45	Reduce administrative costs by avoiding duplication of work in organizations	

(*Continued.*)

Table 1. (*Continued.*)

Code	Concepts	Categories
L10	Increase in livestock and agricultural production	
N19	Creating and maintaining balance among different watershed elements	Environmental consequences
F39	Persistent effects of ecosystem fertilization (human and natural)	
F40	Moving towards sustainable development	
N20	Protection of biological diversity	
N21	Protection and sustainable exploitation of natural resources	
N22	Protection and expansion of green space and vegetation cover	
F41	Control of soil erosion and sediment movement	
F42	Control of water use or gathering and injecting water into underground aquifers	
E46	Mitigating the effects of unexpected events such as floods and droughts	

Local communities' violation of laws affecting watershed basins is another causal factor identified in the integrated watershed management approach. These legal violations include the lack of attention to seasonal grazing factors as well as the use of saplings, trimmed tree branches, and cultivated tree fruits as livestock fodder. Unsuitable uses of forest areas, including the cutting of wood for fuel, pose serious threats to these valuable environments and are among the most destructive forces affecting forests.

Contextual conditions

As mentioned above, physical conditions of the watershed together with infrastructure and constructed facilities are contextual conditions affecting the implementation strategies of integrated watershed management. The physical conditions of the watershed itself include topographical and geomorphologic conditions, natural diversity (e.g., forest, rangeland, water, and soil resources), complex watershed dynamics, and natural resource limitations.

In the interviews, it becomes clear that infrastructure and constructed facilities are crucial for integrated watershed management, which cannot be separated from rural development. The consequences of the lack of rural development, such as widespread poverty, increasing inequality, and migration, have serious effects on watershed management.

Intervention conditions

Intervention conditions are broad-based, general conditions with the ability to facilitate or impede watershed management. In fact, these conditions can facilitate the selection of strategies while engendering problems during their implementation (Rodon & Pastor, 2007). In the present interviews, extension-educational factors, attitudinal factors, motivational factors, and professional ethics were identified as intervention conditions.

Extension-educational factors constitute a widespread category of factors affecting integrated management. They facilitate the selection of strategies, such as the participation of all stakeholders, research and development, and integrity and systems thinking. In the interviews, the importance of making local people aware of plans and rules for protection/exploiting natural resources and holding

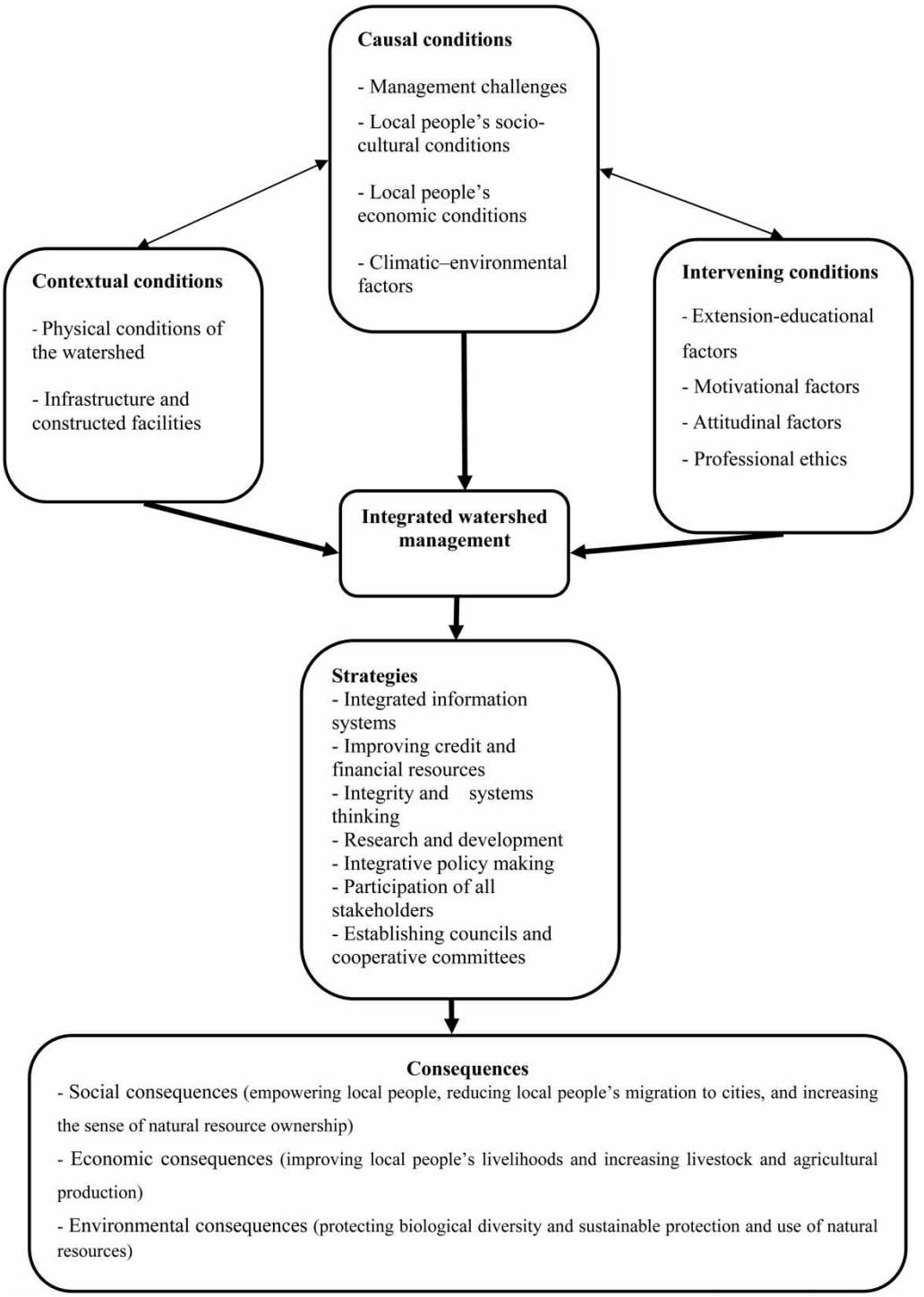

Fig. 2. Paradigmatic model of integrated watershed management.

extension-educational courses was emphasized by local community representatives. Attitudinal factors or stakeholder perceptions, attitudes, and beliefs are factors that affect the implementation of integrated watershed management. Motivational factors are known to be another intervention condition. Finally, a fundamental principle of integrated management is the consideration of ethical values, which facilitate many management mechanisms: professional ethics greatly helps organizations reduce tension and improve success in achieving objectives.

Core phenomenon

The core phenomenon or core category is the central idea or event to which all actions and reactions relate. This category is a subject or concept that must be considered when creating the framework or design (Mohammadpour, 2013). Our study reveals that integrated watershed management is a concept that encompasses other categories and has numerous analytical aspects. In general, it can be said that the interviewed community members emphasized integrated watershed management as derived and abstracted from other main categories. In fact, watershed management is not limited only to implementing technical and construction initiatives for soil conservation and erosion control, fisheries improvement, but also encompasses changing human society and its relationship with the environment. For this reason, the phenomenon of integrated watershed management was considered a fundamental factor and central paradigm of watershed management in Iran.

Strategies of integrated watershed management

The categories presented as fundamental to integrated watershed management include integrity and systems thinking, integrated information systems, improving credit and financial resources, integrative policymaking, participation of all stakeholders, establishing councils and cooperative committees, and research and development.

Based on the collected data, the development of systems thinking among stakeholders is deemed likely to change the integrated watershed management process. On the other hand, integrated watershed management will be useless without considering the role of local communities (as key stakeholders) and their participation at various levels in decision-making and in planning, implementing, and monitoring projects. The integration of information systems is doubly important in watershed management due to the complexity and variety of environmental factors and of stakeholders. The rapid change of information technology is a main source of trouble when using information systems in organizations.

Consequences of implementing the strategies of integrated watershed management

Some extracted categories described the consequences of the applied strategies. The implementation of integrated watershed management had social, economic, and environmental consequences.

Empowering local people, reducing the migration of local people to cities, increasing local communities' willingness to accept responsibility for protecting, renewing, and exploiting natural resources, increasing the sense of natural resource ownership, and improving internal and external organizational coordination and consistency are all social consequences. The participation of local people as key stakeholders in watershed management projects empowers them to participate in watershed management.

Economic consequences included improving local people's livelihoods and reducing poverty, improving economic welfare based on healthy environmental conditions, preventing the waste of energy and resources, reducing the dependence of projects on credit and government financial aid, reducing administrative costs by avoiding duplication of work in organizations, and increasing livestock and agricultural production.

According to the findings, two important consequences of implementing integrated watershed management are the improvement of local people's livelihoods and poverty reduction in local communities. Besides environmental improvement, better economic welfare is an expected result of integrated watershed management. The consequences of creating and maintaining balance among different watershed elements, fertilization of ecosystems (human and natural), moving towards sustainable development, protection of biological diversity, protection and sustainable exploitation of natural resources, control of soil erosion and sediment movement, control of water use or gathering and injecting water into underground aquifers, and mitigating the effects of unexpected events such as floods and droughts were categorized as environmental consequences.

Integrated watershed management has the capacity to sustain balance between the various components of a watershed basin. In fact, the art of integrated management entails balancing various tracts of forest, rangeland, and desert in a watershed basin, so that these resources are managed in a coordinated and consistent way. In addition, integrated watershed management tries not to exploit water resources more than needed.

Discussion, conclusion, and recommendations

Watershed management in Iran needs to be developed via a combination of scientific approaches and indigenous knowledge. Results have indicated that an integrated approach to watershed management is one way forward and the aim of this study was accordingly to design a model for such management. The relevance of this study lies in its conceptualization of the concepts of watershed management in an integrated model. The extracted systematic model that synthesizes the different parts, including inputs (contextual conditions, causal conditions, and intervening conditions), process (strategies of integrated watershed management), and output (consequences) could act as a basis for future quantitative research, in addition a road map for planning, implementing, and monitoring of watershed management projects by all stakeholders. Our interviews indicate that management challenges, climatic–environmental factors, as well as local people's socio-cultural and economic conditions are the most important factors affecting the successful introduction of integrated watershed management.

Based on the identified management challenges, we conclude that existing watershed management in Iran confronts diverse challenges and lacks the capability to establish the sustainable management of watershed basins. Studies by Mutekanga (2012), Smits & Butterworth (2006), and Sharma *et al.* (2005) indicate that the key challenges confronting watershed management are sectoral divergence, the structural weaknesses of organizations involved in participatory watershed management, and the lack of coordinated decision-making to encourage the participation of all stakeholders.

As mentioned, local communities' socio-cultural and economic conditions are other causal conditions that affect emerging integrated watershed management. In fact, factors such as lack of knowledge of sustainability issues affecting natural resource sustainability, disregarding the culture and customs of local communities regarding natural resource protection and exploitation, insufficient consideration

of women's roles in natural resource management, poverty of local people, and the relationship between people's livelihood activities and natural resources indicate a need for integrated watershed management. Mutekanga (2012), Asare (2011), and Ongugo *et al.* (2007) have demonstrated that poverty and local people's livelihood dependence on exploiting natural resources are factors that challenge natural resource management.

In another dimension, extension-educational factors, attitudinal factors, motivational factors, and professional ethics played intervention roles. They were able to facilitate strategies and management techniques such as research and development, participation of all stakeholders, and integrity and systems thinking. In this regard, Mutekanga (2012), Minato *et al.* (2010), Pahl-Wostl *et al.* (2007), and Stagl (2006) demonstrated that extension education workshops and encouraging social learning affected stakeholder participation in natural resources management. On the other hand, Bandoh (2010) concluded that stakeholders' positive attitudes towards natural resources affected their participation in managing these resources. Finally, it is essential to consider stakeholders' rights and to regularize norms such as legitimacy, responsiveness, honesty, and effective communication on the part of public and local officials in the interest of natural resource management (Ribot, 2004; Corbett & Lane, 2005; Lockwood *et al.*, 2009).

In this study, the contextual conditions for implementing strategies of integrated watershed management included the physical conditions of the watershed as well as infrastructure and constructed facilities. In fact, awareness of the topographical and geomorphologic features of watersheds accompanied by information about climatic conditions can provide a fairly exact picture of the qualitative and quantitative functions of the hydrological system. Infrastructure and constructed facilities such as accessible transportation as well as educational, welfare, and sanitary centers all affect integrated watershed management. Mutekanga (2012) and Al-Busaidi (2012) have demonstrated that access to suitable transportation infrastructure is essential to implementing watershed management projects. The development of transportation infrastructure is usually problematic given existing environmental conditions in underdeveloped locations.

In this study, stakeholder participation has been identified as a fundamental means of watershed management that facilitates the use of indigenous knowledge and the establishment of social justice. We also recognize various strategies for integrated watershed management. The participation of all stakeholders is a fundamental and inevitable strategy. Creating jobs and substitute livelihoods to reduce the population of rangeland users and developing appropriate activities such as horticulture, fisheries, small industry, and ecotourism are ways of establishing sustainable livelihoods for local communities.

Local communities' participation in planning activities and participatory evaluation will increase their capacity for natural resource management and help develop their sense of ownership of these resources. Another effect of integrated management is that it reduces dependence on government credit and financial aid, as all stakeholders participate in integrated watershed management projects. In turn, the sustainability of watershed projects and the protection of water and soil resources will improve.

Findings indicate that one environmental effect of integrated watershed management is to reduce the effects of unexpected events such as floods and droughts. In fact, the effects of such events can be reduced by identifying climatic conditions, making spatial plans, implementing suitable rural development plans in watershed basins, and amassing integrative information about the climatic conditions of watersheds. This issue calls for the implementation of integrated watershed management.

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