

# Identify in Indigenous Knowledge and its Application in Rural Crisis Management by Emphasizing Drought, Flood and Earthquake (Case Study: Zuzan in Khaf Province)

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## ABSTRACT

Natural disasters had harmful effects on human societies from past. Therefore, people in different societies, during history, have tried to cope these disasters and to reduce susceptibility which were highly effective. In contrary, emphasis on using developed technologies and its development in rural communities has no benefit except destruction of the environment and undesired outcomes on natural resources and even has intensified these disasters. Therefore, indigenous knowledge is an efficient knowledge which has been developed in a certain society under certain conditions and because of change and evolution over time, has found the capability of mixing with new knowledge such that using indigenous knowledge and restoration this valuable knowledge is a useful step for developing the purposes of sustainable development. This study aims to identify the local knowledge of rural people for coping with drought, flood and earthquake which is a necessity in the development and extension process. Data gathering method is field study and interview with some experienced people, especially expert farmers in the Zuzan plain in Khaf province and in these studies, the basis is using qualitative methods and approaches that using indigenous knowledge like participatory rural appraisal (PRA). Findings show that using indigenous knowledge will reduce damages caused by natural disasters in rural communities and can improve the prevention and preparation process against these disasters and their restriction. Also, in the case of combining with modern knowledge, it will improve the efficiency of modern knowledge.

**KEYWORDS:** indigenous knowledge, drought, reducing risks of natural disasters in rural areas, Zuzan plain area

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## 1. INTRODUCTION

Human communities have been always faced natural disasters like flood, earthquake, drought and etc. and have suffered many damages and losses of these disasters. This is very severe regarding the position of Iran, placing in middle latitude and arid and semi-arid belt, seismic belt and flooding area of permanent rivers and overflow of seasonal waterways such that according to the statistics of civil program of United Nation (<http://www.undp.org.it>), among 40 disasters that occur in the world, 31 cases occur in Iran. Presence of these natural disasters in our country makes it one of the top ten disaster countries (Dadkhah Haghighi et.al, 2004: 37). These disasters destroy the income resources of people and their life possibilities and activity centers which lead to economic and physical damages (Yodmani, 2001: 10).

Rural communities and their production activities (especially agriculture), due to close relationship with natural environment, nature of production factors, working in outdoor (Shirzad et.al, 2005: 23) and limited capacity, have been exposed to these limitations and unpredicted events such that their actions lead to higher capacity against natural disasters (Vazin, 2007: 30).

In this regard, a new approach is presented for managing natural disasters and reducing susceptibility in coping these disasters (Yodmani, 2001: 5). Indigenous experiences or “indigenous knowledge” is sum of experienced and awarenesses that a society obtains by encountering problems and uses it against risks and disasters.

Therefore, this research with the aim of reducing environmental damages in rural areas, studies the indigenous knowledge of rural people in study areas in Khaf Province in order to use these experiences in optimal management of immunization and encountering natural risks in rural areas. Therefore, this research tries to answer this question that how can we use indigenous knowledge and local experiences for reducing environmental damages?

## 2- STUDY AREA

Zuzan plain is one section of Khaf Province located in the south-eastern of Khorasan Razavi. This is 3992km<sup>2</sup> area in north latitude 33°55' to 34°53' and East latitudes 59°22' to 60°5' and divides into villages Kayber and Zuzan and about 41% of area. Qasemabad is the center and the only town of this Province. This section have 25 rural points that Zuzan village is the capital of Zuzan town and Ibrhimi village is center of Kayber village.

Present research has been conducted in the Qasemabad and its villages. Its access road is via Khaf-Qaen access road which is asphalted with unsuitable quality. Dry farming (wheat and barley) and water farming (grains and summer crops) are cultivated in this area. Common pattern of exploitation in this area is household, farmer and sharing and almost all farmers are owners. Each unit includes almost 24 farmers to fields, with one water source such that each unit

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has canal or deep well and about 5 cans and 20 deep and semi-deep wells are used for irrigation in this plain for irrigating fields and in fact, water is scarce and land is abundant and water circulation loop is 12 days. Resource of agriculture water is ground water and drinking water is provided by this source. Ranges of this area are exploited seasonally and its climate is semi-arid.

### 3- MATERIALS AND METHODS

For evaluating programs, there are various models that have certain methods for evaluation approaches and purposes. Most evaluation methods which are used widely throughout the world are non-participatory. In these methods, experts with a brief visit of site and completing questionnaires in which statistical analysis and considering middle responses is dominant criterion, they evaluate the performance. Despite all these benefits, these evaluations methods are biased due to design of questions and mean and hiding diversities.

This study has used participatory rural evaluation method as research method, a method that has done with the aim of empowering local habitants in improving and organizing and its results will lead to sustainable rural development which will briefly introduced in following.

#### 1.3 Participatory rural appraisal

Participatory appraisal includes collective evaluation of participants and users in a program or project. It is a people-oriented process through it the project users transform to key analysts and actors of appraisal process. PRA method is the process of gathering information about villages which are analyzed by people and their intervention. This method emphasizes on the activation of informers; those informers who are not considered yet and instead of completing questionnaire, survey and interview groups are used (Hamadan & Vayci, 1990: 8-12). This method was used from second half of 1980s. In this method, local people conduct drawing, modeling, ranking, scoring, observation, analysis and planning (CHamberz, 2002: 211). Approaches and participatory methods are introduced with improvement and correction in data gathering method and are known as participatory rural appraisal (PRA). In this method, simple and comprehensive techniques are used for data collection and it can be found that at the end of data registration step, it can be analyzed. In this process, villagers or informers are considered as problem analysts and researchers are facilitator and this is villagers who present results and have key rule in data collection and results (Nader Nahdi and ayci, 2002: 65).

Because of participatory appraisal method has more than 30 different techniques, the most important methods and techniques in this research are:

- semi-structured interviews and interview with informed individuals;
- study and data appraisal and learned lessons matrix;
- seasonal calendar and activity diagram;
- causal diagram of aquifer methods and application reason;
- analyzing attitude of villagers about related problems;
- discovering alternative solutions;

Regarding research method, participatory rural appraisal and specific feature of this method i.e. lack of generalizability of results, sampling was not done in this research but it was conducted as semi-structured interviews (individually or 4-5 groups) with informed, expert and experienced people in indigenous knowledge about natural risks and it can be said that 17 individuals were interviews in Qasemabad town and Asadabad and Zuzan villages and data were gathered.

#### 2.3 Definition of indigenous knowledge

Researchers have presented various definitions for indigenous knowledge and each has considered it from a certain view. In most of these definition, titles like indigenous knowledge, technical indigenous knowledge, ethnic knowledge, ethnic ecology, local science, people science and rural science are seen. Among them, indigenous knowledge or IK has been used more (Bozarjmehri, 2003: 13). Indigenous knowledge as a dynamic process is not limited only to material and physical form of environment but it is combination of people, time and place which is obtained through local experiences of people and evolves with social, environmental and technological changes (Vazin, 2007: 30-37). Therefore, it is effective for solving environment issues and reducing people susceptibility against natural disasters.

Attention to indigenous knowledge is accepting diversity in development and this principle is that all people are shared in diversity and richness of civilizations and cultures and build common human legacy. Without recognizing knowledge of indigenous people and its role in preserving the right of indigenous people, sustainable development cannot become successful because indigenous knowledge has the highest adaptation with sustainable development principles. Today, in post-modernism, the emphasis is on plurality not unity. Direction of post-modernism toward plurality which gives value to differences and non-harmonies regarding diversity of indigenous knowledge throughout the world (Welsh, 2004: 6).

Indigenous knowledge has some different aspects:

1. Conceptual aspect: indigenous knowledge which considers determining different aspects of indigenous knowledge.
  2. Technical aspect of indigenous knowledge which is related to its use in agriculture teaching.
  3. Philosophical aspect deals with attitude toward indigenous knowledge and its role in sustainable agriculture.
- Williams Mochina has defined indigenous knowledge quoted McKlour as a knowledge which is the result of experience and problem-solving based on trial and error by groups of active people which have used available resources in their

environment. This is a knowledge which is derived by a certain geographical scope and produced naturally (Chambers, 1992: 13-15). Part of national capital of each nation which encompasses beliefs, values, methods and practical awareness and result of centuries of trial and error in natural environment is indigenous knowledge which is transferred orally from one generation to other generation. Indigenous knowledge derives from real needs and possibilities and environmental limitations; therefore, it has the suitable consistency with condition of every area.

Chambers classifies indigenous knowledge into 4 different areas: a) farm activities; b) knowledge related to environment; c) capacity and talents of indigenous people; d) indigenous people tests. This diversity indicates the application of indigenous knowledge in different aspects and its close relationship with environment and people.

Attention to indigenous knowledge: one main reason of inattention to indigenous knowledge in developing countries is that colonizer countries ignore knowledge and information of people in these countries and always consider them underdeveloped. During recent decades, freedom of some countries from colonial agriculture and extension systems has increased the necessity of considering this knowledge by politicians, planners and scientists. During mid-1980, new attitude was presented as "prioritizing farmer" that concerned the indigenous knowledge. Before this attitude, it was imagined that development of management needs people outside of village system, but in two recent decades, using people knowledge in development process was considered and their knowledge was considered as ideological bridge between new and traditional agriculture that helps researchers and planners. Therefore, recent attention to indigenous knowledge system is as follows:

1. Development in six past decades has imposed unprecedented pressures on natural resources (destruction of natural resources);
2. Development plan which is favored by rich groups and farmers;
3. Some crisis which developing countries' villages are faced with it have external origin and have been created by intervention of institutions outside the village;
4. top-down planning's have failed in managing local natural resources (Bozajmehri, 2003).

In fact, amount of effectiveness of one plan depends more on its scientific and cultural position and its adaptation with customs of area. Experience shows that unsuccessful development policies in recent century and undesired environmental consequences of these policies was due to archiving maximums (maximum exploitation of natural resources, maximum production, maximum consumption and sale) that lead to destruction of ranges and projects, desertification, severe erosion, drought and etc. Today, it seems that those projects that are based on using high energy and technology, are not sustainable and therefore, using traditional systems is considered because of following reasons and their implementation were successful in different parts of Iran and world:

1. Implementing water maintaining projects that solve the problem of water scarcity, development of rural health and production and using ranges.
2. Traditional methods of water maintaining motivate the participation feeling of people.
3. Since these systems use cheap technologies and local aggregates, they have low implementation cost.
4. Most programs are people-oriented and can share society in obtained benefits.
5. Income distribution is based on environment and observing the justice and equality (Chakoshi et.al, 2012: 2).

### 3.3 Natural disasters and their management

Natural disasters are natural events which have destructive effect on society, such that it creates disastrous condition and disrupts the work of society. This condition has consequences and led to the death of some people (Smith, 2003: 17). Natural disasters can be classified based on their resource as following:

- Weather conditions like typhoon, severe cold and drought;
- Changes in the earth's surface like flood, avalanches and slip;
- Displacement of earth layers like earthquake and eruption;

And caused by non-human factors like natural fire, destruction of buildings, accidents and pollutions which are considered as other consequences of natural accidents (Shirzad et.al, 2005: 64). Natural accidents pose problems and issues for villagers that can create crisis in their routine life; therefore, it is necessary to manage these risks. Management of natural risks are actions which are done before, during and after accidents in order to reduce their effects. These actions are different depending on the types of natural and environmental risks which occur in these disasters (Alcantara-Ayala, 2002: 107-124). In the rest of article, we introduce the local knowledge of villagers in encountering drought, flood and earthquake which can manage these risks in different management steps.

## 4. RESULTS AND DISCUSSIONS

### 4-1 drought

Undoubtedly, one of the important factors of sustainable factors is access to water resources that brings life and its lack is poverty and migration. On the other hand, our country, Iran, due to its position in middle latitude and arid and semi-arid belt is among arid areas of earth and with severe dry weather during 5 months with precipitation less than global mean has encountered water provision for drinking, agriculture and industry with significant problems. Drought is a significant process in our country which is repeated periodically. On the other hand, conducting different natural and agriculture resources and causes of success or failure in implementing various projects is caused by low access to water and annual precipitation in different areas especially dry and low water resources.

Regarding long history of agriculture and activities of natural resources in our country, users and farmers have used different methods for coping drought based on indigenous knowledge and area information among this indigenous knowledge can be used as important tool in development planning and management of water resources (tahmasebi et.al, 2006: 237). History of indigenous methods for managing water and soil in world, including Iran, reaches to 3000-5000 years and instead of new methods, these methods have efficiency in these areas (Arab &Dehvati, 2011: 8).

Agriculture history in Khorasan dates back to more thousands before ad because this province have semi-arid weather diversity without enough precipitation; therefore, in some years, it encounters drought and this caused that during centuries, farmers and villagers seek different ways for reducing effects of drought and low water and coping method. Result of these attempts has led to the formation of some indigenous knowledge. Collecting these experiences and findings can be considered as an effective weapon against droughts. Data of field studies relates to Khaf province, Zuzan plain and meeting farmers and visiting their farms and gardens which will be used by managers in order to use them with modern technologies.

#### 1. not-cultivating dry fields

Farmers, especially in the areas with less precipitation, re familiar with droughtphenomena and in drought years, they prevent cultivating dry forms that this condition continues in most parts of province during 2001.

#### 2. Reducing cultivation of water products

Because sources of ground water are limited and water reduces in the drought years; therefore, farmers of different sections in Zuzan plain, especially areas with gardens, reduce their water cultivation level to preserve their gardens and provide minimum water and prevent their drought.

#### 3. Building water storage pool or reservoir

In areas that canals and streams provide the required water for fields and gardens, water level reduces in drought years and if farmers want to direct water continuously to their farms, considerable amount of water evaporates and destroys; therefore, it is necessary to build water storage pool such that after filling the pool, its water uses for irrigating gardens and fields.

#### 4. Dispersion of flood for feeding ground tables

Main well of all canals are placed in the path of seasonal rivers and valleys which water flows in it and farmers by creating barriers in the path of water flow, slow and disperse it and because of high permeability, canals and streams become filled.

#### 5. Dry cultivation of melon

Jahannam plain is a suitable place for producing water melon but in recent years, it has encountered drought which should be solved with certain thought and action. In interview with three experienced farmers of this area, their method was described as following:

- Irrigating field before plow in autumn to spring;
- Plowing earth by 25-30cm depth in spring;
- Cultivating seed with 2m distance Suring plow and distance of rows is 1m;
- Giving soil to plants after growing for better using plant by soil moisture;
- Second soil giving step after the length of plants have reached to 20cm;
- Secondsoil giving step along with branching;
- Fourth soil giving step along with flowering;

#### 6. Using animal manure in gardens and fields

Animal manure has the capacity of absorbing and preserving moisture. Besides, regarding its exceptional capacity in providing nutrients required by plants in agriculture and it doubles the irrigation round and reaches it from 14 days to 26 days.

#### 7. Using straw in irrigating water

In drought years, preserving the moisture at the foot of trees and reducing number of irrigation times are effective factors in coping with drought. For this purpose, in most cases, farmers cover the trees with straw or grasses in order to preserve the moisture and increase the distance of irrigation and use saved water in other cases.

#### 8. Feeding main well of canals

Regarding that some gardens and fields are irrigated by canals and considering that in places irrigated by water, farmers have created sub-streams in the canal and therefore, they feed main well and increases their discharge. This is valuable method for coping drought by farmers.

#### 9. Removing sediments of canals

In most low water areas in Zuzan plain, canals have definite role in providing agriculture water and drinking water and destruction of walls of water transfer tried to remove the sediments of drought which increases the water of canals.

#### 10. Spading foot of trees

Spading foot of trees in summer in order to preserve moisture after irrigation and reducing water evaporation in pistachio gardens in rural areas are among factors which are effective in coping drought and can increase interval of irrigation and saves the water.

#### 11. Cultivating trees resistant to drought

Low water and drought phenomenon are main problems of most areas of our country and in order to cope this problem, farmers cultivate pistachio in most villages which needs less water and has low water and if it is treated well in first and second years, from year 3 it can grow with less water.

#### 12. Blocking irrigation water

Water transfer paths in most areas have coarse grains which causes the penetration of water and creates problem for farmers in droughts and low water years and in order to prevent water penetration in blocking voids in water transfer streams using clay.

#### 13. Restoring public canals

In drought years, in Hayatabad and Jahanabad, because of water scarcity, farmers removed sediments and revealed their sediments in order to prevent its waste in their gardens. Removing sediments was done during 2001-2007 because of drought.

#### 14. Cultivating less-demanding plants

Farm is irrigated after harvesting wheat and then plow it in autumn and in the second half of autumn and winter, precipitation will be stored in this land and in early spring, they cultivate carrot and chickpea which are less demanding and 20mm precipitation needs no irrigation.

#### 15. Giving importance to water division

Drought has caused that farmers give importance to determining the water right and scheduled program for transferring water and determine the water transfer path such that first farmers in the path receive the water first and last farmers receive last in order to reduce waste. Cement and nylon covers are considered by farmers.

#### 16. Water tank

Water tanks are traditional ground reservoirs which are built in the ground and transferred runoffs by a stream for use. Most water tanks are built by clay. Their main purpose is storing water for drinking water, residential and agriculture consumptions. They can reduce runoffs. 15 water tank are in Zuzan plain that 3 of them are used that one of them is in Jahanabad village.

### **4.2. Flood**

Our country is one of the dry parts of the world and has little precipitation. Therefore, sometimes heavy rains fall which it's high speed and less penetration of water leads to flooding and accidents in rural areas. People in this area have built structures that can block food and exploit it. Based on the studies, efficiency of indigenous methods of managing water and soil in different parts of country is very significant. These methods have long history in Khorasan and Khaf which are valuable.

According to the sayings of local people, some of cases which are used in study area are:

#### 1. Alignment mounds

In this method, embankment with soil mounds along with alignment lines are built with 10m distance with each other. 1-2m distance above mound is dedicated to above mound in agricultural products while other mounds are used as mounds in pond level which is appropriate with gradient changes of earth and runoff gathered behind embankments. Building band embankments along with alignment lines is one of the main techniques which is used for preserving species with range and grass value in steep slopes. This method is now using for preserving ranged in Zuzan plain.

#### 2. Crescent mounds

This method includes soil mounds which are built as crescent form in up-stream. Distance between embankments should be such that it creates suitable pond for collecting runoffs. Runoff gathers in the front of mound. Because of soil displacement for mounds, small holes are created that runoff gathers inside them and stores in the root of plant. Building these mounds for correcting and restoring has widespread application in ranges and grasses.

#### 3. Dispersing flood

In this technique, part of flood flow diverts from its path and moves toward nearby farms which are suitable for cultivating plants. In this area, water only stores in the root of plants and it is considered as rain complementary. Water flow transfers via soil wall to other place out of flood path. Implementing this system needs smooth and regulate land. 100hr land are irrigated by this method in Jahanabad.

#### 4. Soil mound

Soil mounds are structures with maximum height 5m and width 4m which are built for charging and controlling flood and its penetration to land and feeding ground waters. Soil Mounds are built at the beginning of path; therefore, they have less width. For constructing this structure, moist soils are hampered in 25-35cm layers and increase the height. In side of structure, overflow is done to exit the excess water. One of the main points in building soil mounds is investigating the site for penetration because if there is impenetrable layer in the soil depth, feeding aquifers is not done because it is the main purpose of structure.

#### 5. Long embankments

Soil embankment is a semi-round crescent form with 10-100m length and 1-2m height. Main application of mounds is preserving and maintaining tree, plant and annual species. This technique is used in up-stream of Qasemabad which are called Dayak.

## 6. Platform

Platform is generally used for lands with high slope and has penetrable soil. The purpose of this work is transforming steep slope to some steps with horizontal level and vertical walls. Using platform is for maintaining runoff, reducing their speed and growth of plants which lead to reduction in erosion.

## 7. Reservoirs

These reservoirs are built along the river in order to preserve the nearby lands. Usually, local aggregates are used in building these reservoirs. Height of these reservoirs is not more than 15m and homogenous soil is used in constructing it. Common soil is clay which has stability capacity. In order to build these dams, after selecting the given layer, a layer with 15-20 thickness is done in order to reach to given height. Width of these crowns is 5-7m and for every 1m reduction in height, 4-5m is added to width of dam.

Overflow of these dams is 2m below crown and this issue should be considered because according to obtained results, destruction of these dams was because of water passing which broke the dam wall. In Jahanabad plain, this technique is used for cultivating dry melon.

Since most activities are for controlling runoffs, important goals of controlling and managing wastewater can be summarized as following:

1. Preserving water by creating runoff penetration opportunity with creating small reservoirs;
2. Improving growth of plants via diverting water from main waterways and directing it in alignment lines.
3. Increasing plant cover with seeding.
4. Developing plant cover.
5. Preserving soil with water erosion.
6. Moving toward excellence of ecosystem.

### 4.3. Earthquake

From emergence of ecological sites, human has tried to answer his needs by dominating environment (Bahraini, 1992: 355). One of important forms of this dominance emerges in settlements such that our ancestors have considered forms and aggregates based on weather conditions and area (Mahmoud & Nikoghadam, 2008: 44).

Indigenous architecture of each country is important instance of sustainable architecture. Therefore, the question is that how can minimize susceptibility to earthquake by indigenous architecture?

Indigenous architecture is part of wealth and national capital which encompasses beliefs, values and understandings of each ethnicity. People meet their needs using this knowledge.

In past, people have found with experience that by vibrating the soil layers, building foundation vibrates by soil layers and this vibration transfers to building. This movement is higher in high part of building.

Another factor which is considered is position and place of place which should not be in sloppy parts and buildings should be constructed in places with suitable slope.

Points that are considered for reducing damages of earthquake were considered in construction including prevention of large doors and high width to height ratio of windows. In order to increase stability and solidarity of structures, stretch resistance of different elements are considered and steel reinforcement were used.

In order to create integrity, walls should be connected by horizontal strand round the building. These strands should have suitable stretch capacity.

Unfortunately, most cities and villages in Iran are near or above faults but design knowledge and technology for constructing buildings are developed during centuries which have less damages. Study of architecture legacy shows that they have not changed and damaged by quake. Therefore, it should be considered that recreating indigenous knowledge along with other technologies lead to reducing damages caused by earthquake.

Table 1: types of indigenous knowledge used in Zuzan plain for coping natural risks

Methods for coping drought	Methods for preventing flood	Methods for reducing risks of earthquake
-lack of dry cultivation farm	-alignment mounds	-reducing height to cortical dimension of building
-reducing water products cultivation level	-crescent mounds	-increasing high diameter of walls
-developing water storage pond	-dispersing flood	-reducing width of wall by increasing wall height
-dispersing flood for feeding gourd table	-soil mounds	
-cultivating dry melon	-long embankments	
-using animal manure in gardens and farms	-platform	
-using straw during irrigation	-dams	
-feeding main well of canals		
-removing sediments of canal		
-spading foot of trees		
-cultivating tress resistant against drought		
-blocking irrigation water		
-restoring general canals		
-cultivating less-demanding plants		
-giving importance to water division		
-water tanks		

Reference: research findings, 2014

## 5. CONCLUSION

Generally, owners and farmers are dependent on their natural resources and therefore, it is important that they be aware of their resources and manner of using them. Studies about using indigenous knowledge in preserving water and soil shows that rural societies have accumulated high knowledge about using sustainable use of water and soil resources using different innovations and their individual and collective experiences have provided guidance for preserving and managing water and soil resources against natural disasters.

Research findings show that indigenous knowledge is effective in reducing effective environmental damages and it is valuable resource about preserving and managing natural risks and improve prevention or reduction, reaction and reconstructing processes.

In water management field, evidences indicate that indigenous methods for management and optimal use of water, not only provides required water for human and animals but it is useful in developing agriculture lands. Based on the extracted indigenous knowledge, collecting and storing water is the main approach for resisting against natural risks and reducing them and for this purpose, methods like developing water collection ponds, aquifers and canals provides the better use of water and prevents waste. What is considered by indigenous experts is methods for reducing evaporation and precipitation by plant including correct plowing, suitable irrigation time and preserving trees in indigenous knowledge for reducing losses of drought that these techniques have helped to collecting water, reducing evaporation and reducing harmful effects even in harsh climate conditions.

In sum, we can say that management plans for these risks using local knowledge has features like less cost, simple implementation, using indigenous aggregates and adaptation with environment which are considered in controlling flood and sediment in aquifers.

Therefore, it is important to integrate indigenous knowledge system with scientific knowledge; it is necessary that development activists use is, especially for developing countries that major percent of their population depend on environment for livelihood and it is necessary that indigenous knowledge gathered and measured and used as practical model for managing rural crisis management.

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