



# Comparative study of the implementation of environmental policies to combat desertification in Kuwait and the Hotan Region of China

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## Abstract

Desertification is one of the most pressing environmental issues in the world today. The environmental problem of desertification can be remedied through better environmental management and policy—these methods are taken to be the most effective ways of combating desertification. This study comparatively analyzes the implementation of environmental policies designed to combat desertification in Kuwait and the region of Hotan in China. The natural causes of desertification in the two regions are largely the same; therefore, the comparison focuses on policies to control the human factors that cause the problem. The comparisons show that desertification policies in Kuwait and Hotan differ in five ways: the role of local government, laws and regulations, timeliness, public participation, and government funding for forestry. This study aims to share China's "top-down" model for implementing the environmental policies designed to combat desertification. Results demonstrate that the Chinese "top-down" model might be applied in Kuwait to combat desertification and improve environmental management. Although both Kuwait and Hotan are different in the political and economic system, both of them suffered from desertification, and desertification combating as a part of national action. The proposed assumptions provide a global strategy and a comprehensive project on combating desertification. Kuwait and China should thus enhance their collaboration and communication and make a joint effort to combat desertification via environmental policy management.

**Keywords** Comparative study · Environmental policy · Desertification · Kuwait · Hotan

## Introduction

Desertification is defined as "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors including climatic variations and human activities" (UNCCD 1994). Today, desertification is a global environmental problem, nearly one quarter of the world land area has become desertified. In Asia, of a total land area of 44 million km<sup>2</sup>, 37% (15.68 million km<sup>2</sup>) is taken up by arid areas.

Desertification has many causes, mainly natural factors and human activities, as shown in Fig. 1 (Hans et al. 2003). These reasons are the basis for the UN's joint action initiative. To analyze just the human factors contributing to desertification in Kuwait and the Hotan region of China, and the policies and regulations implemented to control these.

In the existing literatures, the emphasis of human factors mainly includes population growth, excessive grazing, urbanization evaluation of lateral forces on stabilizing piles and distribution of landslide-thrust, and resistance of slip mass

The literature comparing environmental policies designed to combat desertification (hereafter referred to as "desertification policy") is very limited. Typically, environmental policies in two or more countries are examined, their similarities and differences are enumerated, and an explanation of the observed differences is postulated. Few studies incorporate a holistic approach and comparative analysis in this field. Moreover, when compared to other areas of comparative public policy research, the material in this area tends to be highly descriptive.

In this work, the implementation of desertification policy in Kuwait and in the Hotan region of China is compared. Current

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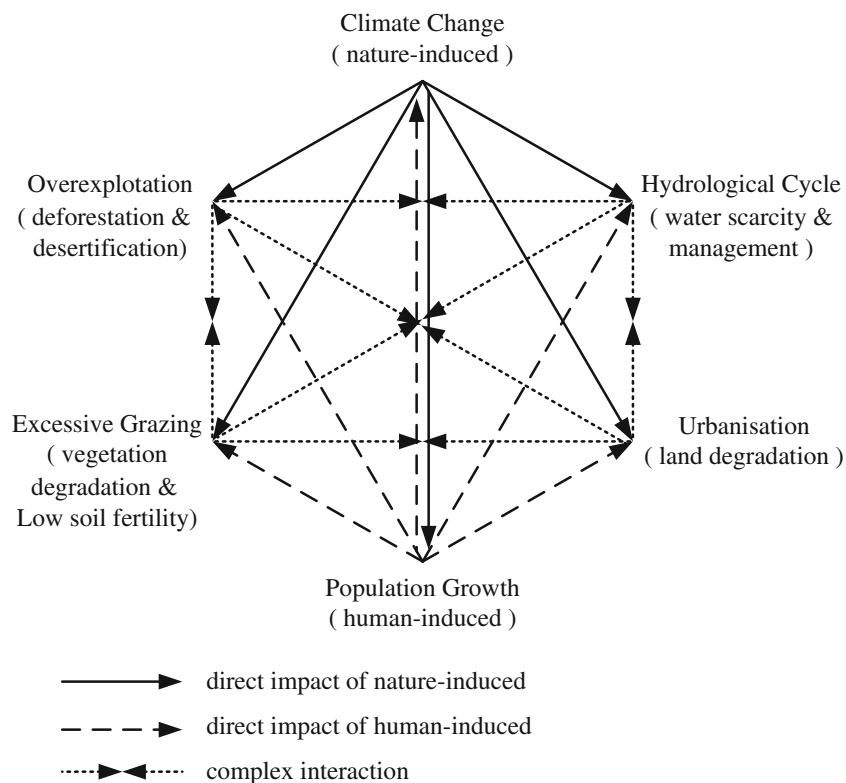
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**Fig. 1** Interaction between climatic and human factors causing desertification (Hans et al. 2003)



policy to combat desertification, protect the environment, and encourage development lags behind what the situation requires. Policy-making regarding desertification needs to be improved, and policy enforcement, local community involvement, and public participation in combating desertification all need to be strengthened. This study will benefit officials in Kuwait and Hotan by suggesting improvements to the legislative system designed to combat desertification and to improve the fragile desert environment. Moreover, it will encourage consideration of a new perspective of environmental management. To share the Chinese “top-down” model for implementing desertification policy and to enhance the public participation, the people in Hotan, highly environmental awareness, but without action, Kuwait has a better public participation in desertification control. Therefore, it is necessary to conduct a comparative study of the present environmental policies designed to combat desertification and achieve sustainable development in the two countries.

#### State of the art

- Land degradation and desertification is a serious global issue facing arid ecosystems. Liu et al. (2013) analyzed on household behavior shortfalls and concluded that desertification rehabilitation is not sustainable in China without continued governmental intervention. Li et al. (2015) analyzed the articulates sustainable development from a Chinese cultural perspective by tracing ideas from Chinese traditional culture and exploring China’s concept of harmonious development with emphasis on environmental management. Akhtar-Schuster et al. (2011) suggested to set up the scientific bodies, which coordinate and stimulate the global scientific research community to support mainstreaming and the up-scaling of efforts to combat land degradation, and could also stimulate national cross-sectoral and multi-stakeholder knowledge exchange. Jasem et al. (2003) recommended that the government of Kuwait should focus on five points, and the most important one is policies, regulations, legislations, and reinforcements. Fikry et al. (2013) investigated that the biotic and abiotic components of the desert ecosystem of Kuwait have witnessed progressive severe and extensive, and implement some national plan to protect the natural desert; the author emphasized policies, regulations, and legislation that play an important role in environmental management. As above mentioned, although domestic and foreign scholars have done more research on the environmental policies to combat desertification in Kuwait and Hotan, and the research perspective and focus are also different, the research results from the implementation of desertification control policies are limited; the specific analysis of the Kuwait and Hotan area belongs to the blank.
- The sections of the paper are arranged as follows. In the third section, the research scope, data, and method are introduced. In the fourth section, the comparison result is analyzed, to share “top-bottom” typical Chinese characteristics for environmental management. In the fifth section, the conclusion is presented.

Methodology

Study area

Hotan is located in the Xinjiang Uygur Autonomous Region of the Eurasian continent, on the southern edge of the Tarim Basin (Fig. 2). The desertified land area there accounts for 74.6% of the total land area. The Hotan region has a typical temperate continental arid climate, which features extreme drought, scarce precipitation, and high evaporation. The average annual temperature is 13.8 °C, though higher temperatures are often experienced, with large temperature differences between day and night. Average annual precipitation is 48.5 mm and average annual evaporation is 2400 mm. Annual sunshine hours received are approximately 2470–3000 h, meaning the whole area receives between 8 and 60% of the annual average sunshine possible at this latitude. The Hotan area is located northeast of the intersection with the northwest wind; therefore, dust and sandstorms are frequent, especially between March and May. Hotan area is the main Uighur ethnic minority areas, Uighur’s religion is Islam, the total population of the whole region is 212.34 million in 2014a, which accounted for 96.4% of Uygur, Han Chinese accounted for 3.4%, 0.2% others, the ethnic population natural growth rate of 11.56‰.

Kuwait is a sovereign Arab state situated in the northeast of the Arabian Peninsula in Western Asia (Fig. 2). It is bordered by Saudi Arabia to the south at Khafji, and Iraq to the north at Basra. It lies on the northwestern shore of the Persian Gulf.

Kuwait has a desert climate that is hot and dry, and 72% of its total land area is desertified. The summers are relentlessly long, punctuated mainly by dramatic dust storms in June and July when northwesterly winds cover the cities in sand, and can reach speeds of up to 50 km per hour. Rainfall is scarce and irregular: the total average yearly rainfall is approximately 89.6 mm. Recorded minimum annual rainfall levels have been as low as 25 mm, while the maximum recorded annual rainfall is 325 mm. The mean annual temperature is 26.9 °C, and average annual evaporation capacity is about 1400 mm. The Kuwaiti population is 348.00 million in 2014a, of which 98% of the urban population, the population growth rate is 4.34%, Islam is the state religion.

Data sources

Kuwait and Hotan are both located in Asia, and both have a typical desert climate. The natural factors that cause desertification are essentially the same in the two regions. These include high temperature, scarce and irregular rainfall, and high evaporation capacity (Evans and Geerken 2004). The proportion of desertified land and natural factors are very similar, as shown in Table 1.

The people in Kuwait and Hotan are both Muslim ethnic area, both of them have own Local knowledge. Local knowledge includes all types of culture-specific information, knowledge, skills, norms, taboos, codes of conduct, customs, norms of behavior, conventions, and traditions on desertification control that are based on local experience, wisdom, practices,

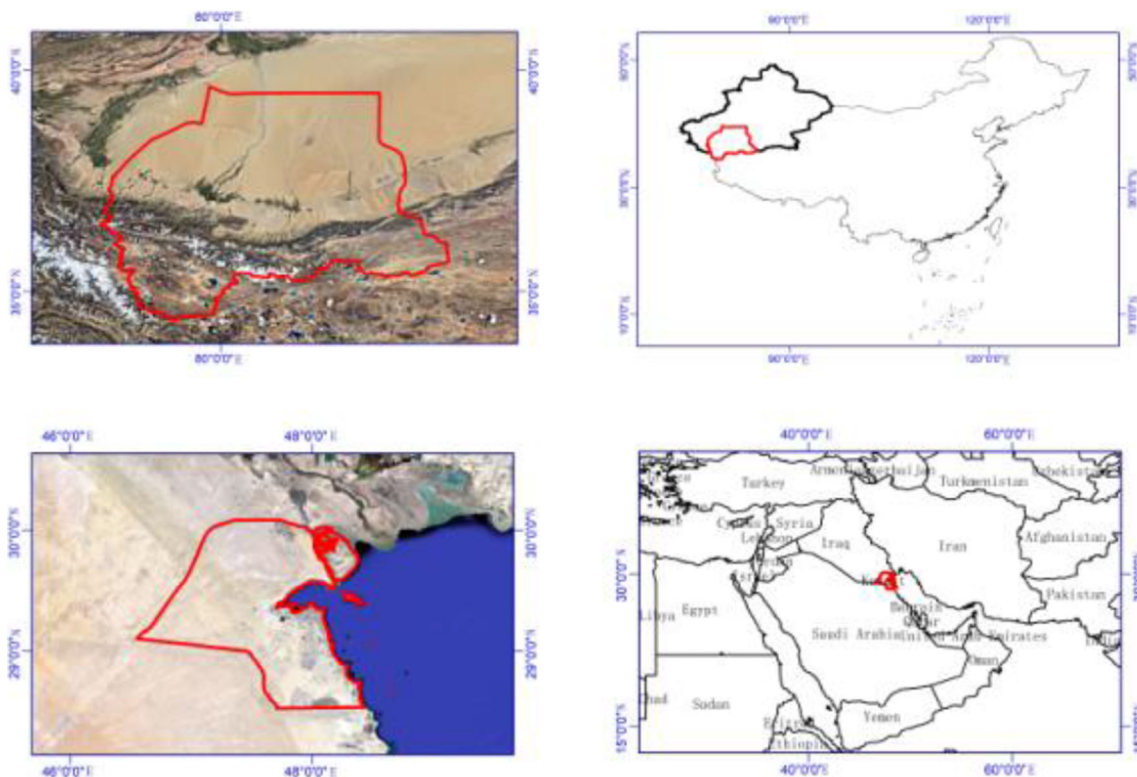


Fig. 2 Location of the study area in Hotan, China, and Kuwait

**Table 1** Comparison of natural factors

	Mean annual temperature (°C)	Average annual precipitation (mm)	Average annual evaporation capacity (mm)	Desertified land area (%)
Kuwait	26.9	89.6	1400	72
Hotan	13.8	48.5	2400	74.6

and histories and are mainly owned by the locals. The people in Kuwait and Hotan ecological ethics is a symbiosis of man and nature, the harmony between man and nature, man is a member of the natural ecosystem, rather than the master of the human nature management “on behalf of the ruler” (Yang 2015). Both of them prefer green, flag of Kuwait on behalf of the green oasis, represents life, where Uighurs are accustomed to settle, first planting flowers and trees where, when dig trenches poplar, willow species when the mill was built, fruit trees behind the house was built, pre-trial grapes.

Desertification in Kuwait is a process of environmental degradation of fragile ecological conditions by intensive human activities. Excessive economic activities can be considered the main cause of desertification in Kuwait (Shahid et al. 1999). Before oil development and production began in 1964, the Kuwaiti population was less than 150,000 and the economy mainly relied on the export of pearls. Changes in economic structure, rapid population growth, urbanization, and human activities have seriously affected the ecological environment, and desertification in Kuwait is becoming increasingly problematic (Jasem et al. 2003). To combat its increasingly prominent environmental problems, Kuwait has enacted a series of laws and regulations on environmental protection, pollution, human health, and animal and plant resources. It also actively participates in regional and international environmental conferences and forums. The Kuwait Environmental Protection Act, enacted in 1981, is the foundation of Kuwaiti environmental protection (Schwilch et al. 2014). Table 2 presents desertification policies and the effect of their implementation in Kuwait.

Sources: Aliyu and Naeema (2015), Benson and Jordan (2009), Mohamed (2001), Ma (2005), Grimm et al. (2000), and David (2008)

Desertification in Hotan is also driven by human factors. For a long time, over-cultivation and overgrazing have occurred as a result of the production of food and to meet the basic needs of local residents. This has resulted in a significant reduction in forest area in the region and has increased the amount of barren farmland, and grassland and vegetation degradation, making the already fragile ecological environment deteriorate further, and making desertification a serious problem. In light of this situation, the Chinese government has developed a series of environmental policies, and the local government of Hotan has developed desertification policies specific to Hotan. The environment of Hotan has been improved by these policies and regulations: this is evident

because desertification has been mitigated and the living conditions of local residents have improved. Table 3 presents the policies designed to combat human factors driving desertification in Hotan and the effects of these policies.

Sources: *National report of the People's Republic of China on environment and development* (Bai et al. 2014; Fleishman 2004; People's Republic of China 2010)

#### Data analysis

Table 4 compares the desertification policies of Kuwait and Hotan and their implementation. It reveals that they differ in five key ways: (1) the role of local government, (2) laws and regulations, (3) timeliness, (4) public participation, and (5) government funding for forestry.

Sources: Harashima and Morita (1998), Li and Yu (2011), Li and Higgins (2013), Yang et al. (2013), and Zhang et al. (2015)

## Result and discussion

This study focused on policies of desertification control as a viable and strategically important method to enhance land availability and sustainability for socio-economic development in Kuwait and Hotan. Various forms of environmental management—the notion that environmental problems like desertification can be solved through better environmental management and policy—are taken to be the most effective response to combating desertification. The pressures on the resources and environment of a rapidly developing country are such that natural conservation issues often take second place in the official order of priorities (Mi et al. 2016; Fu and Liu 2017; Li et al. 2018; Liu 2017; Alberti et al. 2003).

The results of the study show that problems in Kuwait are related to inadequate legislation or lack of enforcement on land use and desertification control. None of the reports examined in this study focused on the policy of desertification control as an equally important action for coping with land use and water scarcity in Kuwait. The most important of these recommendations are the realization of sound policies, strategies and action plans, the development of models for integrated desertification control and management, sound land governance, capacity development, database and information systems improvement, technology transfer, public awareness, and the enhancement of research and development facilities (Said and Hameed 2014).

**Table 2** Policies and the effect of policy implementation on human factors in Kuwait

		Water management Establish water management; water reuse; water conservation; water efficient technologies
	Policies	
	Effect of policy implementation	(1) Wastewater is re-used for agricultural irrigation to replace the brackish groundwater. (2) The Kuwait Institute for Scientific Research (KISR) is in charge of research into water resources. (3) The Ministry of Electricity and Water (MEW) and the Soil and Water Division are in charge of using water resources efficiently.
Policies	Excessive grazing Establish a sound system of grassland utilization; establish Kuwait national desertification prevention and control committee	
Effect of policy implementation		(1) Set up reserves to protect animal and plant diversity. (2) Strict control of grassland grazing intensity and quantity of animals, especially camels. (3) Media campaigns to improve public understanding and implementation of the law to protect animal habitats. (4) In 2015, Kuwait began the “Green Belt” project, whose purpose was to improve air quantity, and to mitigate desertification, drought and the movement of the sand dunes. The project will involve planting a belt of trees and shrubs about 50–180 km long and 5–20 km wide within 5 years. The first phase will be in Kuwait’s northwest.
Policies	Urbanization Prevent and control unlimited industrial expansion and construction; conserve biological diversity; protect the ecological environment and achieve comprehensive development as national policy.	
Effect of policy implementation		(1) Increase investment to restore ecosystem balance and international cooperation. (2) Encouragement of schools and communities to engage in environmental education, and volunteer for environmental conservation projects. For example, on April 23, 2011, the Kuwait Environmental Protection Society launched a campaign to recruit “One million environmental activists”, until October 1 of the same year: the number of volunteers has increased to 861,657.
Policies	Over-exploitation of sand and gravel resources The King of Kuwait proposed to take appropriate measures to protect the economic, financial, and oil resources of the country. He suggested that the government and Congress should shoulder common responsibility, in order to prevent the waste of resources, promote spending rationalization, and increase government support to prevent the brutal exploitation of resources.	
Effect of policy implementation		(1) Rehabilitation of degraded components of the desert ecosystem. (2) Rational control of leisure camping practices and off-road vehicle traffic. (3) Reconditioning of the natural topography through filling quarries and pits, and even removal of unnecessary bund walls and any man-made obstructions. This is in order to re-establish the original aerodynamic conditions, and therefore maintain the natural sand migration conditions, while avoiding an imbalance in the surface sediment budget, as well as re-establish the natural shrub vegetation.
Policies	Rapid population growth In 1967, the Compulsory Education Law. In 1982, the law enacted obligatory literacy education. In 1984, policy was introduced to control the number of foreign nationals.	
Effect of policy implementation		(1) In 2013, the illiteracy rate was less than 10%. (2) Strict control of entry visas. (3) The government’s efforts have reduced domestic foreign labor, and increased developed education, culture, and other high-tech talent, and provided universal access to information technology.

China’s method of combating desertification has typical Chinese characteristics. The Chinese model involves the implementation of regulatory environmental policies at the central and local level by public organizations. China’s environmental policy is “top-down” (Fig. 3), which means that the decision-making bodies are the people’s congresses and people’s governments, in keeping with the governmental model of planned centralization (Liu et al. 2012; Liu 2010).

However, in China’s environmental legislation and policies, although many of the provisions on public participation, but the lack of ways on public participation, methodological issues, the lack of strong public participation to protect the rule of law and practical experience alone is not the public interest responsibility, and the public generally lack expertise. The public participation in combating desertification is mainly reflected in the supervising mechanism, which is the result



**Table 3** Human factors, policies, and the effects of policy implementation in Hotan

	Policies	Water management In 2012, the policy of “the State Council on the implementation of the most stringent water management system view [sic]” was introduced.  In 2013, the Xinjiang Uygur Autonomous Region People’s Government under the Hotan Prefecture Administrative Office issued a policy to “implement the most stringent water management system implementation [sic]” of the ‘three red lines’ control targets of the notice”.
	Effect of policy implementation	(1) The local government in Hotan has promoted efficient water-saving irrigation technologies.  (2) Local government has encouraged farmers to use efficient water-saving irrigation, and has also made efforts to encourage water conservation, public participation, penalties and rewards.
Policies	Excessive grazing In 1985, the Chinese government introduced the Grassland Law. In 2000, the Midwest Reforestation pilot workshop was held in Beijing. In 2002, the Chinese government enacted laws to prevent and control sand erosion. In 2013, the Chinese government announced the “National Plan to Combat Desertification (2011–2020)”.	
Effect of policy implementation	(1) Control of grazing capacity, zoning grazing, rotational grazing. (2) Pasture management for sustainable development, management of grazing season and grazing times, making drinking water distribution points reasonable. (3) Initiated capacity building and environmental education, to help farmers recognize that overgrazing is harmful for grassland ecological environments, and to consciously reduce the number of livestock reared.	
Policies	Urbanization In 2014, a new urbanization demonstration area was constructed in a desert area within Hotan.	
Effect of policy implementation	(1) Plans have been drawn up to establish blocks of land to preserve ecological function, alongside conservation areas, ecologically sensitive areas, ecological construction areas and ecological restoration areas, and to put forward specific countermeasures to combat urbanization, which causes desertification. (2) These approaches involve saving water resources, ecological restoration and construction of key, vulnerable ecological areas, control of desertification and salinization, overgrazing control, urban environmental management, etc. (3) Better planning of construction by setting areas where urbanization is banned outright, establishing restricted construction zones, and controlling spaces suitable for construction, as well as constraining specific behavior related to development and construction.	
Policies	Over-exploitation In 1984, the Chinese government enacted the Forest Law. In 2000, the Premier emphasized that ecologically friendly construction and environmental protection are fundamental for large-scale development in western China. He suggested a step-by-step plan for reforestation and ecological construction to improve the ecological environment and production in western China. In 2002, the “Xinjiang in 2002 reforestation plan” was started.	
Effect of policy implementation	By the end of 2014, the construction of an artificial flood diversion, sand-fixing oasis on the forest periphery and poplar tree windbreak was completed in Hotan. The total forest area in the region is 1,240,780 ha, of which 325,307 ha is made up of plantations. The area of land dedicated to fruit production in 2014 was 190,153 ha, generating a total output of 577,900 t, representing an increase of 9.3%. Specifically, the production of walnuts increased by 20.1% to 120,700 t, jujube production increased by 30.6% to 72,900 t, grape production increased by 5.3% to 192,000 t, and the production of pomegranate increased by 0.6% to 15,500 t.	
Policies	Rapid population growth In 1998, the “National Health Project” was started, and in 2001, the “Citizen Ethics Construction Program” was enacted. These policies aimed to meet government targets to: increase the popularity of 9-year compulsory education, reduce the illiteracy rate; promote good pre-natal and post-natal care; give priority to education development, vigorously develop rural education, and double investment in funding for rural basic education in Hotan.	
Effect of policy implementation	(1) The campaign to provide universal free education is complete in Hotan. (2) Public environmental awareness in Hotan was improved by participation in the June 5 World Environment Day and June 17 Combating Desertification Day.	

**Table 4** Differences in the implementation of desertification policy

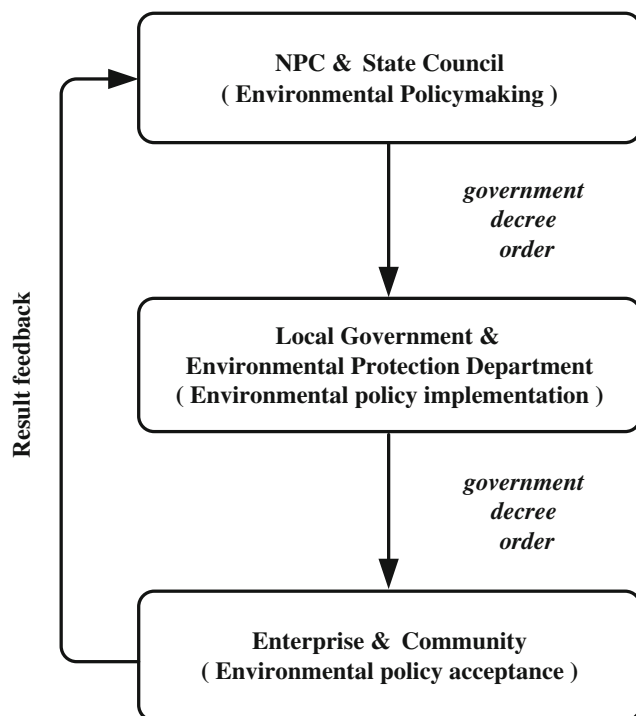
		Role of local government
	Kuwait	Environmental protection does not involve local government participation, and the most senior environmental committee is responsible for all environmental issues.
	Hotan	China uses a Democratic Centralized System of governance, and local governments have limited autonomy. For this reason, the central government has dominated environmental protection activities. However, the Environmental Protection Law of 1989 requires that local governments accept responsibility for the maintenance of environmental quality. Local governments have therefore become more important.
<b>Laws and regulations</b>		
Kuwait	Kuwait has not yet passed laws to combat desertification. However, Article 41 of Law No. 42 of 2014, “Promulgating the Environment Protection Law”, stipulated that “Direct grazing or using lands in agriculture or exercising any other activity that would be detrimental to the quality or quantity of vegetation in any area in a manner leading to desertification, degradation of the environment or wildlife is strictly prohibited.”	
Hotan	The “Prevent and Control Sand Erosion Act” was enacted in 2002, which marked the start of China combating desertification by taking the legal route. This recognizes that the key to controlling desertification is “human management”, and uses legal means to manage people’s behavior in arid areas by regulating land use and management, and the development and utilization of resources. The “Prevent and Control Sand Erosion Act” provides legal authority and legal protection to local governments, and includes the establishment of social investment mechanisms, preferential policy-making, encourages and supports non-governmental organizations to participate in combating desertification, protects the legitimate rights and interests of combating desertification, and moderates the management of the program to combat desertification.	
<b>Timeliness</b>		
Kuwait	The government of Kuwait is increasingly concerned about environmental issues, and revised the Environmental Protection Act in 2014.	
Hotan	China has undergone a regime change from a “centrally-planned economy” system to a “market economy”, meaning there are new requirements for environmental policy. For example, on January 1, 2015, the new Environmental Protection Act was implemented. This law was modified to include requirements such as “to promote ecological civilization construction”, “the construction of Environmental Information System [sic]”, “every year on June 5 for the Environment Day”, “the preparation of national plans for environmental protection”, “establish more stringent national environmental quality standards for local environmental quality standards”, and “the government will establish and improve the ecological compensation system”.	
<b>Public participation</b>		
Kuwait	The Supreme Council for the Environment is responsible for policy-making and the drafting and revising of environmental laws and regulations, according to the inquired questionnaire results, the extent of Kuwaiti participation in environmental protection is relatively high	
Hotan	The public are concerned about the current high degree of public environmental problems, but the low level of participation, low quality and efficiency. According to the questionnaire showed that only 26% of the public that have been involved in activities related to environmental protection, and the public participation in environmental protection lack of knowledge and skills.	
<b>Government funding for forestry</b>		
Kuwait	National policy includes requirements to protect the ecological environment and achieve comprehensive development. There is no specific program to combat desertification that is given a certain amount of funding each year, but there are plans to invest more funds into the Agriculture, forestry, fishery and hunting affairs and services.	
Hotan	Central government funding for forestry in Xinjiang has increased in the last ten years, and in Hotan as a whole, although there was a decline in funding in Hotan in 2011. In 2011, the Fourth National Desertification Monitoring survey showed that the expansion of desertified land area in Hotan has been initially contained, and that desertified land area has begun to decline.	

of this connection, lack of respect and informed mechanism, expression mechanism, as well as appeal mechanisms.

### Conclusions

Relationships between desert and people created complex and diverse. Kuwait and Hotan not passive people to adapt to the desert environment, but creative to adapt, they play a huge initiative, in accordance with the principles of sustainable development by changing the past management, the use of

appropriate technology to establish a series of combating desertification policies and regulations to curb the trend of desertification of land, maintaining a balanced interaction between people and the environment. This could involve strengthening legislation governing environmental protection, ecological construction, and other local issues, as well as increasing environmental law enforcement, in accordance with the principles of sustainable development, public participation in decision-making, and integrated environmental management. This would gradually establish and perfect the legal system surrounding desertification policy and establish the



**Fig. 3** China's environmental policy implementation flow diagram (Source: NPC-National People's Congress)

government as the main regulating body. It would also increase education and public consciousness of environmental issues, and change the behavior of the whole of society to improve voluntary public compliance and participation in modern environmental management. Furthermore, this study has limitations, for example, the institutions play what role in desertification policy implementation? Thus, if science-driven institutional play an important role of desertification policy in Kuwait and Hotan region of China, in what methods can improve the effectiveness of science and have positive effects on the impact of science on institutional change? The study should be further tested in future.

Change in the future development of the traditional “top-down” and “bottom-up” policy to combat desertification single embodiment, to promote “upper and lower interaction” management mode conversion, more scientific and implementation of environmental policy, help to improve citizens' environmental action enthusiasm, better to understand the environmental policies implemented by the government, and to strengthen the citizens' right to information and initiative to help combat desertification maximize the effect of policy implementation.

Combating desertification requires a global strategy and a comprehensive control project. The time is ripe for strengthening partnerships between countries and peoples, and between governments and investors. Kuwait and China should enhance the collaboration and communication between them, and with the strategic support of the “The Belt and Road”

initiative, provide a potential incentive for collective action, build a regional solution, and make a joint effort of combating desertification via environmental policy management.

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