Chapter 2
Literature Review

This chapter is a review of the literature on the concepts and past studies conducted on watershed management. The methods, theories and models related to the evaluation of watershed management projects are also reviewed. This chapter is divided into two sections. The first section focuses on the various technical evaluation approaches carried out in Iran and other countries. The evaluation methods such as the use of double mass analysis, flow-duration curve and survey of structures for estimating sediment trapping efficiencies are also discussed. The second section examines the social evaluation techniques including people participation, benefits and levels of participation in watershed management.

2.1 Technical Evaluation of Watershed Management

2.1.1 Concept of Watershed Management

For planning purposes, watersheds are sometimes used as hydrological units and in some instances management units of river basins. Watershed management has been practised for many years in many countries, often with technical and financial support from a range of organizations.

At the watershed scale, watershed management is the formulation and carrying out a course of actions involving the manipulation of resources in a watershed to provide goods and services without adversely affecting the soil and water base (Sheng, 1990).

According to Dixon and Easter (1991), the watershed is a logical planning unit since it explicitly forces the recognition that sustains land development, depends on the interaction of all activities occurring within a watershed. It is also a convenient unit for performing economic analysis. Many aspects of resource land development can also be evaluated, including on-site and off-site impacts.

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Watershed management techniques include the use of structural and biological methods while management activities were planned to enhance economic and social status of the people living and sustainable exploitation of resources in the area. At the socio-economic level, Hufschmidt (1985) emphasized that the principle goal is to improve upstream conditions in order to maintain, or increase existing on-site output levels while reducing the adverse downstream consequences of land-use activities. It is not uncommon to encounter challenges between watershed communities and the various authorities involved in land use management and resource use.

On a more local scale, watershed management objectives may differ based on natural resource management problems in a given area. In some parts of the United States for instance, watershed management is mainly about protecting water quality and flood control. In the hilly semi-arid areas of India, the focus is on water harvesting and soil conservation. Watershed projects in developing countries generally however focus on typically three objectives, namely, to conserve the natural resource base, optimise agriculture with other natural resources and support rural livelihood to alleviate poverty (Kerr, 2007).

2.1.2 Watershed Management in Iran

In the early 1980s, watershed management in Iran emerged as the new paradigm for planning, development and management of the country's land and water resources. It began during the third Iranian Socio Economic and Cultural Development Plan as a national strategy for land and water resources development. This involved planning and project implementation to sustain and enhance watershed functions that affect the plant, animal and human communities within a watershed (Bagherian, Bahaman, Asnarulkhadi, & Ahmad, 2009).

In Iran, watershed management is mainly carried out at local levels including engineering, biological, bio-engineering and other management techniques (Ardakani & Sharifabad, 2005; Falavarjani, 2001; Niazi & Hassanpori, 2013). Figure 2.1 shows the typical watershed management activities in Iran.

2.1.2.1 Environmental Issues of Watershed Management in Iran

During the last few decades, land and water resources in Iran have experienced dramatic degradation due largely to land development and population growth in the rural areas. According to the United Nation Development Program (2006), Iran faced serious environmental challenges mainly due to unsustainable development and consumption patterns, over-population, institutional fragmentation, inadequate enforcement and socio-economic problems (Ahmadi, Nazari, Ghoddousi, & Ekhtesasi, 2004; Nasri, Feiznia, Jafari, & Ahmadi, 2013).

Consequently, land degradation had resulted in about 95 million hectares of natural lands in Iran exposed to flash floods (Ahmadi, Taheri, Feiznia, & Azarnivand,

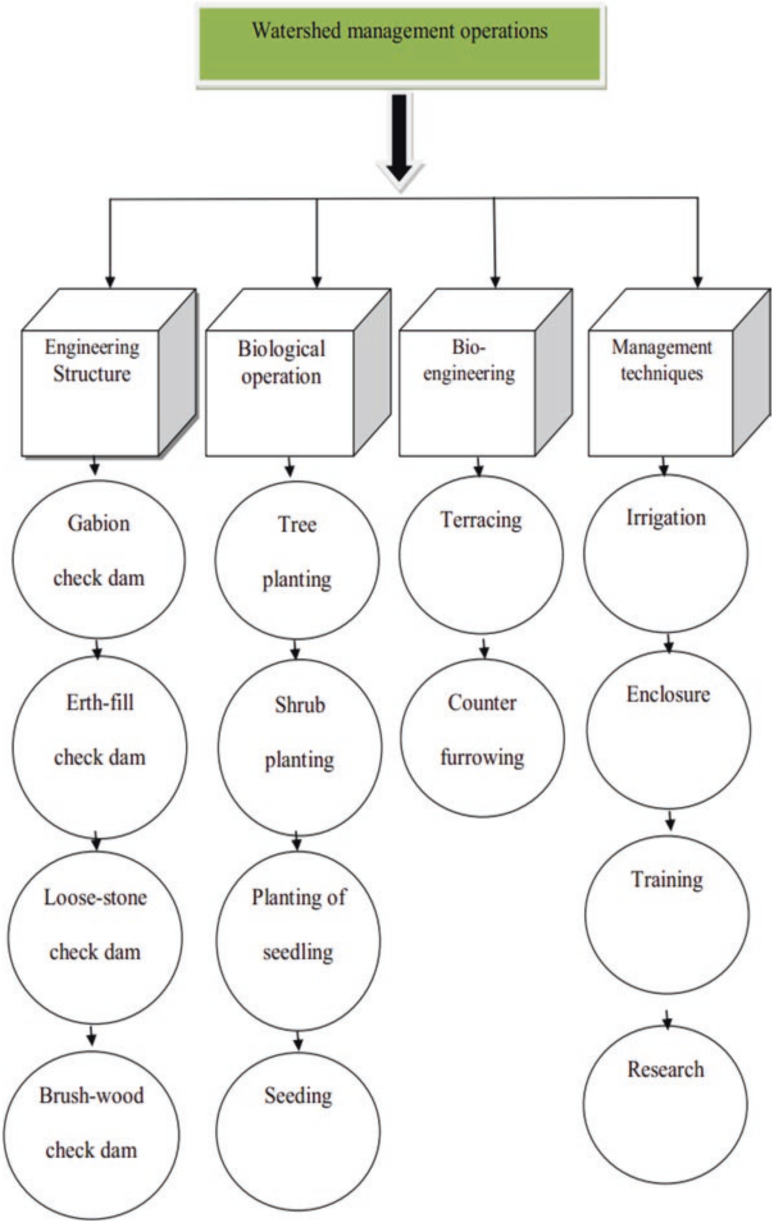

Fig. 2.1 Framework of watershed management operations in Iran

2011; Ghorbani, Jalalian, & Habibian, 2012; Hosseini, Ghorbani, & Torshizi, 2011; Nasri et al., 2013). Timber harvesting for example, led to the decline of forest land, from 18 million ha in 1970 to 12.4 million ha in 2005 (Safamanesh, Sulaiman, & Firuz, 2006; Shahrivar, 2012).

In addition, soil erosion is a serious environmental issue, which affects agriculture and food production. It has been estimated that the average annual soil erosion rate in Iran is more than 10 ton/ha, which adversely affected soil fertility in affected areas (Amiri, 2010; Hosseini et al., 2011; Lashkarian, Hashemi, & Shadfar, 2013). As such, soil conservation is an important consideration in the study watershed along with water conservation, particularly in areas where community agriculture is carried out.

2.1.2.2 Social Issues of Watershed Management in Iran

For sustainable management of natural resources, various policies have been drafted, the most promising of which is the management of natural resources through participation of the local people (Bagherian, Goodarzi, & Shadfar, 2011). The implementation of soil conservation and watershed management projects with people participation make farmers more willing to accept these projects. To develop a successful soil conservation programme, the review of socio-economic challenges in a watershed is essential (Karimi & Lari, 1995). This had led to an increase in the success rate of watershed management projects (Hematzade & Khalighi, 2006; Shafiee, Rezvanfar, & Hohieni, 2008).

2.1.3 WMP Practices Outside Iran

About the end of the nineteenth century, interest in watershed management increased considerably, particularly in drainage basins, which experienced impacts of land use change on water yield, floods and soil erosion (Ahmadi et al., 2004). After the Second World War, watershed management became a subject of great international interest.

Watershed projects were largely developed in the 1940s with varying objectives in the United States (Ahmadi et al., 2004; Noroozi, 2010) when institutional development was closely knitted with economic progress of the country (Gelt, 2000).

2.1.4 History of WMP in Some Asian Countries

Watershed management development took place in countries outside the United States, particularly in Asian countries where much land development took place after World War II. This was also attributed in part, to population growth and increase in the need for food production.

As summarized in Table 2.1, countries such as India, Sri Lanka, Pakistan and Nepal began their watershed management programmes activity in the 1970s. Equally, in Southeast Asia, such programmes were also initiated in the 1970s. Various programmes were initiated from the establishment of watershed management offices to programmes showing the respective communities.

Table 2.1 Brief history of WMP in some of Asian countries

No	Country	Period	Watershed management activities	Source
1	India	1970s	Watershed management initiated	Singh (2000)
		1980s	Community participatory approach began	
		1990s	Development of ideas on sustainable agriculture	
		1994	Establishment of Ministry of Rural Development	
		2000s	Implementation, monitoring and evaluation of WMP	
		2003	Involvement of local communities in watershed management	
2	Sri Lanka	1975–1981	Monitoring of land use effects on runoff and soil erosion	Jayaweera and Zoysa (2004), Hakim (2009)
		1980–1988	Established 10,000 ha of pine plantation in upper watershed areas to improve vegetation cover in sensitive areas	
		1988–1993	Improvement agricultural drainage systems	
		1993–1997	Watershed Management Plan Committee was convened	
		1997–1998	Monitoring and evaluation of sediment in the dam catchments	
		1998–2000	Micro-watershed pilot studies to test appropriate techniques	
		2000–2007	On-farm and off-farm soil conservation programmes	

(continued)

Table 2.1 (continued)

No	Country	Period	Watershed management activities	Source
3	Nepal	1965–1970	The importance of soil and water conservation (SWC) recognised.	Singh, Kharel, Joshi, and Mathema (2004), Pandit, Wagley, Neupane, and Adhikary (2007)
			A systematic approach to WM was first adopted in Nepal in 1966.	
		1970–1974	Department of Soil and Water Conservation (DSWC) under the Ministry of Forestry established	
		1974–1980	– Policies to execute soil and watershed conservation extension were drafted	
			– Fourteen WM projects were implemented in four regions	
			– The approach to people's participation in watershed management in Nepal has been evolving since 1974	
		1982–1985	Environmental impact assessment (EIA) was made mandatory for land use development projects	
		1985–1990	– The Soil and Water Conservation Act was promulgated in 1982, followed by the Soil Conservation Regulation in 1985.	
			– Environment Division established	
			– National Conservation Strategy endorsed by Government	
		1992–1997	People participation plans drafted	
		1997–1998	Natural Resources Management Sector Assistance Program initiated	
		1998–2002	– Nepal Environment Protection Action Plan initiated.	
			– Emphasized people participation including NGO and civil society involvement and integrated WM	
		2002–2007	People's participation, integrated WMP	
4	Myanmar	1975	Watershed management programmes began	F.A.O. (1986)
		1986	Improvement of agricultural drainage and water supply system	
		1988–2004	Monitoring of land use/land cover effects on soil conservation	
		1998	Plans for Improvement of watershed resources initiated	
		2001	The participatory and integrated approaches in watershed management initiated	

5	Thailand	1970	Water resource management problems began	Krairapanond and Atkinson (1998)
		1975	Watershed management planning began	
		1991	Watershed Management projects were established in several watersheds in Thailand	
		1997	Watershed resource management was pronounced successful	
		2000	Improvement of watershed resource development	
		2004	Independent NGO was formed after project to continue activities	
		2005	Integrating watershed management for land degradation and improving agricultural productivity	
6	Indonesia	1970	Watershed management was formally recognized during 1970s	Vermeulen (2007)
		1976	National Watershed Development Program initiated	
		1980–1987	Integrated approach to watershed management initiated	
		2001	300 watershed management projects successful were acknowledged	
		2003	In rehabilitation of degraded forest lands, 470 watersheds involved participation from local communities was reported	
		2005	The Indonesian government introduced programmes to encourage local people's participation to plant trees, conserve forest and promote soil and water conservation	
		2006	Guidelines for watershed management implementation were introduced	
7	Pakistan	1950	Watershed management programmes were introduced	Tennyson (2003), Hakim (2009), Shah (2004)
		1955	Many integrated development projects failed to deliver long-term benefits was reported	
		1958	Watershed management projects improvement reported	
		1960	Pilot projects for watershed management were launched by the Water and Power Development Authority (WAPDA) in 1960, with the primary focus on afforestation and soil conservation on private lands	
		1970	Limitation of Small projects with the assistance of World Food Program in the selected watershed	
		1980s	Development socio-economic political unit for the planning and management of natural resources	
		1985	Development of people participation and community-based integrated watershed management programmes	
		2004	Watershed development programmes using participatory Rural Appraisal(PRA), Rapid Rural Appraisal (RRA) approaches	

2.1.5 History of WMP in Iran

Watershed management in Iran started in the 1950s as an integrated activity (Ahmadi et al., 2004). Reports in the early 1950s highlighted the need for rangeland and forest management to ensure reliable water yield and manage soil erosion (Mohammadkhan, Ahmadi, & Jafari, 2011; Tayari, Salehi, & Irandost, 2008). The important milestones and significant developments in watershed management are summarized in Table 2.2.

Although much recognition was given to the rationale for the need for watershed management programme up to the 1960s, watershed development had no significant impact on the development community in Iran in the 1970s. Only towards the end of 1980s did the situation change radically (Ghoddousi, 2005).

During the 1980s, a series of regional and national meetings on watershed management were held in Iran. The Iranian Government began to manage watersheds through donor supported programmes that had demonstration, training, education and research components.

In the 1990s, these programmes became popular in Iran, which included integrated rural development programmes. These watershed management projects, in turn, focused on increasing watershed productivity. Many of these integrated development projects however, failed to sustain the benefits the projects set out to (Karimi & Lari, 1995).

Several studies were conducted to evaluate watershed management operations. For example, Abbasi, Mohseni, Kheirkhah, Rostamizad, and Hosseini (2010) used the HEC-HMS (Hydraulic Engineering Committee-Hydrologic Modelling System) model for Kan watershed basin in Tehran province to assess the effectiveness of watershed management on runoff. The simulation results showed a reduction of 70% in peak flow and flood volume, which is attributed to the positive role of plantations and soil conservation programmes in reducing catchment runoff.

2.1.6 Literature Review of WMP in KAB

This section of the literature review focused on past studies carried out in KAB. Several studies were carried out from 1986 onwards, largely between Ferdowsi University of Mashhad in collaboration with the Ministry of Agriculture in the field of soil erosion studies.

In the early studies, techniques to control soil erosion, a serious environmental problem, were investigated (Table 2.3). Sediment yields along with soil erosion were determined to estimate the sediment delivery ratio (Saberi, 1995). In these studies, empirical models such as the Universal Soil Loss Equation (USLE) and Modified Universal Soil Loss Equation (MUSLE) were used for soil loss estimation.

Subsequently in the early part of 2000, studies on the effect of vegetation growth or revegetation of landscape and the positive effects on soil erosion were also under-

Table 2.2 Chronology of scientific watershed management activities in Iran (1950–2011)

Period	Year	Important development related to watershed management
1950–1960	1950	The Soil Conservation and Watershed Management Research Institute (SCWMRI) in the Ministry of Agriculture was established
	1951	FAO's experts reported on soil erosion problem in Iran
	1954	Watershed Protection Act was enacted with primary focus on conservation of water resources
	1955	FAO soil conservation and watershed management projects implemented in Karaj, Lar and Latian Dam watersheds
1960–1970	1960	Soil conservation operations under the supervision of FAO's experts were conducted in Syrachal Karaj
	1965	Report on statistics related to sedimentation and erosion in Iran published
	1967	Sediment and erosion plots were established at Karaj Dam with biological and engineering operations proposed and carried out
	1968	First Watershed Plan on Lar and Dez watershed Dam basin prepared by Tehran University
	1969	First Watershed Plan on Lar and Dez Dam basins was prepared by Tehran University
1970–1980	1972	Watershed Management Office in Ministry of Agriculture established
	1973	Implementation of large-scale engineering operations in Karkhe watershed
	1974	First comprehensive watershed management plan was prepared by Iranian experts
	1975	Local laws to protect the forest and pasture initiated
1980–1990	1980	During this year, many reports such as Latian, Lar, Karaj and Dez Dams were published
	1984	Educational workshops were conducted in over 250 villages. Revised rules and regulations were developed with watershed management
	1989	Participatory rural appraisal workshops initiated the Community Action Plan to co-manage watershed areas developed
1990–2000	1993	Improvement of Watershed Management Office in the Ministry of Agriculture Department
	1995	Efforts focused on collecting data (water quality and land use), analysis and interpretation (exploring land use and water quality relationships at a basin scale), and pursuing work on beneficial management practices
	1998	Watershed Management extended to most provinces in the country
2000–2010	2003	The Integration of Ministry of Jihad Construction and Ministry of Agriculture, and the new Ministry was established
	2005	Activities in the field of Watershed Management projects developed
	2009	Contribution of local communities in watershed management
2011	2011	Watershed Management projects in 16 provinces were established. About 10,000 check dams were established from the implementation of 25 projects in Range Management in the country

Source: FRWO, 2011

taken. Tabatabai, Ghoddousi, Golrang, and Abasi (2006), for example, reported that erosion rates decreased from 8 to 6 ton/ha/year due to the effectiveness of check dams (Table 2.3).

Table 2.3 Watershed studies conducted in KAB

No.	Study description	Researchers
1	The first watershed management study in KAB was carried out by Ferdowsi University of Mashhad (1986) in cooperation with the Ministry of Agriculture for on soil erosion control	Ferdowsi University of Mashhad (1986)
2	Study on water supply floods and soil erosion in Mashhad	Mohammadi, Ghoddousi, and Mashayekhi (2008)
3	Soil erosion and sedimentation studies using empirical models such as USLE, MUSLE, PSIAC, MPSIAC and EPM. Sediment yield determined was 22,043.79 ton/year and soil erosion was 698.58 ton/year	Saberi (1995)
4	Study on lichen ecosystem and vegetation for introduction of some plant species for watershed protection	Barkhordari (2006)
5	Sedimentation studies using geomorphic parameters such as area, slope, vegetation, geology and hydrology were assessed. The Aal sub-watershed generated the highest amount of sediment of 43,940 ton/year	
6	Study on landscapes and the role of karst in land drainage	Nasri et al. (2013)
7	Study on soil erosion showed reduction from 8 to 6 ton/ha/year as average vegetation cover increased from 25 to 31% in study area. Effectiveness of sediment trapped in check dams: Gabion check dam 72.25, Brush-wood check dam 22.5%, Loose stone check dam 65.8%	Tabatabai et al. (2006)
8	Flood studies using 1987–2002 data showed that the gabion check dams decreased flood risk	Taghvaee (2008)
9	Runoff depth using NRCS-CN method with GIS showed that no significant difference between the means of observed and estimated runoff depths ($p > 0.05$)	Ebrahimian (2008)
10	The Soil Conservation Service (SCS) model was used for the estimation of runoff from an agricultural watershed.	Hosseini et al. (2011)
11	A study on effectiveness of check dams suggested that the distance and the height of controlling dams have a significant impact on project cost. It was concluded that the suitable selection of the dam distance base on slope can lead to a reduction of 25.4% in construction cost	Abbasi et al. (2010)

Other watershed studies were incorporated in subsequent years, particularly those related to watershed hydrology. Arabkhedri and Zargar (1996), for example, reported on flood discharge. Several flood models were used in these studies, namely, the HEC-HMS models and NRCS-CN model, which attempts to investigate watershed runoff (Ebrahimian, 2008). GIS was also deployed to determine the spatial distribution of runoff generation in the same study.

More specifically, the effectiveness of check dams was also assessed by Abbasi (2012), where the findings suggested that suitable selection of check dam has not only been effective in sediment trap, but also in terms of cost reduction which is an important element in watershed management operations. For example, the study reported that suitable selection of distance base of check dams against slope reduced construction cost by 25.4%.

Based on Table 2.3, the major findings of studies at Kushk-Abad Basin are as follow. All physical and morphological characteristic studies of the basin were carried out by Ferdowsi University of Mashhad, Iran in 1986. In this case study, executive suggestion and cost estimates were specified for each sub-basin.

Saberi (1995) measured soil erosion and sediment rate of KAB and Kardeh basin. By using universal soil erosion model (PSIAC, MPSIAC, EPM and FAO) and hydrometric data of study area, they suggested construction of check dams in order to reduce soil erosion. Dimensions of check dams had been specified for each sub-basin.

Vegetation cover and types was studied by Tabatabai et al. (2006) and the findings of their study that revealed that vegetation cover can significantly reduce soil erosion and sediment rate. Also for estimating structure that was built at the basin, they presented significant differences by comparing the volume of built structures and predicted structures. They pointed out that these differences could have been triggered by the lack of public funds in the watershed management projects in recent years. They also declared that the occurrence of extended drought period could be the main reason for the failure of the bio-engineering projects.

Also the most important conclusion of studies conducted by Ebrahimian (2008), Izanlou and Vafa khah (2010) using HEC-HMS and NRCS-CN models is that Curve Number (CN) amount of basin has been reduced by watershed management operation. Also the variation in the amount of concentration time and lag time before and after WMP was measured, and it was probably due to increase in concentration time after operation.

One of the most central recent findings at the study area Abbasi et al. (2010) was investigating is the size of the check dams and the distance between them. An important conclusion of the study was that if distance between check dams calculation was based on channel bed slope, it would lead to 25% decrease in construction cost. This decrease can be effective in watershed management operation cost in the study area.

Previously, an investigation on land use and effect of vegetation cover and check dams on reduction of flood risk were conducted by Taghvaee (2008), and the findings concluded that Gabion check dam totally led to 12% reduction in flood risk.

According to several conclusions and findings from previous investigations in the study area focusing on flood, soil erosion, vegetation cover and built construction, it is imperative to adopt an integrated evaluation research approach in watershed management study. Also, there are three villages, Goosh, Bahreh and Kushk abad, at the study area. Whereas fulfilment of watershed management projects at the villages was accepted gladly, it would be necessary to evaluate the social paradigms and assess factors related to peoples' participation besides the technical evaluation aspect of watershed management operation. This research has been carried out to fulfil these aims.

2.1.7 Technical Evaluation of Watershed Management

This section concentrates on the literature relevant to the technical evaluation of watershed management operations, at national and international levels. In recent times, the scope of watershed management has broadened from the initial concept of technical evaluation to an integrated discipline that applies technical, environmental and socio-economic concerns (Tennyson, 2003).

2.1.7.1 Concept of Evaluation

Evaluation means the analysis and interpretation of baseline data against those obtained through monitoring. Evaluation shows the merits and demerits of implemented activities and provides feedback on the project phases so that they will be improved or adopted in future plans or phases. It also enables the elimination of errors from the design of the project, which usually occur in the early stages of the project.

2.1.7.2 Review of Technical Evaluation of Watershed Management Methods

To assess the impact of watershed management projects, two methods, namely, quantitative and qualitative, are frequently used (Kerr, 2007). The quantitative method may involve direct measurement or statistical in nature, usually involving before and after implementation assessments of a specific project. This is also accompanied by qualitative analysis where necessary to improve the understanding of an assessment.

The assessment of watershed management projects is fundamental to measure the effectiveness or even failure of the watershed management projects (Bagherian, Ghoodousi, & Rangavar, 2005; Rahimi, Soufi, & Ahmadi, 2012). Lack of evaluation and review over time can result in the loss of initial investment allotted for such projects (Rahimi et al., 2012; Shafiee et al., 2008).

Case Studies in Iran

In Iran, some quantitative methods have been applied in watershed management evaluation, such as double mass curve, moving average, flow-duration curve, rainfall-runoff and soil erosion modelling (Frootan, 2003; Mousavi, Heidary, & Khamse Pour, 2011; Sadeghi, Sharifi, Frootan, & Rezaee, 2004).

In these methods, daily precipitation and runoff data belonging to pre and post periods of implementation were collected. The double mass curve can show the positive effects of measures in runoff reduction. The reducing trend in runoff volumes can also be verified using a 5-day moving average. Studying the flow-duration curve can depict the obvious changes in water discharge and flow duration. The achievement of a gradual alteration in hydrologic response of the watershed can also be confirmed with the analysis of hydrologic regime. In Iran, among qualitative methods, the questionnaire technique is the most common approach for watershed management evaluation (Ahmadi et al., 2004; Hossini, 2003; Mohseni, Hoseyni, Ahmadi, & Najafinejad, 2008).

In Iran, despite the initiation of implementation watershed management projects during the past 50 years, natural resources continued to be degraded. Therefore, appropriate research needs to be conducted to evaluate the effectiveness and to recognize the reasons of the failure of these projects (Ahmadi et al., 2004).

Although a number of assessments on watershed management projects were carried out in the past, there were gaps. Furthermore, the most common method of assessment was based on surveys (Hossini, 2003). Nevertheless, a search on the literature suggests that work on watershed management assessment in the past can be broadly divided into five areas of interest: (i) runoff and flood, (ii) rainfall, (iii) check dam, (iv) soil erosion and sediment and (v) rangeland management (Table 2.4).

Strengths and Weaknesses of Previous and Recent Studies in Iran

According to previous studies conducted in Iran, majority of researches in watershed areas are based on two sub-groups, namely, quantitative evaluation methods or in qualitative models and questionnaires.

Generally, most of the previous works attempted to evaluate the studies using one of these two methods, and the researchers discovered weaknesses in the approach. Most of the results in Iran or in other countries are focused on only one method, namely, qualitative or quantitative. The reason may be due to some difficulties arising from combining both methods.

So far, nobody has evaluated any research by correlating technical and social matters or by combining both. In technical evaluation, one watershed management programme should be evaluated from two perspectives, namely, qualitative or quantitative. But as mentioned previously, there is a gap in this research area and there is a need to provide some solutions to the aforementioned matter in the future.

In Iran, several watershed plans have failed or operated with less output, because of two reasons. The first reason is related to level of knowledge or not having enough information about the designed watershed plans. The second reason can stem back to financial matters; constructors prefer to operate the projects with government's financial support.

In Iran, millions of cubic meters of water as runoff and huge amounts of soil have been lost due to erosion or other reasons annually and the government needs to have new watershed plans to control the water loss and increase the stability of the soil. Therefore, evaluation of current plans can provide useful information on important issues to identify the weakness of the management system of the projects and thus help to suggest suitable solutions.

Table 2.4 Watershed management studies in Iran

No.	Watershed management assessment	Study area	Result(s)	Sources
1	Runoff and flood	Kan watershed	Results revealed a significant decrease in peak flow rate and 70% reduction in runoff volume	Abbasi et al. (2012)
2	Runoff and flood	Gazmahale watershed	Investigated the effect of WMO on the hydrological status. Results showed 47% reduction in direct runoff by applying WMO	Haghgou (2011)
3	Runoff and flood	Kan watershed	In this research, HEC-HMS model was examined to route the rivers, without feasible results. Convex routing method was used to simulate the inflow and outflow hydrographs. Manning equation was used to calculate the peak flow after constructing check dams	Arekhi (2012)
4	Runoff and flood	Abnama watershed	The results showed that lag time is a sensitive parameter. Model validation using optimized lag time parameter showed reasonable difference in peak flow. It was also concluded that model could be used with reasonable approximation in hydrologic simulation in Abnama watershed.	Majidi and Shahedi (2012)
5	Runoff and flood	Kabkian and Delibajak watersheds	The hydrologic parameters, Curve Number (CV) and Initial abstraction (Ia) were compared in the study basins. In the Kabkian basin, CV and Ia ranged from 61–66 and 33 mm–40 mm, respectively. In the Delibajak watershed, these parameters range from 51–55 and 47–51 mm. This variation is due to differences in slope, geologic formations, vegetation cover and land use in sub-basins	Asadi and Boostani (2013)
6	Runoff and flood	Kan watershed	Results showed that for two objective functions, Green & Ampt, SCS and Initial and constant method placed in first to three preferences, respectively. So, Green & Ampt method have been suggested for using in similar area and conditions.	Abbasi (2012)
7	Rainfall	Keshar watershed	Using quantitative methods viz. double mass curve, moving average and flow-duration curve analysis. The double mass curve showed the positive effects of measures in runoff reduction. The reduction trend in runoff values was verified by moving average. Studying the developed flow-discharge curve depicted the obvious reduction in high as well as low discharge and an extension in flow duration.	Sadeghi et al. (2004)
8	Rainfall	Manshad watershed	Based on the simulation results, the effect of structures on reduction of peak discharge and flood volume were 9.82 and 7.75%, respectively. On the other hand, by increasing the return period of flood, the structured effects on the reduction of peak discharge and flood volume have been decreased.	Tayari et al. (2008)

No.	Watershed management assessment	Study area	Result(s)	Sources
9	Rainfall	Jajarm watershed	Studied the impacts of WMO in the on the socio-economic status of the residents. This study indicated that artificial recharge led to a significant increase in groundwater level and prevented sand storms and flood events	Rajaie, Esmaili, Abbasi, and Ziaei (2011)
10	Rainfall	Taham watershed	The positive effect of WMO on the erosion rate and flood control was also demonstrated	Fatolahi (2010)
11	Check dam	Quzmahaleh watershed	Results showed that check dams as mechanical measures had low effect on time of concentration while biological practices lead to deceasing in curve number with an average value of 4.5. This results in decreasing of peak flow and flood volume meanly 19% and 14%, respectively.	Heshmatpour (2001)
12	Check dam	Idelou watershed	The results indicated metal check dam construction with tree planting controlled soil erosion and sediment production and improving the natural resources of the basin, respectively. So this method is recommended for applying in the same areas.	Abbasi (2012)
13	Check dam	Karaj watershed	Results showed that useful life, objective and the efficiency of watershed operations were achieved by 75.5%, 65% and 60%, respectively. He noted that the cooperation of people in the project performance greatly increased the project successfulness.	Mohammadi, Ghoddousi, and Mohseni (2005)
14	Check dam	Jamal Abad watershed	Results showed reduction from 11 to 7 ton/ha/year as average vegetation cover increased from 18 to 28% in study area Effectiveness of sediment trapped in check dams: Gabion check dam 76.84, Brush-wood check dam 41.5%, Loose stone check dam 66.5%, Seeding 24.7% and tree planting 67.7%.	Ghodrati, Ghoddousi, and Dadashi (2004)
15	Check dam	Kame watershed	Evaluation of the effects of tree planting and controlling dams, i.e. metal, gabion and loose stone check dams. It was concluded that these operations had significant effects on the reduction soil erosion and sedimentation rate.	Mohammadi et al. (2008)
16	Check dam	Marand watershed	This study evaluated the success or failure of each of the three WMOs, including engineering, biological and management operations. A series of engineering operations, i.e. Lose stone and Gabion check dam, also biological operations, including planting and seeding, were evaluated. Results showed the significant impact of WMOs on sediment load reduction	Safamanesh et al. (2006)
17	Check dam	Kan watershed	Results showed that check dams as mechanical measures had low effect on time of concentration while biological practices lead to decrease in curve number with an average of 3.1. This effect resulted in decrease of peak flow and flood volume meanly 21% and 11%, respectively.	Abbasi et al. (2010)

(continued)

Table 2.4 (continued)

No.	Watershed management assessment	Study area	Result(s)	Sources
18	Check dam	Marmeh watershed	From statistical tests, it was found that there was no meaningful difference at a validated level of 95% in this area. Gabion check dams intended to reduce the suspended load did not achieve the objective. In the management of watersheds and erosion-sediment control projects, the research found that gabion check dams may not be an effective control method	Zehtabiyan, Ghoddousi, Ahmadi, and Khalilizadeh (2011)
19	Check dam	Kardeh watershed	In this research, the watershed management projects were evaluated by quantitative and qualitative methods. Effective factors in operation of project were categorized into seven groups. The results showed that according to the invented model, the final score calculated by the method mentioned was 29 (out of 100), which indicates weak operation for this project	Ebrahimian (2008)
20	Soil erosion and sediment	Ziarat watershed	The result of this study showed no significant differences between the rate of suspended sediment load before and after WMO.	Ghorbani et al. (2012)
21	Soil erosion and sediment	Ramian watershed	Results showed significant reductions between sediment load and flood volume before and after WMO. The efficiency of controlling structures in sediment trapping was investigated. It was concluded that the annual average of sedimentation has reduced, significantly.	Tajiki (2007)
22	Soil erosion and sediment	Taham watershed	Using *t*-tests showed significant differences (at $p < 0.01$) between the parameters “hydraulic radius” and “bed slope” before and after WMO	Fatolahi (2010)
23	Soil erosion and sediment	Babolrud watershed	The study evaluated WMO using hydrological models and showing 70% reduction in sediment load.	Khosravi, Safari, Habibnezhad, and Mahmoudi (2011)
24	Soil erosion and sediment	Sanganeh Watershed	The results of comparing erosion and sediment values using USLE, AUSLE, MUSLE models with measured values showed that no significant difference was observed between the estimated and measured values ($p < 0.05$).	Rahmati, Javadi, and Rangavar (2013)
25	Soil erosion and sediment	Ghareh Aghach watershed	The results showed that MPSIAC model indicated that 60.8% (5444.28 ha) of the total watershed area was classified at class III of erosion category with medium sedimentation, respectively. Basin erosion and sediment was calculated as 71,169.5 ton/year and 29,260.42 ton/year by MPSIAC model, respectively.	Amiri, (2010)

No.	Watershed management assessment	Study area	Result(s)	Sources
26	Rangeland management	Kame watershed	Using a comparison between control plots and treated plots, demonstrated the positive effect of WMOs on the biological condition of the Kame watershed.	Mohammadi et al. (2008)
27	Rangeland management	Bojnord watershed	The trend of vegetative canopy covers before WMO was negative, while after that it changed to positive state. The average canopy cover changed to 30–60% after WMO (5–10% increase for per year).	Zadbar, Arzani, Azimi, Mozafarian, and Naseri (2011)
28	Rangeland management	Galesoo watershed	Results showed that the ground cover in mechanical operation area was significantly ($p < 0.01$) higher than that in the control plots. Furthermore, ground cover in the pitting area was higher than that in the furrowing area.	Habibzadeh, Godarzy, Mehrvarz, and Javanshir (2007)
29	Rangeland management	Halaj watershed	In a case study, biological operations were evaluated, in terms of operation efficiency. Overall efficiency rates of biological and mechanical operations were 73% and 71%, respectively. However, this study was conducted in a few sub-watersheds and randomly chosen of structures.	Amiri (2010)
30	Rangeland management	Kakhk Gonabad watershed	Overall efficiency rates of biological, bio-mechanical and mechanical operations were 77%, 72% and 76%, respectively. However, this study was conducted in few sub-watersheds and randomly chosen of structures	Bagherian et al. (2005)
31	Rangeland management	Torbat-Hyedarie watershed	Results showed that the efficiency of biological operations was lesser than mechanical operations due to the lack of maintenance. However, this study suffers from the lack of access to statistical records before WMO, which resulted in an incomplete comparison of the present situation with the past state.	Mohammadi et al. (2008).
32	Rangeland management	Talesh watershed	The results have shown that range condition in sowing area is excellent, whereas it is medium in other (control) areas. The results have also shown that there is a significant difference in canopy cover and production in two study treatments at the confident level of 99%.	Ghaderi, Safaeeian, and Sadeghi (2008)
33	Rangeland management	Kechik watershed	The results showed that the differences in plant cover of the catchments were significant at $p = 0.05$ level, the average of plant coverage's were 96.2%, 52.9% and the runoff amounts were 17.43% and 35.38% in protected and unprotected catchments, respectively.	Hematzade and Khalighi (2006)

Nowadays, incorrect water usage or lack of planning in the execution of projects may cause potential loss of water and soil. Therefore, over the past 40 years, all the watershed projects have attempted to solve this problem. However, researchers need to work harder in this area to save these endangered natural resources in the future. Unfortunately, there are not enough efforts to identify why these projects have failed or what are their weaknesses in order to provide suitable solutions for future projects.

However, good progresses have been achieved in certain successful projects in relation to watershed management, which will be helpful for the future watershed projects to decrease erosion and sediment (Abbasi, 2012; Amiri, 2010; Fatolahi, 2010; Ghodrati et al., 2004; Majidi & Shahedi, 2012). Today's studies in the area of Hydrology have also received considerable achievements using GIS and different hydrologic models including EPM, PSIAC, BLM, HEC-HMS and so on. Most of these results have been broadly used by watershed administrative units to determine the dimension and number of administrative structures. This scheme can help executives to save more time and improve the efficiency and effectiveness of the project (Noroozi, 2010; Rahimi et al., 2012; Rahmati et al., 2013; Saberi, 1995; Sadeghi et al., 2004).

Also, due to increase in the magnitude of erosion and sediment discharge in fields and the lessening of contribution by people in supporting watershed projects, the government involvement in providing particular supports for specific projects on social fields has risen. Consequently, some social evaluating plans in many watershed fields have been executed around the country. Many of these projects have been successfully executed and therefore, resulted in higher willingness of people to participate in watershed projects (Bagherian et al., 2011; Effati, 1992; Faham, Hosseini, & Darvish, 2008; Hossini, 2001; Karimi & Lari, 1995; Rezaei, Soleimanpour, Mehrdost, & Vedadi, 2011; Shahroudi & Chizari, 2008). However, after receiving many achievements from the recent evaluation of projects, it appears that there are still not enough supports for consolidated projects.

In Iran, the first technical evaluating watershed project has been done by the Department of natural resources, Tehran University (Program and Budget Organization) at the White River Dam in year 1987. However, unfortunately due to the lack of the project importance, it has not been published. During 1995–2014 periods, there were few attempts to evaluate watershed projects in the fields of Lar, Karaj, Latian, Kakhak and Kardeh dam, and the results have been published. However, as it was mentioned earlier, this study is the first research work conducted in Iran, analysing watershed projects using technical and social aspects.

Therefore, in conducting this research, the study must be characterized by two features. Firstly, all watershed projects, mechanical and biological, should have already been implemented in the field and at least 5 years should have passed since their implementations. Secondly, the study field must receive potential interest among the villagers to participate in the project implementation. These two conditions are necessary to get comprehensive assessment of the project. In that respect, the watershed field of kushak-Abad has necessarily fulfilled both conditions. Between 1996 and 2002, few watershed projects in both mechanical and biological have taken place in this field, and additionally, it has also been selected for execution as one of the pilot project with supports from villagers. Hence, this research attempts to fill this knowledge gap.

Case Studies in Other Countries

Watershed management assessment began in the United States in the early 1930s. Under the supervision of the soil conservation service (SCS), Bennett (1932) concluded that the selection of appropriate structures and technical specification was important in checking soil erosion. This was supported by subsequent studies as reported by Doty (1971) and Satterluand (1982), which suggested that structure selection was of primary importance in which mismatching structure including biological methods can cause future soil degradation than intended.

An important study by Sworth (1987) who examined traditional and conventional conservation practices concluded that soil erosion control by vegetation improvement and slope moderation was one effective approach. Hudson (1991) stressed that simplicity of practices and conformity with local knowledge are essential in construction, operation and maintenance of soil and water conservation measures.

Liu (1992) indicated that the check dams have a positive effect in controlling the stability of the branches. At upstream intervals of the check dams, the streams are wider, and furthermore, when the capacity of structures was filled and sedimentation rate relatively stabilized, the process of stream erosion and sediment transport is limited with flood control. They also noted that if the gradient of the streams in be reform the flood level is reduced, but there is no report on distance and height of check dams, which on completion of this part will reduce cost dramatically.

Brown stated that watershed plans should be consistent with watershed characteristics and some factors such as development facilities, culture and operational practices, potential and natural capabilities of common soil and water resource operations, economic and social situation in the region must be considered.

Wang et al. (2004) evaluated two watershed areas of Ming- T and Ming- Hu economically. The results of this study showed that the level of profitability in the short time is less than the amount spent and the cost ratio is equal to 65%. However, in the long run and at least 15 years after performance of the project, the cost benefit ratio was 1.2. This study also indicated that in the case of successful watershed projects that were supported after proper performance, the economic profitability was expected after nearly two decades.

In India, where much watershed management assessment was carried out, biological practices found some degree of success. For example, Pawar (1998) indicated that biological practices in Maharashtra between 1992 and 1996 showed increase in vegetation survival rate by 51.3%, which in turn, reduced runoff and erosion rates by 47% and 235%, respectively. Subsequent studies in the same area in Maharashra by Sarkhot (2002) suggested that further improvement to the environment can be achieved through the use of simple techniques coupled with building a caring culture among the land users towards natural resources and watershed management. Support from the government agencies and cooperation from the private enterprises are equally important.

Kerr (2007) believed that watershed projects play an increasingly important role in managing soil and water resources throughout the world. Research is needed to ensure that new projects draw upon lessons from their predecessors' experiences. However, the technical and social complexities of watershed projects make evaluation difficult. Quantitative and qualitative evaluation methods, which traditionally have been used separately, both have strengths and weaknesses. Combining them can make evaluation more effective, particularly when constraints to study design exist.

Wong and Cheng (1998) investigated the effect of forestation with mechanical operation (terraces) on the water flow. He concluded that the water flow reduced by 50%. However, scientific solution regarding to the terrace dimensions and its relationship with the number of seedling planted has not been provided.

2.2 Social Evaluation of Watershed Management

In the social evaluation of watershed management projects segment, the primary focus is on the involvement of people and the impact these projects have in affected areas. The discussion in the following sections deals with a brief overview on the concept of participation and related benefits to society and socio-economic factors, which may affect their participation. Some methods of participation and their evaluation are also discussed.

2.2.1 Concept of Participation

According to Oakley (1991) while it is difficult to give one definitive term on participation, it is generally accepted that participation is important for empowerment (Baum et al., 2000). Oakley and Marsden (1984) conceived participation as a continuum to illustrate the direct relationships between the interpretation of participation and development analysis. In rural development, participation includes people's involvement in decision making and sharing of benefits of development programmes (Cohen & Uphoff, 1977).

While community participation is an active process by which beneficiary or client groups influence the direction and execution of a development project to enhance their well-being (Cohen & Uphoff, 1977), the main concern of People Participation (PP) is on the formation of small, informal and self-reliant groups of the rural people to build institutions that are long term in serving their interests (FAO, 1992).

The World Bank (1995) in its proposed strategy for sustainable development calls of a "people-centred" approach that improves the poor's access to productive assets, allow them to participate in designing and implementing development programmes, and foster their involvement in institutions from village to national level.

Participation in development programmes was formulated in the mid-1970s with the United Nations taking into consideration people participation as an essential element of the development process. Participation assures the equality of access to facilities foster individual and community empowerment and to organize different skills within a community (Cohen & Uphoff, 1977). In addition, participation by individuals in local groups can play a key role in over-coming the social isolation and the loss of confidence.

In recent years, people participation has gained importance, particularly in sustainable agricultural and rural development projects. Irvin and Stansbury (2004) believed that citizen participation will produce more public decision making, which is important for project success and development. The government of Iran in recent years has established several policies to protect and to manage the natural resources. However, these efforts were mostly top-down strategies, which were largely unsustainable and to a certain degree, unsuccessful. New approaches are needed to gain better results in watershed management.

2.2.2 Benefits of Participation

Many researchers and development specialists have emphasized on the benefits and importance of PP in development programmes. According to Clayton, Oakley, and Brian (1998) PP can: (1) increase the efficiency of development activities by involving local resources and skills, (2) increase the effectiveness of activities by ensuring that they are based upon local knowledge and they are more relevant to local needs, (3) build local capacities and develop the ability of local people to manage and negotiate development activities, (4) increase the range of activities, (5) better target the benefits to the poor people through the identification of key stakeholders, (6) ensure the sustainability of activities and (7) improve the status of women by providing their opportunity to play a main role in development works.

According to some studies, participation is also important for social integration. Participation has also been used with more specific connotations, most importantly in social capital. According to Putnam (1993), society with high level of social capital is characterized by high civic participation and high social participation. Social participation is accompanied by trust and generalized reciprocity, which are mutually dependent and often enhance each other (Azkiya & Ghaffari, 2001).

2.2.3 Participator Watershed Management (PWM)

In recent years, participatory watershed management emerged as a new paradigm for sustainable rural livelihoods and occupied the central stage of rural development in the fragile and semi-arid environments of the developing nations (Rezaei et al., 2011; Shafiee et al., 2008). PWM aims at creating a self-supporting system, essential for sustainability (Baghaie, 2006; Wani, Singh, Sreedevi, Pathak, & Iyer, 2006). The PWM also provides opportunities to the stakeholders to jointly negotiate their interests, set priorities, evaluate opportunities, and implement and monitor the outcomes.

2.2.4 Monitoring and Evaluation of Participation

Participatory monitoring and evaluation must be an integral part of PWM. Some evaluation reports (e.g. Gregory, 2000; Guba & Lincoln, 1989) have shown that watershed management projects cannot succeed without full participation of project beneficiaries and careful attention to issues of social organization, because their success depends on consensus among a large number of users. Moreover, collective capability and action are required for management of the existing and new structures created during the project. Otherwise, the costs and benefits of watershed interventions are location specific and unevenly distributed among the affected people.

Gregory (2000) suggested that evaluation is a social process, which implies the need for a participatory approach while Guba and Lincoln (1989) opined that evaluation is an appropriate methodology for supporting participation, an important part in development efforts.

Oakley (1991) suggested indicators for evaluating project's benefits: (1) Organizational indicators—knowledge of the project organization, membership in organization and attendance at project organization meetings, (2) Participation indicators—number of project groups, attendance in group meetings, active involvement in group meetings and contribution of free labour to project activities; and (3) Development momentum indicators such as frequency of contacts between clients and development agencies, training received and internal sustainability.

Casley and Kumar (1987) also provided some important indicators in participation evaluation. However, his indicators were more towards grass-root groups or organizations. He postulated that the impact of a project on beneficiary participation could be measured through: (1) the benefit growth of organization, (2) organizational structure, (3) efficiency and effectiveness of the organizations, (4) leadership quality, (5) contribution to the project effectiveness, and (6) long-term validity.

Miller (1991) in his discussion on social participation scale provided another perspective on indicators of evaluating participation in voluntary organizations. He proposed four indicators: (1) membership, (2) attendance, (3) financial contribution and (4) members of committee.

It is clear from the above mentioned that in attempts to evaluate projects, some assessment on the people project interacted is needed as a feedback mechanism to the development of the projects which is even more so in WMPs.

2.2.5 Methods of Participation

The methods of participation are dependent on the level and scope of participation. These can range from very simple ways to the more organisational approach. For example, Boyle (1981) suggested ten methods of participation, including task force, ombudsman, advocacy planning, formal hearing, unobtrusive measures, brainstorming, content analysis, nominal group technique, surveys and advisory committees.

Chetkov (1986) outlined several methods that are more people oriented for achieving participation. These methods are: (1) voting or signing a petition, (2) being interviewed for a survey, (3) participating in decision after a lecture, (4) contributing evidence to the proceedings of a commission or a committee, (5) giving warning or protesting and (6) undergoing a happy or painful experience together with others.

On a more even assessment approach, Oakley (1991) suggested four broad types of PP in projects and programmes including: (1) Involvement: the rural poor people get involved in and benefit from the activities of rural development projects, (2) Community development: the rural poor people participate in specific tasks, (3) Organization: the rural poor people participate through a formal organization and (4) Empowerment: the rural poor people participate in development projects and access to, and share in the resources required for rural development.

In later development when economic consideration becomes essential in project assessments, the variable of economics was included. For example, Lisa (2000) outlined two types of participation: (1) social participation, which is reflected in the involvement of people in community meeting groups, organized for local programmes, and (2) economic participation, which is reflected in clients' benefits from the programme. On a more even level approach, Dolisca, Carter, McDaniel, Shannon, and Jolly (2006) suggested three types of participation namely, (1) environmental participation, which involves environmental activities, (2) economic participation, which includes clients' benefits from the programme and (3) social participation, which includes client participation in local groups and organizations.

2.2.6 Factors Affecting Participation

2.2.6.1 Socio-demographic Characteristics

Watersheds are largely endowed with natural resources, which are beneficial to society. Perception about watersheds, however, may vary depending on one's socio demographic characteristics. Individuals perceive different expectations may influence decision making. Several studies have shown that the level of participation depended on the individual characteristics such as age, gender, marital status, education, household size, income and other related variables. (Dolisca et al., 2006; McDowell & Sparks, 1989).

From the literature, it appears that socio-economic characteristics vary in their influence and determination of participation. Age, for instance, had no influence on first management. For example, Thacher, Lee, and Schelhas (1997) and Dolisca et al. (2006) reported that younger people are willing to participate in forestry activities, but older ones are interested mainly in collecting forest resources. Studies, which found no clear relationship between age and participation, include those by Ghasemi (2001) and Motevalli (2002).

Education, however, appeared to be important in many studies particularly those related to forest management and conservation (Faham et al., 2008; Glendinning, Mahapatra, & Mitchell, 2001; Lisa, 2000; McDowell & Sparks, 1989; Wilson, 1997).

Other variables that showed positive correlation with participation were land ownership and tenure (Bagherian et al., 2009). Dolisca et al. (2006), for instance, noted that ill-defined and insecure property rights discourage investment in natural resources management by removing incentives. The lack of secure land rights should then be the main cause of farmers' non-participation in forestry programmes.

According to Wilson (1997), income can be seen as an unclear variable for participating in environmental programmes. For instance, households that are not entirely dependent to their farms for income do not need to maximize profits and may be more willing to adopt environmentally friendly farming practices. In situations where agriculture is the main source of income, farmers are discouraged from planting trees on their homesteads (Salam, Noghuchi, & Koike, 2000).

2.2.6.2 Knowledge and Awareness

Knowledge, awareness, attitude and behaviour are four interrelated components of an individual's behaviour. The knowledge of participation in certain activities includes utilization of information, and a better understanding by individuals in which their participation is sought (Bagherian et al., 2011).

Several studies revealed that knowledge is an important parameter to determine how the benefits from development programmes are perceived. People cannot be expected to exhibit positive attitudes toward programme if they are unaware of the benefits and costs associated with their participation. According to Infield (1988), Mkanda and Munthali (1994), Dolisca et al. (2006) and Shahroudi and Chizari (2008), education and knowledge about watershed management and forest conservation issues make people more positive in their views.

Rezaie, Vadadi, and Mehrdoost (2012) found that there are positive relationships between intensity of participation and four dimensions of knowledge including general knowledge, knowledge of objective, knowledge of function and knowledge of component. Spencer (1980) noted that little knowledge of opportunities for learning or for the place to get such programme contributed to the lack of adult population in education programme.

2.2.6.3 Attitude Toward Programme

Attitude represents an individual's degree of like or dislike for an item. Attitude can also be viewed as one's relatively enduring affective, cognitive and behavioural dispositions toward various aspects including persons, events and subjects.

Several studies highlighted the relationship between attitude and participation. Rezaei et al. (2011) found that there is a positive relationship between farmers' attitude toward programme and their intensity of participation in agricultural development programmes.

Nepal and Weber (1995) who studied the complexities and dynamics of the local people's perceptions, attitudes and motivations toward wildlife conservation found that people disliked restrictions regarding the use of park resources in spite of having positive attitude toward wild life conservation.

Although Rishi (2003) pointed out that understanding of attitudes is one of the central concerns in social life and is vital for bringing desired change in the behaviour, knowing attitudes may be useful for the success of implementation of programmes.

2.2.6.4 Expectations of a Programme

Expectations contribute to a "norm of reciprocity" because individuals have certain beliefs about what a programme provide to them in exchange for their efforts. To a certain degree, expectations are formed from societal norms. Programme managers can establish a baseline of perceived support based on an understanding of expectation of programmes.

According to Rezaie et al. (2001) on satisfaction, human beings' experience in their social associations depends on the expectations they bring to them as well as on the actual benefits they receive in them. The man who expects much from his associates will be more easily disappointed of them than the one who expects little, for example. Rezaie et al. (2001) also believed that these expectations of social rewards are based on the past social experience of individuals and on the reference acquired standards. An individual, who derives outstanding rewards from associating with other programmes, increases his attraction to them.

2.2.6.5 Satisfaction from Previous Programmes

Satisfaction depends on the expectation, which is shaped by previous experience (Rezaei et al., 2011). Individuals will try to maintain those exchanges which have proven to be rewarding in the past and break off those which proved to be more costly than rewarding. New relations which have a good chance of being more rewarding than costly will be established.

Several studies have shown the importance of prior experience on decision of participation in the current projects (Bagherian et al., 2009; Effati, 1992; Hosseini et al., 2011). Based on the social exchange theory, experiences from previous programmes were therefore considered important to people participation in WMP.

2.3 Summary

Various studies on watershed management in Iran and other countries were reviewed. Most studies were carried out to assess specific problems related to technical aspects as well as social contribution. Few studies were carried out to determine the economic component, however. Most revealed the benefits of soil and conservations techniques that would probably impact similarly in the semi-arid environment of KAB.

While several studies on technical assessment had been carried out in Iran in recent years, few were attempted to assess the social component. It would appear that while technical assessment was more straightforward, the social assessment may be more complex because of social behaviour and social exchange complexities.

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