



## SOCIO-ECONOMIC ASPECTS OF SOME WATERSHED MANAGEMENT PROJECTS IN MATEH-SANG WATERSHED, IRAN

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### ABSTRACT

Watershed management plays an important role in supplying water, especially in arid areas. Adjust the water flow, exploitation of seasonal flood waters and reservation of precipitation is one of the ways to solve water shortage. Objective was study of socio-economic aspects of some watershed management projects in Mateh-Sang watershed. The study has been carried out using questionnaires that their validity were tested by professionals of watershed management and natural resource experts. Reliability coefficient was determined using SPSS software and Cronbach's alpha coefficient was obtained between 76.0 and 78.0 for different scales. To evaluate the economic impact of watershed management projects in the region, the cost-benefit analysis, questionnaire survey and chi-square test have been used. The benefit cost ratio of 1.03 is obtained which shows the economic feasibility of the projects. Chi-square test results in social debate and evaluation of watershed management project through questionnaires, representing a decrease of migration, reduce flooding, reduce unemployment, flood and sedimentation control, satisfaction of watershed management projects and participate fully in the projects. Also in the economic debate, the results of statistical analysis of the relationship between watershed management projects (mechanical) and increasing the production and vegetation cover, increasing the number of livestock, increasing the amount of water in water resources and increasing the area of farm lands and horticultural lands and reducing the area of bare lands imply a rejection of the null hypothesis and statistical significance of these relationships. In general, watershed mechanical projects in this study have demonstrated the multi-functional positive aspects.

**Keywords:** watershed, benefit cost ratio, flood, participation, migration, natural resources.

### INTRODUCTION

In the province of Sistan and Baluchestan, due to low rainfall, the water has a special value and traditionally, people dug wells and aqueducts to reach the water and to sustain their lives. According to the indigenous experience and knowledge, effective measures such as the creation of traditional stone structures were performed and at the top of the structure, agricultural cultivation was done to reserve water in subterranean aquifer and to transfer of water from one basin to another basin. Efati (2000) has studied the effects of watershed management projects to improve the social and economic situation of the village residents. Data collection and evaluation tool in the mentioned study was the questionnaires. The results suggest that implementation of watershed management projects has resulted in creating a variety of jobs, such as temporary, permanent and supplementary jobs. It also states that, in connection with public participation in the studied projects, the majority of the projects implemented in partnership with people and they executed less theoretical contributions. Taymoori and Omrani (2010) in a study to evaluate the performance of the watershed management projects focused on Kelidar watershed. In this study, the mechanical and biological treatment which performed before and after the implementation of flood control measures and forage production were compared and biological treatment is economically justified. The results showed a reduction in flood peak discharge at different return periods due to the mentioned operations and the positive role of them in increasing the vegetation cover and soil conservation. Navkhegar *et al.* (2012) in an analysis of watershed management projects implemented in the basin

Kahurestan showed that due to the increasing in the severity and duration of periods of drought in recent years, The types of projects have been implemented over the years has not changed from the initial years of statistical period and between methods implemented in this region, the lowest percentage (76, 40, 0) of the projects is allocated to implement projects dealing with drought. Mirjalili (2012) in his research has examined the economic, social and cultural impacts of the spreading projects in the management of watersheds in the Miankooch basin states that the implementation of the spreading projects, in addition to flood control and prevention of land degradation, will increase the level of groundwater, the area under cultivation and will increase the employment. The study was conducted as a survey using a standard interview and data was collected using systematic random sampling. The results show that by the implementation of the spreading project, the pasture forage production increased about 32 percent and the number of livestock increased about 10 percent. Researches carried out by Mansouryan and Mohammadigolrang (2007); Mohammadigolrang *et al.* (2006); Ravgani *et al.* (2010); Azari *et al.* (2011); can be also noted as researches in this field. Dhyani *et al.* (1993) by the economic analysis of watershed management activities in the Fakut watershed of India showed that the cost-benefit ratio is equal to 1.93. They have shown that these measures are quite affordable. Kerr and Chung (2002) in the evaluation of the watershed management projects suggested that watershed management projects increasingly play an important role in the management of soil and water resources around the world and emphasized that new project must be implemented based on the



lessons from the past experience. Both qualitative and quantitative evaluation methods which used separately have strengths and weaknesses, and their combination makes the effective evaluation. Khakbazan and Hamilton (2012) have investigated the economic evaluation of tillage management practices in the watershed of southern Manitoba. It was conducted using the model of plowing index based on plowing practices, production costs and net income. The index and the economic effects model of land management practices for three rotations were conducted under three tillage systems in the basin scale. The results suggest that many farmers prefer the conventional tillage to the tillage with machinery due to the increased investment, with this attitude, the use of machinery have a low return rate. In this regard the new research, including (Gorsevski *et al.*, 2013; Kunz, Moran, and Kastle, 2013; Newton *et al.*, 2013; Saravanamuthu and Lehman, 2013; Khoshnam *et al.*, 2015) would be presented. The present study aimed at economic assessment of the watershed mechanical projects (earth fill dam, masonry dam and loose rock dam) conducted at the Match-Sang watershed and the positive effects of watershed management practices in the area was specified.

## MATERIALS AND METHODS

### Characteristics of the study area

The study area, named Match-Sang watershed is located in the Sistan and Balouchestan province, south east of Iran. In terms of the political divisions, the area belongs to the city of Nikshahr, the nearest district to the study area is Qasr-e Qand and the village of Match-Sang is located in the center of the basin as largest village. The number of residential point within the area is three settlements called Tuk, Match-Sang and Jaan Abad. Match-Sang watershed is a mountainous area with a relatively severe complication of topography and this feature is dominant in almost all the basin. The yearly average temperature, precipitation and evaporation of the study area is 22 centigrade degree, 190 and 1304

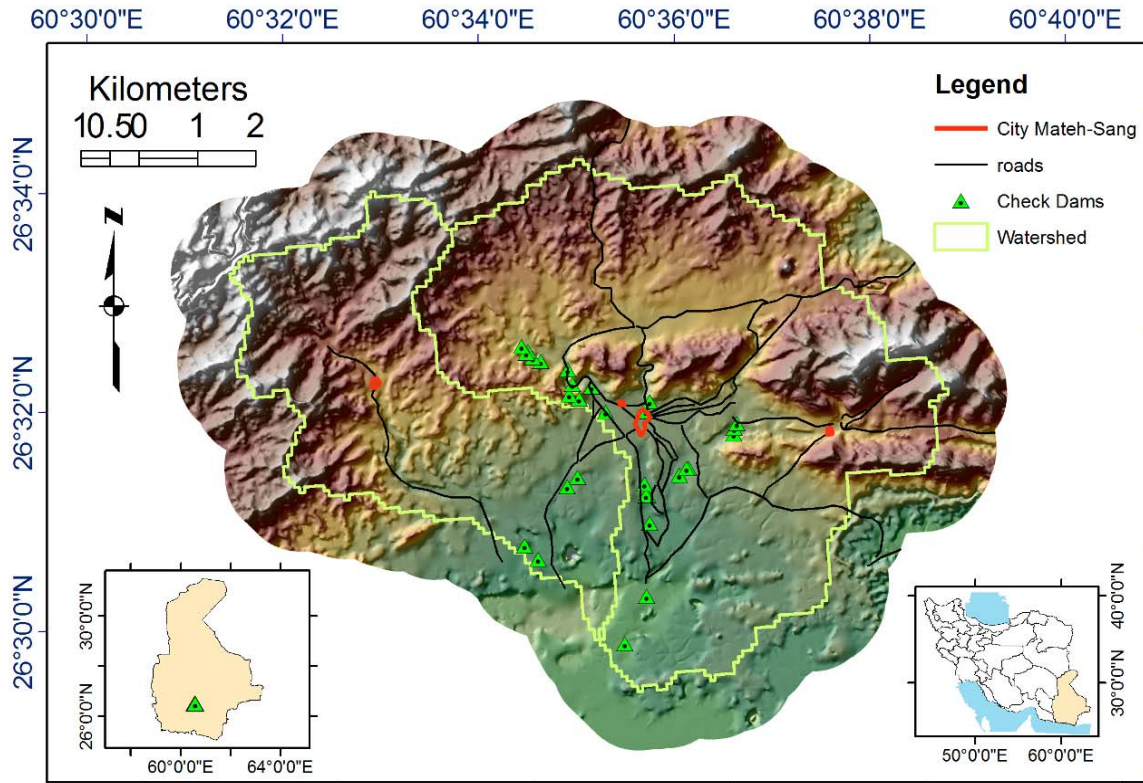
millimeter, respectively. The highest and point of the area is 1660 meter above the sea level in the north of the area and the lowest point of the area is 1060 meter above the sea level, in the exit point at the south of the area. Match-Sang Mountain in the East and Karvandar Mountain in the west side are the high specified points of the basin.

## METHODS

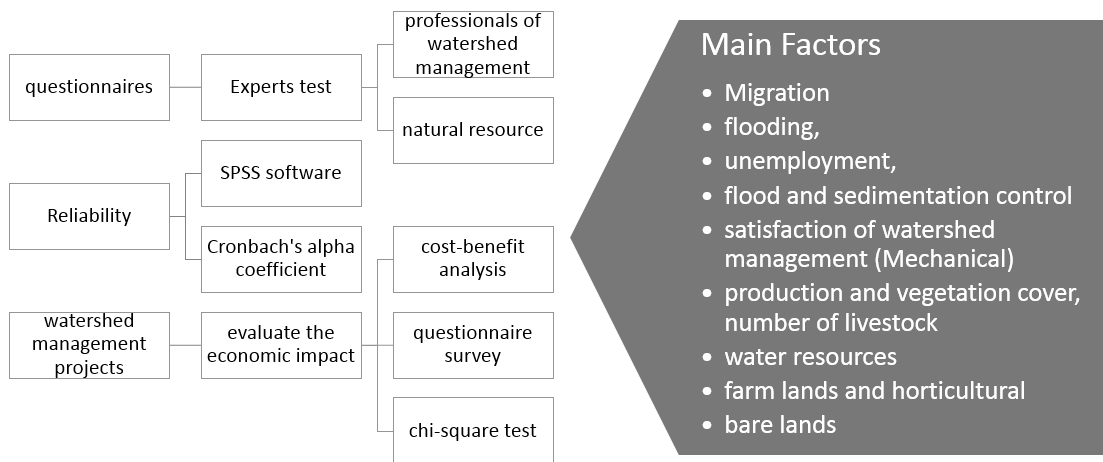
The questionnaire was used for assessing the quality of the research and the obtained results were analyzed by the chi-square test. The information is obtained through random sampling. The form contains information on size of family, education status, employment status, as well as agricultural and horticultural land, land reclamation, the land production and livestock status. Questionnaires were set using experts view and watershed planning issues and their validity was examined. The questionnaires were completed by the informants working with residents and local dignitaries with an interval of one month to assess the reliability. After collecting data, processing and analysis carried out using SPSS. After extracting the results and preparation of statistical tables, data were analyzed and the report was compiled. The cost-benefit ratio is used for economic evaluation of the watershed management projects. In library studies, collecting related books and articles and checking the references of the relevant organizations was done. The construction progress was carried out in the form of 5 type and 235 structures, including 45,823 cubic meters of stone and mortar, 1500 cubic meters of loose rock dams and 61,158 cubic meters of Earth fill dam. With the implementation of the operations of 2800000 cubic meters of water in the tank structure extraction is performed. With the implementation of the operations, 2800000 cubic meters of water were extracted from the tank of structures. Identification of 25 dams built in the basin of was performed with the mapping and field visit.

**Figure-1** shows a map of the layout structure and

**Figure-2** shows the flowchart of the study.



**Figure-1.** Layout map of location of structures and Match-Sang watershed in Iran.



**Figure-2.** Flowchart of study.

**RESULTS**

The benefit to cost ratio: the cost-benefit ratio was used for economic assessment of the project. Using this method, it can be concluded that the projects are economically feasible or not? For this purpose, the total benefits were calculated and was divided to the total cost.

The total cost is composed of the fixed costs, variable costs and maintenance costs.

Cost of watershed management project (in US dollar) in the Match-Sang watershed in 2005, was shown regardless of the current cost of the construction Table-1.

**Table-1.** Shows the cost of the project in 2005.

Total cost (USD\$)	The cost per unit (USD\$)	Volume of operations (m3)	Conducted operations type
220848.33	3.61	61158	Earth fill dam
432772.77	9.44	45823	Masonry dam
5416.66	3.61	1500	Loose rock dam
659037.76			

Benefits of the project are the total benefits that can be achieved after the dam Construction. These benefits include benefits from the cultivation of agricultural and horticultural plants, the volume of the extracted water and

seedlings in the region. Table-2 shows the benefits of the project.

Match-Sang watershed

**Table-2.** The income that obtained through several years of implementation of watershed management projects in Match-Sang watershed.

Total income (USD\$)	Total income units between 2005 and 2012 (USD\$)	Operation amount	Benefits of the project
371777.77	0.132	2800000	Water Extraction (m <sup>3</sup> )
85875	631.11	135	Increasing in acreage of the agricultural products (ha)
219000	750	292	Increasing in acreage of the horticultural products (ha)
3500	12.5	280	Seedling
680152.77			

According to Table-1 and Table-2 the cost-benefit ratio can be achieved. To do this, it needs to convert the total cost to present value using the annual inflation rate. The total cost (659,037.77), with an estimated annual inflation rate (the average inflation rate for 2005 to 2012 = 8.15) has been equal to \$ 203,406.72. The benefits of the project is \$ 209, 923.69, which by dividing it to the total costs, the cost-benefit ratio in this period will be equal to 1.03 and indicates the feasibility of the projects in the region. The watershed management projects have different useful lives and considering the average useful life of 30 years, the ratio of 2.4 is obtained.

#### Chi-square test and questionnaire results

The following results were obtained through the analysis of the produced socio-economic questionnaires:

65 percent of respondents have announced that their use of the facilities in the village is high.

85% of respondents have announced that the change rate of the agricultural lands prior to the construction of a large watershed project is high.

70 percent of respondents believe that the watershed management operation is effective in water discharge of wells and water resources.

100% of respondents believe that the construction operation is effective in preventing the loss of surface water and groundwater.

72.5 percent declared that the construction projects are effective in reducing unemployment.

100% of respondents believed in a positive impact of the construction projects on income and employment of the residents.

70% of respondent have declared that watershed management projects had a positive effect on the number of livestock in the region.

100% of respondents declared that the implementation of construction projects had an effective impact on the flood and sedimentation control.

100% of respondents have been announced that they are ready for the partnership in the implementation of the new watershed management projects.

100% of respondents were satisfied with the implementation of the projects.

77.5% of the respondents believed that the implemented construction projects have a positive impact on the vegetation cover of the area.

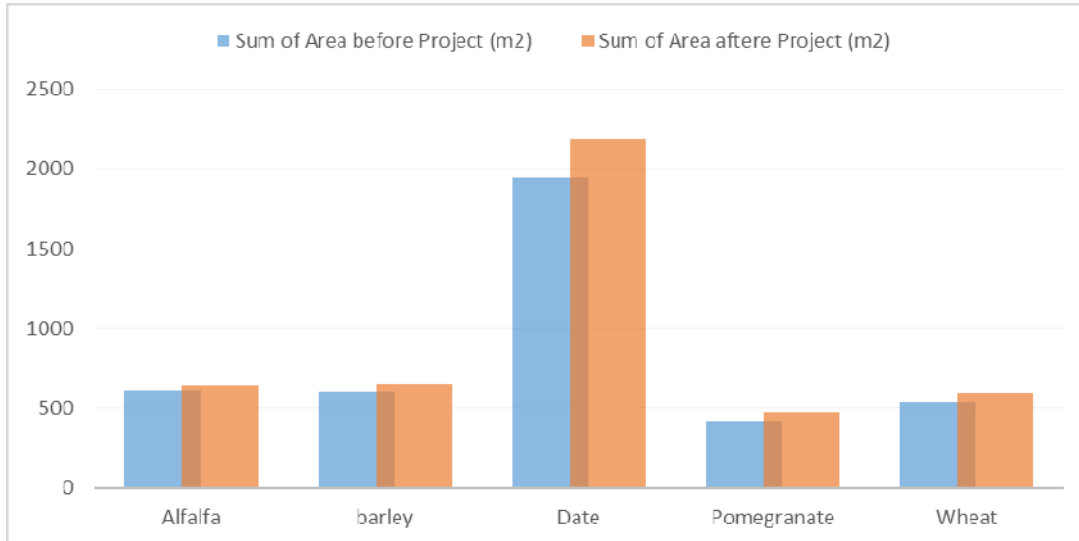
50% of respondents declared that the watershed management projects increase the forage production.

Basically, the economic situation in each geographic area affected by the position and its environmental potentials. In rural and tribal areas, including Match-Sang watershed, activities such as agricultural and proletarian activities determines the status of the region. The proportion of skilled people and environmental potentials are effective in the formation of different jobs and earn money to contribute to the family income.

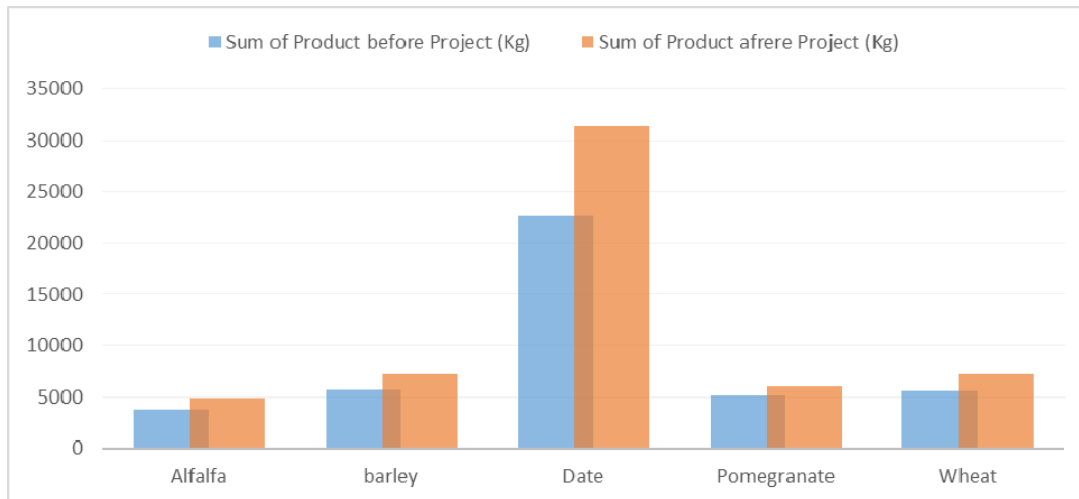


Table-3 and Figures (3, 4 and 5) show the results of the questionnaire and the chi-square test for the impact of watershed management projects to increase the area under cultivation, increasing the amount of

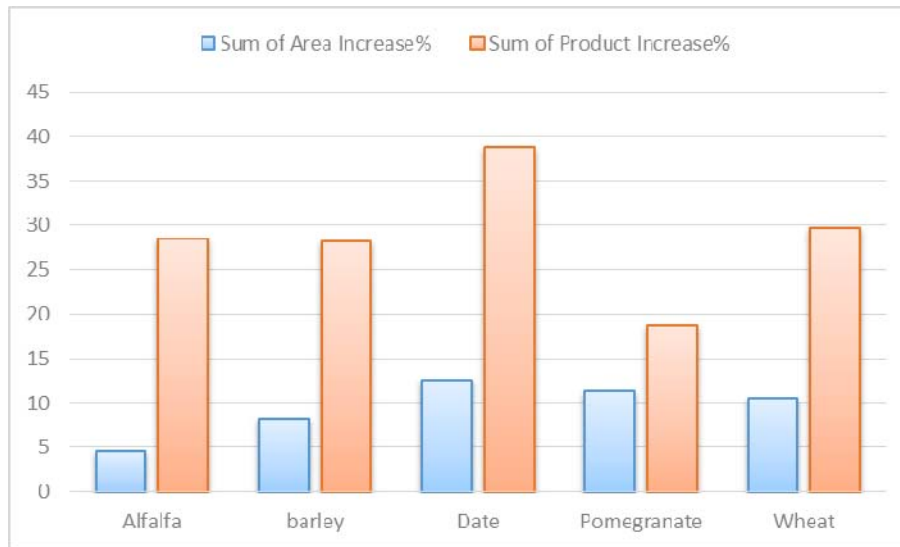
agricultural and horticultural land, immigration rate, and the number of floods, the amount of products and the amount of bare lands.



**Figure-3.** Effect of watershed management projects on the land area under agricultural and horticultural.



**Figure-4.** Comparison of the area under cultivation of the agricultural and horticultural crops.



**Figure-5.** Comparison of the agricultural and horticultural crops.

**Table-3.** The results of the questionnaire using the chi-square test.

The amount of products				The amount of bare lands				The number of floods				Immigration rate				F	Period
Very high	Hgh	Medium	Low	Very high	Hgh	Medium	Low	Very high	Hgh	Medium	Low	Very high	Hgh	Medium	Low		
0	9	7	24	0	29	11	0	23	17	0	0	0	0	8	32	O.F.	Before the project
0	.520	7.5	12	0	15	10.5	14.5	11.5	8.5	3	17	0	0	4	36	E.F.	
0	32	8	0	0	0	10	30	0	0	6	34	0	0	0	40	O.F.	After the project
0	20.5	7.5	11	0	15	10.5	14.5	11.5	8.5	3	17	0	0	4	36	E.F.	
36.969				59.048				80				8.889				Chi <sup>2</sup>	
2				2				3				1				D.F	
0.000				0.000				0.000				0.003				P Value	

F = frequency , observation , E= Expectation , D.F= Degrees of freedom

Social and economic issues of the Match-Sang watershed management projects analyzed using chi-square test and the questionnaire. What were the social and economic impacts of operations implemented in the watershed area for residents? It was one of the fundamental issues in this study. The cost-benefit ratio was used for economic assessment of the project. For this purpose, the total benefits were calculated and was divided to the total cost. The total cost is composed of the fixed costs, variable costs and maintenance costs. The total cost was \$ 659, 037.77 in 2005. Benefits of the project are the total benefits that can be achieved after the dam Construction. These benefits include benefits from the cultivation of agricultural and horticultural plants, the volume of the extracted water and seedlings in the region.

The volume of the extracted water was equal to 2800000 cubic meters. The average price per cubic meter of water of wells and aqueduct varies from 2005 to 2012; the total income from 2005 to 2012 is estimated to be 0.135 IRR and the benefit obtained from the extracted volume of water is equal to US \$ 371, 777.77. With the implementation of watershed management projects, the agricultural lands have increased in the amount of 135 hectares, from 2005 to 2012 and the total income per hectare is equal to US \$ 636.11. The profit from the increasing the acreage of agricultural crops is \$ 85, 875. Also, increasing the acreage of horticultural crops is equal to 292 hectares and the total income for each unit per hectare is equal to \$ 750 from 2005 to 2012. The obtained benefits from the increasing in the acreage of agricultural





crops is \$ 219000. Another benefit of the project is the seedling of more than 280 palm trees in the region and the average price of them is \$ 12.5 for every species and the total cost was estimated about \$ 3,500. According to Tables (1) and (2), the cost-benefit ratio can be achieved. To do this, it needs to convert the total cost to present value using the annual inflation rate. The total cost (659,037.77), with an estimated annual inflation rate (the average inflation rate of 2005 to 2012 = 8.15) has been equal to \$ 203, 406.72. The benefits of the project are \$ 209, 923.69, which by dividing it to the total costs, the cost-benefit ratio in this period will be equal to 1.03 and indicates the feasibility of the projects in the region.

## DISCUSSION AND CONCLUSIONS

The economic results of watershed management operations, according to the conducted calculation and analysis indicated that the project is economically feasible. The results are consistent with the obtained result by Dhyani *et al* (1993), they conducted the economic analysis of watershed management activities in the Fakut watershed of India. It is also similar to the results obtained by Golrang *et al.*, (2006) which aimed at the assessment of the socio-economic impacts of the projects in the watershed of the Shahid Yaqoobi Dam. Accordingly, we suggest that these operations will be considered by the villagers and will help to the economic and social development of the region. The results of the economic evaluation of the watershed management projects through questionnaires represent the increase in the crop production, vegetation cover, the number of livestock, water resources, agricultural and horticultural lands and decrease in the bare land area of the watershed. The results of the chi-square test of the relationship between the performance of the watershed management projects in the study area indicates that the null hypothesis is rejected thus the relationship between the crop production and the performance of the watershed management projects is statistically significant. It means that 60% of respondents declare that the yield is low and after performance of the watershed management projects, 80% of respondents declare that the yield is high. According to Figure-4, it can be seen that there is no significant difference between the wheat cultivated areas, before and after implementation of watershed management projects and the area under cultivation of wheat has increased as a result of the watershed management projects to 57 square meters. There is no significant difference between the areas under cultivation of barley; alfalfa and pomegranate before and after implementation of watershed management projects and the area under cultivation of these crops have increased to 50, 28 and 48 square meters, respectively. But there is a significant difference between the area under cultivation of palm trees, before and after the implementation of watershed management projects, and the area under cultivation of palm trees has increased to the amount of 244 square meters. There is a significant difference between the area under cultivation of agricultural and horticultural crops, before and after the implementation of watershed management projects. The

production rate is increased after the implementation of watershed management projects. It is similar to the results obtained by Golrang *et al.*, (2006) which aimed at the assessment of the socio-economic impacts of the projects in the watershed of the Shahid Yaqoobi Dam. Chi-square test results show that there was no significant difference between the average rate of the bare lands before and after implementation of the project, 72.5% of the respondents before the project declared that the bare land area is high and after that 75% of them have announced that the bare land area is low. Also, 77.5% of the respondents have announced that the project has a positive impact on vegetation cover and 70% of them declared that the project has a positive impact on increasing the amount of livestock. 55% of the respondents have announced that the project has high impact on the agricultural and horticultural land and 25% of them it has low impact. 75% of the respondents have announced that the project has high impact on the discharge rate of the wells and water resources and most of the water resources are permanent. It also discusses and estimates the positive impact of watershed management projects on the employment, income, nutrition of groundwater resources and the prevention of loss of the surface water. The obtained results are in agreement with the results of research studies cited in the literature, which all of have been applied in the assessment of watershed management projects. According to the obtained results, it can be concluded that watershed management projects are economically feasible and to a large extent solve the problems of the villagers. It is better to develop such projects in rural areas. Social outcomes of the assessment of the watershed management projects through questionnaires represent a decrease of migration, reducing the number of floods, reducing unemployment, flood and sedimentation control, satisfaction of watershed management projects, participation in projects. According to the villagers and on the basis of the results obtained using the chi-square test, 80 percent of respondents said that after the implementation of watershed management projects the number of emigration has been reduced. It is significant at the level of 95% and the H0 hypothesis is rejected. It means that there was significant difference between the average number of immigrants before and after the implementation of the project. Of course, the droughts occurred after the project has led young people to migrate outside of the basin to find a better job. According to the results obtained using the chi-square test, by the implementation of watershed management projects, the frequency of floods has been decreased. It is significant at the level of 95% and the H0 hypothesis is rejected. It means that there was significant difference between the average number of floods before and after the implementation of the project. The frequency of floods, before the implementation of the watershed management projects was high but the positive impact of the implementation of the project result in decreasing of the occurrence of floods in the area. It is also similar to the results obtained by Mansouryan and Golrang (2007) which aimed at the assessment of the socio-economic impacts of the projects in the Kameh watershed, Khorasan.



The results show that 72.5% of the respondents have announced that the project has positive impact on the unemployment and it is in agreement with the result obtained by Efati (2000). In the implementation of the projects of the Mateh-Sang watershed, many of the facilities in the village have been used so that 65% of the villagers have announced that the use of village facilities was high. The projects have a good influence in the region. So the projects result in complete satisfaction of the villagers with the full cooperation of the people and the government's plans for future. One hundred percent of respondents were satisfied with the implementation of the projects in Mateh-Sang watershed. But the researches which have done by Mansouryan and Golrang (2007) showed a negative impact of the watershed management project and dissatisfaction of the people. Also, One hundred percent of the people have also said that the project has resulted in flood control, reduced sedimentation in the basin and people satisfaction. Indifference to social issues and interacts with residents of the catchment area; the lack of consultation with them, ignoring their effective participation was effective in reducing the efficiency of the projects. A watershed management project in addition to achieving goals such as the development of groundwater resources, reduce erosion and important issues of soil and water, needs to be useful for residents and local beneficiaries. Generally, in this area it was found that the watershed management projects are useful in various aspects. Economically, the benefit cost ratio of the project is feasible and in terms of social issues, it also helps to reduce the migration of people and to increase their satisfaction.

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