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Socioeconomic Impacts of an International Carbon Sequestration Project on Rural Communities in Hossein Abad Ghinab, East of Iran

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ABSTRACT

Aim This paper aimed to evaluate the socioeconomic impacts of an international carbon sequestration project in Hossein Abad Ghinab in southern Khorasan Province of Iran.

Materials & Methods The performance of the project has been assessed from the standpoint of changes in demographic conditions, local communities' participation, literacy rate, access to health facilities, access to energy sources, satisfaction rate, and status of microfinance funds. The changes in these indicators have been monitored from 2004 to 2017. The required information was also elicited from a social survey, and a questionnaire was completed for 142 households as well through analysis of the previous reports.

Findings According to the findings of this research for the main indicators, the project has successfully improved the economic status for access to credits. As for annual income, the average household income from agriculture, livestock, and handicrafts have declined significantly from 2004 to 2017. Concerning the social implications, although some progress could be seen in access to energy sources and literacy rates, however, the project faces a reduction in public acceptance and satisfaction (from moderate to low).

Conclusion We have concluded that the project has been partly successful in bringing positive socioeconomic changes to the region, yet given the present obstacles such as budget limitation and public participation, the sustainability of the outputs, in the long run, could be a major challenge for project managers.

Keywords Carbon Sequestration; Rural Population; Socioeconomic Factors

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Introduction

Over recent years, the sequestration of carbon has been pursued in forestry projects as a suitable alternative to tackle global warming and climate change issues [1]. Carbon sequestration is very important in the face of global warming, which is caused by the accumulation of greenhouse gases such as carbon dioxide, methane, nitrous oxide, sulfur hexafluoride in the atmosphere. Greenhouse gases have kept the planet's temperature livable in different geological periods due to the Earth's thermal radiation's entrapment inside the atmosphere. However, during the twentieth century, due to the sharp increase in greenhouse gas emissions by human activities, unprecedented changes have occurred globally. Burdensome issues in countries and communities have convinced them to tackle this destructive phenomenon through increased carbon storage and sequestration. Among these, vegetation's carbon storage was one of the easiest and most cost-effective carbon storage methods [2].

Land degradation in developing countries has resulted in low income, destitute, and huge carbon [3]. Poverty in these areas affects millions of people, mostly women, and children, living in rural areas. The rural economy is largely dependent on agricultural and livestock production, and any plans to help rural deprived people should, at the same time, aim at improving social welfare and livelihood. Carbon sequestration through establishing vegetation in these countries seems to be a promising option to counter the global warming problem and provide economic incentives to people to participate in these projects and benefit from them [4]. Studies show that if carbon sequestration projects are undertaken with small landholders, it will help alleviate rural poverty and improve local livelihoods [5]. These stands will provide important biodiversity hotspots and ecosystem goods and services to local people by establishing vegetation cover. For example, Molua [6] reported that the livelihood of more than 50 million people in Congo directly depends on the forest's ecosystem services.

Carbon sequestration projects are implemented in a participatory form by including the empowerment of local communities, developing local economic activities, and capacity building to fulfill the requirements for physical aspects of the project, such as restoring and enhancing vegetation. More importantly, if the local people's livelihood is ignored, rehabilitation programs in these areas will attract a low level of participation and put the durability of the achievements in a state of ambiguity [7-9]. This issue becomes even more important when the project is being implemented in a region with poor local people. Pullanikkatil & Shackleton [10], by evaluating a carbon sequestration project through forestry in Nepal, argued that neglecting the poor will result in a low level of participation in these activities projects. The authors further argued that little is known about the relationship between how neglecting local poor communities would affect these projects' success. Besides local people's participation and especially the poor, the project's revenues are of high importance. A study in Vietnam on the success of forestry projects [11] showed that contrary to the government's common claims, it is hard to claim the lack of fair distribution of benefits of the project between the landholders' success activities.

Based on what has been argued thus far, relying solely on the amount of carbon sequestered can be misleading. On the other hand, disregarding extraneous aspects that could affect the project's success would undermine achievements. Carbon sequestration projects affect and receive influence from several factors. Therefore, the study of carbon sequestration from various aspects (including socioeconomic, environmental, and physical) can provide a comprehensive view of its success and effectiveness. Humphries *et al.* [12] attribute the success of carbon sequestration projects through forestry to factors such as initial support from governments and other partners for start-up capital, subsidized access to pieces of training and technical assistance, and navigating complex bureaucratic systems, and the positive effect that improved productivity over time, scale economies, and access to markets. The evaluation of the economic and social indicators (including the lifetime of the project, discount rate, project cost to benefit ratio, distribution of revenues, land-use change, inflation rate, etc.) allows managers and planners to evaluate the efficacy of the investment and to apply corrections if needed and even terminate the project. Measures that can be undertaken to guaranty better outcomes include: a) protecting the right and access of

local people to use natural resources; b) supporting participation, receiving opinions, and using traditional knowledge in managing the project; c) increasing the participation of the poor rural people in the agricultural programs and market-based activities; d) support for poor local people in policy development and project management. On the other hand, project managers' participation in informing public mobilization groups, facilitating communication between the involved members of the project and the local people, and using a flexible and consistent manner in planning and implementation can contribute to the project [13]. According to the provided preamble, we have tried in this study to examine the impact of an international carbon sequestration project on economic and social indicators in a deprived and remote area in the South Khorasan province of Iran. The first phase of the project started in 2003 and ended in 2009, and the second phase began in early 2010 and continued until 2012. The Forests, Range and Watershed Management Organization of Iran (representing the Government of the Islamic Republic of Iran as an executive body), the United Nations Development Program, and the Global Environment Facility partnered in implementing this project. The project site is 40 km to the east of Sarbisheh city and has been severely damaged by high grazing pressure. With the global objective of presenting a carbon sequestration model in arid and semi-arid regions, this project's goal was to revitalize the degraded lands of the Hossein Abad plain with the participation of rural development groups with the regional goal of improving the human development index. In this regard, rural development groups were formed through holding regular meetings and discussions. Subsequently, various training sessions were provided, and it was attempted to involve some of the local people as facilitators. The project is designed to provide sustainable and affordable methods for degraded lands in Iran to sequester carbon above and below ground via over-sowing and afforestation. On a global scale, the project seeks to reduce carbon emissions while at the same time improving the economic situation in the region. The indicators selected for evaluation and monitoring are demographic changes, participation rate, literacy rate, access to health and education centers, dependency on rangelands for energy supply, the establishment of microfinance funds, satisfaction level, credit allocated to the project spatial distribution of the impacts. Land-use change and on the other hand, land improvement are important sources of demographic changes and ecosystem rehabilitation results in less emigration and economic growth. In a seminal work, Walter [14] showed that degradation of the ecosystem and land-use change result in significant emigration in rural areas as cohorts of people are attracted to larger cities to get involved in the fast-growing, domestic construction, tourism, and related service sectors. At the same time, villages face growing shortages of agricultural labor. One of the advantages of such projects in deprived areas is establishing education centers such as schools or providing training opportunities that benefit marginalized groups of the society such as the poor or women which will finally reveal literacy rates. A similar effect was reported by Kapila *et al*. [15] in Punjab of Pakistan, when rural empowerment resulted in improved literacy rates, especially among women. The same results were reported in Nepal by Setia & Tandon [16]. The authors also introduced the importance of micro funds in forming Self Help Groups to develop their skills. One of the main important aspects of carbon sequestration projects is attracting a wide range of stakeholders to participate in training activities and accomplish a major project's goals. Local communities' involvement in these projects is vital as not only how the tasks are performed but also how the achievements are maintained after the project duration. Robinson *et al.* [17] and Reyes-García *et al*. [18] emphasize the importance of cooperation between project and local communities for both of them to benefit from each other's involvement. Another important issue is energy and food security. Destruction of vegetation could result in energy insecurity (as most of the energy in poor rural community is provided by uprooting bushes from rangelands) and food insecurity as less rangeland will be available for livestock grazing [19]. Public perception of the project, as well as their satisfaction with the outcome or performance of managers, defines a major part of any project's success. Sometimes such projects cause unwanted consequences causing public objection, especially when these negative effects directly target impoverished residents [20]. Public perception of the project and satisfaction level will define the participation rate in

undertaking the project's task and maintenance of the outcome and hence is an important factor. We also monitor the project's budget inflow, which is an important issue when evaluating carbon sequestration [12]. Budget allocation and initial support from governments and other partners exercise a serious effect on project success or failure. Natural resources management effects usually do not stop at administrative boundaries [21]. The location of population centers and infrastructure arrangements and so many other extraneous causes, such as political or economic factors, define the distribution of the effect of carbon sequestration projects. It is important to identify the spatial distribution of such projects' effect to know if the benefits of these activities are equitably distributed among the local people as it might affect many other aspects of the project. This research's main objective is to monitor and evaluate the changes made due to its implementation over a long period from 2004 to 2016 on the mentioned socioeconomic indicators. This study's main hypothesis is that the project has improved economic and social indicators in the area. These research results are valuable to project managers and policy makers on evaluating this project and better planning and implementing future similar projects.

Materials and Methods

Study area

Hossein Abad Ghinab plain and its surrounding elevations with an area of 144,000 ha area located in Sarbisheh, South Khorasan Province of Iran (Figure 1). The average height of the site is 1830 m. There are 31 villages in the project site with about 3,290 people, from which 15 villages were studied and monitored over time to evaluate the project's impacts and performance. Farming and animal husbandry are the main occupations of local people.

Research and data collection method

In this study, data on demographic changes, participation, literacy rate, access to health and education centers, dependency on rangelands for energy supply, the establishment of microfinance funds, satisfaction level, credit allocated to the project, and spatial distribution of the impacts were collected from both first and secondary sources. Part of our data was collected in a household survey during July 2018. The team initially evaluated the questionnaire and pretested before application with a small number of local residents (no =18) and six items of the questionnaire, which yielded an alpha Cronbach 0.78, which indicates a satisfactory level. From the total number of 185 questionnaires, which was estimated based on the population size (577 households source: results of population census in 2017) using Cochran's Formula at the significance level of 95%, only 142 questionnaires were filled, and the rest was rejected for data unreliability which lowered the significance level of the result to 90% which is still suitable for social surveys [22]. Household heads were selected as the target audience of this social survey as they are the direct responders to the project and decision-makers in the family. Some 25 questions were asked about the impact of the project and public participation in related activities. Other information, such as access to health facilities and literacy rates, were extracted from the national population census in 2017 as well as project audit reports. Statistics related to mechanical operations, budgeting, empowerment of the local people, participation rates, and microfinance funds were also extracted from the project monitoring team's audit reports from 2004 to 2008 and the results obtained by the research team in 2018. Collected data was analyzed and illustrated by Microsoft Excel. The items of the questionnaire are listed in Table 1.

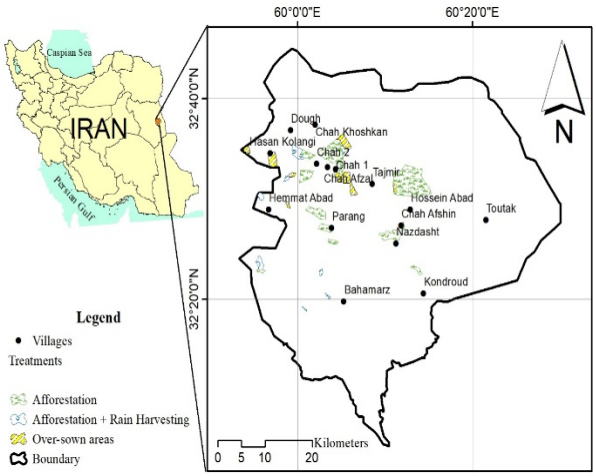

Figure 1) Location of the project site for the International Carbon Sequestration Project in Hossein Abad Ghinab plain in Iran and the location of villages within the project site

Table 1) Items inquired in the questionnaire to evaluate the impact of the carbon sequestration project in Hossein Abad on socioeconomic indicators

Variable	Definition and Evaluation
Occupation, age, and other demographic factors (not used here)	It is classified into five levels: unemployed, laborer, employee, farmer-rancher, and freelance.
Education	It includes primary school, middle school, diplomas, pre-university, bachelor's, masters, and doctorates.
Income	Divided into agricultural products, crafts, and animal husbandry
Access to health centers	It includes two items of the health centers' existence and the impact of the project on improving access to health care. The project's impact on people's access to health centers and health care has been questioned on a range from very little to very much.
Access to schools	It includes two items of the education centers' existence and the impact of the project on improving access to education. The project's impact on access to educational facilities such as schools was questioned on range from very little to too much.
Participation	This item was questioned based on the presence or absence of participation in project-related activities and the willingness or unwillingness to participate in them.
Satisfaction	Satisfaction with project performance and belief in project profitability was evaluated from ineffective to highly effective. The audience's satisfaction with the plan's appropriateness and its goals with the project executive area was evaluated on a range from inappropriate to very suitable.
Energy Sources	The energy source was divided into oil, gas, and rangeland plant categories.
Access to energy sources	The project's impact on access to energy sources and improvement or restriction of access to any of the former energy sources due to the implementation of the project was measured.

Findings

Demographic changes

The results of the census of villages located in the area of the carbon sequestration project in 2017 (Diagram 1) showed that the population from 2179 (466 households) in 2007 had reached 2165 (577 households) in 2017. During the early years, there was an increasing trend in population size, followed by a declining trend in the coming years. It should be noted that the number of households in 2017 was higher than in 2007, which reflects the decrease in family size. According to our results, Hasan Kolangi, Tajmir, Nazdasht, Bahamarz, and Kondrood have been facing a high population growth rate, while Hussein Abad, Ghinab, Parang, Chah Khoshkan, and Doogh have had declining population growth. Likewise, the comparison of population censuses conducted between 2003 and 2009 in the region showed that while the population growth rate of Nazdasht, Bahamarz, and Kondroud villages was very high with 26.7, 3.5, 2.5%, respectively, the village of Chah Khoshkan and Parang had a negative growth rate of 2.2-9.9%. It seems that the implemented plan has not led to significant changes in the population in the Hussein Abad Ghinab area.

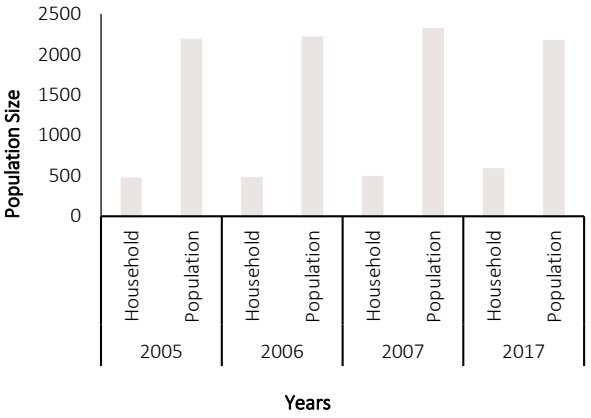

Diagram 1) Changes in population size of the monitored villages located within the carbon sequestration project site over different years

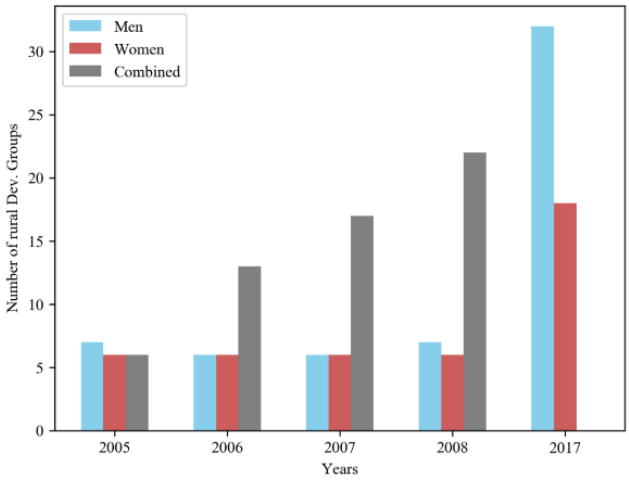

Diagram 1) Number of rural development groups participating in educational activities in the International Carbon Sequestration Project in Hossein Abad Ghinab

Descriptive findings of the questionnaire

In this study, a questionnaire was used to extract information about some indicators. This study's target population was the villagers covered by the carbon sequestration project, a cohort of 142 people were questioned. In this questionnaire, 25 questions were asked about the project's impact and participation in related activities (Consult Table 1 for more information on the items listed in the questionnaire). A summary of the demographic characteristics of this study is presented in Table 2. Other items considered in the questionnaire will be explained separately.

Table 2) Summary description of the participants in the survey by each village

Villages	Number of participants	Average age (yr)
Hemmat Abad	18	32
Parand	5	26
Chah Khoshkan	5	23
Hossein Abad	3	45
Tootak	2	35
Kondroud	10	35
Tajmir	15	28
Bahamarz	5	32
Nazdasht	40	26
Chah Afzal	12	27
Chah Afshin	8	35
Chah 1	8	29
Chah 2	11	25
Hasan Kolangi	3	32
Total	142	

Investigating gender and age structure of villages

The gender ratio is usually calculated by dividing the number of men by the number of women in the same population. The gender ratio depends largely on the relative mortality of men and women and the relative distribution of emigrants in areas with a high emigration rate. Therefore, in regions where men account for more immigrants, a higher gender ratio would be encountered [23]. Based on the questionnaire results in 2009 from 2311 people, the population consisted of 1,172 women and 1139 men, representing 97.2% men per 100 women. These figures were 104 men and 90 women in 2016. The age distribution of the population was based on 5 years' intervals. The demographic classification of villages based on the major age groups showed that 12% of the population aged under 4, 11.9% of the population 5 to 9, 13.9% of the population 10 to 14 years, 12.4% of the population 15 to 19 years, 10.5% of the population 20 to 24years and 39% higher than 24 years.

Participation of local people in the project

The participatory activities can be categorized into two groups of educational activities and rehabilitation activities. Likewise, the number of rural development groups participating in educational programs has increased in recent years, peaking in 2016 (Diagram 1-3). In terms of individuals and groups' participation in rehabilitation programs, an incremental trend can be observed at the beginning of the project's implementation, followed by a decreasing trend from 2011 onwards, reaching its lowest level in 2016. Although pivotal rehabilitation activities have been completed, maintenance operations such as irrigation, inter-cropping, seedling production, and seed collection are underway. Accordingly, the level of public participation in the project has dramatically decreased since the beginning of the project, which could challenge the region's measures' effectiveness in the future. Based on the figures, women had a lower participation rate and more participants than men, mainly because of the activities' nature, which leaned towards men, such as those requiring work force for plantation bed preparation, plantation, and irrigation, inter-cropping, etc. This project's participation in this project mainly concerns their role in craft production, training programs, self-help groups, or group meetings. Unfortunately, data is lacking on a village-to-village basis, which prevents us from drawing a conclusion on which villages participated the most and which villages had lower participation rates. Data on workers involved in the project from the villages outside the project site is also not available, which might further lower gender distribution accuracy in participatory activities.

Literacy Rate

According to the obtained statistics, there has been a noticeable change in the literate population rate from 2004 to 2016 (Table 3). One of the indirect impacts of the carbon sequestration project in this area has been the empowerment of local communities in various activities, such as constructing educational centers. On this basis, it appears that the actions undertaken have had a positive impact on the literacy rate in the region, in the sense that the literacy rate reached 85% in 2017 from 69% in 2004, showing a 16% improvement.

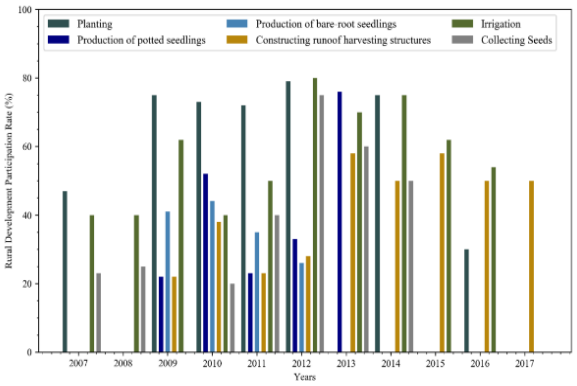

Diagram 2) Participation rate in rehabilitation activities by rural development groups in different years in the International Carbon Sequestration Project in Hossein Abad Ghinab

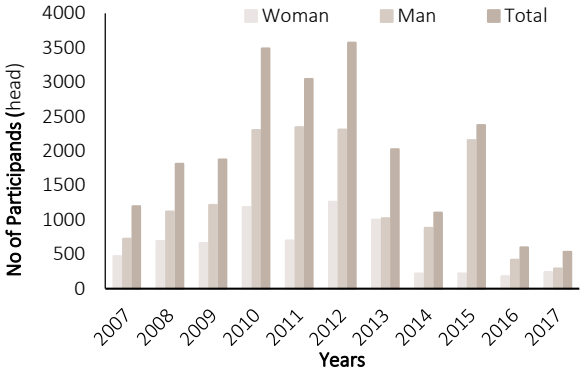

Diagram 3) Number of participants in rehabilitation activities by rural development groups in different years in the International Carbon Sequestration Project in Hossein Abad Ghinab

Table 3) The change of literacy rate within the population of over 6 years of age across villages located in the Hossein Abad plain

No	Villages	2004	2017
1	Hasan Kolang	68	69
2	Tajmir	73	75
3	Hossein Abad Ghinab	56	65
4	Nazdasht	72	81
5	Chah Afzal Hosseini	73	64
6	Chah Shahid Afshin	67	72
7	Parang	50	69
8	Chah Khoshkan	63	73
9	Bahamarz	62	81
10	Kondroud	61	75
11	Totak	69	72
12	dough	40	67
13	Hemmat Abad	59	69
14	Chah 1	73	58
15	Chah 2	88	89
	Total	**69**	**85**

Unfortunately, due to the lack of high schools (except for only two small villages of Nazdasht and Chah 2), most students leave school after completing primary or secondary education. Distance, poverty, and inability to afford the cost of education, adherence to the traditional beliefs that girls do not need official education, and the conditions governing the nomadic and rural economy that require the temporary dedicated workforce are the main causes of the low level of formal education and graduation. Undoubtedly, given the above issues, educational facilities' development at the secondary level and high schools is a definite necessity for the area.

Access to health facilities

There is only one health center in the village of Nazdasht, covering only the villagers of Nazdasht, Chah Shahid Afzal, and Chah Shahid Afshin. It should be noted that the new building opened in 2007 and has a general practitioner once a week. The main health issues in the area include those related to respiratory problems and eye diseases because of low air quality in summer and frequent occurrence of sand storms and issues related to water quality (direct interviews). However, given inadequate access to health facilities has compounded the region's situation and hence needs further attention from the project managers or higher authorities. From the viewpoint of drinking water status, only Nazdasht, Tajmir, Chah 1, Chah 2, Hasan Kolangi, and Hossein Abad villages are provided with a central water network. The villages of Nazdasht, Hemmat Abad, and Chah 2 have sanitary baths, and in the villages of Bahramz and Hemmat Abad, new baths are under construction. The village of Nazdasht and Chah 2 also have a morgue. In terms of sewage disposal status, in all villages, false wells are used. The villages of Doogh, Parang, Nazdasht, Chah 1, Chah 2, and Hasan Kolangi also have a cemented reservoir pool to store water. In general, 9 villages (69% of the villages) have drinking water network, 5 villages (38.7% of the villages) have sanitary baths, 2 villages (15% of the villages) have morgues, 3 villages (23%) have hairdressing salons, and one village (8% of the villages) has a health center. Unfortunately, some villages' endeavors, such as the Tajmir, for the construction of public baths or raising funds to buy domestic water heaters, have failed.

Reducing dependency on rangelands for energy supply

According to the information obtained from questionnaires, 33 households (6.8%) used firewood for cooking, heating, and bathing, which shows a 12.6% reduction compared to 2008. In total, 23 households used firewood and gas, 5 households used firewood and oil, and 14 households used a combination of firewood, gas,

and oil for cooking. Some 83% of households used solely oil for heating, 17 households used solely gas, and 13 households used gas and oil. In 2008, 75 households from the region villages used firewood from rangelands as fuel, which showed a 70 household reduction compared with 2007. Nevertheless, traditional ovens in many villages show that shrubs and bushes are still an energy source for some of the households. The main reason is the shortage and inadequacy of distributed oil and gas cylinders in the villages. Although people are deeply aware of the importance of not using rangelands as firewood (based on personal communications with local residents), the lack of other energy sources has forced the people to rely on rangelands for their fuel consumption. In any case, the number of households who used firewood for their fuel consumption has decreased by about 51.7% since 2007. Perhaps one of the main causes of lower dependency on rangelands has been the distribution of gas ovens and cylinders among rural development groups.

Microfinance funds

Microfinance funds provide self-financing for productive activities and livelihood improvement. In each group, several enthusiasts, voluntarily or recommended, are trained to implement business plans. Low-income groups and rural women have been the top priority of the microfinance funds to boost employment. During recent years, because of the major economic situation, the loans provided by these funds are not enough for start-up projects, but they will still provide some assistance in field-related activities such as fixing pieces of machinery or buying livestock, among other minor issues. As the amount of money collected in these funds varies, it is difficult to provide an average value of the micro-loans provided to the stock-holders, and no official data record is available on this item.

The results obtained regarding the number of members and the volume of accumulated capital in the project site's microfinance funds are presented in Table 4. Accordingly, the number of members in the period between the start and the end of the survey has risen from 427 to 413, indicating a decrease in the number of contributors. However, the volume of capital accumulated increased from 80 million Rials to more than 360 million Rials over the same period, which suggests an increase in the funds' ability to provide loans to the villagers in the region. Nevertheless, out of the total number of investigated villages, no microfinance funds have been established in Chah Shahid Afzal and Shahid Afshin. On the other hand, the funds are not available in villages such as Parang, Chah Khoshkan, Bahamarz, and Tootak due to lack of cooperation or financial inability.

Until 2018, around 1237 loan requests were received by the funds. Of the loans paid, 747 were ordinary loans, and 490 were business loans, which, according to statistics, resulted in the creation of 539 stable job positions. The job opportunities created include the start-up of packaging workshop for dried fruits, handicraft production, traditional towel manufacturing, and marketing.

Public perception of the project

One of the important indicators in evaluating this project's effectiveness in achieving its goals is the level of satisfaction of the participants in the project. Accordingly, the statistics obtained from the reports from different years and the current level of satisfaction were obtained using the questionnaire, presented in Fig. 5. The data was classified based on the Likert range from ineffective to highly effective. Accordingly, in 2006, 34.5 % of rural households assessed carbon sequestration projects' performance as highly effective, 31% as effective, 24.1% less effective, and 10.3% as ineffective. This assessment shows that a significant portion of the region's people initially had an optimistic view of the project's outcome. In 2007, these figures were 2.41% as highly effective, 34.5% as effective, 2.9% less effective, and 5.9% as ineffective, respectively, indicating an improvement in people's perspective of the project. In 2008, these figures were 39% as highly effective, 41.55% as effective, 3.7% less effective, and 7.8% as ineffective, which had no significant changes from the previous year. In 2017, based on completed questionnaires from 142 target villages, people's evaluation of this project's effectiveness for improving their livelihood has decreased to 21.8% as highly effective, 19.2% as effective, 24.8% as less effective, and 25.9% as ineffective. Proportionality of the project with the study area based on public perception (physically, environmentally, socio-economically) indicated that 20% of the audience had selected very suitably, 35.2% suitable, 28% average, 12%

inappropriate, and 4.8% very inappropriate options indicating that more than half of the audience perceived the project to be appropriate to the region's conditions and its socioeconomic characteristics.

Table 4) Status of microfinance funds at the beginning and the end of the study period in the Hossein Abad area of South Khorasan

No.	Village	2004		2017	
		No. Members (Household)	**Accumulated Fund** (Thousand Iranian Rials)	**No. Members** (Household)	**Accumulated Fund** (Thousand Iranian Rials)
1	Hasan Kolangi	16	6235	13	27030
2	Tajmir	39	6532	63	165970
3	Hossein Abad Ghinab	7	10000	7	15100
4	Nazdasht	143	18260	150	468930
5	Chah Afzal Hosseini	-	-	-	-
6	Chah Shahid Afshin	-	-	-	-
7	Parang	12	1800	-	-
8	Chah Khoshkan	15	1700	-	-
9	Bahamarz	20	2600	-	-
10	Kondroud	46	5400	60	10450
11	Totak	6	1640	8	11790
12	dough	12	570	-	-
13	Hemmat Abad	45	3980	54	13100
14	Chah 1	40	14610	35	49000
15	Chah 2	26	13400	32	27800
	Total	**427**	**8111**	**413**	**366000**

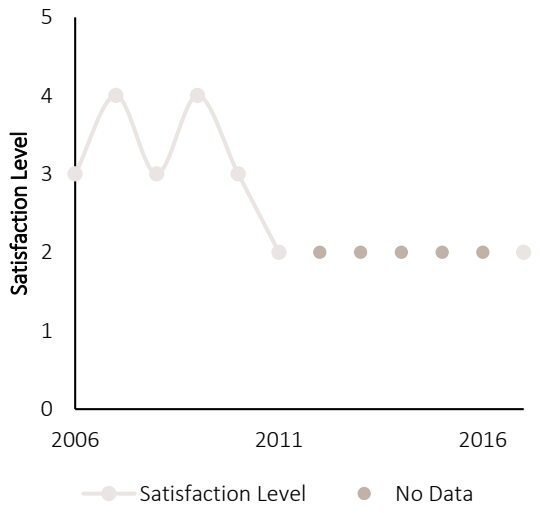

Diagram 4) Satisfaction level among the local people about the outcome of the International Carbon Sequestration Project in Hossein Abad plain of South Khorasan Province (Dashed Line indicates No Data)

Status of credits allocated to the project

Table 5 shows the credits allocated to the international carbon sequestration project in the Hussein Abad area. The data on rehabilitation activities included plantations, seeding bed preparation, labor, seedlings production, and seed collection. The maintenance budget included irrigation and inter-cropping. According to the obtained statistics, the project's largest budget was allocated in 2011 and the lowest amount in 2016. Failure to allocate funds to the project in the future can greatly affect the potential impact of the actions undertaken. Accordingly, the total budget allocated to the project's monitoring and evaluation was 770 million Rials, which was not available in exact terms. Our follow-up on the budget allocation from the central office in Birjand city indicated that no fund has been raised for project maintenance or supporting self-help groups over recent years, which could seriously endanger this project's outcome.

Table 5) Credits allocated to the International Carbon Sequestration Project in Hossein Abad of South Khorasan Province (Million Iranian Rials)

Fiscal Year	Credit	Rehabilitation budget	Maintenance budget
2005	80	10.6	25.8
2006	96	46	13.5
2007	68	29.5	16.5
2008	100	-	-
2009	122	-	-
2010	Unavailable	Unavailable	Unavailable
2015	0		
2016	0		

Spatial distribution of impacts

To determine the spatial impact of the project, the project site was divided into two upstream

and downstream sections (Fig. 6). Thus, the site's average annual income per capita downstream has decreased from 3,917,000 to 1,580,000 Tomans. Meanwhile, in the site's upper reaches, the average annual income per capita decreased from 3,313,000 to 1,230,000 Tomans. However, there seems to be a significant difference in income between the two sections of the watershed. Results for two items of satisfaction with project performance and project suitability for the area also indicated a higher rate of satisfaction with the project's outcome in the downstream section of the area (averaging 2.8 on the Likert scale meaning above-average satisfaction) while degrading to merely inappropriate and average (averaging 1.6 on the Likert scale) in those villages located upstream of the area. We did not find significant differences in other items for these two sections of the site.

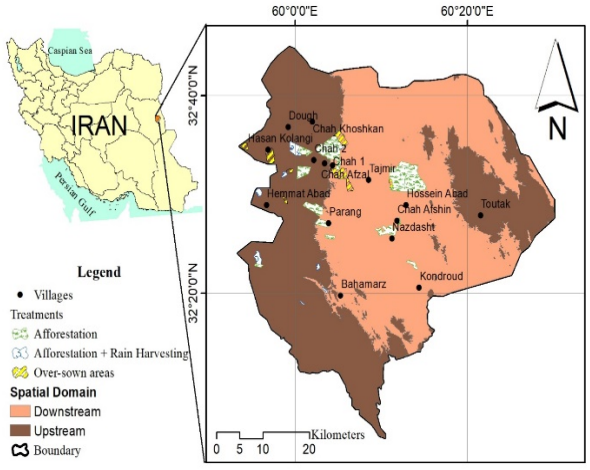

Figure 2) Upstream and downstream sections of the carbon sequestration project site in Hossein Abad Ghinab

Discussion

The study of changes in the dimension, structure, and development of the population in rural areas is one of the issues considered in evaluating rural development programs after implementation. Sustainability of regional rural development and carbon sequestration projects depends on the integrated status and the coordination between rural resource-environment conditions and rural socioeconomic development [24]. As argued by so many authors, well-designed and implemented dryland rehabilitation programs can result in poverty alleviation, food security and livelihood improvement, healthy ecosystems, improved biodiversity conservation, and mitigation of greenhouse gases [25-28] The study of quantitative changes in factors such as the number of households and individuals, age, gender, occupation, education, employment, migration, etc., at different intervals, can raise awareness of the effectiveness of rural development programs to meet their predefined goals [28]. According to the results, this project's implementation has not had a significant impact on the population, so that the population size changed from 2,179 to 2,165 over the studied period. The lack of influence on the population can be seen as a positive sign of the migration process's decline. According to the available reports, before implementing the project, the region had a fairly high rate of migration. Emigration is often seen as seasonal (temporary, periodic) or permanent within the studied area's boundaries. In 2009, about 87.1% of permanent migrants aged 15 to 64 did not show any significant growth compared to previous years. Most emigrants are leaving in the hope of seeking a job or to continue education, with the former being a major category. The harsh environmental condition, unemployment, the lack of job opportunities, and high labor income in cities caused a high rate of emigration in the early years of implementing the project. Reuveny & Moore [29] also considered the destruction of the environment and low environmental quality as the most important reasons for emigration from such areas.

The total number of registered emigrants in 2009 from the villages surveyed was 41, which was much lower than that in 2008 with 74 people. This figure has reached 42 in 2017, which shows a significant difference compared to 2008. Some of the migration occurred in the form of the village to village displacement. For example, some people from Parang permanently migrated to Nazdasht and were falsely reported as emigrants. For this reason, the project's outcome, such as establishing microfinance funds, paying labor costs, and providing some facilities, has helped reduce migration in the region. Similar results were obtained by Collett *et al*. [30] in Nepal. They observed that restoring 20,000 hectares of degraded lands and empowering locals with various facilities significantly reduced emigration.

Perhaps one of the strengths of this project has been enabling the participation of many people in the region. Participatory activities conducted in most educational programs and rehabilitation

activities have improved the income of the community and created 539 stable jobs. Holding training courses such as carpet weaving, doll production, beekeeping, mushroom breeding, building nurseries, etc. have contributed to the local people's income. Empowerment, community participation, and social capital are the most important ingredients of a successful rural development program [31]. Anderson *et al*. [32] argue that most forestry projects do not increase local access and control over valuable assets, and by complicating the regulations and providing new rules render the utilization of resources more difficult and lead to impoverishment. Even with these bottlenecks, in most forestry projects, local people tend to participate as they see their lives dependent on these resources and seek higher incomes through their participation. Of course, reducing the project's budget over recent years has slowed down the trend of participation.

Although the number of rehabilitation activities has been significantly reduced, the number of development groups and microfinance participation in some villages has improved dramatically. In some villages, due to the lack of repayment of installments, as well as the cancellation of meetings, funds formed at the beginning of the project have been virtually inactivated. The mismanagement of funds and the payment of loans to abusive individuals has also been the cause of other microfinance units' shortcomings. Nevertheless, in general, these funds' existence and their sustained activity can be seen as positive outcomes of the project. Vecchiato & Tempesta [33] also argue that the tangibility of the project's benefits is one of the main reasons for the high rate of local participation in rehabilitation activities. Newton *et al*. [34] reported that a) access to information, b) access to technical assistant, c) access to rural credit through farmer-technician partnership, and d) financial incentives promote forestry and carbon sequestration projects. However, financial incentives are compared with the opportunity cost for the land, and therefore if the provided incentive is not satisfactory, the project will attract low levels of participation [35]. Along with participation, Minang *et al*. [36] introduced the importance of innovative participants who participate not only physically but by providing problem-solving ideas and solutions. This type of participation requires a close partnership between private and public sectors, increased capacity development, capital investment, and deploying incentives (financial and non-financial) [36]. Smith *et al*. [37], Walton *et al*. [38], and Dai *et al*. [39] reported that the implementation of forestry projects directly increases the population's income. At the same time, Trac *et al*. [40] observed that in some cases, the implementation of these projects could lead to lower-income by reducing public access to primary sources of livelihood. Also, Perez *et al*. [41] argued in support of these findings that although carbon sequestration projects can help people through income generation, at the same time, they can create social tensions and engage people in the bureaucratic system, which leads to lower public satisfaction. The project carried out in Hossein Abad benefited from a high participation rate, which could be attributed to providing financial incentives to local people.

One of the important points made during the interviews with the target audience was the existence of a sense of ownership of the project so that, in many cases, the villagers themselves had the responsibility to protect the treated areas. The sense of ownership can sign the influence of local people's participation in this plan. Chhatre & Agrawal [42] also observed that when a sense of ownership is stimulated among the local people, they will protect the project's achievements. Chandran and Surendran [43], in an attempt to explore the factors that affect farmers' willingness to adopt drip irrigation in part of India, found that increasing income acts as a positive factor in boosting public participation project's activities. Along with this finding, Fisher *et al*. [44] emphasized the importance of justice and the sense of ownership among people as two important driving factors of public rejection of carbon sequestration through forestry projects. The relationship between the sense of ownership and public acceptance of forestry projects has also been emphasized in the work of Handberg [45].

Another positive outcome of this project was to improve people's access to energy and reduce their reliance on rangelands for fuel consumption. A 52% reduction in fuel supply from rangelands has shown improved energy access due to the project's implementation. However, the survey results indicated that overall satisfaction with improving energy access is still low, and major problems were still existing during the hot season of the year. Thus,

one of the main priorities is to maintain the project's achievements and improve public access to energy, particularly gas. Amirarsalani [46] identified the lack of access to energy sources as one of the most important environmental forest degradation factors in Iran. Providing natural gas, other energy sources or electrification could directly translate into less reliance on rangelands and forests for fuel, which reduces deforestation and rangeland degradation [47]. González-Eguino [48] sees energy poverty directly linked to general poverty and emphasizes the importance of tackling energy poverty when seeking poverty alleviation. Access to energy not only reduces natural resources degradation but works as a means of development [49].

The results showed a significant difference between the upstream and downstream areas of the project site. In many remote villages such as Doogh, Hassan Kolangi, and Hemmatabad, general satisfaction with the project's economic impacts had a significantly lower level. On the contrary, central villages such as Nazdasht, Chah 1, and Chah 2, and Hossein Abad reported higher relative satisfaction with the project's effectiveness. Limiting treatments to central parts and not paying enough attention to marginal areas is one of the main reasons for decreasing satisfaction in those villages. Seher & Löschner [21] believe that political, economic, and other factors could result in the non-even distribution of project revenues among local people, which could undermine the project's achievements and sustainability. There is not enough evidence on the distribution of the benefit of carbon sequestration projects and rural empowerment in Iran and globally, which is one of this research's main strengths. It can be seen that the project was mainly aimed at improving the conditions of the central regions and has somewhat neglected the upper reaches of the area. Becu *et al*. [50] observed that implementing watershed programs in the basin's upper reaches could affect the down streams hydrology and socioeconomic factors.

Conclusion

We have found positive and negative impacts on socioeconomic indices. In addition to the project's strengths, the lack of documented and organized statistics on project monitoring, budgeting, and expenditures have made it difficult to evaluate the project. Hence, we believe that lack of clarity is the main problem of this and other similar projects in Iran, and much more attention should be channeled towards monitoring and evaluating carbon sequestration projects and data collection for project evaluation. Without organized and systematic data collection and analysis, it is extremely difficult to claim such projects' success or failure. For example, the lack of precise statistics in 2015 to date and the lack of budget allocations have made it difficult to assess the project's financial dimension accurately. In a very similar work, Ulomi [51], in his research in Burkina Faso, reported that accurate financial data in carbon sequestration projects contribute to the clarity of the project's achievements be seen as an experience for future projects for budget allocation. Unfortunately, this has not been seen in monitoring and documenting the current project, which should be further pursued in detail in future projects. Finally, the project seems to be successful in improving some socioeconomic indicators in the region, but the sustainability of these outputs can be a major challenge for project managers. In this research, we provided a brief overview of the carbon sequestration project's socioeconomic influences in Hossein Abad Ghinab, while other aspects of the project, including the physical and environmental aspects, will be addressed in future publications. Overall, we believe that this international project's implementation has been partly successful in bringing positive changes to the area in terms of some socioeconomic indices. However, maintaining these achievements is even harder than inducing them in the long term. It appears that major economic issues and lack of budget will greatly undermine the project's outcomes and, consequently, the sustainable development in the region, which was the primary goal of the project.

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