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RESEARCH ARTICLE

Carbon Sequestration Projects in Desert Rural Areas and Lands of Iran: Participatory Management of Natural Resources Stabilized among Local Communities

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ABSTRACT

Today, the environment and natural resources are exposed to increasingly numerous interests and demands, which sometimes generate conflicts and the livelihood of millions of rural households worldwide is closely related to them. The current level of livelihood dependency of local livelihood on environmental income is reported as high in many developing countries. The Sustainable Development Goals (SDGs) highlight the links between human well-being, economic advancement, and a stable environment. As mentioned and discussed in this article, Carbon Sequestration Projects (CSPs) for Community-based Rural Development and Sustainable Natural Resources Management in Arid and Semi-arid lands of South Khorasan province, east of Iran, could have a tangible and important role for improving the environment and social conditions, problems and troubles in this border, frontier, isolated and deprived area of Iran. Advocacy, extension, and development of the community-based and button-up approach in the field of natural resources management at the national level must be considered. Objectives of this outcome are to: Introduce the participatory approach and the methods used by CSP to national and provincial decision makers, train and advocate the participatory model of natural resources management, form a nationwide working group, incorporate practices and the community-based approach of CSP into the Iranian National Socio-Economic Development Plan. Introducing more diverse sets of profitable and less environmentally reliant income-generating activities, along with the development of a more educated rural population, will stimulate development in rural areas, alleviating environmental pressure on environmentally fragile ecosystems. CSP mainly addressed ensuring the sustainability of village development groups. One of the main objectives of CSP is to have the concept of participatory management of natural resources stabilized among local communities. In this article, the author discusses and states the most important aspects of CSPs for Community-based Rural Development and Sustainable Natural Resources Management in Arid and Semi-arid lands in South Khorasan province, east of Iran.

Key words: Arid and semi-arid, carbon sequestration projects, community-based rural development, environment, Iran, south Khorasan province, sustainable natural resources management

INTRODUCTION

Our planet and global society are facing increasingly disruptive challenges. Extreme weather events are harming communities worldwide, destroying infrastructure, homes, and harvests essential for our well-being (Brinken *et al.*, 2025).

The Sustainable Development Goals (SDGs) highlight the links between human well-being, economic advancement, and a stable environment. This approach is relevant to numerous urgent issues, such as the security of water, energy, and food supplies, the alleviation of poverty, economic

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progress, climate change, and public health (Werku, and Woldeamanuel, 2025).

Today, the livelihood of millions of rural households worldwide is closely related to the environment (Dehghani Pour *et al.*, 2018).

The SDGs of the United Nations strive to improve the quality of life for people in developed, emerging, and developing countries by addressing social and economic factors while prioritizing environmental sustainability.

The achievement of the SDGs established by the United Nations requires a comprehensive and balanced strategy that addresses all goals rather than focusing on just a few (Werku, and Woldeamanuel, 2025).

The loss of agricultural production due to climate change and natural disasters has attracted widespread attention. The global environmental situation has faced many serious challenges in recent times, with climate change, ecological degradation, and loss of biodiversity becoming increasingly serious problems. Moreover, environmental problems pose multifaceted problems for agricultural production. Global warming may lead to higher temperatures in certain areas, which may affect crop growth cycles and yields. For example, high temperatures may lead to limited growth of crops such as wheat and maize, or even to heat damage (Feng *et al.*, 2025).

Moreover, climate change can lead to changes in precipitation patterns and the possibility of extreme weather events such as droughts or floods, which directly affect agricultural production.

Droughts can lead to insufficient water for crops, while floods can lead to inundation of crops or damage to land. In addition to having an impact on crop yields, high temperatures and frequent changes in precipitation may lead to soil erosion, salinization, or acidification, which directly affect soil fertility. And in some areas, over-tillage or poor farming practices, combined with climate change, can lead to soil degradation, which in turn can affect the health of crops (Feng *et al.*, 2025).

The World Food Programme (WFP) predicts that climate change could lead to a nearly 20 per cent increase in global hunger and malnutrition by 2050, affecting millions of people around the globe, especially in developing countries. Although climate change poses a challenge to global food production, with the development of modern agriculture, many new yield-enhancing and food preservation technologies are beginning to be gradually applied.

Climate change (CC) can further reduce productivity and make production more volatile (Feng *et al.*, 2025). As the material foundation of human existence and the cornerstone of socioeconomic development, the ecological environment plays a crucial role in realizing sustainable development. Against the backdrop of global climate change, human social development, and ecosystem deterioration, ecological environmental protection has increasingly become one of the key issues of concern for scholarly organizations around the world.

Ecological vulnerability refers to the response and resilience of ecosystems to external disturbances at specific spatial and temporal scales and is the result of the joint action of natural factors and socioeconomic activities (Wu *et al.*, 2025).

Today, natural resources are exposed to an increasingly numerous interests and demands, which sometimes generate conflicts. the mobilization of communities appears to be a real alternative to the “top down” injunctions, which often focus on the economic and political at the expense of the ecological balance and the needs of local populations. Some farmers exclaim that real people who protect nature are local communities themselves. If it is questionable to say that communities are really only practical to protect the environment, there is no doubt that they are the main victims of environmental degradation (Gandin, 2012) .

The compromise between natural conservation and economic development has always been debated among governments, villagers, and industries to seek sensible solutions meeting different needs. It is underlined that both built-environmental sensitivity and residents’ adaptability are critical determinants in an integrated human-natural system that has experienced significant shocks (Chiang *et al.*, 2014).

Conversion of forests to other land uses is currently economically rational for rural people because cropping, animal husbandry, and non-forest environmental products by far account for the major share of all rural households’ total income while forests do not seem to supply any products that the majority of households cannot collect from the non-forest environment as well (Ve Pouliot and Treue, 2013).

The basic goal of sustainable development was to create a nexus between socially acceptable

economic growth and environmental management. Within this framework, agriculture would be created to achieve profitability, community well-being, and environmental safety (Udemezue *et al.*, 2021).

Carbon Sequestration Project (CSP) mainly addressed ensuring the sustainability of Village Development Groups (VDGs). One of the main objectives of CSP is to have the concept of participatory management of natural resources stabilized among local communities [Figure 1].

CSPS AND CARBON CAPTURE AND STORAGE (CCS) TECHNOLOGY AND DEPLOYMENT

Environmental Factors Controlling Soil Organic Carbon (SOC) Storage

Land degradation and erosion are serious environmental problems in the world. It is well established that in degraded areas, soil is shallow; soil nutrients and plant available water capacity are reduced (Yüksek, 2016).

Carbon dioxide (CO_2) is the single most important greenhouse gases (GHG) derived from human activity and responsible for 74% of global warming over the past decade. SOC plays a key role in the C cycle since it represents twice the amount of atmospheric C and 70–75% of the Earth's terrestrial pool. Even minor changes in the SOC pool can have a critical effect in the global C cycle, influencing the atmospheric concentration of GHGs in the atmosphere and therefore the global climate change. At the same time, soils can act as sinks for atmospheric CO_2 by sequestration of organic C and are able to store C for long periods of time. It has been reported that 89% of mitigation potential by agricultural management depends on SOC sequestration. However, large uncertainty remains concerning the scope of these feedbacks and considerable differences exist among prediction models. A more accurate quantification of the response of terrestrial C, with a large proportion deriving from the soil C pool, is therefore crucial for understanding the Earth's response to global warming and climate change (Muñoz-Rojas *et al.*, 2016).

In the last years, there has been a significant increase in the number of studies on SOC sequestration conducted in Mediterranean regions. The climate in these regions is characterized by seasonal dryness, and many subareas are classified as arid or semi-arid. In Mediterranean agricultural systems, levels of productivity are typically low and there is a largely dependency on irrigation. As a consequence of their low SOC contents, these areas are often degraded and vulnerable to environmental changes, and climate change is predicted to have a large impact upon them. Most of the prediction models suggest higher temperatures and decreases in rainfall in Mediterranean areas compared to other systems, which could promote higher decomposition rates of SOC. Thus, increasing SOC contents in these environments with appropriate land management techniques or land use changes could also be beneficial for soil erosion control, soil fertility, and, ultimately, food production. Biogeochemical cycles of N, P, S, and other plant nutrients are driven by SOC dynamics, and benefits can be obtained even after relatively short periods of time. Several approaches have been applied to evaluate climate change impacts on SOC stocks, being soil carbon models amongst the most effective tools to assess SOC stocks, dynamics and distribution, and to predict trends under climate change scenarios. Global Climate Models are indispensable to simulate global climate since they provide simulations of atmospheric general circulation and project climate variables, such as temperature and precipitation, in future climate scenarios (Muñoz-Rojas *et al.*, 2016).

Concerns over global warming and carbon emissions have sparked interest in methods of sequestering carbon, which has been released through the burning of fossil fuels. Human activity is already directly and indirectly affecting almost half of the terrestrial biological carbon cycle. If this cycle were properly managed, it could be a major contributor to the mitigation of CO_2 (Farrelly *et al.*, 2013).

Soils are the largest and, undoubtedly, the most important carbon reservoir in the terrestrial carbon cycle. SOC originates from litter fall, roots, and soil biomass decomposition, root exudates, and microbial fixation. SOC storage is the balance between the input of dead plant material (leaf and root litter) and losses from decomposition and mineralization processes (heterotrophic respiration). SOC distribution and storage are the basic measures used to study soil productivity, hydrology, and

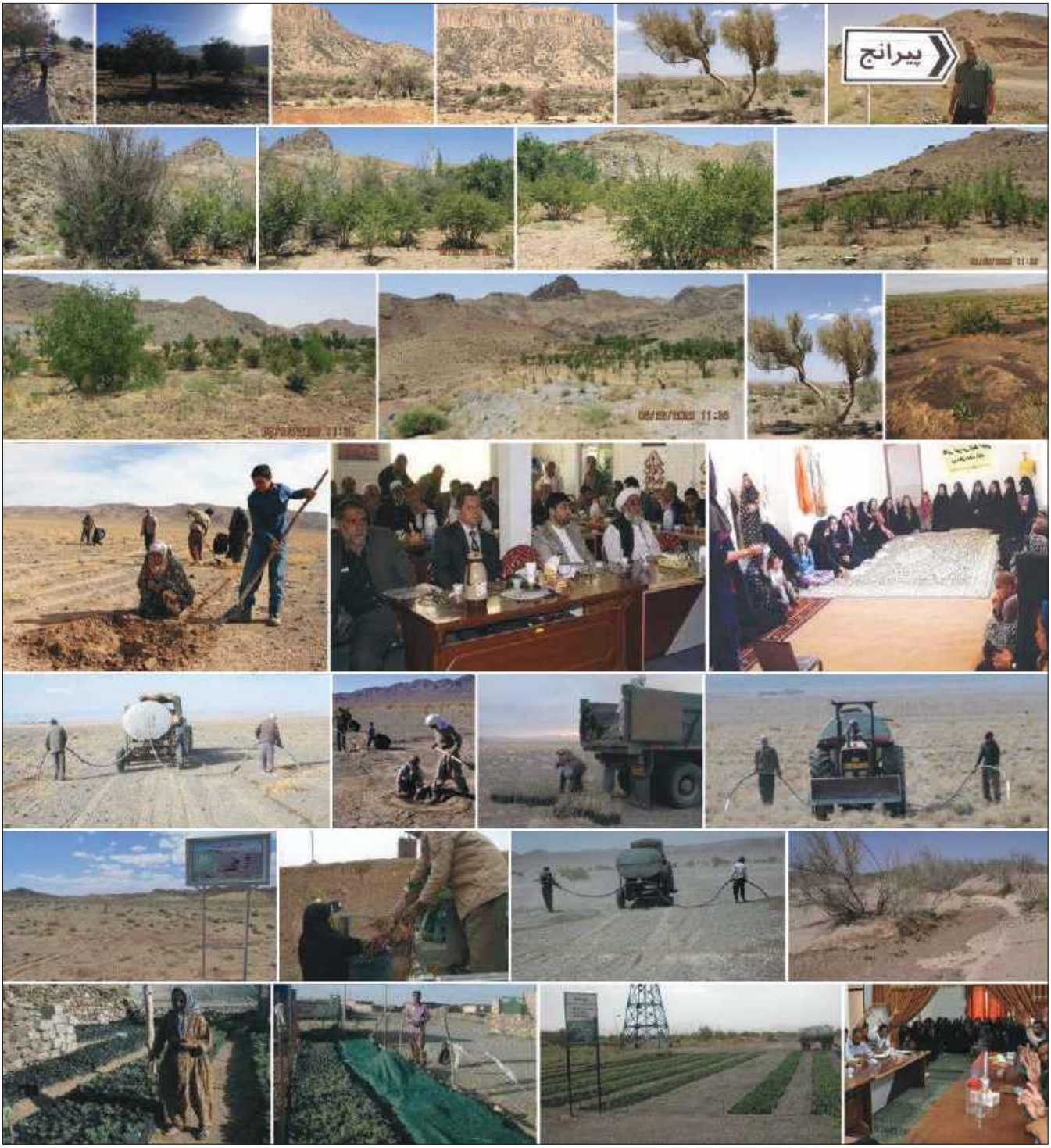

Figure 1: Rural people's participation in various stages of the international Carbon Sequestration Project (CSP) and Carbon Capture and Storage (CCS) Technology and deployment in Fars and south Khorasan provinces, South West and East of Iran (2005–2025) (Pictures by: Author and General Department of Natural Resources and Watershed Management of south Khorasan province, South East of Iran. Spring and summer 2025)

the balance among GHGs. Forest clearance and conversion to intensive agricultural uses could drastically release SOC into the atmosphere in the form of CO_2. Cultivation and tillage practices lead to lower SOC stocks. by studying the effects of land use change on loess soils reported that deforestation caused a remarkable loss of SOC in a cultivated toposequence compared to adjacent natural forest. They estimated the average SOC storage of the upper 60 cm depth of the forest and deforested cultivated

lands as 184.8 and 58.8-ton ha, respectively (Ajami *et al.*, 2016) [Figures 2 and 3].

Efficient use of energy, progress of renewable energy, and enhancing CO_2 sequestration to mitigate more CO_2 can be alternatives for the reduction of greenhouse gas emissions. Regarding major geological formations, such as these Cond largest natural-gas reservoir and the third-greatest oil reservoir in the world, and these Cond largest basin in the Middle East, storage of carbon and enhanced oil recovery seem to be a suitable choice for CCS. Moreover, in Iran, due to a vast and area, the presence of various saline lakes that containing different species of microalgae and the opportunity of establishing microalgae culture ponds, the capture unit and microalgae culture can be located close to carbon sources, which are scattered and far from geological formations. Besides CO_2 mitigation, microalgae cultures can also produce valuable products and cause carbon capture more efficient (Ghorbani *et al.*, 2014).

Hence, as long as it is costly to use renewable energy technologies and efficient energy systems, gas turbines will be dominant systems in power generation operations, and fuel oil is the main fuel in the cement and steel industry. This lead to continuity of fossil fuels dependency and therefore, greenhouse gas emissions. For at least half a century, abandon using the fossil fuels will not be the solution for the greenhouse gas problems and this means that methods for taking advantage of fossil fuels without releasing CO_2 must be developed. CCS is a mitigating approach for CO_2 emissions and has been greatly attached to fossil fuels combustion. Furthermore, EIA studies show that CCS can afford %20 of the required aforementioned emission reduction. Therefore, it is necessary to use CCS technology for supporting the emission reduction efforts. CCS capability in mitigation of climate change will be proved only if it is implemented in developing countries, which are greatly dependent to fossil fuels in affording their energy demands, along with developed ones. So, it is important to evaluate Iran's conditions and features, as a developing country in the Middle East, for the implementation of CCS as a GHG emission mitigating option (Banan and Maleki, 2013) [Figures 2 and 3].

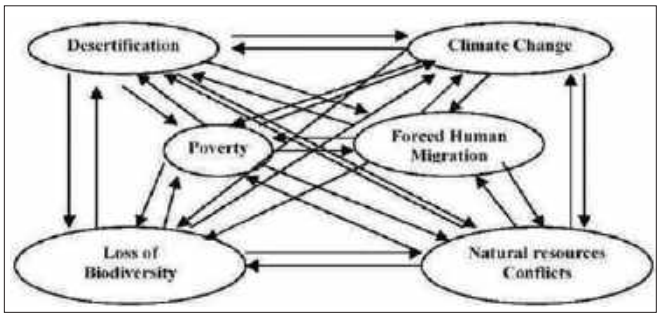

Figure 2: Multimodal and multidimensional correlations and communication between the present environment, natural resources, land and water hazards, vulnerability, problems, and crises in rural areas

THE CSP IN ARID AND SEMI-ARID AREAS OF IRAN

CO_2, as the most prevalent greenhouse gas, plays an indisputable role in global climate change. Although most researchers believe that the growth in CO_2 concentration is due to emissions from industrial countries, knowing the potential for sequestration of CO_2 by plants can help managers of rangeland ecosystems to balance animal and

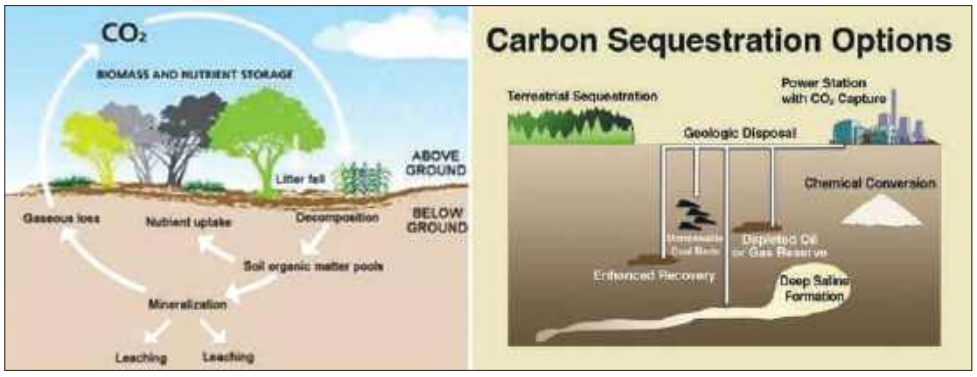

Figure 3: Carbon cycle in nature (left) and various options for Carbon Capture and Storage Technology, which is a dominant strategy among all the long-term carbon abatement strategies in many countries (right)

Figure 4: International Carbon Sequestration Project (CSP) and Carbon Capture and Storage (CCS) Technology and deployment in south Khorasan province, south east of Iran (2005–2025) (Pictures by: Author and General Department of Natural Resources and Watershed Management of South Khorasan province, South East of Iran, 2025)

Figure 5: In compliance with watershed management objectives of Carbon Sequestration Project, two check dam including a tire check dam with operation volume of 180 cubic meters in the 1st quarter of 2013 and also a rock check dam with operation volume of 400 cubic meters were built in Hemmatabad village for which the Al-Qadir Cooperative served as the contractor (Forest, Rangeland and Watershed Management. Carbon sequestration Projects of south Khorasan province, south east of Iran, 2025)

Figure 6: The Profile of Village Development Groups representatives engaged in seedling production (contractors) (Forest, Rangeland and Watershed Management. Carbon sequestration Projects of south Khorasan province, south east of Iran, 2025)

Figure 7: The Profile of VDG representatives engaged in gathering and planting seeds and seedlings of a variety of species by VDG members from Nazdasht, Gazdez, and Hemmatabad range lands for being used in sowing and seedling production operations (Forest, Rangeland and Watershed Management. Carbon sequestration Projects of south Khorasan province, south east of Iran, 2025).

plant management. Different procedures can be used to reduce the amount of greenhouse gas, but the reduction of CO_2 by plants and soil is valuable, so that it is emphasized by researchers.

Although different land uses (e.g., rangelands, forests, and farming) sequester different amounts of CO_2, rangelands may play a significant role because of the vast area they cover. The United Nations Development Program (UNDP, 2000) has pointed out that, if managed correctly, Iran's rangelands could reduce 1 billion tons of CO2, which is equivalent to burning 20 million tons of petroleum. Hence, rangelands are important for reducing CO2. Iran's rangelands cover more than 86.1 million ha, and the area of steppe rangelands is 46 million ha (Alizadeh *et al*., 2011).

Carbon sequestration is the process involved in carbon capture and the long-term storage of atmospheric CO_2. Carbon sequestration describes long-term storage of CO_2 or other forms of carbon to either mitigate or defer global warming and avoid dangerous climate change. It has been proposed as a way to slow the atmospheric and marine accumulation of GHGs, which are released by burning fossil fuels [Figures 4-7].

KEY ACHIEVEMENTS OF THE CSP TO DATE

- Upstream impact: The tenets of the CSP methodology have been integrated into the 6th National Development Plan.
- Afforestation: Improved the productivity of arid lands.

Figure 8: The Profile of advocacy, extension and production of vermi-compost by local farmers are engaged in vermi-compost production in the Project area (Forest, Rangeland and Watershed Management. Carbon sequestration Projects of south Khorasan province, south east of Iran, 2025)

- Replication: The project is now being implemented in 18 provinces.
- Coverage: The project now covers 3,798,547 hectares. This includes 764 villages and 241,310 residents.
- Publications: Numerous publications and documentary films shedding light on the efficiency and effectiveness of the CSP have been published, thus facilitating its replication across Iran [Figures 4-7].

The labile pools of soil organic matter enable assessment of the variation in land use changes and other management practices. It seems that the quality of soils was decreased with the adoption of agriculture and therefore sustainable management practices should be employed in order to achieve soil stability and biological productivity in the area. It should be mentioned that the SOC is also essential for enhancing soil quality, sustaining and improving food production, and maintaining clean water. Changes in total soil organic matter content, in response to the alterations in soil management practices, are difficult to detect because of the generally high background levels and natural soil variability. Moreover, soil organic matter is a heterogeneous mixture of materials, ranging from active or labile fractions (e.g., microbial biomass, particulate organic matter, and soluble organic matter) decomposing in a matter of months and the more resistant or non-labile fractions remaining in the soil with turnover rates measured in millennia (Shahriari Geraei *et al.*, 2016).

Figure 9: Using potentials and capacities of villagers through formation of village development groups (VDGs), giving priority to women and low-income groups (Forest, Rangeland and Watershed Management. Carbon sequestration Projects of south Khorasan province, south east of Iran, 2025)

Achievements of CSPs in Hossein Abad watershed motivated to proceed with replication of the Project's model in new sites around the country where there are similar climatic, environmental, and cultural conditions. The second phase of CSPs, being implemented in a 5 year period was kicked-off in 2010 with a total budget of $ 2 million to cover a 225 ha area and 40 villages. CSP is a joint project of the Iranian government and the UNDP, which has addressed inclusive natural resources and rural development with emphasis on improving the socioeconomic status of local communities [Figures 4-7].

The Project approach is based on the broad involvement of local people in all stages, including planning, implementation, supervision, and evaluation. The Project has been benefiting from both academic and indigenous knowledge (Alizadeh *et al.*, 2011).

The executive mechanism of CSP is underpinned on the following principles:

1. Draw local people's participation through their membership in VDGs
2. Adopt an integrated and comprehensive approach for sustainable natural resources management and rural development
3. Use local communities', in particular women's participation in various environmental activities, such as rehabilitation, natural resources protection, and management

Figure 10: To improve VDG and Micro-credit Fund performance and in addition get the secretaries trained on accounting, account book keeping and filing issues, the accountant and some experts of Carbon Sequestration Project (CSP) regularly participated in meetings of VDGs in which checks of the approved loans were handed to the applicants, as well (Forest, Rangeland and Watershed Management. CSPs of South Khorasan province, south east of Iran, 2025)

Figure 11: Implementation of educational and extensional courses for rural communities in aspects of Carpet weaving, Jujube and barberry products, Fish and seafood cooking, etc. (Forest, Rangeland and Watershed Management. Carbon sequestration Projects of south Khorasan province, south east of Iran, 2025).

4. Mobilize the villagers' small amounts through the formation of micro-credit funds (MCFs), aiming to support setting up micro-business and the livelihood of villagers with small loans
5. Holding vocational training courses to facilitate alternative livelihoods generation by local people (Alizadeh *et al.*, 2011) [Figures 8-12].

ENVIRONMENTAL CHANGES AND LOCAL DEVELOPMENT

Today, natural resources are exposed to increasingly numerous interests and demands, which sometimes generate conflicts. the mobilization of communities appears to be a real alternative to the "top down" injunctions, which often focus on the economic and political at the expense of the ecological balance

Figure 12: Implementation of Training workshop on traditional fabric and towel weaving, organic poultry breeding etc., (left) and Implementation of educational and extensional courses for improvement of Health Index etc. (Forest, Rangeland and Watershed Management. Carbon sequestration Projects of south Khorasan province, south east of Iran, 2025).

and the needs of local populations. Henceforth, it is necessary to deepen the reflection on the concept of sustainable development and promote approaches integrating more disciplines and dimensions (Gandin, 2012) [Figures 8-12].

Some farmers exclaim that real people who protect nature are local communities themselves. Since neither policy nor financial or technical assistance benefits local communities, the efforts of each peasant, villager, farmer, or rancher is considered the only real action to protect the environment.

Figure 13: Implementation of educational and extensional courses for improvement of promotional environmental extensional programs to promote local students' knowledge and awareness on the significance of rangelands as well as the major environmental issues, especially at the local level in local schools. These programs include documentary films, dissemination of natural resources-based novels and puzzles among students. (Forest, Rangeland and Watershed Management. Carbon sequestration Projects of south Khorasan province, south east of Iran, 2025)

Respondents insist that such efforts are made by their own will, with few resources available to communities. They even explain the reason for these actions has become much more universal than local, as evidenced by the discussion of a farmer:
"we must protect nature not only for us but for the whole planet". If it is questionable to say that communities are really only practical to protect the environment, there is no doubt they are the main victims of environmental degradation (Gandin, 2012). Changes in rural land use to reduce flood risk are encouraged by governments in many countries, but they may face considerable opposition by land managers. Local participative processes are thought to help overcome opposition.
Social learning is a challenging target in participative processes during policy implementation (Rouillard *et al*., 2014) [Figures 8-13].

WATERSHED MANAGEMENT MEASURES OF (CSP) IN IRAN

In compliance with the watershed management objectives of CSP, two check dams, including a tire check dam with an operation volume of 180 cubic meters in the 1st quarter of 2013, and also a rock check dam with an operation volume of 400 cubic meters, were built in Hemmatabad village, for which the Al-Qadir Cooperative served as the contractor. Furthermore, upon the Kasrab villagers' application to the Project for tackling destructive floods, building a tire check dam in the uplands of the village was commenced and accomplished in the 4th quarter of 2013. For this, members of Hemmat VDG held talks and designated Mr. F. Hayati as the contractor. In addition, people agreed to actively participate in the operation so that they provided labors needed to build two structures, with construction of a rock check dam in the village, a 300-m-volume structure was carried out through the collaboration of 75% of the VDG members. It is noteworthy to mention that based on the agreement made with the contractor, some part of the contract profit was deposited into the group (Forest, Rangeland and Watershed Management. CSPs of south Khorasan province, south east of Iran, 2025) [Figures 8-13].

Building Water Troughs

Regardless of the amount of forage produced, the rate of Regardless of the amount of forage produced,

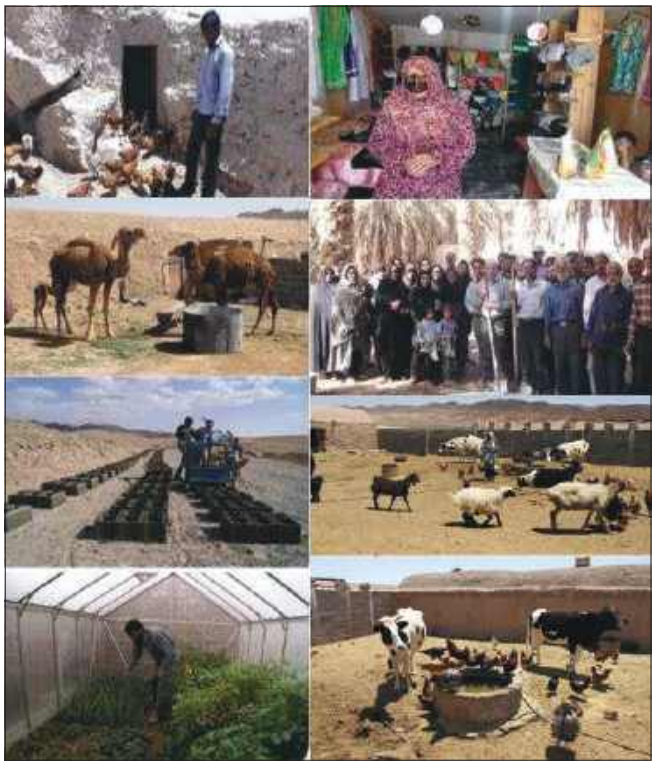

Figure 14: Carbon Sequestration Project (CSP), to improve the local income index and generate alternative livelihoods for decreasing traditional herding and make a decline in pressure on the rangelands has been involved in providing entrepreneurs of micro-enterprises with some loans and also in holding a lot of vocational and skill training courses (Forest, Rangeland and Watershed Management. CSPs of south Khorasan province, south east of Iran, 2025)

the rate of utilization of forage by livestock directly depends on the amount and distribution of water resources in a rangeland. In addition, uniform distribution of water resources in rangelands is of importance as it enables to take full advantage of forage all over the range [Figures 8-12].

This, in turn, will improve vegetation cover and animal products and also will decrease wind and water erosion. In 2013, the project took action to build 5 water troughs in Hemmatabad, Kasrab, Sula Best, Nazdasht, and Chah Panjsar. Furthermore, in accordance to the result of need assessments done and the experts' standpoints, repair and maintenance of some herd watering wells and construction of some ponds with a total volume of 110 cubic meters, as well as installation of 1 wind water pump were undertaken in Kasrab, for which the people in-kind contribution rate has been 65%. (Forest, Rangeland and Watershed Management. CSPs of south Khorasan province, south east of Iran, 2025).

Figure 15: Exhibition of rural products (Forest, Rangeland and Watershed Management. Carbon sequestration Projects of south Khorasan province, south east of Iran, 2025)

Seedling Production

In 2013, as an initiative, the Project decided to assign the seedling production to rural people, aiming to raise their motivation and respect to natural resources as well as to promote the culture of seedling production and have further VDG members involved in rehabilitation measures. So, unlike the previous years, seedlings are being produced in villagers' houses. The Profile of VDG representatives engaged in seedling production (contractors) [Figure 7].

Seed Collection

In this connection, 7 tons of seeds of a variety of In this connection, 7 tons of seeds of a variety of species, including Haloxylon spp., Atriplex spp., and Allenia subaphyllum, were gathered by VDG members from Nazdasht, Gazdez, and Hemmatabad range lands for being used in sowing and seedling production operations [Figure 7].

Advocacy, Extension, and Production of Vermi-compost

At the time being, 3 local farmers are engaged in vermi-compost production in the Project area. In the

Figure 16: Author's book that published at 2025 and some of the text of this article obtained from it (Reference number 14). Available online at: https://www.amazon.co.uk/Environment-Natural-Resources-Water-Rural/dp/6207463994

3rd quarter of 2013, design and production of vermi-compost pack aging bags was accomplished, which paved the way for supplying the packaged products to the market [Figure 8].

Formation of VDGs

CSP is a people-oriented initiative working for and with local people. For this reason, the Project has basically put its focus on using the potentials and capacities of villagers through the formation of VDGs, giving priority to women and low-income groups. VDG formation is considered the first step for the mobilization of local communities, emphasized by the Project documents in both phases. To now, 63 VDGs, including 18 male, 14 female, and 31 mixed groups with 1771 members and 1263 households (41% females and 59% males) have been formed in 37 villages of CSP site which came together in 3794 sessions since the beginning of the Project and 436 sessions to save a sum of 284322000 IRR in the year 2013 [Figures 9-15].

VDGs used their within-group savings to support employment generating and also service providing plans of their members, so that 43 VDGs from 21 villages provided 1836 million IRR of loans for 183 plans in 2013.

Noteworthy to say that 388 plans out of 954, equal to 41% are employment generating plans, while the balance of 566 plans are service providing, that is, applied for medical expenses, appliances, and dowry purchase. Moreover, women offered approximately 50% of the applications (476 out of 954) and 39% of employment generating plans (184 out of 476 employment generating plans) females.

As ACC holds regular monthly sessions, the plans received from VDGs get reviewed and approved for lending at the end of each session. The ACC accountant later takes part in relating VD meeting and fills out some forms in compliance with the ACC regulations and hands a check to them.

Strengthen and Development of Micro Credit Funds

To oversee and improve VDG and MCF performance and, in addition, get the secretaries trained on accounting, account bookkeeping, and filing issues, the accountant and some experts of CSP regularly participated in meetings of VDGs in which checks of the approved loans were handed to the applicants, as well. In addition, to enhance the proficiency of the heads and secretaries of VDGs on financial management and accounting, a training workshop instructed by the experts of a qualified company was arranged for 60 participants [Figures 9-15].

ASSESSMENT OF EDUCATIONAL NEEDS WITH PARTICIPATION OF LOCAL COMMUNITIES AND RELEVANT ORGANIZATIONS TO DEVELOP AND IMPLEMENT A TRAINING PROGRAM

Training and Advocacy

Implementation of educational and extensional courses for rural communities has been focused as a key tool to approach sustainable development in most of countries in particularly in developing

countries, where a great portion of their populations are living in rural areas.

Evidences developed at the national level on indicates that most of rural areas of Iran are deprived of an acceptable level of educational and extensional services, so there is a remarkable gap between rural and urban areas, which its removal requires a more inclusive planning to broadly cover all rural areas and subjects to improve socioeconomic conditions in these areas [Figures 9-15].

CSP to increase public knowledge and awareness and enhance skills and income at the local level, in accordance to the need assessments undertaken through PRA technic, has been running some vocational and skill as well as extensional courses every year.

Aligned with these objectives, the project held several training programs in collaboration with various provincial and township level organizations, such as the Technical and Vocational Training office, Education office, Cultural Heritage Handicrafts and Tourism office, The Foundation of Elites, Governor's office of Sarbisheh, Natural Resources Management (NRM) office of Sarbisheh, Directorate of Natural Resources & Watershed Management-South Khorasan Province (DNRMSKP), etc. in 2013. The list of these programs is as follows:

Carpet weaving

This workshop was attended by 19 members of 4 VDGS, namely, Montazeran Mahdi, Imam Reza, Om-Al-Banin, Rahrovan Hedayat, and hosted by Mr. Hassan Dashtban between January 6-15, 2013, in Gazdez Village.

Jujube and barberry products

This one-day workshop was attended by 15 members of Vahdat and Hamkari VDGS on February 8, 2013, and hosted by Mr. Mohammad Reza Saadati, an active member of the Vahdat group of CS2.

Fish and seafood cooking

In line with interaction with the Agriculture-Jihad office of Sarbisheh township and upon the official request of that administration to hold an extensional program on fish and seafood cooking to boost using seafood by local households and improve their health level, it was held on February 14, 2013, in Kasrab village, and 15 trainees from 3 female VDGs, namely, Om-Kolsum, Zoleykha, and Maryam, came together at an active VDG member's home, Ms. Soghra Hosseini.

Nut-mixed whey production and GHP

The 1st workshop on nut-mixed whey formulation was held both practically and theoretically. Besides, the Project ran the 2nd round of personal hygiene (GHP) between January 14-16, 2013, for 3 days, in which 91 female members from 19 villages and 27 VDGs of Hosseinabad watershed, including Nazdasht, Hosseinabad, Kondrud, CS1, CS2, H. Kolangi, Tajmir, Gondakan, Ebrahimabad, Abasabad, Dehik, Fan, Ghanbar, and Nargesak were present.

Promotional class on agricultural and animal products insurance

On advocacy and extension of agricultural and animal products insurance against frost and drought and upon local people's request, a relevant workshop was held in Gazdez village on June 17, 2013, with the collaboration of Agriculture-Jihad office, as well as Keshavarzi (agriculture) Bank and Dey Insurance Co. of Sarbisheh township, which participated by 25 individuals from 5 VDGS.

Training course on fodder species cultivation

Over local people's request, on the improvement of cultivation practices of some fodder species as sorghum, fodder maize, barley, and millet, a training workshop was held with collaboration of the Agriculture-Jihad office of Sarbisheh on June 17, 2013, in which 25 members of 5 VDGs came together.

Introductory workshop on UNDP financial regulations (NIM)

This 2-day workshop was arranged in FRWO on June 9-10, 2013, to post the participants with more information and knowledge on financial and disbursement regulations of UNDP, in which the finance expert of CSP took part.

Nut-mixed whey production

The 2nd workshop on nut-mixed whey production gathered 18 people from 3 female VDGs, namely,

Maryam, Zoleykha, and Omkolsum, in the venue of a rural mosque in Kasrab to solve the problems come up with the former formula on July 13, 2013 [Figures 9-15].

Educational and orientation workshop on handicraft

In connection with implementation of outcome2, output 8, activity 2-7 of 2013 AWP of CSP and in accordance to contract signed between CSP and a qualified individual consultant aiming to raise production and marketing of handicrafts in CSP demonstration site, the first program was undertaken with participation of the Project team since June 30 to July 2, 2013, in 6 villages including Gazdez, Kasrab, Tajmir, Hematabad, Naztween September 1-4, 2013 in 4 villages based on the preliminary assessment made by the consultant in terms of potentials and motivation of people and villages. Similarly, the consultant ran the 3rd relevant training workshop in 4 villages, including Tajmir, CS1, CS2, and Kasrab, with attendance of 72 participants from 7 VDGs on 20 November 20, 2013. Furthermore, the consultant organized another workshop lasting for 6 days and servicing 60 trainees from 9 VDGs between November 25-30, 2013.

Training workshop on traditional fabric and towel weaving

This workshop took place in Gazdez village since July 1–15, 2013, in 150 h and was attended by 11 people from 4 VDGs, namely, Montazeran Mahdi, Maryam, Hazrat Maasumeh, and Mola-Al0 Movahedin.

Training course on organic poultry breeding

A series of workshops were held in the 3rd quarter of 2013 in 5 villages and included various topics as the importance of organic chicken breeding in villages, how to grow, chicken feed, proper plant condition, chickens disease, zoonotic disease in human and poultry, symptoms of disease in mature chickens, interventions and treatments against disease.

Training course on drought management and rangelands importance

This training course on drought and range management was held in CS1 village in the 3rd quarter of 2013. During the workshop, a PowerPoint was delivered on relating topics as rangelands' importance and services, range conservation practices, local vegetation cover, proper and pre-tested methods to raise fodder output, as well as soil productivity, etc.

Promotional and educational classes on vermi-composting and renewable energies

This promotional workshop held in the 3rd quarter of 2013 in 7 villages purposed to introduce vermi-compost and new energies, and regarding the facilities provided by Al-Qadir cooperative to local communities.

Family counseling course

These series of courses on family counseling, aiming to promote family relationship skills among local women and adolescent girls, were held in the 3rd quarter of 2013 in 10 villages.

Over the workshops, the instructor, Ms. Mokhtaripur, discussed on various topics such as proper and Islamic customs of marriage, marriage problems, proper children training, rights of each spouse in the family, duties of each spouse toward the other, etiquette during an engagement, marriage rituals, family adjustment, etc., attributing to religious sayings and teachings of Shiite Imams.

Consultation workshop on legal issues

In the 3rd quarter of 2013, a workshop on legal issues was organized for 284 people from 14 villages. The topics discussed were land ownership, addiction, drug trafficking, family issues, etc.

Training class on livestock fattening

During this class held in the 3rd quarter of 2013, a Professor from Birjand University delivered his lessons as a PowerPoint, which were focused on various topics on livestock breeding, including place, disease, proper feeding, zoonotic disease, etc.

Training workshop on compost production in Kerman province

A series of training workshops instructed by CSP experts were held on compost production once in shifting sand dunes fixation station of Gonbaki,

Rigan township and the next time in replication site of CSP in amirabd, Shahdad township both theoretically and practically to promote and extend relating experience of CSP in which, totally 80 trainees, including project managers, experts as well as representatives of local communities attended

Training workshop on accounting and financial management

The workshop was purposed to promote the managerial level of ACC in which 60 people, from heads and secretaries of VDGs, along with members of the board of directors, were trained by Mr. Fereydun Ghorbani, a prominent provincial instructor, in 2 days on Nov. 9-10, 2013.

The topics discussed were as following:

1. Concept of cooperation and collaboration among VDGs
2. The importance of holding regular meetings
3. How to disburse a loan
4. How to calculate commission fee, default, and penalties
5. How to raise the fund revenue and decrease its costs
6. The importance of providing income-generating loans
7. How to calculate the default penalty
8. Importance of establishing MCFs in villages
9. Reasons for opening common bank accounts for all MCFs in each village
10. Calculation of commission fees based on turnover for payment to the fund officials
11. How to raise a fund capital and the balance
12. Set indicators and criteria for lending
13. The role of MCFs' financial management in rural development
14. How to develop the balance sheet (profit and loss) and write a bank book [Figures 9-15].

Training workshop on replication of CSP

The 2nd training workshop on CSP replication was held in Isfahan city on November 22-23, 2013, aiming to elaborate technics used by CSP in terms of social mobilization and community empowerment, in which representatives from replication sites, namely, Isfahan, Azarbayjan Gharbi, Kerman, Markazi, Semnan, Alborz, and South Khorasan, took part. Dr. Murali, UNDP Deputy Resident Representative, was the opening, in this program.

Improvement of Health Index

Activities carried out to improve health indicators in the area welcomed by rural people.

Therefore, based on an agreement made, it was extended as an oral examination scheme while patients get introduced to the Health Service of Sarbisheh for being benefited of a 30% discount for healthcare.

Distribution of water purification devices

To accomplish objectives of the project to improve

To accomplish objectives of the project to improve the health index and the outcome 2, output6, activity 1-2 of 2013 AWP to supply sanitary drinking water in the area, the Project office along with ACC took action to identify the applicants for water purification devices and further a number of 37 devices were purchased from ACC resources and distributed as a loan.

Promotional Environmental Extensional Programs

In connection with achieving the objectives of outcome 4, output 6, activity 2, 2013 AWP of CSP, and to promote local students' knowledge and awareness on the significance of rangelands as well as the major environmental issues, especially at the local level, the Project continued holding extensional programs in local schools as the past years. These programs include documentary films, dissemination of natural resources-based novels and puzzles among students [Figures 9-15].

Establishing and Development Micro-enterprises and Monitor Outcomes

Employment opportunities generated

CSP, to improve the local income index and generate alternative livelihoods for decreasing traditional herding and make a decline in pressure on the rangelands, has been involved in providing entrepreneurs of micro-enterprises with some loans and also in holding a lot of vocational and skill training courses.

Exhibition of Rural Products

As a side event of the 10th anniversary, the products and documents of CSP were exhibited which as a side event of the 10th anniversary, the products and documents of CSP were exhibited which it was broadly welcomed by the visitors. In this connection, a variety of rural products initiated by the Project, including packages of nut-mixed whey, barberry, and Jujube labeled with Zima brand, as well as traditional fabric, herbal distillates, dehydrated vegetables, pastry, signboard carpets, etc., were represented to participants. Moreover, some packs of the products were donated to visitors. The Project also exhibited the products of the local community during the holy Quran fair [Figures 9-15].

CONCLUSION

Ecological vulnerability assessment can objectively analyze the condition of ecosystems and explain the change patterns and causes of vulnerability (Wu *et al.*, 2025).

Two important aspects of socioeconomic change are: changes in population, particularly population decline and turnover; and changes in employment (Williams & Schirmer, 2012).

Both environmental and agricultural policies directly influence how individuals' manage their farms and are therefore expected to have had an impact on farmers' participation decisions (Murphy, G., *et al.*, 2014).

Despite the ongoing debate on climate change as a result of increased emission of GHG into the atmosphere, there is scientific evidence that the global climate is changing and that human activity's contribution is significant (Muñoz-Rojas *et al.*, 2016).

Land degradation and erosion are serious environmental problems in the world. It is well established that in degraded areas, soil is shallow; soil nutrients and plant available water capacity are reduced (Yüksek, 2016).

Soil erosion and loss of soil nutrients are being repeatedly mentioned as a global threat to the environment and agricultural productivity. The land use and its impact on soil qualities continue to be highlighted (Xiao-Yin *et al.*, 2015).

Therefore, the scientific evaluation of ecological vulnerability is a key measure for preventing ecological degradation, improving the ecological environment, and promoting green and sustainable development, and is of great significance to the realization of the balanced and coordinated development of the region in terms of "economy, society, and ecology" (Wu *et al.*, 2025).

It is recognized that the synergy of traditional and scientific knowledge leading to wisdom for social resilience building. the community-based adaptability by mobilizing scarce resources to cope with and respond to actual and expected stresses. It is underscored that human adaptability influences risk perceptions, and perceived risk determines the residents' responses, while human adaptation to environmental change refers to a process, action, or outcome in a system in the context of human dimensions. Essentially, community perceptions about land use reflect a shift in perspective from community deficits to the potential to mobilize resources on social resilience building, while individual performance is 'intertwined' with the coping capacity of others (Chiang *et al.*, 2014).

Today, the livelihood of millions of rural households worldwide is closely related to the environment. The current level of livelihood dependency on environmental income is reported as high in many developing countries. Therefore, the dependency of local livelihood on environmental income is considerable in developing countries. This has been considered as one of the main drivers of environmental degradation and depletion, especially in developing countries (Dehghani Pour *et al.*, 2018).

The United Nations World Water Development Report 2024 reveals that nearly half the global population is currently experiencing water scarcity. The projected 60% surge in global food demand by 2050 is of particular concern, which is expected to intensify pressures on already-strained freshwater resources further. This challenge is especially acute in countries where the ratio between population and resource endowment is severely imbalanced (Gu *et al.*, 2025) [Figures 9-15].

Traditional ecological knowledge may be claimed as a potential source of resilience. Humans and ecosystems are interdependent components of social–ecological systems, and ecosystem services are the benefits people obtain from ecosystem processes. It is argued that social resilience becomes significant in maintaining human well-being, which

may be useful in response to both reactively and proactively to severe environmental challenges, for instance, human-induced climate change that is expected to be the main driver of the landscape in the future. Further, social resilience, comprising adaptive responses to basic life-supporting ecosystem services, is crucial in dealing with risk events while also maintaining options for future human development faced with environmental change. It is argued that understanding societal response and environmental risk in human–natural interplay is significant to social resilience building. The notion of risk perception addresses residents' reactive awareness and their proactive actions in response to this wastewater discharge, specifying the relationship of industrial development to rural society and its role in policy. In particular, it highlights the ethnic characteristics of the locals–their environmentally friendly attitudes and values play a significant role in maintaining resilient social systems during adaptation to environmental change (Chiang *et al.*, 2014).

Introducing more diverse sets of profitable and less environmentally reliant income-generating activities, along with the development of a more educated rural population, will stimulate development in rural areas, alleviating environmental pressure on environmentally fragile ecosystems (Dehghani Pour *et al.*, 2018).

As mentioned and discussed in this article, CSPs for Community-based Rural Development and Sustainable Natural Resources Management in Arid and Semi-arid lands of South Khorasan province, east of Iran, could have a tangible and important role for improving the environment and social conditions, problems and troubles in this border, frontier, isolated and deprived area of Iran.

Advocacy, extension, and development of the community-based and button-up approach in the field of natural resources management at the national level must be considered.

Objectives of this outcome are to: Introduce the participatory approach and the methods used by CSP to national and provincial decision makers, train and advocate the participatory model of natural resources management, form a nationwide working group, incorporate practices and the community-based approach of CSP into the Iranian National Socio-Economic Development Plan [Figures 9-15].

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APPENDIXES

Author book covers that were published at 2025, and some of the text and pictures of this article were obtained from it (Reference number 20) [Figure 16].