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Carbon Management in Rangeland for Improving Livelihood and Ecological Function in Iran (Part I and II)

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ABSTRACT

Objective: Iran is one of the largest producers of fossil fuels such as oil and gas in the world, which also has a large domestic consumption. This increased air carbon and the consequent greenhouse effect and climate warming then its negative effect on drought and flood. The purpose of this study was to investigate and evaluate the status of carbon sequestration in Iran with regard to the projects carried out from different aspects.
According to less precipitation, Iran is dry country. Average annual rainfall is 234 mm in which less than a third of the world average. For this reason, the density of vegetation in most parts of the country except the northern strip is low. Carbon sequestration cannot be done without vegetation. Also lack of vegetation heavy affects impressions on natural resources and the environment, including soil erosion (which is a source of carbon sequestration), biodiversity, water loss, oxygen, ecotourism and so on. It would definitely be said that Iran could be one of the most attractive regions of the world for ecotourism in terms of natural scenery, including waterfalls. Increase the carbon serious damage to these attractions.

Methods: This article review some projects implementation in three province such as: Yazd, Kermanshah and Sistan v Baluchistan name as MENARID. Renewable energy such as solar and wind in excess of 90% of the country is abundant and due to low incomes and lack of capital among the villagers cannot use them, so the government with the participation of international organizations (UNDP) such as MENARID attempting to run a project of the use of this energy as a pilot experiments in environmental and natural management. MENARID is a Middle East and North Africa Regional Development for Integrated Sustainable Development. MENARID provides valuable lessons and experiences for promoting Integrated Natural Resource Management (INRM) in arid, semi-arid and dry sub-humid environments.

Results: Result show that MENARID can help to prevent the destruction of vegetation by villagers to fuel.

Conclusion: Conclusion show that correct understanding of changing carbon storage in soils and biomass under rangelands proper management system, can lead to increase carbon sequestration potential.

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Introduction

From early 1980s up to present, the atmospheric concentration of carbon dioxide and other greenhouse gases have been take into attention almost due to use of increased fossil fuels (Frank et al., 2002). It has the devastating effects on the natural life of creatures through the increasing of the warmth of weather and greenhouse gases. Also it caused in damaging natural ecosystem, flooding, drought and extreme climatic events and ecological imbalance disruption(Emmerich, 2003). Carbon sequestration is one of the options to reduce greenhouse gases in soil or plant bodies. It is the process which atmospheric carbon dioxide is absorbed in plant tissue as structural and nonstructural carbohydrate(Conant et al., 2001).

Carbon is the currency of most biological systems and is constantly cycled through the earth (Figure 1).

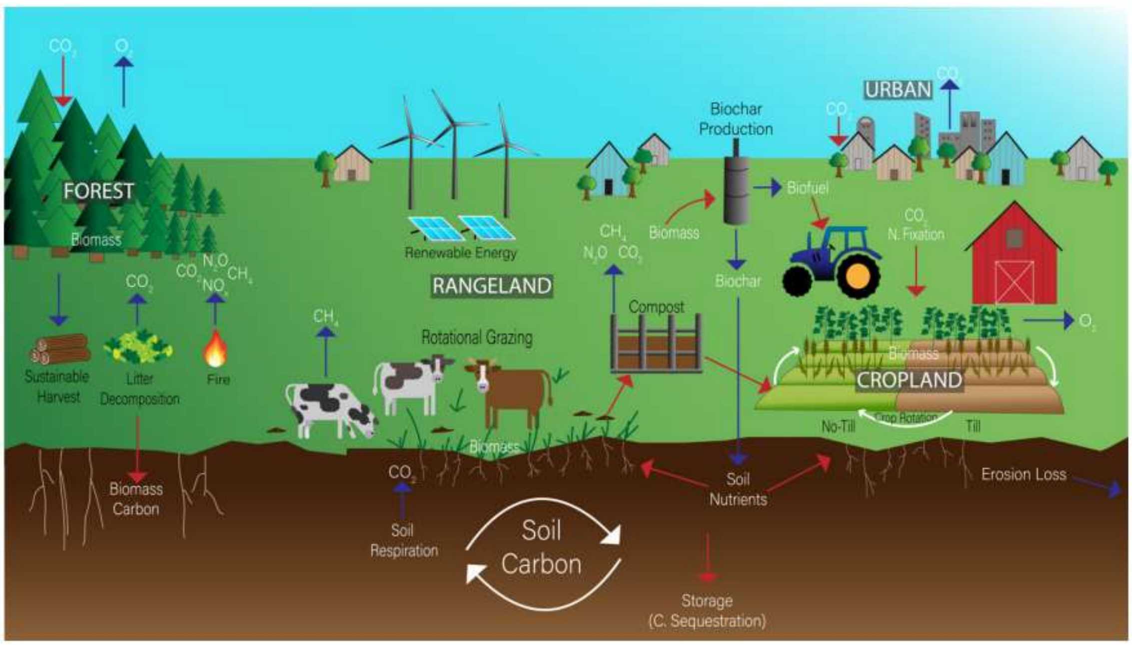

Figure 1. Illustrative schematic of the carbon cycle in forests, rangelands, croplands, and urban environments with potential management practices to increase carbon sequestration or reduce carbon loss. Figure created by Dr. Rajan Ghimire, NMSU (Spackman and Allison, 2023).

Towards Sustainable Use of Rangelands in China's North West is based on the program of the International Conference Implementing GEF Objectives in a Systems Framework held in Lanzhou, Gansu, China in October 2008. Topics include Livestock husbandry development and agro-pastoral integration in Gansu and Xinjiang; Ecological restoration and control of rangeland degradation. Despite widespread degradation, the articles reveal the approaches that are likely to lead to recovery of these rangelands and better livelihoods for the local herders and farmers. Carbon sequestration and biodiversity conservation in mountaingrasslands are just a few of the covered subjects (Ruijun et al. 2010)

Global warming and is a worldwide concern raised due to emissions of anthropogenic greenhouse gases. Oil & gas producing countries which are the members of the Kyoto Protocol, including Iran, have held a committee to reduce these gases, especially CO2 emissions. One way of reducing emissions is using carbon capture and storage technology in geological formations, known as Carbon Capture and Sequestration (CCS).

There is a close and direct relationship between the number of oil and gas reservoirs and amount of CO_2 emissions in natural resource of the country, then cause air pollution (Figures 2 and 3).

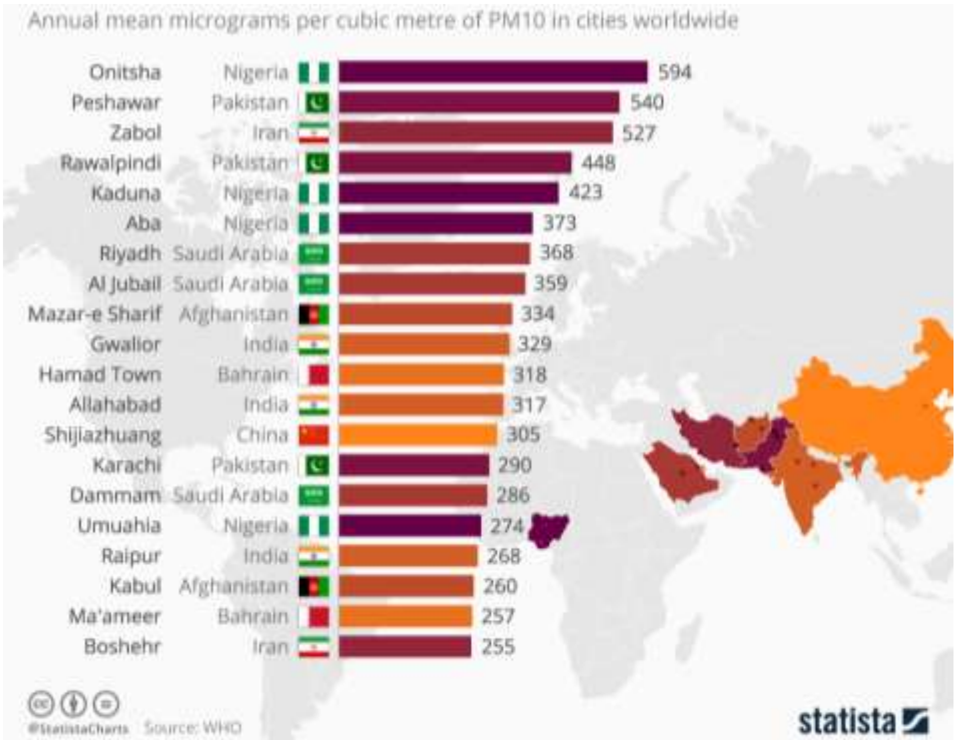

Figure 2. The 20 worst cities worldwide for air pollution(McCarthy, 2016).

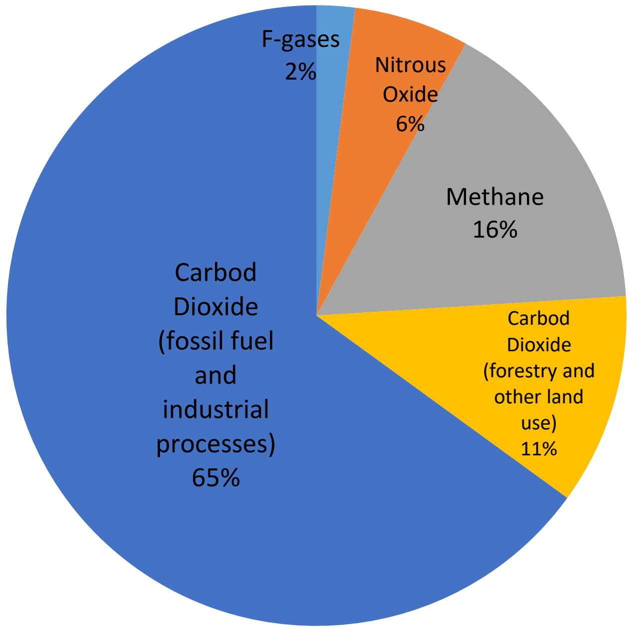

Figure 3. Global greenhouse gas emissions by gas (Anonymous, 2014).

Fossil fuel consumption and consequently more and more production from oil and gas reservoirs have always faced numerous environmental challenges around the world.

Production and emission of a huge amount of acidic and greenhouse gases are considered as one of the environmental issues that causes global warming. Global warming and therefore climate change lead to temperature changes, violent storms, floods and droughts. In addition to these problems, global economic growth would encounter noticeable recession. CO_2 is the prime component of the greenhouse gases that its emission has shown an upward trend recently (Azin et al., 2015).

Figure 4 shows the logarithmic trend of CO_2 production in Iran, Saudi Arabia, Egypt, Japan, Germany and USA.

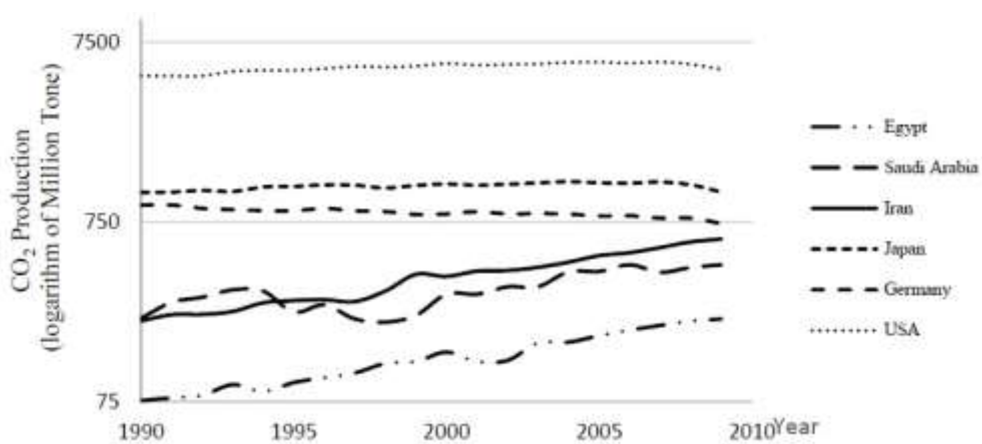

Figure 4. Annually CO2 production in different countries (Lokhorst and van Woerkum, 2011).

One of the most significant affects due to carbon dioxide emission is climate change. Climate changes pose great threats to the main services of ecosystems such food and water security and health. Climate change impacts effect on quality of herder's life as well as water quantity, food insecurity, poverty, social insecurity, social conflicts, income continuation, migration, income continuation, job insecurity and hope for the future in this society.

Batjes and Sombroek according to the study about carbon sequestration show that the need is stressed for an up-to-date database on soil resources and for a global monitoring system in order to permit the study of changes in soil organic matter quantity and quality over time, as determined by changes in land-use and climate(Batjes and Sombroek, 2030).

Livestock grazing is the primary use of rangelands. These lands have the potential to sequester 2.3 to 7.3 billion metric tons of carbon dioxide (CO2) equivalents per year (Bai & Cotrufo, 2022).

Iran Introducing according to natural resources

The Islamic Republic of Iran lies in western Asia. In the north it is littoral to the Caspian Sea and borders Azerbaijan and Turkmenistan. It is contiguous with Turkey and Iraq to the West. In the South the country is littoral to the Persian Gulf and the Sea of Oman and abuts Pakistan and Afghanistan to the East. The area coverage of different types of climate in Iran is 35.5% hyper-arid, 29.2% arid, 20.1% semi-arid, 5% Mediterranean and 10% wet (of the cold mountainous type). Thus more than 82% of Iran's territory is located in the arid and semi-arid zone of the world. The average rainfall in Iran is about 250 mm, which is less than 1/3 of the average rainfall in the world (860 mm). In addition, this sparse precipitation is also unfavorable with respect to time and location. Another important climatic element is extreme temperature changes that sometimes range from -20 to +50$^{\circ C}$. Severe drought is also recognized as a feature of Iran's climate. In the last three years, the country has suffered severe desiccation and this lack of rainfall has resulted in extensive losses. Based on the research and assessment carried out during the Climate Change Enabling Activity Project under UNFCCC and using the scenarios proposed by IPCC, it is estimated that if the CO_2 concentration doubles by the year 2100, the average temperature in Iran will increases by 1.5-4.5°C which will cause significant changes in water resources, energy demand, agricultural products and coastal zones. The direct adverse impacts of climate change include changes in precipitation and temperature patterns, water resources, sea level rise and coastal zone, agriculture and food production, forestry, drought frequency and intensity and human health. The indirect adverse economic impacts result from the response measures taken by the developed countries(Amiri and Eslamian, 2010).

Iran's carbonate-based economy and it is depending on the fossil fuels and having large number of these resources, put Iran in the top nine countries according to the CO_2 production aspect. However, Iran produce only two percent of global CO_2 emissions, this level is worrying since its production has a sharp upward trend (Anonymous, 2005). The other worrying point is that, major amount of this pollutant is located in the south and south-west provinces of Iran, so that Khoozestan, Bushehr, Fars and Kermanshah are the most polluted province respectively (Saeed et al., 2010). Therefore, in order to improve energy carriers, Iran requires investment in different plans to capturing and preventing emission of these gases into atmosphere. Kyoto protocol is one of the effective ways to transfer new environmentally friendly technologies into developing countries. Iran, as a massive CO_2 producer must apply a good management to implement CCS technology (Azin et al., 2015).

The per capita annual CO_2 emission in Iran is 5.69 tons(Anonymous, 2015a). Being an oil producing country, Iran emits large amounts of Green House Gases (GHGs) in the energy sector, which is associated with exploration and production of fuels and oil products that are mainly consumed in other countries. According to inventory statistics, about 83% of the total GHGs are emitted from the energy and industrial processes sectors. The remaining 17% of the total is generated from non-energy sectors including forests, agriculture and waste sectors. Relevant indicators forecast an annual rise of 5% to the current level of GHGs(Anonymous, 2015b).

Economic costs

Cost and economic justification are the fundamental questions on CCS projects. The answer to these questions is not simple since CCS costs depend on a variety factors such as energy price that may be different in each country, investment costs and costs of legal requirements(Anonymous, 2005). In addition to the large contribution of capital investment, this technique is a lone-term project and needs expedient predictions(Gunter et al., 1997). Therefore, economic costs for CCS projects can be divided into beneath parts(Anonymous, 2005).

Social impact

Nowadays everyone in developed countries get used to hear new about climate change and methods to reduce the amount of greenhouse gases through Medias. However, people in developing countries should be warned about the global warming and encouraged to implement plans to reduce the emissions. Hence, it should be publicized and government must take measures to research on its ground and take the stockholders attention to investment on CO2 storage. The need to strengthen education about CCS requires courses at which local professors and lecturers become the students and learn about many aspects of the CCS(Azin et al., 2015).

Grazing and carbon sequestration

Rangeland ecosystems in arid and semi-arid regions have high potential to sequester carbon because they are composed by half of terrestrial ecosystems and involve 10% organic carbon storage in comparing the total terrestrial biomass carbon stocks and 30% organic soil carbon (Dungait et al., 2005). In the meantime, salt marsh rangelands had also high potential because of its wide range and management practices can have a direct effect on the carbon sequestration. These ecosystems include important source of carbon cycle and are impressed by each weather alteration, management methods and environmental conditions as well as have potentials for moderating global carbon cycles(Conant et al., 2001).

Livestock Grazing is included one of the most important and most common types of land application in the world's rangelands which have more effects in the soil and vegetation. Also, Livestock grazing has the potential to substantially alter carbon storage in rangeland ecosystems by: 1) modifying the magnitude and relative allocation of carbon to above- and underground biomass. Altering microclimate and the availability of light, water, and nutrients influencing the quantity and quality of carbon inputs by modifying the species composition and functional diversity of plant communities(Binkley et al., 2003).

Today, there are many uncertainties about whether the increasing of grazing livestock is caused to decrease carbon storage. There are more conflicting reports on the effects of grazing livestock on soil and biomass organic carbon and the global studies demonstrated why could be had both positive and negative effects on carbon sequestration. The results are related to climate and management strategies(Smit and Kooijman, 2001).

The same as the global scale, In Iran, the recognition of the effects of grazing on the carbon storage in the rangelands is very important, because it is covered almost 53 percent of the country (86 million hectares) and grazing land is included one of the most important utilization system of land(Arzani et al., 2007). Moreover, there are many conflicts between the comparison of carbon sequestration on medium, high and non-grazing sites which is due to the variety of ecological conditions(Smith et al., 2008).

Attaeian (2016) noted climate change has been a major global challenge since the 1880s. Sequestration of carbon(C) in rangelands ecosystems could provide a net carbon sink to offset increases in atmospheric C in global scale. Her study showed that maximum and minimum rangeland areas were observed in Sistan and Baluchestan and Mazandaran (Nowshahr) Provinces, respectively. Maximum above-ground biomass C storage was about 1.07 Mg Cha-1y-1 in Fars Province. The minimum amount occurred in Qom province with only 0.023Mg C ha-1 y-1. In summary, mean carbon CO2fixation was about 0.25 Mg C ha-1 y-1in Iran's rangelands from 2003 to 2013. Considering the total rangeland area(≈ 84.8 million hectare) and productivity of Iran, 11770.011 Gg C y-1 carbon is stored in above-ground biomass annually providing at least 5885 Gg organic C sequestration potential(Attaeian, 2016).

As the results show, the rangeland ecosystems are unevenly distributed across the country (Figure 5).

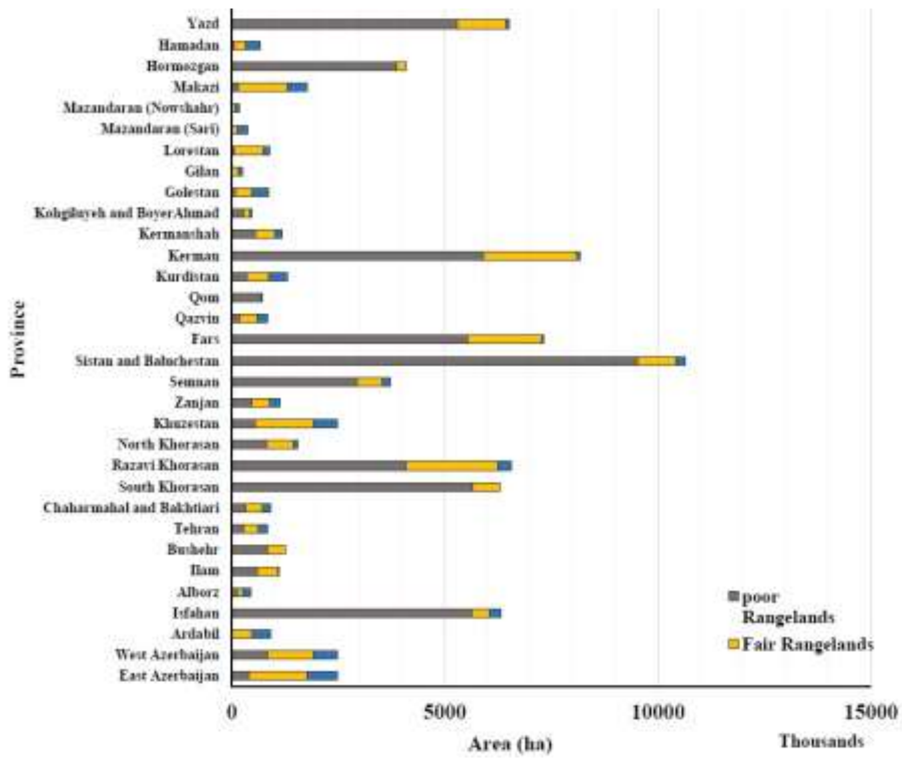

Figure 5. Total area of rangeland ecosystems in different provinces as classified in poor, fair, and good conditions (Attaeian, 2016).

Motamedi et al., (2016) showed that a significant difference between the root and aboveground biomass of *Artemisia fragrans* under three grazing intensities. They pointed out that highest and lowest aerial biomass in two low and high grazing intensities was 5.18 and 76.42 g, respectively. Moreover, the maximum average of underground biomass per plant (95.32 g) and its minimum amount (46.56 g) belong to low and high grazing intensities, respectively(Motamedi et al., 2016). Also, proper management of existing rangelands, or restoration of degraded rangelands through improved management, can sustain or increase soil carbon sequestration and contribute to mitigation of atmospheric CO_2 increases (Abril et al., 2001). It seems that restoration of degraded rangelands through improved management caused to accelerate the process of carbon cycle in grazed ecosystems, but in many cases the effects of grazing on carbon storage ecosystem were irregular and highly variable and difficult to predict the effects. Few studies have actually measured the complete C budgets of native grasslands, but the data available suggest that C content varies widely among different grassland types. The effects of grazing management on the ecosystem processes that control C cycling and distribution have not been sufficiently evaluated in native grassland ecosystems.

The researches in this field are performed to investigate the changes in carbon sequestration on the intensity of management by grazing on rangelands ecosystems in Iran’s rangelands. Therefore, the manner of its effects on the storage of carbon in rangelands could be determined and the sequestration of carbon in ecosystems can be increased by using their findings towards the planning and management of rangeland and manner of their optimal usage form.

There is different carbon sequestration in different grazing management according to low, medium and over grazing in which researched in different areas in Iran about this subject.

Yousefian et al., (2012) studied under title evaluation of enclosure effects on soil carbon storage (Case Study: Rangeland of Shahtappeh-Chah Mahmood and Chiro in Semnan Province) and showed that there was a significant difference ($P<0.05$) between OC% and OM% of baseline in enclosure and no enclosure rangeland. Soil OC% and OM% in baseline in the first depth was more than the second depth in two study areas. There was a significant difference ($P<0.05$) between soil OC% and OM% in baseline and inter-path of plants in two depths of enclosure and no enclosure rangelands. Soil bulk density (gr/ha) in baseline and inter-path of plants in 15-30 cm was more than 0-15 cm. In enclosure and no enclosure rangelands, grazing had no significant effects on soil organic carbon storage of baseline in each depth. So, the total carbon in 0-30 cm in each region was 47.46 and 40.85 ton/ha, respectively. There was a significant difference between carbon storage of baseline and inter-path of plants ($P<0.05$) in two depths in enclosure and control rangelands. It was concluded that higher carbon sequestration occurs in the soil, the soil biological and mechanical activities can increase(Yousefian et al., 2012).

Niknahad Gharmakher et al., 2015 revealed that the response of plant and soil carbon storage to the exclosure in Gomishan rangelands was positive and there was a significant difference between exclosure and grazing areas for the stored carbon of plant biomass and soil. After a 20 year exclosure, the value of carbon sequestration per hectare in Gomishan rangelands was estimated as 14743 $/h. It can be argued that the education and extension of carbon sequestration in Iran will offer new incentives to restore the degraded rangelands(Niknahad Gharmakher et al., 2015).

Khosravi Moshizi et al., in 2015 show that rangeland types had significant effect on carbon sequestration as *Zygophyllum eurypterum-Artemisia sieberi*, *Artemisia sieberi-Pteropyrum aucheri*, *Astragalus microcephalus –Stipa barbata*, *Artemisia sieberi* and *Artemisia sieberi-Salsola brachiata* respectively with 65.84, 53.92, 43.32, 33.17 and 24.77 (T/ha) regarding the highest and lowest carbon sequestration amounts. Carbon sequestration hotspots and cold spots were mapped by using hotspots analysis. *Zygophyllum eurypterum-Artemisia sieberi* and small parts of both types *Artemisia sieberi-Pteropyrum aucheri* and *Astragalus microcephalus–Stipa barbata* with 65.34 (T/ha) were carbon sequestration hotspots. Majority of *Artemisia sieberi-Salsola brachiata* and small parts of *Artemisia sieberi* with 23.78 (T/ha) included carbon sequestration colds pots. PCA analysis also showed that life form, clay and vegetation cover were the most important factors influencing on the hotspots. It was concluded that soil characters also play effective roles to stock carbon in semiarid rangeland ecosystems although rangeland types demined with Phanerophyte species had a greater probability of being identified as carbon sequestration hotspots(Khosravi Moshizi et al., 2015).

Naseri in 2014 showed significant differences between treatments for total C stocks (soil+biomass+litter). NR and ADF management with the average values of 535.32 and 177.14 ($t.ha^{-1}$) had the highest and lowest C stocks, respectively. Among the components of the ecosystem, soil had a main role in C sequestration followed by above biomass, roots and litters. PS management had the highest C stocks in plant biomass and litter but its soil C stocks were significantly lower than NR. Perennial grasses, bushes and perennial forbs were dominant in PS and NR management that play the most important role in plant C stocks. In conclusion, proper management of natural rangelands and more attention to vegetation and soil conservation may lead to store a considerable amount of C stocks in these lands(Naseri et al., 2016).

Farazmand et al. (2017) determined that lowest carbon sequestration was obtained in high grazing intensity that had a significant difference with other sites. Enclosure and high grazing with average values of 42 and 6 (kg/ha) had the highest and lowest carbon sequestration amounts by *Prangos ferulacea*, respectively. Stocking rate of 2.9 (au/ha) was introduced as the suitable grazing intensity to protect the ability of carbon sequestration by *P. ferulacea*(Farazmand et al., 2017).

Iran's rangeland plant and Carbon Sequestration

Grazing intensity has a major effect on soil and biomass organic carbon storage (C). Various plants and ecosystems with different characteristics have their unique responses to the grazing. Recognizing the effects of grazing intensity on C in various environments dominated by Halocnemum strobilaceum, such as Incheboron salt land of Golestan province, helps planning the grazing strategies. Result show that the sum of underground and aboveground biomass C in light grazing site was more than the heavy and moderate grazing sites, which were about 1.17, 1.07 and 0.567 ton/hectare respectively. Amount of soil C for the mentioned sites were 162.56, 137.39 and 80.76 ton/hectare, respectively. Besides, the depth 0-20 cm in all sites had a higher C. The soil C comprised more than 99 percent of ecosystem total stored C (biomass and soil C) in each site. In terms of total ecosystem C, the heavy and moderate grazing site had about 84.37 and 32.20 ton/hectare less C compared to light grazing site.

It is concluded that light grazing intensity in saltalnd region can lead to maintenance of C in high level and grazing systems should avoid high stocking rates because it may adversely affect soil C. Heavy grazing has more negative effects on C compared to moderate grazing. Both soil and biomass respond similarly to different grazing intensities. The soil, especially first depth as the main resources of C, should be protected from deterioration to prevent C decling. In view point of C sequestration, it is suggested to plan grazing intensity in light level and protect the soil of rangelands(Ehsani et al., 2017).

Capability investigation of carbon sequestration in two species (*Artemisia sieberi* Besser and *Stipa barbata* Desf.) under different treatments of vegetation management (Saveh, Iran) has been studied by Alizadeh et al., (2010). The study results show that the amount of carbon sequestration in above ground and underground biomass of *Artemisia sieberi* Besser and *Stipa barbata* Desf. is different in three regions. It, of course, has not any difference between under and surface ground's biomass of *Artemisia sieberi* Besser in long-term exclosure. Carbon sequestration in the *Stipa barbata* Desf. was totally more than *Artemisia sieberi* Besser. Altogether, the average sequestration of the long term exclosure was 5.842gr/m², the medium-term exclosure was 4.115gr/m², and grazable area was 5.975gr/m² so that there is not valuable statistical difference in terms of total amount of carbon sequestration to three sites(Alizadeh et al., 2010).

Choupanian et al., in 2012 show that the highest rate (118.68 kg/ha) of sequestered carbon was observed in the altitude of 1900-2100 m above sea level in the northern direction while the lowest stored rate (39.13 kg/ha) was found in 1100-1300 m in the southern direction(Choupanian et al., 2012).

Mahdavi and Esmaili in 2015 show that the rates of carbon sequestration in different species, vegetation organs and soil layers were different and increased in wooding species. Also, the rate of soil carbon sequestration in the upper depth was more than the lower one; thus, carbon storage in soil near short trees (*Atriplex canescens, Haloxylon persicum)* was higher than that near shrubs *(Artemisia sieberi)* and herbaceous form *(Agropyron desertorum)*(Mahdavi and Esmaili, 2015).

Tavakoli in 2016 determined that carbon has been sequestered between 133 to 3293 kg/ha in different sites in which James and Sefarsakh had the highest and the lowest amount of organic carbon in plant vegetation parts. Soil organic carbon obtained about 6313 kg/ha on average. The best linear regression equation (R_2=0.90) for estimating aerial biomass of *H. salicornia* obtained by using crown area in the equation. It seems that conservation of natural vegetation of *H. salicornia* and or restoration of degraded lands by this plant, have good potentials for carbon sequestration for globally action commitment and providing benefits such as forage and fuel for local people(Tavakoli, 2016).
Some plant that used in carbon sequestration as below:

Halocnemum strobilaceum, Halostachys caspica, Artemisia sieberi, Aeluropus lagopoides and Aeluropus littoralis

Carbon storage in soil and parts of plants

Saeedifar and Asgari (2014) researched to investigate the effects of soil compaction on soil carbon and nitrogen sequestration, physical (aggregate stability, saturated soil moisture content, bulk density, and porosity) and chemical (EC, pH, organic carbon and nitrogen) features. The results showed that Four and six times to-and-fro passing heavy tractor caused a significant reduction in soil carbon and nitrogen sequestration respectively from 3.26 t ha-1 and 149.62 kg ha-1 (in control) to 1.70 ton ha-1 and 48.16 kg ha-1for T3 and T4 treatments. While soil compaction treatments resulted in significant decrease in organic carbon, total nitrogen and saturated soil moisture values(Saiedyfar and Asgari, 2014).

Carbon sequestration in soil, leaf and litter of three tree species, viz. *Eucalyptus camaldulensis*, *Prosopis juliflora* and *Ziziphus spina-christi*, plantation in Dehloran city showed that the amount of sequestered C in leaf, litter and soil was significantly different among these species. The highest amount of sequestrated C was in leaf and the lowest amount in the soil. It shows that this study would be useful for selection of appropriate species to develop green space and forest parks. Forest plantation would capture significant amounts of atmospheric C, and would be expected to contribute to soil quality and conservation(Mirzaei et al., 2016).

In a semiarid region of central Iran, effects of parent materials, physiography and landscape position, land use, and management practices on association of organic carbon with secondary (aggregates) particles and aggregate stability can have important consequences in terms of carbon sequestration and budgeting, deciding on the proper land use strategy and suitable soil conservation practices. Motaghian and Mohamadi (2012) demonstrated that aggregate organic carbon content was highest in mesoaggregates (9 g kg-1), followed by microaggregates (7 g kg-1), while the least OC concentration was found in macroaggregates (3 g kg-1). Both aggregate size fraction and slope aspect significantly impacted aggregate organic carbon concentration. Although a significant effect of aggregate size on aggregate organic carbon content was found(Motaghian and Mohammadi, 2012). Naseri in his study under title the potential of carbon sequestration in the soil and biomass of a *Nitraria schoberi* L. stand in central Iran show that total carbon sequestration of the *N. schoberi* L. stand (28.06 Mg/ha) was significantly higher ($p<0.01$) than the control area (18.64 Mg/ha) in the Hoze Soltan region(Naseri, 2014).

There is direct relationship between carbon sequestrations in soil under plants (0-30cm) with the sequestration in biomass. Height effect on biomass and it cause on carbon so that in 1800-2000 elevation section of the Siahkhor basin most carbon sequestration obtained in different parts (Root and shoot) of three rangeland species such as *Gundelia tournefortii, Astragalus verus and Stipa barbata* (Azhari et al., 2012, Ariapour et al., 2013). Also most of the carbon about 95% there is in soil and 5% in biomass and *Astragalus gossypinus* has more potential to *Stipa barbata* and *Eryngium bungei* for carbon sequestration (Chagooie et al., 2014, Ariapour et al., 2015, Razjoo et al., 2013).

Changes of soil carbon stock

The effects of different climatic, soil, geometric, and management factors on soil organic carbon (SOC) degradation and sequestration potential by "Intelligent Approaches to Analyzing the Importance of Land Use Management in Soil Carbon Stock in a Semiarid Ecosystem, West of Iran" study show that management factors especially tillage and crop residue scenario parameters and grazing management in rainfed land use in the semiarid conditions dominantly controlled SOC stock sequestration or degradation in different land use(Parvizi et al., 2017).

Mahdavi et al., in 2011 indicated that there was a significant difference between the amount of the soil organic carbon under the plants and the carbon between the plants on each area separately ($P<0.05$). The results also showed that the amount of organic carbon under the plants is greater than that between them in the treated exclosures while the grazing areas proved a different result. It can be seen from the mean of the total carbon sequestration that there is also a statistically significant difference between the medium-term exclosure with a mean of 22.45 ton/ha and the long-term exclosure with a mean of 17.76 ton/ha and the grazing rangelands with a mean of 18.50 ton/ha(Mahdavi et al., 2011).

Taghi Kashki et al., 2015 study show that changes in soil organic carbon showed a very slow trend. Based on soil texture and variations of seasonal and annual rainfall, soil moisture caused variations in vegetation factors(Kashki et al., 2015).

Soils are both sinks and sources of C with great potential to mitigate climate change. Global estimates indicate that they contain between 1,206 Pg of soil organic carbon (SOC) to 1-m depth to more than 1,550 Pg C, which is twice the amount of C present in the atmosphere. Nevertheless the overall the C stocks could reach as much as five times that of the atmosphere considering that many soils are much deeper than 1 m. Instead, emissions from land use change are estimated to make up to 20 % of atmospheric CO_2 through loss of biomass and SOM(Zdruli et al., 2017).

Sustainable Land Management Is the Answer for Carbon Sequestration and Food Security

Sustainable Land Management (SLM) can increase productivity by improving water use efficiency, optimizing nutrient cycling and supply for crop production, enhancing vegetation cover and improving food security. Healthy soils produce healthy food, support healthy living and promote a healthy environment.

United Nations Development Program in Iran about Carbon Management

UNDP is the United Nations Development Program, and operates in nearly 170 countries and territories around the world. UNDP partners with people at all levels of society to help build nations that can withstand crisis, and drive and sustain the kind of growth that improves the quality of life for everyone(Anonymous, 2017).

This is a critical time for the world. For UNDP, this period as a huge opportunity to advance the global sustainable development agenda. Recent year, world leaders adopted the 2030 Agenda for Sustainable Development to continue the work of the Millennium Development Goals. UNDP is working to strengthen new frameworks for development, disaster risk reduction and climate change. UNDP support countries' efforts to achieve the new Sustainable Development Goals, or Global Goals, which will guide global development priorities for the next 15 years (ibid).

What are the Sustainable Development Goals?

The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity (ibid).

The SDGs work in the spirit of partnership and pragmatism to make the right choices now to improve life, in a sustainable way, for future generations. UNDP provide clear guidelines and targets for all countries to adopt in accordance with their own priorities and the environmental challenges of the world at large. The SDGs are an inclusive agenda. UNDP has the experience and expertise to drive progress and help support countries on the path to sustainable development (ibid).

Iran launches its first National Strategic Plan to step up the battle against climate change

Iran launched a national strategic plan today aimed at helping the country to adapt and mitigate to risks from climate change.

MENARID- Institutional Strengthening and Coherence for Integrated Natural Resource Management

What is the project about?

MENARID is a Middle East and North Africa Regional Development for Integrated Sustainable Development. MENARID provides valuable lessons and experiences for promoting Integrated Natural Resource Management (INRM) in arid, semi-arid and dry sub-humid environments. It also addresses regions suffering severe land degradation and loss of ecosystem services. Its overall objective is to:

- Promote INRM in the production landscapes of the MENA region.
- Improve the economic and social well-being of targeted communities through the restoration and maintenance of ecosystem functions and productivity.

The goal of the project is to promote climate-resilient integrated management of renewable natural resources, while maintaining the capacity of ecosystems to deliver the goods and services needed to support local livelihoods (ibid).

What have we accomplished so far?

In Iran, MENARID has so far accomplished the following:

- **Implementation**: INRM was introduced and implemented in 40,000 hectares at four main demonstration sites and 260,000 hectares at two replication sites.
- **Rehabilitation**: 49,109 tons of Carbon are sequestrated annually through INRM resulting in rangeland biological soil and vegetation rehabilitation and reduced deforestation.

- **Participatory rehabilitation**: Traditional water management practices were revived in dry and semidry areas. This was achieved by rehabilitating more than 4,040meters of *Ganat* and though the participatory rehabilitation of 1,600 meters of irrigation channels.
- **Risk reduction**: Five types of resilience-enhancing measures have been employed in 13,714 hectares including wind erosion control, flood control, soil erosion control, sustainable agriculture, and cultivation of resistant species.
- **Finance**: A Payment for Ecosystem Services (PES) concept for natural resource management in Iran was introduced by piloting four PES schemes in the project sites.
- **Innovation**: Water harvesting practices have been implemented as a new model for natural resources management and created 100 hectares of forest park as a pilot.
- **Mitigation**: Drought resistant species were introduced to 1,124 hectares of pilot lands as a drought/climate change adaptation measure.
- **Empowerment**: Participatory INRM approaches were introduced to local communities leading to establishment of local groups of women and men and 87 groups now being actively involved in INRM practices.
- **Empowerment:** Women are now empowered in project pilot sites through 26 women-led businesses as a means of alternative livelihood, creating 297 jobs for women, and are heavily involved in policy-making processes of the project (Figure 6).
- **Increased Awareness**: Public advocacy on INRM was carried out through publications, events, interviews, national TV programs, newspapers and other media.
- **Project Start Date:** November 2010
- **Estimated End Date:** December 2017
- **Coverage:** Partner institutions and up to twelve Iranian provinces (as pilot sites – Kermanshah, Sistan and Baluchistan, Yazd and SMLWR Project Pilot Sites – Tehran and Semnan), North Khorasan and Great Karoon Watershed, includes 7 provinces (ibid).

Figure 6. Women are now empowered in project pilot sites.

Carbon Sequestration Project (CSP)

The CSP project aims to promote area-based development in order to sustain the eco-system – including carbon reduction. It also promotes socio-economic development by creating jobs and income generation. It does this in three main ways:

1. Improved rangeland management with the help of the local communities;
2. Ensuring that the process is managed by village development groups; and
3. Ensuring that the work is funded through micro-credit systems and networks.

The project's achievements during the first phase prove that degraded lands can be economically and feasibly restored by, and for, local communities (ibid).

What is the project about?

The Carbon Sequestration Project (CSP) aims to sequester atmospheric carbon in arid and semi-arid areas of Iran and improve the socio-economic status of local communities. It uses a community-based natural resources development approach. The project aims to achieve three main objectives:

- Global level: provide a model to demonstrate that carbon sequestration in arid lands can be carried out in an economical way and so contribute to the potential of such lands to act as carbon sinks.
- National level: restore degraded natural resources.
- Local level: improve socio-economic status of local communities and enhance ecosystem services (ibid).

Carbon Sequestration Project (CSP) expands to 10 more provinces– agreement

Iran and the international community took steps towards tackling the problem of desertification. After small area for Carbon Sequestration Project (CSP), this project expanded activities to a further 10 provinces.

Over the past decade, the project's main impact has been to re-afforest large swathes of Iran either desertified or under threat of desertification. Through the project's successful work then extended to cover the following provinces: West Azarbaijan, Fars, Golestan, Ilam, Isfahan, North Khorasan, Khorasan Razavi, Qom, Sistan and Baluchistan and Yazd.

Evidence shows Iran's five main environmental threats to be the following:

1. Water scarcity
2. Land degradation and desertification
3. Energy efficiency and Greenhouse Gases (GHGs)
4. Air and water pollution– including dust and sand storms, and
5. Biodiversity loss

According to the Government's own statistics, Iran has been significantly affected by desertification in recent years. As a result, the Government– and in particular the Forest, Range

and Watershed Management Organization (FRWO) has set the rehabilitation of degraded lands as one of its top environmental priorities.
In line with this strategy, the Carbon Project uses a collaborative and community-based approach to manage, rehabilitate and sustainably use natural resources.
Starting in a pilot site near Birjand (South Khorassan) back in 2004, the project has developed an applied participatory model. Implemented by FRWO the project has received financial support from the Global Environment Facility (GEF), UNDP and FRWO has invested substantial national resources. It is significant to note that this is the first project where the Government / FRWO have shared the national resources with UNDP's resources in a joint budget for the project increasing efficiencies and synergies.
Following success in first stage of CSP, the FRWO and UNDP agreed to extend their collaboration. The main objective of the second phase was to apply participatory methods and, through this, empower local people but on a larger scale in the district. This way they take on the responsibility to protect, restore and sustainably use their natural resources.

To date, the project's key achievements and outcomes have included:

- Developed capacity at local level;
- Empowered men and women;
- Increased awareness at national and local levels in terms of participatory natural resources management;
- Generation of micro-enterprise to strengthen livelihood of local people;
- Villagers' broad participation for rehabilitation and economical management of degraded natural resources; and
- Improved Human Development Index of which considerable and active women's involvement in decision-making, planning, implementation and monitoring process in the pilot district in South Khorosan province is considered the most significant achievement.

The first phase of CSP project was initiated in the South Khorasan Province with support from the Global Environment Facility (GEF) in 2003. Now through up-scale and replication, the project is at various stages of implementation across 18 provinces in Iran. Given its success, it is quickly developing into the rural development model of choice in Iran.
Over the years, the project has demonstrated both the carbon sequestration potential of significant quantities of marginal land and the potential of local communities to engage in sustainable rural development. The project has empowered local communities, generated sustainable enterprises, built local institutions, thus ensuring ownership by local communities. These communities have, in turn, assumed responsibility for the restoration, conservation and sustainable use of Iran's limited land and water resources (ibid).

What have we accomplished so far?

Overall accomplishments:

- **Upstream impact:** The tenets of the Carbon Sequestration Project methodology has been integrated into the 6th National Development Plan.
- **Afforestation**: Improved the productivity of arid lands.
- **Replication:** The project implemented in 18 provinces.

- **Coverage:** The project covers 2,832,471 hectares. This includes 623 villages and 214,105 residents (ibid).

Achievements at main project site (Birjand)

- **Jobs:** 577 permanent job opportunities were generated, particularly in doll-making and herbal distillation. Local dolls of Hosseinabad were recorded as national cultural heritage.
- **Training:** 400 training and extension programs were held.
- **Loans and micro-credit:** 63 Village Development Groups (VDGs) and a micro-credit system were established. More than 2,400 loans were provided.
- **Rehabilitation:** Over 30,000 hectares of land was rehabilitated.
- **Gender empowerment:** Women have been involved in all project initiatives. Approximately one-third (8,600 out of 24,500) of the person-days of labour needed for restoration works was provided by female VDGs.

Achievements at replication sites

- **Village Development Groups:** Number of newly-formed Village Development Groups (VDGs) has risen to 1,744 groups.
- **Micro-credit Funds:** 255 Micro-credit funds have been established.
- **Rehabilitation:** 25,223 hectares of rehabilitation measures were carried out by VDGs.
- **Training:** 26 capacity-building workshops on participatory natural resources management approaches were held for 910 provincial managers, social mobilization consultants and facilitators (ibid).

PROJECT OVERVIEW:

Project Start Date: March 2010

Estimated End Date: December 2017

Coverage: Partner institutions and eighteen Iranian provinces (South Khorasan, Tehran, Kerman, Semnan, Alborz, Markazi, Bushehr, West Azerbaijan, Fars, Golestan, Ilam, Isfahan, Khorasan Razavi, North Khorasan, Qom, Sistan & Balouchestan, Yazd, South Kerman districts– Jiroft & Kahnuj)

Focus Area: Combined Resilient Economy and Environmentally Sustainable Development

Partners: Forests, Rangelands and Watershed Management Organization (FRWO)

The Middle East and North Africa Regional Program for Integrated Sustainable Development (MENARID) International project is being conducted in including Algeria, Egypt, Iran, Jordan, Morocco, Tunisia and Yemen. In Iran, the project started in September 2010 as a joint activity between Global Environmental Fund (GEF), United Nations Development Program (UNDP) and Forest, Rangeland and Watershed Management Organization (FRWO) of Iran (as Iran government representative).

The current project is comprised of three (3) substantive and complementary components as below:

1. Improved knowledge and understanding

2. An enabling environment

3. Community driven approaches

MENARID Demonstration sites and Focal Areas

MENARID, a full size GEF project in Iran, is executed in four type of agro ecosystems (rang lands, rain-fed agriculture, irrigated agriculture and forest/woodlands) where cross-sectoral coordination is essential, located in five provinces, Sistan and Baluchestan, Kermanshah, Yazd, and also Semnan and Tehran which are pilot sites of Water and Land Recourses Sustainable Management(Hablehroud).

The project is priorities in four focal areas:

1-Land Degradation: The project objectives align closely with supporting sustainable agriculture and rangeland management in the land degradation focal area strategy. It is consistent to develop an enabling environment that will place sustainable land management in the mainstream of development policies and practices at the national and local levels in Iran.

2-International Waters: By identifying interactions between different sources and the multiple use demands of water, the project will ensure that water is not over-used and supplies are available to feed above- and below-ground sources for adjacent territories.

3-Biodiversity Conservation: The project will address the regulatory and institutional constraints to mainstreaming of biodiversity conservation into livelihood activities in the wider agricultural production landscape surrounding protected areas.

4-Climate Change Mitigation: Through its focus on measuring, monitoring and demonstrating carbon sequestration and its attendant benefits to ecosystems and livelihoods, the project will fully support management of land use, land-use change and forestry as a mean to protect carbon stocks and reduce greenhouse gas emissions.

MENARID Key Stakeholders

The project key stakeholders are classified in four different groups as below:

1-Government: at local, provincial and national levels is a primary stakeholder as it continues to coordinate environmental protection and national development objectives in its actions.

2-Local Communities: especially the poorest and most vulnerable who are not only the custodian for critical biodiversity and globally-important environmental assets but are also dependent on the quality of local natural resources.

3-Private Sectors: are another stakeholder potentially benefiting as opportunities arise for the development and implementation of activities and initiatives that have potential to be commercialized.

4-Civil Society and NGOs: will have a significant stakeholder role in promoting awareness of integrated natural resources management, especially in project sites and in developing linkages both to human welfare and to sustainable resources, ecosystem and environmental management (ibid). Figure 7 show official organization of the MENARID project.

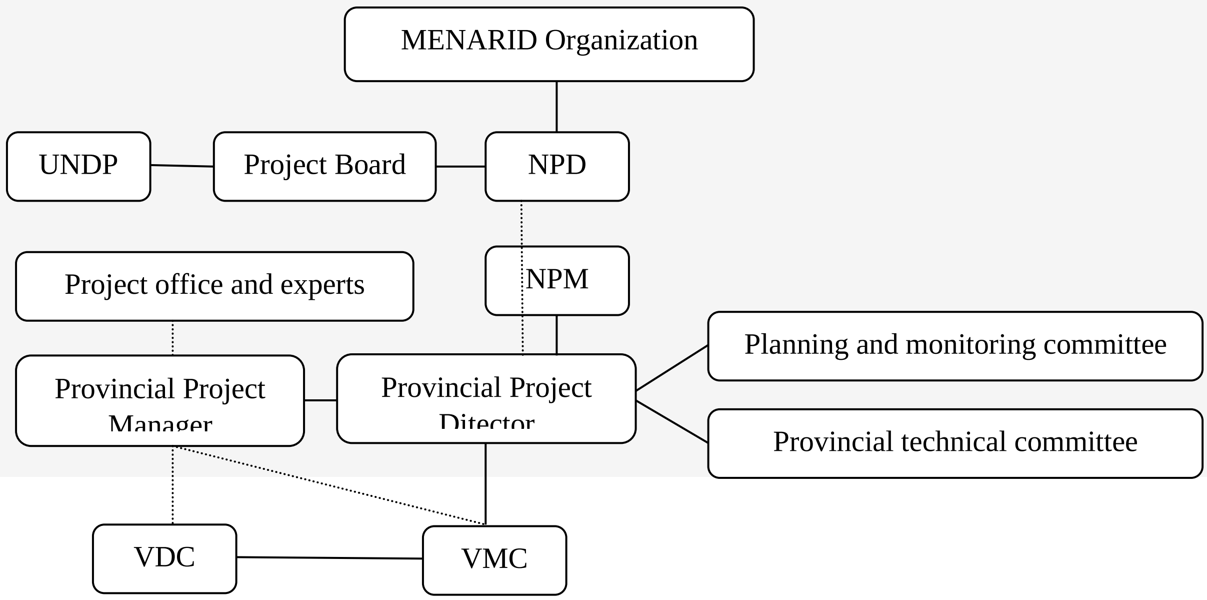

Figure 7. Project Execution Structure.

UNDP: United Nations Development Program
NPD: National Project Director
NPM: National Project Manager
WMC: Watershed Management Committee
VDC: Village Development Committee

MENARID in Yazd Province

The study is prepared in four individual subjects, social, water, erosion and carbon sequestration. Behabad is the site which is located in Yazd province. There are four villages selected as pilots, Asfij, Karimabad, Kamcoye and Banestan. Villages are so selected that actions could be placed from mountains to the lower parts in the plain (Figure 8).

Figure 8. Study area according to province and country, Behabad.

Allocation of resources to sustainable activities

There are 110 deep and semi deep wells in Behabad plain that their water table is decreasing 25 cm a year. This means water management is very important in the area. Conversion of alfalfa to pistachio orchards is one of the wise decisions made by the people and encouraged by Jihad organization. Now instead of 28 m3 for one hectare of alfalfa only 8m3 is used for the same area of pistachio. There are other problems such as water use efficiency which is estimated to be 33% and needs more accurate plans to promote it. Rangelands are used under their capacity and it seems that efforts of the Natural Resource Office for Behabad have been fruitful. Oil and its products are used in the area for fuel and there is no need to cut the bushes. For future however, alongside with increase of oil price other scenarios such as usage of solar energy should be put in place.

Carbon sequestration

Dominant species in the area is *Artemisia sieberi* which is typical of rangelands surface of dry parts of the country. There are some studies on carbon sequestration of rangelands with the same species. In Semnan for instance it is 25.5 tons per hectare per year. Analysis of soil and biomass of rangelands in the area shows that 87% of carbon is sequestrated in the soil. Contribution of biomass and litters are 12.9 and 0.01 percent respectively. In this study each vegetation composition of village surrounding area were investigated and measured i.e. table 1, then carbon content of soil and biomass was determined via samples of soil and plants taken to the lab.

Table 1. An example for vegetation information.

Species	Vegetation cover%	Density	Annual production(Kg/Hec)
Artemisia sieberi	4.5	5000	56
Scariola orientalis	2.7	2100	28

Eryngium bungei	0.5	560	6
Astragalus spp.	0.6	500	8
Launaea acanthodes	0.4	370	5
Pteropyrum aucheri	0.5	45	8
Peganum harmala	0.3	250	5
Noaea mucronata	0.2	400	4
Acanthophyllum spp.	0.1	100	3
Other perennial	0.4	-	5
Annuals	0.3	-	9
Total	10.5	9325	137

All sampling points are recorded by GPS and finally total carbon sequestration for each village is calculated. Results are given in tables, i.e, tables 2-6 for rangelands.

Table 2. Carbon sequestration for Asfij.

Species	Area (ha)	Production (Kg)	Carbon sequestrated (Kg/year)	Sequestrated CO_2 (Kg/year)
Artemisia sieberi	69.3	2011.8	1015.7	3727.8
Scariola orientalis	23.3	379.6	197.7	725.6
Astragalus sp.	4.7	70.3	35.9	131.7
Salsola tomentosa	18.4	228.8	86.8	318.7
Launaea spp.	5.9	50.8	24.7	90.6
Others	21.3	878.3	403.2	1479.6
Total	142.9	3619.6	1764.0	6474.0

Table 3. Carbon sequestration for Banestan.

Species	Area (ha)	Production (Kg)	Carbon sequestrated (Kg/year)	Sequestrated CO_2 (Kg/year)
Artemisia sieberi	28.6	1369.6	696.4	2555.7
Scariola orientalis	12.3	228.6	119.0	436.9
Eryngium bungei	7.3	110.2	55.9	205.3
Astragalus sp.	3.3	33.9	17.3	63.5
Amygdalus scoparia	0.5	10.9	5.5	20.1
Stipa barbata	1.6	22.1	10.7	39.4
Others	6.8	72.9	33.5	122.8
Total	60.3	1848.1	938.4	3443.8

Table 4. Carbon sequestration for Karimabad.

Species	Area (ha)	Production (Kg)	Carbon sequestrated (Kg/year)	Sequestrated CO_2 (Kg/year)
Artemisia sieberi	97.8	2640.5	1333.2	4892.9
Scariola orientalis	20.0	144.2	75.1	275.7
Cornulaca monacantha	48.6	1183.0	574.9	2109.9
Others	26.3	395.0	181.3	665.4
Total	192.8	4362.7	2164.5	7943.8

Table 5. Carbon sequestration for Kamkoye.

Species	Area (ha)	Production (Kg)	Carbon sequestrated (Kg/year)	Sequestrated CO_2 (Kg/year)
Artemisia sieberi	331.6	22043.3	11129.7	40845.9
Artemisia aucheri	274.5	22436.4	11442.0	41992.3
Scariola orientalis	144.7	3695.9	1925.0	7064.6
Eryngium bungei	22.5	135.2	68.6	251.8
Astragalus sp.	117.5	1791.5	914.2	3355.1
Amygdalus scoparia	41.1	1083.9	546.7	2006.5
Others	222.1	10172.9	4669.3	17136.5
Total	1153.9	61359.2	30695.6	112652.7

Same information is available for crops and soil in the area. At the end total carbon sequestration for the area is calculated (Table 6).

Table 6. Carbon sequestration (C.S.) for the area.

Village	Area (ha)	C.S. by rangelands (Kg/year)	C.S. by crops (Kg/year)	CO_2 sequestrated by rangelands (Kg/ha.year)	CO_2 sequestrated by crops (Kg/ha.year)
Asfij	2288.8	1764.0	456535.6	12597.6	3.00
Banestan	738.8	938.4	431409.5	11994.5	5.68
Karimabad	3550.4	2164.5	657738.9	11279.9	2.38
Kamkoye	9254.2	30695.6	97224.3	15183.5	12.20
Total	15846.7	35562.5	1642908.3		

It is concluded that total carbon sequestration for the area is 1678 tons per year.

MENARID in Kermanshah Province

Summary report of Razin site, Kermanshah

Razin watershed is 14680 ha located on the north of Kermanshah city, geographically 34^{o} N and 47^{o} E. its highest point is 2867 m/asl and the lowest part 1407 m. There are 10 sub basins and three hydrological units in the area. The number of villages is 20 of which 4 are selected for MENARID pilot sites, Razin, Zamele, Bolan and Sarab Shahhossein (Figure 9).

Figure 9. Razin basin and its villages.

Carbon sequestration

Methodology of carbon sequestration in brief it could be said that relation between photosynthesis and co_2 consumption is used. Regarding the area of rangelands and forests it is estimated that there are 395 ton/y dry matters by rangelands and 492 ton/y by forests. Relevant calculations shows that there are 1557 ton dry materials in the area. References say that 40% of dry matters are carbon so total carbon sequestrated within the year is 623 tons. Carbon content of soil also is measured and it is figured that the most carbon content belongs to forests which are 6.7% of the soil. All it is estimated that total carbon sequestration for the area is 3614 tons/Y. Recently land uses has been changed in some country as well as Iran that caused carbon sequestration reserve in soil and plant (Figure 10).

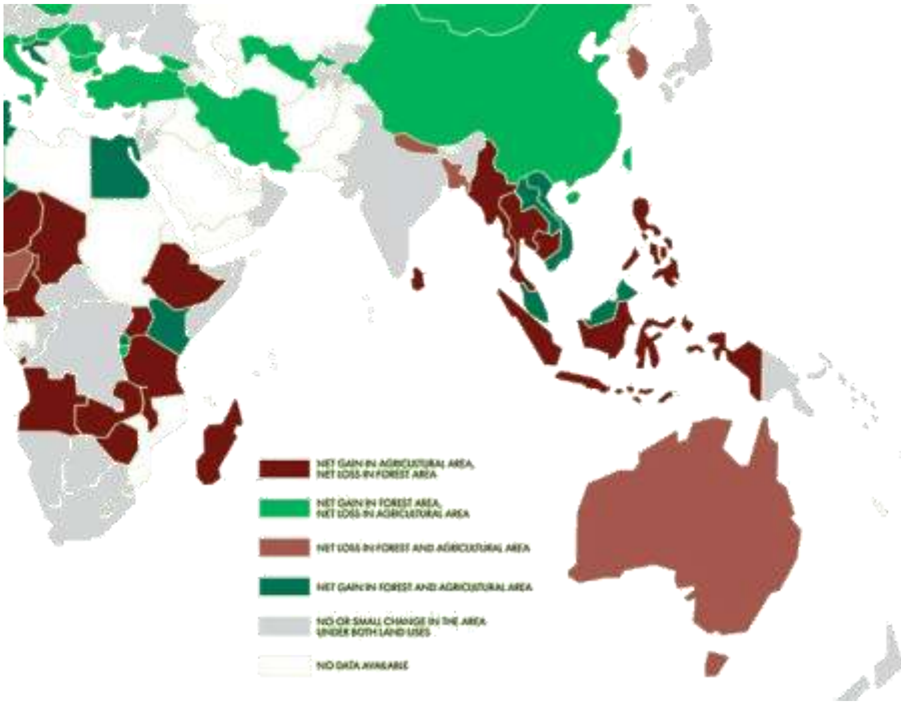

Figure 10. Net changes in agricultural and forest area, by country/territory, 2000-2010 (FAO, 2015) and (FAO, 2016).

MENARID in Sistan and Baluchestan Province

Selected site is 18250 ha located at the edge of Zahedan-Zabol main road. The area is surrounded by Sistan River at north, the main road at east, Shibab no.1 canal from south and Hamon Lake, its rangelands, from west (Figure 11). From 24 villages in the area four are selected for MENARID project. Total population of the area is 8890. Of the whole area of MENARID site 9644 ha (52%) are irrigated farms, 1382 ha (7.5%) are manmade forests mostly for combating desertification, 5435 ha (30%) rangelands, 455 ha (2%) river banks, 523 ha (3.5%) residential and 811 ha (5%) are bare lands.

Figure 11. Boundary of MENARID site in Sistan & Balochestan province.

Carbon sequestration

There are three sources for carbon sequestration in the area, rangelands, agriculture and horticulture. There some manmade forests mostly Haloxylons.

Rangelands

Rangelands are segmented to different vegetation types on the basis of their physiognomy. Then annual biomass of vegetation, Arial and underground, are taken to the lab and carbon content of them were measured. For the task, detail of vegetation annual production for each and all vegetation types are determined (Table 7 and 8).

Table 7. Annual production of *Tamarix stricta- Suaeda fruticosa* type.

Species	Cover %	Production (Kg/ha)
Tamarix stricta	36	390
Suaeda fruticosa	8	160
Aeluropus spp.	3	22
Phragmites communis	0.6	8
Arundo donax	0.5	7
Cynodon dactylon	0.9	9
Salsola spp.	1	14
Total	50	610

Total annual production of this vegetation type is around 600kg per hectare. Since these species are not palatable a small part of it is grazed so most volumes of their carbon are sequestrated.

Table 8. Annual production of *Aeluropus spp*.- *Tamarix stricta* and *Suaeda fruticosa* type.

Species	Cover %	Production (Kg/ha)
Suaeda fruticosa	10.2	270
Aeluropus spp.	2.5	19
Tamarix stricta	4.1	42
Halostachys belangeriana	0.8	18
Salsola spp.	0.6	10
Other perennial	0.8	12
Total	19	400

According to the species of the type only 20% of annual production is grazed (Table 9).

Table 9. Annual production of *Tamarix stricta- Aeluropus spp.* Type.

Species	Cover %	Production (Kg/ha)
Tamarix stricta	28	320
Aeluropus spp.	31	180
Suaeda fruticosa	2	45
Halostachys belangeriana	0.7	18
Capparis spinosa	0.6	10
Alhagi camelorum	0.8	14
Salsola spp.	0.9	18
Other perennial	1	20
Total	65	625

For all vegetation type's measurements are done and results are available (Table 10 and 11).

Table 10. Information of carbon sequestration for all vegetation types.

Vegetation type	Species	Area	Total production(kg)	CO_2 sequestrated	Carbon sequestrated (kg)
1	*Tamarix stricta*	328.68	128185.20	399873.73	108074
	Suaeda fruticosa	73.04	11686.40	31137.48	8415.53
	Aeluropus spp.	27.39	602.58	1603.87	433.47
	Other	4.5	41.1	28020.30	7573.05
2	*Suaeda fruticosa*	98.63	26631.18	70956.65	19177.47
	Aeluropus spp.	24.18	459.33	1053.58	284.75
	Tamarix stricta	39.65	1665.17	5194.51	1403.92
	Other	2.2	21.27	814.65	220.17
3	*Tamarix stricta*	62.16	19891.2	62050.60	16770.43
	Aeluropus spp.	68.82	12387.6	28414.06	7679.47
	Suaeda fruticosa	4.44	199.8	532.35	143.87
	Other	8.8	146.52	406.98	109.99
4	*Halostachys belangeriana*	4.50	832.5	2215.84	598.87
	Suaeda fruticosa	1.50	82.5	219.81	59.40
	Aeluropus spp.	2.00	52	119.28	32.236
	Other	1.3	15.3	43.93	11.88
5	*Aeluropus spp.*	3093.20	618640	1419006.00	383515.10
	Suaeda fruticosa	84.36	2530.8	6743.11	1822.46
	Capparis spinosa	22.50	112.48	299.38	80.91
	Other	174.34	5174.3	13657.00	3691.08
Total	-	4126.19	829357.23	2072363.11	560098.10

Table 11. Information of carbon sequestration for irrigated cropping system.

Activity	Area (ha)	Yield (kg)	Carbon sequestrated (Kg/year)	CO_2 sequestrated (Kg/year)
Cropping	350	525000	321.30	3682.35
Horticulture	11.2	23520	995.23	289.65
Total	361.2	548520	1316.53	3972.00

When information of soil carbon content is added to those figures table will emerge which shows the total carbon which is sequestrated (Table 12).

Table 12. Total figure of carbon sequestration in Zabol.

Vegetation type	Sampling point	Are (ha)	Organic Carbon (%)	Sequestrated CO_2 (kg)
1	Under canopy	456.5	3646.8	12289.9
	Bare land	456.5	1905.9	6422.9
2	Under canopy	183.7	1467.8	4946.4
	Bare land	783.3	3270.2	11020.6
3	Under canopy	144.3	1152.8	3884.8

	Bare land	77.7	324.4	1093.2
4	Under canopy	9.3	74.3	250.3
	Bare land	40.7	169.9	572.6
5	Under canopy	3374.4	26957.2	90845.6
	Bare land	2249.6	9392.3	31651.9
Crops	Under canopy	350	1092.7	3682.4
	Bare land	310	618.2	2083.2
Gardens	--	11.2	85.9	289.6
Total	--	14883.8	50158.4	169033.6

Iran's climate change office

Iran Climate Change Office has developed an inventory of both direct greenhouse gases and indirect greenhouse gases for the base year 1994.

Climate Change Impacts in Iran

Based on the research and assessment carried out during the Climate Change Enabling Activity Project under UNFCCC, and using the scenarios proposed by IPCC, it is estimated that if the CO2 concentration doubles by the year 2100, the average temperature in Iran will increases by 1.5 - 4.5ºC which will cause significant changes in water resources, energy demand, agricultural products, and coastal zones. The “direct” adverse impacts of climate change include changes in precipitation and temperature patterns, water resources, sea level rise and coastal zone, agriculture and food production, forestry, drought frequency and intensity, and human health. The “indirect” adverse economic impacts result from the response measures taken by the developed countries.

Land-use Change and Forestry Sector

Forests, ranges and soils play an important role in the global carbon cycle both as carbon sinks and sources of CO2. The global carbon cycle is recognized as one of the major bio-geo-chemical cycles because of its role in regulating the concentration of CO2. For this sector, land-use change and its effects on emission and removal of CO2 can be determined and calculated. The most important land-use changes are:

- Changes in forests and other woody biomass stocks,
- Forests and grasslands conversion,
- Abandonment of cropland, pasture, plantation forest, or other managed lands which revert into their natural grassland or forest conditions, and
- Changes in soil carbon.

The greenhouse gases emitted from land-use change and forestry sector are CO2, CH4, N2O, NOx and CO. It should be mentioned that forests, ranges and soils can be considered as CO2 sinks as well.

Agriculture Sector

The following are sources of GHGs emissions in the agriculture sector

- Livestock

Enteric fermentation
Manure management

- Agricultural soils
- Crop residues burning
- Rice fields

In addition, the greenhouse gases emitted from this sector are CO2, CH4 and N2O(ICCO, 2017).

Experiences about rangeland burning

As it is clear there is positive and direct relationship between carbon sequestration and fire in rangeland. In recent years most of the Iran's rangeland has been burnt (Figures 12 and 13). Especially in Lorestan province that there is different reasons such as: natural and unnatural (Intentional and Unintentional). In some years that there is heavy precipitation and maximum of normal precipitation, forage and biomass growth very high and especially when there is no any herbivores or low density to grazing, so it cause natural burning. But most of the burning is unnatural because of some reasons fall in five main categories such as: 1-Climatic 2-Economic 3-Cultural and sociology 4-Managerial and 5-Educational

Each of those falls in many reasons that it according to viewpoint of herders and experts. Most of the main reasons that mentioned by many researchers are seize land, unknown land owners, lack of facilities for rangeland conservation, lack of special rules and regulations on the use of pastures, lack of warning boards around recreational areas and high-risk areas, lack of firefighting equipment respectively. In sum according to experts and herders viewpoint to fire in rangeland are economy, law and technical methods to management(Amouzade et al., 2014, Naderi et al., 2017).

Figure 12. Rangeland burning by some reasons.

Figure 13. Rangeland burning by some reasons.

In some county and provinces of Iran such as Shiraz province, Marvdasht city, most of the farmers believe that must fire pastures of the agriculture land after harvesting wheat, barley and other cereals such as corn for healthy of lands and combating with diseases. This will slow down the fertility of the land as well as damage to the 2,500-year-old monuments of Persepolis by emission of CO_2 in air. Emission of the gas in atmosphere cause acidic rains and destroys historical places with calcareous structure as well as effect of global warming. The cities' promotion agencies are trying to educate farmers on this issue, which says that burning after farms does not have an impact on the fight against diseases and reduces the productivity of land. Like this belief there is between some farmers that have land near rangeland to combat with *Eurygaster integriceps* HEM: Scutelleridae fire the upper rangelands. For this and to educate new methods to combat with disease ministry of Jihade Agriculture in whole of the country an office to promote farmers and herder's knowledge.

Iranian government beside international agencies and organizations are trying to reducing emission of CO2 in atmosphere. So, one of the ways is using solar cells and develops to high productivity of the cells. Nowadays it used in villages for cooking, water warming and heat the rooms (Figure 14)

Figure 14. Using solar energy of daily activates.

In some conservative region that is so far form cities and cannot develop electricity like Gahar-Oshtoran Kooh area, established solar panels to person come for recreation and light. This help to save trees, shrub and grasses around the lake for cooking, warming and light (Figure 15)

Figure 15. Using solar energy in Gahar Lake.

Application of solar energy for living between Nomads

There is a project in Tehran University, natural resource department to using solar energy ways for nomads to meet the needs. In this study they are trying to do low cost according to nomads economy and also easy using this system. This system will be useful to fencing, light, cooking, heating, and warming for all society in which has not electricity because of for from city and not infrastructures. Some panels will establish in corner or a safe place in rangeland. It will produce enough electricity for living and will reserve in a battery for needed time for example in the night for light or cooking time or weak electricity for fencing. Also they are promotion of battery life, high productivity electricity and estimation number of fencing line to send a low voltage steam. In this system first step is estimation of needed electricity for a family with at least five people (Figure 16).

Figure 16. Application of solar energy for living between Nomads.

Ecotourism industry which can help sustainable development in natural resources

One of the harmless usage natural resources are ecotourism industry. This subject helps to nomads, herders, rural and other utilization of nature to boost income for living. They have to avoid degradation of plant in rangeland and rehabilitation of plant to promotion of green space to recreation of people that cause protection of plant in which are main source of carbon sequestration.

Conclusion

Carbon sequestration is very important and fundamental for the sustainability of natural ecosystems and plays a very vital role in human life. Natural hazards such as floods, fires, the spread of pests and diseases, etc. are directly and indirectly related to carbon sequestration. The role of rangeland and forest vegetation in helping to sequester carbon on a large scale is effective in the climate of the Earth. The benefits of the environment and natural resources cannot be directly calculated due to the gross national income of countries, and governments must spend money on this very important issue. Due to its global role, the United Nations has implemented carbon sequestration projects in many countries in cooperation with governments. In Iran, these projects have been implemented and evaluated in different climatic regions. In all of these projects, due to the use of solar energy, it helps to prevent the production of fossil fuels, and the development of these types of methods helps to preserve vegetation and, as a result, prevent global warming.

Conflict of interest statement

I certify that there is no actual or potential conflict of interest concerning this article.

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