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Ex-ante Impact Study on the Integrated Natural Resources Management in the Middle East and North Africa Region Rangelands Rehabilitation Project in Iran

Habib Shahbazi [1*], Hamidreza Alipour [2] and Akram Abbasifar [3]

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Abstract

The purpose of the Integrated Natural Resources Management program in the Middle East and North Africa Region (MENARID) is to bring national investment projects in the field of Integrated Natural Resource Management (INRM). The impact evaluation study tests whether the selected technology has significantly contributed to restore and maintain of the ecosystem functions and productivity, and whether has improved the economic and social well-being of the targeted communities. We chose Kamkooyeh Village in the Behabad County where a "Village Development Group" (VDG) has been established by following participatory and capacity building approaches such as social mobilization and micro credit mechanism. A set of complementary activities and interventions were recommended and implemented in the site by consultation and active participation of the local communities and beneficiaries. One of the proposed interventions is rangelands rehabilitation project (RRP). The expected benefits and costs of the RRP were predicted through financial valuation and an ex-ante evaluation of socioeconomic impacts. The financial and social benefit-cost ratio of RRP was estimated to be about 0.97 and 2.15, respectively.

Keywords:
Impact Study, MENARID, Rangelands rehabilitation, ICARDA, Kamkooyeh Village, Iran

[1] Assistant professor, Department of Agricultural Economics, Sayyed Jamaleddin Asadabadi University (SJAU), Hamedan, Iran
[2] Department of Management, Rasht Branch, Islamic Azad University, Rasht, Iran
[3] Research Assistant, Consumer and Producer Protection Organization, Ministry of Industry, Mine and Business, Tehran, Iran.
* Corresponding author's email: Habib_susa@yahoo.com

INTRODUCTION

The purpose of the Integrated Natural Resources Management (INRM) program in the Middle East and North Africa Region (MENARID) is to bring national investment projects in the field of INRM. Within the scope of MENARID, ICARDA planned to support a full and details impact study that captures the adoption of all INRM technologies implemented by the Iran MENARID project titled "Institutional strengthening and coherence for Integrated Natural Resources Management", and further assess a few high potential technologies selected in close collaboration with the local project team, and for which primary and secondary data are available. Such a study should also explore the gender aspect of the technologies analyzed. This approach should contribute to decisions related to up scaling of the activities within and outside of the target project area as wells as learning for policy and decision making in integrated NRM development under similar conditions in the future.

The impact evaluation study should test the following objects: The technology, in the specific context in which it has been implemented, has significantly contributed to restore and maintain of the ecosystem functions and productivity, and has improved the economic and social well-being of the targeted communities. This hypothesis should be tested in the project districts that are predominantly covered by the assessed technology.

The impact study focuses on attribution and contribution of these technologies in bringing about desired changes, and also covers its relevance, effectiveness, efficiency, impact and reliability. To achieve this goal, it:

i. determines extent and depth of the use of the technologies/practices by the target beneficiaries,

ii. measures the economic and environmental benefits of using this technology; and

iii. Undertakes a benefit-cost analysis of the technology, considering the full cost of the technology (costs of utilization, costs of promotion, subsidies and etc.).

We chose Kamkooyeh Village in the Behabad County (Iran) where a "Village Development Group" (VDG) has been established by following participatory and capacity building approaches such as social mobilization and micro credit mechanism. A set of complementary activities and interventions were recommended and implemented in the site by consultation and active participation of the local communities and beneficiaries. The proposed interventions include Rangelands rehabilitation project (RRP) by different practices like seeding and plantation in hilly landscapes/terrains

Since Kamkooyeh village is located in a hyper arid region (near to desert and with mean annual rainfall of about 153.9 mm) so water saving and water use optimization is a very important and necessary issue. This issue is more important in agriculture sector because it consumes more than 90% of the available water resources. One of the solutions for conserving water in soil profile, reducing runoff, soil conservation and as a result reducing soil erosion rate, forage production, increasing carbon sequestration and improving plant biodiversity, an intervention including sowing and seeding of natural vegetation cover has been done by one of the community member in his own lands (based on the customary right) in upstream of Jannat Watershed. This practice covers about 10 hectares and has been implemented by three labors and also one day work of 30 persons (members of village development group).

The seeding practice should be done before snow fall to give more opportunity for germination of seeds and also to be covered by soil because of sheep and goats walk but there was a small problem (delay) in providing seeds. On the other hand, this spring has less precipitation because of drought condition, but there is a hope that next year, the plants could grow better.

The sowing intervention had two aspects. One to test different sowing methods to find out which one is better for this area and on the other hand to convince local beneficiaries that they can rehabilitate and also improve rangelands condition by these type of intervention which is useful for their animal grazing and improving their own livelihood condition.

Rural development policy impact study could evaluate from economic, ecosystem and social aspects. These appraisals are categories to two approaches of ex-ante and ex-post evaluations (Shahbazi, 2013, Hosseini and Shahbazi, 2013 and 2014). One of evaluation methods is benefit-cost analysis approaches. Rangelands Rehabilitation Project (RRP) in Kamkooeh village is not operational yet. So, RRP impact study is ex-ante evaluation. This executive MENARID policy in Iran will be evaluated from economic, ecosystem and social aspects by ex-ante benefit-cost analysis approach. Benefit-cost analysis is method for project relative advantage according to optimal and effective allocation of resources.

Benefit-cost analysis is a method for evaluating relative advantage of investment projects in terms of efficient allocation of resources. Benefit-cost analysis aims to improve the efficiency of resources for economic prosperity in other words; the aim of the evaluating is to help select the best type of desired decision to the efficient use of resources (Wieck, 1993).

The first theoretical framework of benefit-cost analysis is bringing up by French engineer and economist, Dupit in 1844. He used the concept of consumer surplus. After that date the benefit-cost analysis has played a vital role in the economic well-being (Vreeker *et al*., 2002). The first practical application of benefit-cost analysis was in 1930 for the development of water resources in the US (Pakzad, 1993). There are many definitions for benefit-cost analysis. Boardman *et al.* (2005) believed that benefit-cost is balance for measuring. Reh (2015) believed benefit-cost analysis is method for finding all the costs and benefits of a project as quantity value. In developing countries due to lack of capital resources, the best alternative investment allocation is a critical issue (Khalili, 1995).

Accordingly, many studies have focused on the evaluation of rural development projects. In Iran Malek Hosseini and Mirakzade (2014), assessed economic impacts of development projects on rural area (Kermansha province irrigation and drainage network). Salehi (2002) showed that the watershed project had positive impact on rural migration reducing and employment increasing. The effect of watershed projects on rural development, Efati (2000); Mansourian and Mohammadi Golrang (2003) also conducted a study. Hosseini Tavasol *et al.* (2007) studied the economic development impact of rural dam in Khuzestan, assessed the impact of villager's contribution in rural development and successful implementation of rural projects. Other studies in this filed are conducted by Khobfekr (1999) and Dadrasi Sabzevar (2007). Abbasifar (2008) assessed the economic and environmental impact of foresting projects in Iran. She also used the benefit-cost analysis. All of these studies have been used ex-post evaluation approach.

In other countries, Tolliver *et al.* (2011) study was to quantify the investment and maintenance needs of the county and local roads that serve as agricultural logistics routes in North Dakota. They found that the estimated resurfacing costs per mile of major agricultural distribution routes is 40% greater than the estimated resurfacing cost per mile on non-agricultural routes. They also discovered the average annual cost to resurface and maintain paved agricultural roads are $18,300. Jahren *et al.* (2005) conducted a study of Minnesota rural roads for the Minnesota Department of Transportation (DOT). The objective of the study was to identify the methods and costs of maintaining and upgrading a gravel road. They concluded that the historical costs to maintain both gravel and bituminous roads were between $1,500 and $2,500 per mile.

Anderson and Sessions (1991) used Mixed Integer linear Programming (MIP) to analyze the intermittent road management problem. They compute the total costs and open road segments if opening and closing costs are not considered simultaneously with transport and road maintenance costs. The total costs are 13% higher than the optimal solution that considers all four costs simultaneously. Baumet *et al.* (1986) estimated the benefits of keeping groups of existing roads in the county road system. Hanson *et al.* (1985) describe the variable costs of the predominant types of vehicles operating on Iowa rural county roads. Helmberger *et al.* (1990) develop a method to assess the economic impact of a rural road management study.

Sebealy *et al.* (2003) evaluate the impact of agricultural equipment on the actual response of low-volume roads in South Dakota. Other studies in this filed are conducted by Byrd and Gildestad. (2001).

In this section, first of all, the objectives of the impact study were mentioned then the study area was introduced. After that, the implemented projects (interventions) in the study area were introduced and were evaluated. In the next section, the methodology of the impact study will be explained. In section three, calculation of the environmental, economic and social benefits of the practice and B/C analysis (financial, economic and social) would be explained. In section four, conclusion and recommendation would be explained.

MATERIALS AND METHODS

We chose Kamkooyeh Village in the Behabad County in Yazd Province (Figure 1) where a set of complementary activities and interventions were recommended and implemented in the site by consultation and active participation of the local communities and beneficiaries including Rangelands Rehabilitation Project (RRP).

Due to the short time elapsed since the start of the interventions, (the lifetime of the largest intervention or project is approximately one year) so nobody expects to observe the resulting impacts in such a short period. Therefore, an ex-ante study was done to predict the potential impacts in the future.

In this project, we should consider all of the intervention or measures simultaneously while predicting the potential impacts. Accordingly, the impacts of this intervention (technology) on maintenance, restoration, or improvement of productivity, ecosystem functions, and social welfare of local communities were evaluated separately by considering the following Steps:

Ecosystem functioning (environmental, biophysical and biological) benefits

Ecosystem functioning (environmental, biophysical and biological) benefits of "Rangelands Rehabilitation Project (RRP)" are including: including "water conservation and increasing water infiltration", and as a result, "increasing ground water recharge" plus "reducing flood hazard" plus "soil erosion control" (because of low runoff in hilly landscapes) and on the other hand, improving natural vegetation cover and as a result, more "Carbon & CO_2 sequestration" plus "biodiversity value" plus "soil erosion control" (because of existing a better protection cover for the top soil by the improved canopy cover).

Calculation of "increasing water infiltration" benefits

Calculation of "increasing water infiltration" benefits in terms of "increasing ground water recharge" benefits plus "reducing flood hazard" benefits plus "soil erosion control" benefits is as the followings:

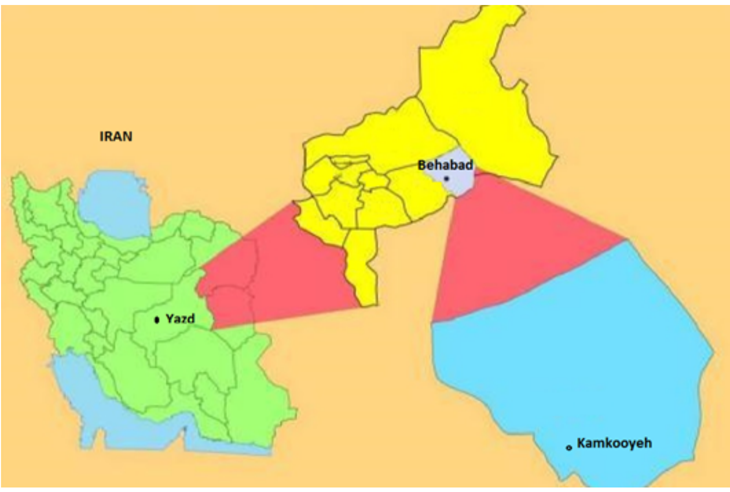

Figure1. Kamkooyeh Situation

$V_{IWI}= V_{IGWR}+ V_{RFH}+ V_{SEC}$ (1)

Where V_{IWI} is "increasing water infiltration" benefits V_{IGWR}, V_{RFH} and V_{SEC} are "increasing ground water recharge" benefits" plus "reducing flood hazard" benefits plus "soil erosion control" benefits, respectively. After field visit, by using a rainfall-runoff model (like *SCS*-Curve Number method) and considering canopy cover percentage of rangelands, before and after rangelands rehabilitation measures, the model will shows the impact of this activity on runoff control and also by using soil erosion model (like *PSIAC* or *USLE*), the impact of this activity on soil erosion control, would be determined and its benefits would be calculated.

Calculation of "CO_2 sequestration" benefits

Calculation of "CO_2 sequestration" benefits is as the followings:

$V_{CS}= R_{AV}\times A_i\times C_i\times T_{con}$ (2)

Where V_{CS} is "CO_2 sequestration" benefits because of rangeland rehabilitation measures, R_{AV} is carbon sequestration (ton/ha), A_i is area of rehabilitated rangelands (ha), C_i is the ratio of the increased biomass because of rangeland rehabilitation measures and Tcon is average tax on CO_2 dispersion-average countries (IRR/ton).

Calculation of "biodiversity value (V_{BS})" benefits

For calculation of "biodiversity value (V_{BS})" benefits of the improved rangeland (after rehabilitation measures), De Groot *et al.* (2012) table would be used. They have calculated the value of 10 different ecosystem services (in US $) in 2012.

Calculation of "soil erosion reduction" benefits

Calculation of "soil erosion reduction" benefits is as the followings:

$V_{EE}=Q_I\times (M_N\times P_N+M_P\times P_P+M_K\times P_K)$ (3)

Where V_{EE} is "erosion reduction" benefits, Q_I is quantity of sediment (m^3), M_N is percentage of Nitrogen in sediment, PN is market price of Nitrogen fertilizer, M_P is percentage of Phosphate in sediment, P_P is market price of Phosphate fertilizer and M_K is percentage of Potassium in sediment, P_P is market price of Potassium fertilizer.

Sum of the benefits from water conservation and "increasing water infiltration", "CO_2 sequestration", "biodiversity value" and "soil erosion reduction" are ecosystem functioning (environmental, biophysical and biological) benefits of *RRP*. It means, $V_{RRP}=V_{IWI}+V_{CS}+V_{EE}+V_{BS}$.

Economic (improving of productivity) benefits

Economic (improving of productivity) benefits of RRP, that is, Calculation of "improving of productivity" benefits is as the followings:

$E_{RRP}=Q_F\times P_F$ (4)

Where E_{RRP} is economic (improving of productivity) benefits of *RRP* because of improved vegetation cover after rangeland rehabilitation measures, Q_F is the amount of the increased livestock feed (ton), P_F is livestock fodder price (IRR/ton).

Social benefit/well-being

Social benefit/well-being of RRP could be determined by using the following equation:

$SV_{RRP}=[1+((IN_{nmd}/IN_{pre\text{-}nmd})\times \gamma_{RRP})]\,[V_{RRP}+E_{RRP}+EM_{RRP}]$ (5)

Where SV_{RRP} is social benefit of *RRP*. V_{RRP}, E_{RRP} and EM_{RRP} are ecosystem functioning, economic benefits and employment value (temporary job opportunity for local community of *RRP*, respectively.

In addition to environmental and economic benefits of *RRP*, there are other impacts such as increasing active participation of local communities, improved group working manner, social mobilization which will cause improvement in social capital, therefore the rate of social participation could be calculated by using the $[(IN_{mnd}/IN_{pre\text{-}mnd})\times\gamma_{RRP}]$ equation.

Actually, by considering this coefficient (rate), social benefits of *RRP* would be increased. In this equation, IN_{mnd} is average income of the village after implementation of the *MENARID* project, $IN_{pre\text{-}mnd}$ is average income of the village before implementation of the *MENARID* project and γ_I is the technology acceptance rate for *RRP*.

Calculation of "*EMRRP*" benefits

Calculation of "*EMRRP*" benefits is as the followings [1]:

$$EM_{RRP}=Q_{EM1}\times P_{w1} \quad (6)$$

Where EM_{RRP} is employment value of RRP activity, Q_{EM1} is number of the employed labors, Pw1 is labor daily wage in that region.

Benefit-cost analysis

Benefit-cost analysis of *RRP* is as follows:

Net annual equivalent uniform benefits of RRP could be calculated according to SVRRP for life period of the projects (for example, 20 years) and then Net annual uniform cost of RRP interventions for useful life period of the projects. Benefit-cost analysis would be determined based on the following equation:

$$B/C=\left[SV_{RRP}-EM_{RRP}\right]\Big/\left[C_{RRP}\left[\frac{r(1+r)^n}{(1+r)^n-1}\right]+K_{RRP}\right] \quad (7)$$

Where SV_{RRP} is annual social benefits of RRP intervention and EM_{RRP} is employment value of *RRP* intervention. C_{RRP} is net annual uniform cost (operational & overhead expenses) of *RRP* intervention, n is the life time of the project and *r* is the annual discount rate. Also K_{RRP} is the annual working capital cost (operational and maintenance costs).

Data

Some data such as water price in the study area, production price and agricultural production quantity are collected by questioners from local beneficiaries in the village, some data such as soil and carbon sequestration properties are collected from baseline studies, some data such as budget of projects (the allocated budgets) are collected form provincial project team. As it was mentioned before, the required data for doing this impact study were collected from different sources. First of all, those data that could be extracted from existing reports (base line study, the filled questioners by the *MENARID* team), field visit, were organized.

RESULTS

In this section, calculation of the environmental, economic and social benefits of the *RRP* practice will be explained. Benefit-cost analysis (financial, economic and social) of the projects would be presented in the last section.

Evaluation of ecosystem and socio-economic benefits of the RRP

In total, this practice (rangelands rehabilitation measures) has been implemented in 12 ha of rangelands. Its environmental functions includes: water conservation and "increasing water infiltration", and as a result, "increasing ground water recharge" plus "reducing flood hazard" plus "soil erosion control" and on the other hand, improving natural vegetation cover and as a result, more "Carbon & CO_2 sequestration" plus "biodiversity value" which their values will be explained in below.

Increasing ground water recharge and reducing surface runoff (flood hazard control):

Before explaining the calculation methodology, it is necessary to mention that:

- Based on the baseline survey, canopy cover of rangelands was 14.5% that it should be improved by 20% and to become 34.5%
- Soil characteristics (such as surface texture, infiltration rate and drainage condition) of the area has been assessed in medium rate and its infiltration rate is varying 3.81 to 7.62 millimeters (mm) per hours.
- After seeding and planting measures, vegetation cover condition has been changed from poor to moderate and *SCS – CN* (Curve Number) reduced from 79 to 69 therefore surface runoff from rehabilitated rangelands has been decreased (because of more infiltration rate).

Calculation of monetary value of ground water recharge

First of all, it is necessary to determine change in surface runoff depth after seeding and sowing measures:

$$Q=\frac{(P-0.2S)^2}{P+0.8S}$$

[1] *Although in economic and project evaluations literature, employment of installing projects is a cost item, but in social evaluations, this item is social benefit because of income development of farmer. For accurate evaluations benefits in comparison of cost, we subtracted employment benefits from social benefit (see equation 7).*

Where, Q is surface runoff depth (in inch), P is Precipitation depth (in inch), S is the maximum potential retention (after runoff begins). The equation [$S= 2540/CN - 25.4$] are used for calculation of S.

It was mentioned that after implementation of *RRP, CN* of the rangeland would be changed from 79 to 69. Therefore, S_1 (before the project) and S_2 (after the project) would be calculated as:

$S_1(CN=79)=(2540/79)-25.4= 6.75$

$S_2(CN=69)=(2540/796925.4=11.41$

Since change in the runoff depth is important so for simplifying the calculation, it could be assumed that precipitation depth *(P)* is equal to 1 inch.

$$Q_1 = \frac{(1-0.2\times 6.75)^2}{1+0.8\times 6.75} = 0.16$$

$$Q_2 = \frac{(1-0.2\times 11.41)^2}{1+0.8\times 11.41} = 0.02$$

$$Q_1 - Q_2 = 0.14$$

It means because of Rangelands rehabilitation measures; runoff depth would be decreased about 0.14 inches. This runoff depth is equal to 0.364 cm (36.4×10^{-4} m). On the other hand, decrease in runoff depth means increase in ground water recharge in rate of 36.4×10^{-4} m per unit area of ground surface. By considering 12 ha of rangelands under *RRP* measures (equal to 120000 m^2) in total 436.8 m3 of water would be infiltrated in ground water. This volume of water is equal to 436800 liters. Since discharge of the village *Qanat* is about 17 lit/sec so infiltration time becomes 25694.1 seconds (equal to 7.14 hours).

Monetary value of this function in case that unit price of irrigation water as 250000 IRR, it would be 1784300 IRR and unit price of irrigation water as 300000 IRR, it would be 2191200 IRR.

The function of reducing in soil erosion rate

Soil erosion causes sedimentation problems in downstream. In this section change in sediment yield as an indicator for evaluation of impact of *RRP* on soil erosion control, would be determined. Based on the MPSIAC model, sediment yield could be estimated by the following equation:

$Q_S=18.6\, e^{0.0353R}$

Where Qs is sediment yield (cubic meter of sediment in each square kilometer of rangelands) and R is degree of sedimentation which will be derived from 9 causative factors (sum of their scores).

For calculating changes in Qs (or ΔQs), it is necessary to calculate changes in R (or ΔR), before and after implementation of *RRP*. It is necessary to mention that among 9 causative factors of soil erosion, only runoff factor (Y_4), Land cover factor (Y_6) and Land use factor (Y_7) could be change therefore it would be as:

$Y_4=0.2\ X_4$ *(Runoff)*

$X_4=$*Runoff depth (mm)* $\times\ 0.03$

$Y_6=0.2\ X_6$ *(Land cover)*

$X_6=$*Area percentage of bare lands*

$Y_7=20 - 0.2\ X_7$ *(Land use)*

$X_7=$*Canopy cover percentage*

For determining of ΔR, it is necessary to determine ΔY_4, ΔY_6 and ΔY_7.

First:

$\Delta Y4=0.2\ \Delta X4$

Where, ΔX_4 is Runoff depth (mm) × 0.03. Then,

$\Delta Y_4=0.2\ [364mm\times 0.03]=0.22$

Second:

$\Delta Y_6=0.2\ \Delta X_6$

Where ΔX_6 is percentage of bare lands before the project minus percentage of bare lands after the project. Based on the baseline survey, canopy cover was 14.5% therefore percentage of bare lands before the project becomes:

100 – 14.5=85.5%

The target of the *RRP* is improving the natural vegetation cover to 34.5% so its percentage of bare lands after the project becomes:

100 – 34.5=65.5%

Then,

$\Delta X_6=85.5 - 65.5=20\%$

$\Delta Y_6=0.2\times\ 0.2=0.04$

Third: $\Delta Y_7=20 - 0.2\ \Delta X_7$

Where, ΔX_7 is primary canopy cover percentage minus secondary canopy cover percentage. Then,

$\Delta X_7=14.5 - 34.5=-20\%$

$\Delta Y_7=- 0.2\times(-20\%) +\ 0.04$

Finally,

$\Delta R=\Delta Y_4 + \Delta Y_6 + \Delta Y_7=0.22 + 0.04 + 0.04=0.3$

Now sediment yield changes could be estimated.

$$\Delta Q_s = 18.6\, e^{0.0353\Delta R}$$

$$\Delta Q_s = 18.8\, \mathrm{m}^3/\mathrm{km}^2$$

It means in each 100 ha, 18.8 m^3 of the sediment would be decreased. Therefore, in the rehabilitated rangelands (with area of 12 ha), about 2.26 m^3 of the sediments would be decreased.

Monetary value of this function would be evaluated based on cost of cleaning of the reservoir pool. Since each year about 2.26 cubic meters of the sediments would be decreased and its cleaning cost is equal to wage of one day labor so reduce in sediment yield worth equal to one day labor wage which is about 350000 to 400000 IRR [2].

The function of increase in carbon sequestration

To evaluate the monetary value of carbon sequestration the equation 2.9 could be used.

In Kamkooyeh area, in each 1153.9 ha of rangelands, 112652.7 Kg of carbon could be sequestrated per year. In other words, in this region, in each hectare of rangelands, 97.7 Kg (equal to 0.098 ton) of carbon could be sequestrated. Based on European Union records in year 2014, Tax for carbon emission is about 20 Euros per ton. Since increased canopy cover is about 20% so it could be calculated as:

0.098 ton × 12 ha × 20% × (20€ × 43000 IRR)=202272IRR

(In the above equation, 43000 is exchange rate of Euro and IRR in year 2014)

Therefore, the monetary value of carbon sequestration in 12 hectares of rehabilitated rangelands would about 202300 IRR.

Economic benefits of RRP

This value would be calculated based on valuing added dried forage. Canopy cover of natural vegetation was 14.5% before the project and its produced dried forage in hectare was 193 Kg. The objective of implementation of RRP is improving canopy cover in such a way to reach 35.5% (it means 20% increase in canopy cover percentage) therefore, in each hectare of rangelands, 38.6 Kg of dried forage would be increased:

193 Kg/ha × 20%=38.6 Kg

Therefore, in total 12 hectares of the rehabilitated rangelands, 463.2 Kg of dried forage would be increased.

By considering unit price of dried forage in the region is about 9000 IRR in year 2013 so added monetary value in this part would be calculated as:

463.2 Kg × 9000 IRR=4168800 IRR

Therefore, after seeding and plantation measures in 12 hectares of rangelands, in total 463.2 Kg more dried forage would be produced which its value is about 4168800 IRR.

The employment value of RRP

In seeding and plantation measures RRP, one person with annual wage of 3500000 IRR and 9 labors (man/day) with wage of 400000 IRR have been worked so 7100000 IRR is its employment benefits.

9 days × 400000 IRR/day=3600000 IRR

1 person × 3500000 IRR/year=3500000 IRR

3600000 + 3500000=7100000 IRR

Social benefit of RRP.

Calculation of acceptance rate of the project

It was supposed that RRP implemented at 90 hectares of rangelands but in practice only 12 hectares of it has been implemented. Therefore its acceptance rate is as:

Acceptance rate=12 / 90=0.133

By considering the average income of the villagers as 41910000 IRR and assuming that after implementation of the MENARID project, the average income of the villagers could reach to the average income of Yazd province (110312101 IRR) or the average income of the country (101281362 IRR) then the monetary value of participation of the villagers would be determined as:

Based on the records of the Central Bank of Iran and also Center for Census data of Iran in year 2012:

- average monthly income of rural households at national level=101281362 IRR
- average monthly income of rural households at Yazd province=110312101 IRR

[2] *Each euro is equivalent to 43,000 IRR.*

A1- by considering national level: *101281362 / 4191000 × 0.133=0.35*

A2- by considering Yazd province level: *110312101/41910000 × 0.133=0.32*

It means the coefficient of added benefits, in the case that average monthly income of rural households at Yazd province is the target, would be 0.35 and in the case that average monthly income of rural households at national level is the target, would be 0.32.

Therefore, by considering the above mentioned rates, social benefits would be increased because of people participation in this activity and also improved social capital. The summary of the results of Eco systemic, economic and social benefits of *RRP* is shown in the Table 1.

Benefit-cost analysis of *RRP*

For calculation of benefit-cost of the implemented projects, equation 7 has been used. In this section both financial and social Benefit-cost analysis has been done.

Before benefit-cost analysis, implantation cost of the project including GEF, UNDP, Iran's Government, MENARID and Local Community Costs (Budgets) has been shown in Table 2.

Financial benefit-cost analysis

In this section only financial and economic benefits of the RRP has been considered. It means financial benefits of RRP in comparison to their costs would be analyzed. If lifetime of the projects considered as 20 years and annual discount rate assumed to be 12 percent, annual uniform cost of *RRP* has been presented in Table 3. In this table it is assumed that annual cost (current cost) of the project to be equal 30 percent of their financial and economic benefits. As it is clear in the Table 3, benefit-Cost ratio of RRP is less than 1 (about 0.97) and therefore financially (economically) is not acceptable.

Its sensitivity analysis for change in discount rate as 11 and 13 percent has been done which the result shows 1 percent increase in discount rate, benefit-cost ratio will be decreased to 0.92 and 1 percent decrease in discount rate, benefit-cost ratio will be increased to 0.1.01.

Social benefit-cost analysis

In this section only social benefit of the RRP has been considered. It means social benefits of RRP in comparison to their costs would be analyzed. If lifetime of the projects considered as 20 years and annual discount rate assumed to be 12 percent, annual uniform cost of RRP has been presented in Table 3. In this table it is assumed that annual cost (current cost) of the project to be equal 30 percent of their social benefits. As it is clear in the Table 3, in benefit-cost ratio of RRP is more than 1 (2.15) and therefore economically and socially are acceptable which is very impressive.

Its sensitivity analysis for change in discount rate as 11 and 13 percent has been done which the result shows 1 percent increase in discount rate, benefit-cost ratio will be decreased to 2.10

Table 1: Benefits of Rangelands rehabilitation Project (RRP) (10000 IRR)

Benefits	Water	Unit Price	Average
	25	30	
Ground Water Recharge	178.4	219.1	198.8
Decrease in Soil Erosion	40		40
Increased in Carbon Sequestration	20.2		20.2
Economic Values	416.9		416.9
Employment Creation Values	710.0		710.0
Ecosystem Benefits	238.7	279.4	259.0
Social Benefits (without considering participation values)	1365.5	1406.2	1385.9
Social Benefits (with considering participation values based on Yazd province condition)	1802.5	1856.2	1829.4
Social Benefits (with considering participation values based on Iran condition)	1843.5	1898.4	1870.9
Total average			**1850.2**

Table 2: Operational and overhead expenses in the Kamkooyeh village (GEF, Government of Iran & UNDP) in 10000 IRR

Stakeholders	Expenses type		Level	Operational and overhead
GEF	Official	Management	National	100
			Provincial	14
		Official & Equipment	National	2
			Provincial	2
	Travel		National	DW
			Provincial	160
	Capacity	Meetings & workshops	National	-
	building		Provincial	InC
		Consultancy service	National	-
Government of Iran	Operational		Provincial	600
			Provincial	-
	Official	Management	National	20
			Provincial	180
	Operational	Official & Equipment	National	4
Local Community			Provincial	8
			Provincial	1200
	Operational		Cash	-
Total			In Kind	L1
				2290

DW: Distance Work
InC: Included in consultancy expenses
L1: 11 ha of seedling and mass plantation

and 1 percent decrease in discount rate, benefit-cost ratio will be increased to 2.20.

DISCUSSION AND RECOMMENDATIONS

According to the findings from calculations, the followings recommendations are proposed for better implementation of the projects:

I. In arid and semi-arid region which are facing with water shortage issue, flood hazard and soil erosion, using rangeland rehabilitation could improve water conservation and increasing water infiltration", and as a result, "increasing ground water recharge" plus "reducing flood hazard" plus "soil erosion control" (because of low runoff in hilly landscapes) and on the other hand, improving natural vegetation cover and as a result, more "Carbon & CO_2 sequestration" plus "biodiversity value" plus "soil erosion control" (because of existing a better protection cover for the top soil by the improved canopy and finally could have significant impact on socioeconomic condition of villagers.

II. Absolute attention to aspects of the economic benefit and sectoral viewpoint is a serious threat for the success of the projects. As the results show, socio-economic evaluation can lead to better and more accurate evaluation of the project impacts. Hence, integrated planning is more effective and efficient tool in design and implementation of the projects.

III. There is a risk that MENARID team are being more involved in the details of the implemented projects (hardware work) and paperwork so there is less attention to software works (in-

Table 3: Summary of benefit, cost and B/C ratio of RRP intervention

Type of Evaluation	Benefits (in 10000 IRR)	Cost (in 10000 IRR)	Annual uniform cost (in 10000 IRR)			B/C		
			Discount Rate			Discount Rate		
			12%	13%	11%	12	13	11
Financial	416.9	2290	431.6	451.1	412.6	0.97	0.92	1.01
Social	1850.2	2290	861.6	881.1	842.6	2.15	2.10	2.20

stitutional coherence and strengthening to achieve the goals of INRM).

IV. Integrated management/planning should provide a full coordination among all stakeholders. In some cases, there is a lack of coordination among the key stakeholders. As an example, in the project of irrigation water supply, the responsibilities of MENARID team have been well-fulfilled, however, those responsibilities by the local government and the villagers remains to be accomplished. As a result, during the field visit it was observed that the pipeline system was not under operation.

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