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The Role of Solar Energy in Reducing Pasture Degradation in Iran: Case of Carbon Sequestration Project

SEYED JAMAL F. HOSSEINI[1] and ZAHRA SOLTANI[2]

[1]Department of Agricultural Extension and Education, Science and Research Branch, Islamic Azad University, Tehran, (Iran).
[2]Islamic Azad University, Birjand Branch, Birjand, (Iran).

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ABSTRACT

The main purpose of this study was to examine the perception of pasture owners about the role of solar energy in reducing degradation of pastures in South Khorasan Province of Iran. The research design was carried out by descriptive and analytical methods. The total population of this study was 340 respondents who participated in carbon sequestration project in arid region of province. The data collected by using questionnaire and 310 respondents returned the questionnaires. Results of stepwise multiple regression showed that 31% of the variance in perception of respondents about the role of solar energy in protecting pastures could be explained by variables of their knowledge about importance of pastures, interests about solar energy and satisfaction about solar energy.

Key words: Solar Energy, Iran, Pasture, Rangeland.

INTRODUCTION

Natural resources have an important status in social and economic development of the world. Unfortunately, in many countries especially in developing countries, increasing population, rapid urbanization, lack of knowledge about importance of natural resources along with inappropriate planning resulted in rapid degradation of forests and rangelands.

Iran is no exception and based on the latest statistics in every second about 300 square meters of forests and 400 square meters of rangelands are destroyed in Iran and annually this is accounted for destruction of about one million hectare of rangelands.

Several factors contribute to the destruction of rangelands and among them are irregular grazing, overgrazing, rapid urbanization and industrialization, converting the rangelands to farming lands and lack of knowledge and training about appropriate use of rangelands[1].

Human being has caused much of destruction of rangelands and policymakers have realized that they should look for ways to involve local population in protecting and revitalizing of natural resources.

Utilization of pastures for cooking and heating is considered as one of the main causes of rangeland degradation in some parts of the world where energy is not easily available. The status of rural household energy consumption plays an important role in farmers' daily life, especially in developing countries or regions[2].

Rural energy is generally recognized as an important element of rural socio-economic development, not as an end in itself, but through the demand for the services made possible through energy inputs, such as potable water pumping,

extension of the day by lighting and cooking. As a general trend, an increasing energy demand - both in quantity and quality - is highly correlated with socio-economic development. Yet, the rural populations of many developing countries have been excluded from most of the benefits of economic development and the transition to better (quality) energy services[3].

Renewable energy is considered to be the basis for sustainable energy supply systems. Population growth, key incidents and movements in the development of sustainable energy technology, different available forms of renewable energies and today's economic crisis have led to introduction of renewable energy as a clean option that can have major rule in our common future[4].

The major advantages of the renewable energy technologies at the moment include the simplicity of the technologies, ease of maintenance as well as their enhanced environmental friendliness over fossil fuel system[5].

However, the development of renewable energy in rural areas faces several challenges such as slow adoption; lack of research and development; lack of awareness, slow dissemination of information; inadequate policy, poor integration of renewable energy in development plans and inadequate commitment by[6].

Solar energy is diffused in many parts of the world with the ambition to improve the situation in rural areas. Solar energy as a renewable energy source is considered as an important alternative options for farmers. In many developing countries, solar energy has the potential to improve the living conditions of rural households and contribute to the country's future energy security[7].

Particularly in rural areas, solar related technologies represent viable small-scale sources of renewable energy. Photovoltaic systems are portable, increasingly affordable and require minimal maintenance. Photovoltaic systems may be used by an individual households or may be linked together to form a grid with sufficient energy production to power an entire community[8].

India like many developing countries, at the household level, traditional burning of biomass or use of inefficient technologies for domestic applications like lighting is common, triggering concerns related to fuel or technology switching. In Uttam Urja, it focuses on opportunities to promote cleaner energy options through delivering improved energy efficiency[9].

Bangladesh is another example. experiencing a gradual shift towards exploring renewable energy resources as a driving force for rural development. A few public sector and non-government organizations have started to develop renewable energy technology (RET) projects in rural areas. The lessons learnt from different demonstrations of RET projects reveal that with careful forward planning renewable energy can provide far-reaching economic, environmental, and social benefits to people living in remote rural areas in Bangladesh[10].

The use of solar photovoltaic systems of 25 W^p to 50 W^p (frequently called solar home systems, or SHSs) has been spreading fast in the rural areas of Sri Lanka as a source of energy. The large-scale penetration of solar home systems in Sri Lanka has helped rural communities both in terms of improved socio-economic conditions and reduced adverse environmental impacts, contrary to the belief that the financial burden of such systems imposed on the families outweighs the benefits[11].

Sambo pointed out that one of the main barriers in adopting the renewable energy in Nigeria was lack of awareness of potential alternatives in energy resources[5].

Ali Mirzaee in a study about localization of new energies concluded that informing rural population about benefits of new energies would accelerate the speed of adoption in rural areas of Iran[12].

Although research and development activities are still being seriously undertaken in various aspects of renewable energy utilization, a number of the technologies have since been shown to be feasible and ready for adoption[5].

The average annual solar radiation in Iran due to special geographical location is 5 kilowatt hours per day and this figure compared with other countries is very significant. Therefore, using solar energy in different parts of the country, especially in the desert regions could be an efficient energy option.

In 2003, government of Iran with cooperation of UNDP and Global Environmental Fund started the carbon sequestration project in Hussain Abad region of South Khorasan Province near the border with Afghanistan.

The project area is about 144000 hectares and the goal of project is to reduce degradation of pastures by promoting solar energy through a participatory process

This project through the mobilization of local communities will strengthen the community, social, human, financial, and natural/environmental conditions of the region. An important component of this project is to promote the utilization of solar energy in order to overcome the problem of pasture degradation.

It is expected after the completion of project more than 9000 hectares of degraded pastures through participatory and capacity building phase would be revitalized.

In first phase of project in 2003-2004, a rapid appraisal was done to identify plants grow in the pasture areas of the region. Five varieties of Haloxylon Persicum, Atriplex Canescens, Artemimsia Seiberi, Iris Reticulate and Dorema Ammoniacum was identified and so far more than one and half million sapling was planted in the degraded pasture areas.

The paper examines the perception of pasture owners about the role of solar energy in protecting the rangelands in South Khorasan Province of Iran. The findings would highlight the strategies for policymakers to support promotion of solar energy in rural settings of Iran.

MATERIAL AND METHODS

The methodology used in this study involved a combination of descriptive and quantitative research and included the use of correlation, regression and descriptive analysis as data processing methods. The total population for this study was 310 residents of Hussain Abad who used solar energy for heating purposes. Data were collected through interview schedules.

A series of in-depth interviews were conducted with some senior experts in the Department of Energy in South Khorasan Province to examine the validity of questionnaire. A questionnaire was developed based on these interviews and relevant literature. The questionnaire included both open-ended and fixed-choice questions. The open-ended questions were used to gather information not covered by the fixed-choice questions and to encourage participants to provide feedback.

Measuring residents' attitudes towards solar energy has been achieved largely though structured questionnaire surveys. The final questionnaire was divided into several sections. The first section was designed to gather information about personal characteristics of respondents. The second section was designed to measure the attitudes of respondents about the role of carbon sequestration project in protecting the pastures. The respondents were asked to indicate their agreements by marking their response on a five point Likert-type scale. The next section explored the impact of solar energy on preventing the degradation of pastures and respondents were asked to indicate their opinion in a 5-point Likert format with responses from 1—completely disagree to 5—completely agree. Further section dealt with questions about satisfaction about solar energy. The last section was about knowledge regarding the benefits of solar energy. The variables and their measurement scale are presented in Table 1.

Content and face validity were established by a panel of experts consisting of faculty members at Islamic Azad University, Science and Research Branch and some specialists in the Department of Energy in South Khorasan Province. Minor wording and structuring of the instrument were made based on the recommendation of the panel of experts.

A pilot study was conducted with 25 persons who had not been interviewed before the earlier exercise of determining the reliability of the questionnaire for the study. Computed Cronbach's Alpha score was 75.0%, which indicated that the questionnaire was reliable.

Dependent variable in the study included role of solar energy in protecting pastures which were measured by perception of respondents about the impact of solar energy. The independent variables in this research study were the knowledge of respondents about benefits of solar energy, interests of respondents about solar energy, knowledge of respondents about carbon sequestration project, age, educational level, and satisfaction about solar energy. For measurement of correlation between the independent variables and the dependent variable correlation coefficients have been utilized and include spearman test of independence.

RESULTS

The results of descriptive statistics indicated that the 208 respondents were male and 102 were females with average age of 36 years old and more than 44 percent were illiterate. More than half of respondents indicated that their main occupation was farming.

In order to finding the perception of respondents about their attitudes about carbon sequestration project, they were asked to express their views. Table 3 displays the respondents' means about the three statements. As can be seen the highest mean number refers to the role of the project in protecting pastures (mean= 4.47) and lowest mean number refer to knowledge about benefits of solar energy before implementing project (mean=2.01).

Table 4 shows the means of respondents' views about the satisfaction with using solar energy and interested in using solar energy in the future. As can be seen from this table, respondents were very much satisfied with using solar energy (mean=4.39) and very much interested in using solar energy in the future (mean=4.58).

In order to finding the means of respondent's view about factors influencing them to adopt solar energy, respondents were asked to express their views (table 5). As can be seen the highest mean number refers to interests of respondents about natural resources (mean=4.28) and lowest mean number refers to the role of relatives in persuading them to adopt solar energy (mean=3.04).

Spearman coefficient was employed for measurement of relationships between independent variables and dependent variable. Table 6 displays the results which show that there were relationship between perception of respondents about role of solar energy in protecting pastures as dependent variable and independent variables

Table 7 shows the result for regression analysis by stepwise method. Independent variables that were significantly related to perception of respondents about role of solar energy in protecting

Table 1: Variables and their measurement scale

Variables	Measurement Scale
Attitudes about carbon sequestration project	Five-point Likert
Impact of solar energy	Five- point Likert
Satisfaction about solar energy	Five- point Likert
Knowledge about solar energy benefits	Five- point Likert
Martial Status	Categorial
Age	Categorial
Educational Level	Categorial
Occupation	Categorial

Table 2: Demographic profile of respondents

Demographic Variables	Number	Percentage (%), n =310
Age (years)		
Less than 20	19	6.1
20-26	56	18.1
27-33	79	25.5
34-40	46	14.8
36-40	12	10.3
41-47	47	15.2
48-54	26	8.4
55-61	16	5.2
more than 61	21	6.8
Mean= 36 years		
Education		
Illiterate	137	44.2
Elementary	116	37.4
Secondary	40	12.9
High School	8	2.6
Diploma	9	2.9
Professional	7	6.1
Bachelors	3	2.6
Occupation		
Livestock owner	104	33.5
Farmers	167	53.9
Others	39	12.6

Table 3: Means of Respondents' Views about the carbon sequestration project and its role in protecting pastures (1=very little; 5=very much).

Statement	Mean
Role of project in protecting pastures	4.44
Knowledge about benefits of solar energy before project implementation	2.01
Knowledge about benefits of Solar Energy after implementing project	4.23

Table 4: Means of Respondents' Views about satisfaction with solar energy and tendency toward using it (1=very little; 5=very much).

Statement	Mean
Satisfaction with using solar energy	4.39
Interested in using solar energy in future	4.58

Table 5: Means of respondents' views about factors influencing them to adopt solar energy (1=Very Little; 5=Very Much)

Statement	Mean and Standard Deviation	
	Mean	SD
Interested in protecting natural resources	4.28	0.846
Recommendation of natural resources experts	4.28	0.716
Accessibility of solar energy	3.93	1.090
Relatives/Friends	3.04	1.465

Table 6: Correlation measures between independent variables and role of solar energy in protecting pastures

Independent variables	Dependent variable	r	
Age	Role of solar energy in protecting pastures	0.062	0.106
Educational level	Role of solar energy in protecting pastures	0.099	0.094
Knowledge about benefits of solar energy	Role of solar energy in protecting pastures	0.000	0.235**
Interested about solar energy	Role of solar energy in protecting pastures	0.000	0.340**
Knowledge about carbon sequestration	Role of solar energy in protecting pastures	0.000	0.206**
Satisfaction about solar energy	Role of solar energy in protecting pastures	0.000	0.198**

**p<0.01.

Table 7: Multivariate Regression Analysis (Role of solar energy in protecting pastures as dependent variable)

	B	Beta	T	Sig.
Constant	0.529	-	1.570	0.117
Knowledge about benefits of solar energy	0.345	0.330	6.451	0.000
Interested about solar energy	0.338	0.291	6.103	0.000
Satisfaction about solar energy	0.222	0.215	4.244	0.000

R^2=.0.31

$Y=0.330x_1+0.291x_2+0/215x_3$

pastures were entered. The result indicates that 31% of the variance in the perception of respondents about role of solar energy in protecting pastures could be explained by the knowledge about benefits of solar energy, interested about solar energy and satisfaction with solar energy.

DISCUSSION

The perception of respondents about the role of solar energy in protecting pastures was discussed in this article. As the regression analysis showed, the knowledge about benefits of solar

energy, interested about solar energy and satisfaction about solar energy caused 31% of variance on the perception of respondents regarding the role of solar energy in protecting pastures. This result is consistent with Ali Mirzaeei conclusion in which knowledge about benefits of solar energy have impact on adopting this type of energy[12].

Based on the results of the mean score, respondents indicated that the main factor influencing them to adopt the solar energy was their interests about natural resources. Wijayatunga and Attalage indicated that adoption of solar energy in Sri Lanka resulted in improving natural resources and reducing the environmental destruction[11].

The results also show that authorities should explore ways to increase the participation of the rural population in planning, implementing and evaluation of solar energy. The lack of support from respondents may hinder the progress in the sustainability of solar energy. In Bangladesh, participation of rural population through non governmental organizations has developed renewable energy technology and this has resulted economic, environmental and social benefits in rural areas[10].

The results demonstrated that success of solar energy will depend on the informing population about benefits, and in this regard the authorities should provide accurate and on time information.

There is no single and appropriate intervention for developing and protecting solar energy in rural areas and in view of the numerous and varied constraints and opportunities, there is need to develop location- specific strategies.

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