Available at www.sciencedirect.com

INFORMATION PROCESSING IN AGRICULTURE XXX (2017) XXX–XXX

journal homepage: www.elsevier.com/locate/inpa

Implementing conceptual model using renewable energies in rural area of Iran

Mehdi Karami Dehkordi [a,*], *Hossein Kohestani* [a], *Hossein Yadavar* [a], *Ramin Roshandel* [b], *Mostafa Karbasioun* [c]

[a] *Department of Extension and Rural Development Engineering, Faculty of Agriculture, University of Shahrekord, Iran*
[b] *Department of Energy Engineering, Sharif University of Technology, Iran*
[c] *Rural Development and Extension Department, Shahrekord University, Iran*

A R T I C L E I N F O

Article history:
Received 30 July 2016
Accepted 28 February 2017
Available online xxxx

Keywords:
Iran
Conceptual model
Renewable energy
Rural area

A B S T R A C T

In a glance, more than three billion people live in the rural areas of low and middle income countries. In most cases, rural households have many unmet energy needs including cooking, lighting, heating, transportation and telecommunication needs. The main goal of this study is Implementing Conceptual Model Using Renewable Energies in Rural Area of Iran. In this study, the Weibull and Angestrom distribution methods were used to assess the potential of wind and solar energy range in Chaharmahal va Bakhtiari province of Iran (The Case study). After determining the values calculated based on meteorological stations' data, the IDW interpolation method in GIS software was used for the entire geographic range of the province. After reviewing multiple regions and identifying potential classes, a village which has the potential to be enough sun and wind energy was selected (Kahkesh village) and then a field survey based on biomass resources was accomplished. The needs of rural residents and rural renewable energy potential was evaluated by study conceptual frameworks during one year. By dividing the value of frameworks energies the amount of energy saving can be calculated. Finally, it recommended that for utilizing the renewable energies in rural areas, as will be discussed in the present work and particularly using the conceptual frameworks, is performed.

1. Introduction

In many parts of the world, lack of access to modern energy services continues to impede sustainable development. Recent assessments suggest that about 1.3 billion people still do not have access to electricity [1], and more than 2.6 billion people rely on traditional biomass for cooking and heating [2]. Research accentuates that during 2013, people in remote and rural areas of the world (more than 47% of the world population) have lived in the rural regions [3]. Nowadays, global energy systems are highly reliant on fossil fuels. However, in spite of strong economic development emanating from the energy system in the last century, fossil fuel depletion, environmental damage and territorial imbalances [4] have led to a global shift toward clean energy (5). In order to improve access to electricity, modern cooking, heating and cooling along with installation and the use of distributed renewable energy technologies have significantly increased.

* Corresponding author. Fax: +98 41133345332.
E-mail address: karami596@yahoo.com (M. Karami Dehkordi).
Peer review under responsibility of China Agricultural University.
http://dx.doi.org/10.1016/j.inpa.2017.02.003
2214-3173 © 2017 China Agricultural University. Publishing services by Elsevier B.V.

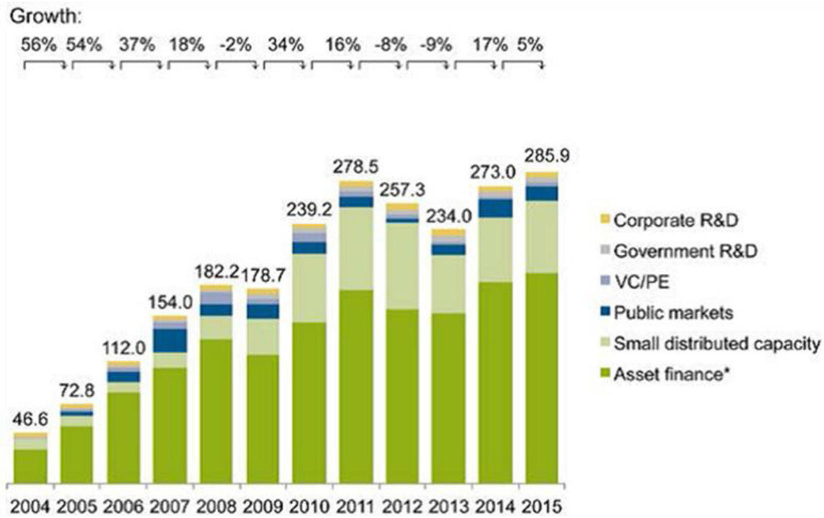

Fig. 1 – Total global new investment in renewable energy (2004–15) [8].

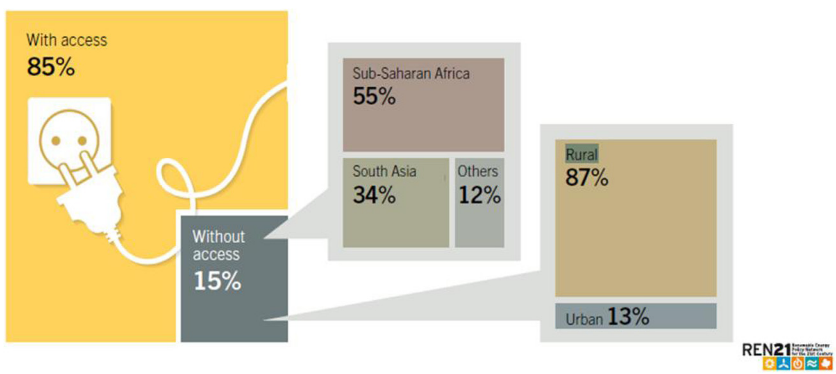

Fig. 2 – World Electricity Access and Lack of Access report by Region, 2012 [13].

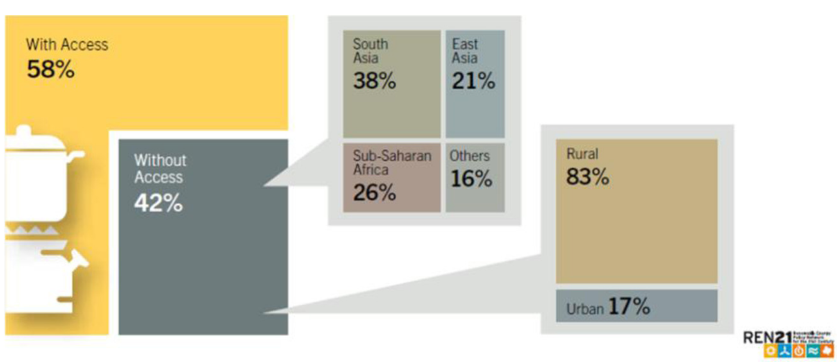

Fig. 3 – World Clean Cooking Access and Lack of Access report by Region, 2012 [13].

This expansion was a direct consequence of improvements in affordability, inclusion of distributed energy in national energy policies, greater access to financing, increased knowledge about local resources, and more advanced technologies that can be tailored to meet customers' specific needs [6].

As Fig. 1 shows, the total new global investments in renewable energy increased from $46.6 billion in 2004 to $285.9 billion in 2015 (Fig. 1). According to the International Energy Agency [7] the utilization of renewable energy will triple between 2008 and 2035. Also, it is anticipated that the share in renewable electricity production in the Middle Eastern regions the heart of the world's fossil fuel reserve will amount to 16% in 2035 [7].

According to TAVANIR, about 5.5% of households in villages in Iran's rural areas with less than 20 households still do not have electricity [9]. Also, the average annual cost of energy for rural households and its share in total household expenditure is higher than in urban households [10]. How-

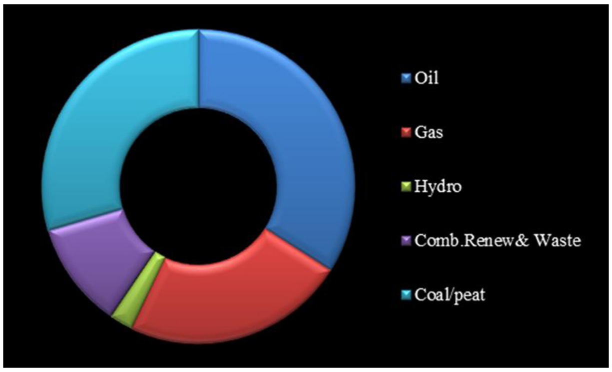

Fig. 4 – Iran energy mix scenario.

ever, it seems that unsuitable access to energy resources and its destructive impacts have inevitably led to some negative consequences; such as deforestation, soil erosion, low soil productivity, the increasing emission of green house gas and the spread of various human diseases due to traditional energy systems [5].

In the following, in order to more clearly from the subject, is paid to (i) energy consumption, (ii) current situation of energy in Iran and (iii) and a summery of background with a focus on renewable energy in Iran and rural area.

2. Energy consumption

Today, the energy of the world is mostly provided by different kinds of fossil fuels like coal, oil and natural gas [11,12]. Around 66% of required electricity of the world is generated by fossil fuel utilization. For example, Iranian economy strongly relies on crude oil export and obviously oil price fluctuations significantly impact on country's development [3]. According to the most recent available data (as of early 2015), approximately 1 billion people, or 15% of the global population, still lack any access to an electricity grid. Approximately 2.9 billion people lack access to clean forms of cooking. As it is illustrated, the people live without electricity and clean cooking options are scattered around the world (Figs. 2 and 3).

Unluckily, lack of electricity and clean cooking solutions still remains basically a rural issue. Confirming this fact is the presence of 941 millions in rural areas compared to 139 million inhabitants in urban areas, without any means of electricity. Similarly, there are 2.4 billion villagers in comparison with about 400 million citizens lacking clean cooking. Nonetheless, the raw numbers portray little about emerging trends. While figures look bleak, the situation of electrification is improving. Supporting this claim, it has been reported that from 1990 to 2012, the global electrification rate climbed from 75% to 85% (Figs. 2 and 3) [6,13].

Fossil energy carriers provide more than 97% of the energy in Iran (14). The country suffers from undesirable levels energy consumption. As far as energy systems are concerned, even goal- oriented subsidies and increasing energy carriers' prices have not motivated a reduction in energy consumption. According to the Majlis (Iranian Parliament) Research Center [14], both targeted subsidies and rising energy prices have not had significant influence in reducing energy consumption in either urban or rural areas. he amount of energy consumption in Iran is so unbridled that per capita energy consumption in the country is 68% higher than the global average consumption; i.e. fourteen times higher than Japan, five times higher than India and Pakistan [9]. Iran is ranked 13th in the world with regard to the average annual energy consumption which equals to 155 million tons of crude oil [15]. Given that the annual electricity consumption increases over 10% in Iran, this is an undeniable necessity to pay attention to "energy portfolio" in order to promote energy security. According to Tavanir Company, a total of 205.951 million kW h of electricity was consumed in Iran in 2014 [9].

3. Current situation of energy in Iran

Iran is an energy superpower, which has the fourth largest oil reserves and the second largest natural gas reserves in the world [16,17]. Already today, Iran faces high level of domestic

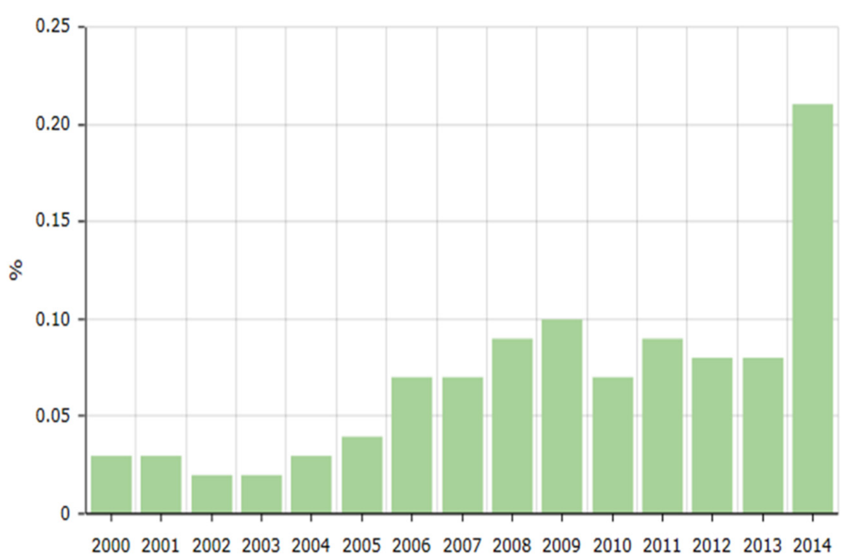

Fig. 5 – Share of wind and solar in electricity production in Iran [22].

Please cite this article in press as: Karami Dehkordi M et al. Implementing conceptual model using renewable energies in rural area of Iran. Info Proc Agri (2017), http://dx.doi.org/10.1016/j.inpa.2017.02.003

Fig. 6 – Countries share of wind and solar in electricity production in the world (lowest ten and highest ten) [23].

Table 1 – Completed of solar PV in rural areas in Iran [25].

No.	Province	Completed
1	East Azerbaijan	70
2	Ardebil	32
3	Boshehr	19
4	Chaharmahal Va Bakhtiari	48
5	Lorestan	101
6	South Khorasan	30
7	Khuzestan	70
8	Zanjan	78
9	Semnan	29
10	Quazvin	39
11	Kurdistan	25
12	Kermanshah	43
13	Fars	43
14	Kerman	18
15	Guilan	5
16	Mazandaran	24
Total		674 KW

consumption of natural gas. It has the third highest level of consumption of natural gas in the world, after the United States and Russia. The domestic consumption of natural gas in Iran is projected to grow by 7% yearly in the next decades, making Iran the largest natural gas consumer in the world [18]. Already today per capita energy consumption in Iran is fifteen times higher than in Japan and ten times higher than in the European Union. Energy intensity of Iran is three times higher than global average and two and a half times higher than the Middle-East average. The country is also the second largest gasoline consumer in the world following the United States [42].

Iran is one of the main non-renewable energy producers in the world due to its plentiful fossil fuel resources. Utilization of natural gas and petroleum in transportation and industrial sectors has been developed vastly in Iran because of their low prices [12]. After Venezuela, Saudi Arabia and Canada, Iran hold the fourth largest crude oil reserves in the world. Also, statistics show that Iran is the second largest natural gas reserve in the world [19]. Since Iran has plenty of fossil fuel resources, alternative fuel and renewable resources have not been taken into consideration seriously.

As the coal, oil and natural gas are non-renewable fossil fuels, the contribution of non-renewable fuels in the energy pattern of the world and Iran is about 81% and 99%, respectively. Despite of the existence of plenteous renewable energy resources, the contribution of renewable and sustainable energy in energy mix of Iran is less than 1%. As Fig. 4 shown the scenario of mix energy in Iran compared to the world in recent years [20].

Electricity demand in Iran has been reported to be 50,000 MW which is around 80% of what has been generated by the fossil fuel consumption. It has been projected that Iran's electricity demand will be 200,000 MW in 2030. Obviously, fossil fuel resources will not cover this percentage in 2030 [21]. This increasing trend of energy demand will be met by Iran by becoming the importer of energy in future and some new strategies should be taken into account by Iranian government in the case of energy mix(use of renewable energy).

Recently, transition to the renewable and sustainable energy resources has been accepted as a crucial factor in energy mix by Iranian Government and different programs for green energy development have been established by renewable energy organization of Iran. Fig. 5 shown the Share of wind and solar in electricity production in Iran and in Fig. 6 share of wind and solar in electricity production in the world top and down that Iran is the last country in the list of ten of the world in this field [22].

It is necessary to take into account Iran's approach to renewable energy at national, regional and strategic levels. In rural and especially in remote areas, the renewable energy development is inevitable because of unsuitable access to energy resources and its devastating consequences. The dispersion of villages, lack of access to suitable roads, the high price of fossil fuels compared to the villagers' income, and high costs of fuel transportation have resulted in an increasing consumption of wood, bushes, thorns and animal wastes [24].

Fortunately, as mentioned above, Iran has access to significant potential resources of renewable energy that could help provide sustainable energy in these regions as seen in the completed of Solar PV in rural areas in Iran in Table 1 [25]. Moreover, it seems that the development of renewable energy in rural areas in Iran is possible because the general policies and regulatory incentives support it [25].

Main policies for renewable energy in Iran are Supporting private sector for dissemination of renewable energy applications that areapproaching economic viability, Supporting manufacturers for transferring and localization of renewable energy technologies which are expected to become competitive in medium terms, e.g. PV systems. Supporting the research centers to expand the research programs for RE technologies that are becoming competitive in longer than 10 years period and providing sustainable and accessible energy to the poor and isolated areas. With regard to the implementation of these policies, regulatory incentives are provided by the government in Iran.

The main goal of this study is implementing the conceptual model using renewable energies in a rural area for the purpose of Energy Saving in Chaharmahal VA Bakhtiari province. The solar, wind and biomass energies were considered. To access this objective in the first, need to identify the optimal point (The point contains enough potential energy sources). The study is divided into two parts that in first part paid to identify multiple sources of energy consumption and annual energy needs (present situation). In the second part, the analysis of the recoverable energy (rational and justified) from renewable sources must be performed in the case study. Finally, the percentage of energy saving from conventional sources of energy is assessed by comparing the first and the second part of the study.

4. Background

Wijayatunga and Attalage found that the usage of biomass for cooking was rather independent of the level of electrification, while electricity usage was directly correlated to the household income level [26].

Ramachandra et al. performed a broad survey of 90 villages to study the regional and seasonal effects on energy use, but did not include space heating [27]. Reddy performed a comprehensive study measuring all energy use in six villages. Per capita energy use for each village ranged from 10,800 to 13,900 MJ cap_1 yr_1 (The following ranking was found for the various energy sources in order of average percentage contribution to the annual total energy requirement. firewood, 81.6%; human energy, 7.7%; animal energy, 2.7%; kerosene, 2.1%; electricity, 0.6% and all other sources, 5.3%.) [28] Village energy utilization sectors were domestic (88.3%), industry (4.7%), agriculture (4.3%), lighting (2.2%), and transport (0.5%). A similar study in the Indian state Assam by Sarmah et al. reported that per capita energy use for six rural villages was 7500e12,700 MJ cap_1 yr_1 (fuel wood is preferred for domestic energy consumption, (2) easy availability encourages excessive consumption, (3) 21.5 to 42% more energy is consumed in winter than in summer for meeting cooking, water heating and space heating needs, (4) rice residues and dung are present in abundance but go to waste owing to the easy availability of fuel wood, and (5) commercial fuel kerosene is the only alternative for domestic lighting.) [29].

Njiti and Kemcha reviewed the energy studies of Cameroon and found wood consumption rates were reported to be between 260 and 580 kg cap_1 yr_1 [30] Their review also noted that most wood collection occurs during the dry season when there is no farming activity. In Mali, a recent study reported wood consumption in different districts, with 510e910 kg cap_1 yr_1 in the Sahel and 110e290 kg cap_1 yr_1 in the Niger delta and Sahara [31].

Madubansi and Shackleton performed a ten year study of five villages in South Africa before and after grid electrification, Results indicate a changing pattern of energy use for lighting and powering entertainment appliances, more specifically from dry-cell batteries and paraffin to electricity [32]. Before grid electrification, domestic energy use for the five villages was 8100 to 14,000 MJ cap_1 yr_1. Households in the study used an average of four different energy sources before and after grid electrification. For heating and cooking, the study noted that 45% of households used only wood, and 50%ofhouseholdsusedwoodandkerosenebefore grid electrification. Following grid electrification, the number of households using only wood remained unchanged; 22% of households used wood and kerosene, and 31% of households supplemented these fuels with electricity. Household fuel choice for lighting showed little evidence that electricity had replaced other options (8%), but it was common to find households that coupled electricity with candles and kerosene (76%). Before grid electrification, disposable batteries were used to power personal electronics in 81% of households. After grid electrification, only 28% of households used batteries.

Zha et al. estimated and compared the energy related CO2 emissions from urban and rural residential energy consumption from 1991 to 2004 [33]. Yao et al. analyzed the rural residential energy consumption in China from 2001 to 2008 and its corresponding impacts on climate change. result showed, The percentage of biomass energy consumption dropped from 81.5% in 2001 to 70.9% in 2008, while the percentage of

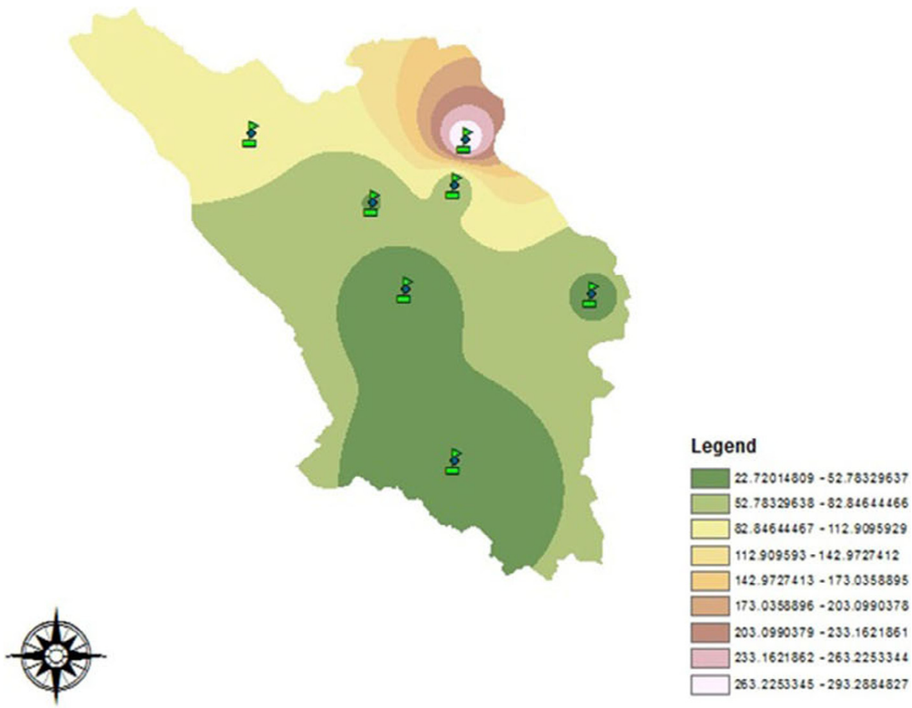

Fig. 7 – Map of Analysis of wind energy in areas with potential for productivity.

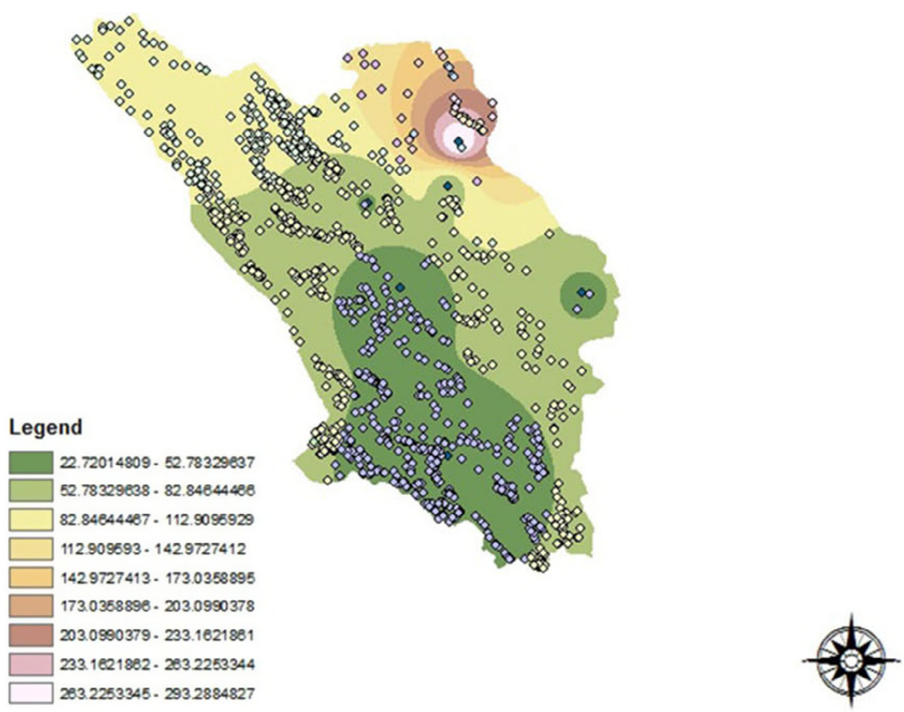

Fig. 8 – Map of Rural dispersion area in yearly zoning.

commercial energy increased from 17.1% to 25.1%. Besides, other renewable energy increased very fast with annual growth rate of 19.8% [34].

Zhuang et al. estimated that the area of marginal-land resources suitable for the cultivation of the major energy crops measures 19.90 million hectares and may be capable of producing approximately 58.65 Mt of biodiesel annually. The results indicated that total area of marginal land exploitable for development of energy plants on a large scale was about 43.75 million ha. If 10% of this marginal land was fully utilized for growing the energy plants, the production of biofuel would be 13.39 million tons [35].

A number of studies have been conducted for assessing agricultural energy consumption for different geographical

ARTICLE IN PRESS

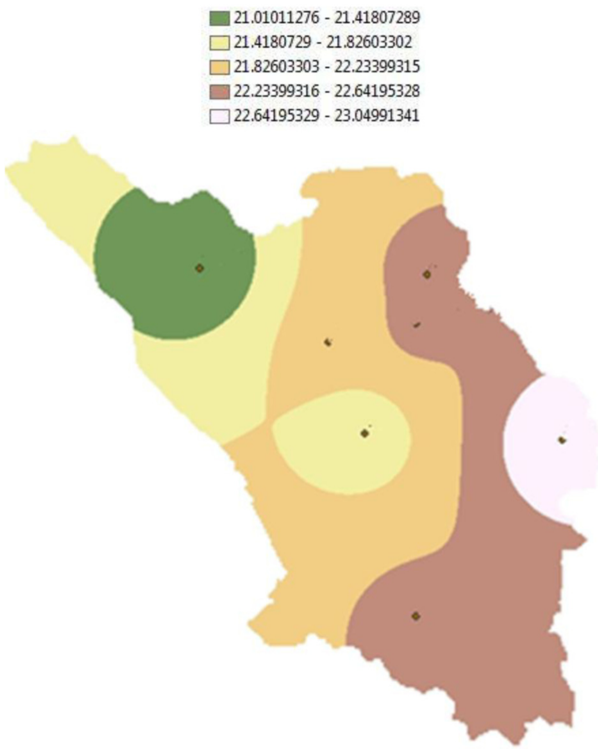

Fig. 9 – Map of Zoning radiation-Yearly(Mj/m^2).

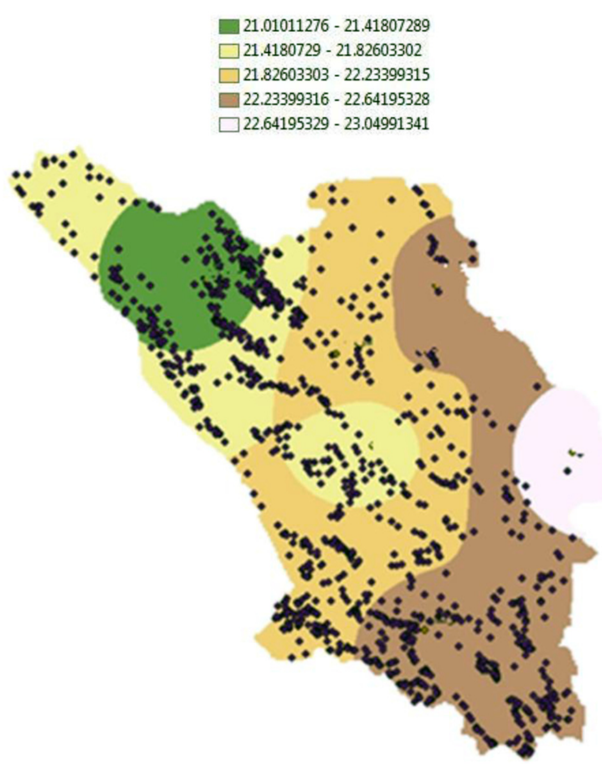

Fig. 10 – Map of Rural dispersion area in yearly zoning radiation.

situations and agro-climatic conditions, different types of crops cultivation in different sizes of farms [36–44]. A positive relationship has been found between energy economical consumption (particularly commercial energy consumption) and agricultural production [37,40,43]. Energy consumption in agriculture increases with increase in the size of farms, irrigation accounts for the largest share [38–43]. From a sustainability point of view, the potential for producing hydrogen from clean renewable energy sources is preferable [45–48]. Water electrolysis powered by photovoltaic (PV) energy is one of the promising options and generally the most desirable option for remote power supply applications [49–51].

Kardoni [52] believed that there are several challenges for the development of renewable energy in developing countries including Iran. One of these challenges is the lack of social acceptance and awareness, a point emphasized by several studies as a serious obstacle. Noorolahi and Yosefi [53] stated that changes in the current regulation of the energy sector, legislation supportive rules of renewable energy, training and development of human resources, creating the necessary motivation to keep experienced and qualified manpower and planning for technology transfer during international agreements for technology transfer during international agreements for cur- rent projects are of great importance to achieve sustainable development goals in terms of energy resources. According to [14], the main challenges facing the renewable energy development in Iran are the low price of conventional energy compared to renewable energy and the lack of consensus about the importance of investment in renewable energy sources among authorities and policy makers that, in turn, ends up with lacking a rigorous plan for renewable energy.

5. Materials and methods

In this study in order to receive the goals, in different parts of the wind, solar, biomass energies and surveying in the case study, different method are used that each of them has specific steps which they are explained in the following.

5.1. *Surveying in the case study*

In order to gathering the necessary data, an elementary questionnaire entitled as "the basic information questionnaire in rural area" was designed. Its purpose was to obtaining the public data collection of the case study and base information of each household. It is assessed by primary pre-test with interview with a number of villagers in this area. The final questionnaire, after preliminary sample evaluation, validity and reliability check and do the panel of expert's corrections (rural development expert and expert on energy) was distributed among the case study villagers.

The main goal of questionnaire design, was analyzing the villager demands (the present situation) in the sections related to the energy resources in household, agricultural and rural industry's consumptions that explains a part of the conceptual Fig. 12. Moreover, besides the questionnaire, the structured interviews, semi structured interview by applying the focus group technique, survey and direct observation as a data collection tools were used from a rural key informant.

The sampling method in the questionnaire was random according to the Cochran's formula (sample size: 187 house-

Fig. 11 – View of the Kahkesh village.

Table 2 – Rating of wind energy potential in different areas of Chaharmahal va Bakhtiari province.

Station name	Wind power density	Rank	Station name	Wind energy density	Rank	Station name	The percentage of wind speed >3.5 m/s	Rank
Ardal	22.72	7	Ardal	16.35	7	Ardal	30	4
Farsan	51.13	4	Farsan	36.81	4	Farsan	39.60	2
Kohrang	85.66	2	Kohrang	61.67	2	Kohrang	28.30	5
Borujen	49.88	5	Borujen	35.91	5	Borujen	32.80	3
Shahrekord	60.32	3	Shahrekord	43.43	3	Shahrekord	25.70	7
Saman	293.29	1	Saman	211.17	1	Saman	68.10	1
Lordegan	33.66	6	Lordegan	24.23	6	Lordegan	26.30	6

Table 3 – The calculated radiation in meteorological stations in Chaharmahal va Bakhtiari province (MJ m^{-2} in day).

No.	Station name	Above sea level	Total of sun radiation	Rank
1	Ardal	1875	21.56	6
2	Farsan	2059	21.90	5
3	Kohrang	2365	21.01	7
4	Borujen	2260	23.05	1
5	Shahrekord	2050	22.34	3
6	Saman	2075	22.35	2
7	Lordegan	1611	22.32	4

hold). The sampling method in interview was purposed sampling and using of Snowball method till achieve to the theoretical saturation.

5.2. *Wind estimation in the case study*

In this article, Probability Density Function (PDF) and Cumulative Distribution Function (CDF) have been used regarding the Weibull distribution using the following equations for wind energy analysis [54],

$$f(v) = \frac{k}{c}\left(\frac{v}{c}\right)^{k-1} \exp\left[-\left(\frac{v}{c}\right)^{k}\right] \quad (1)$$

$$F(v) = 1 - \exp\left[-\left(\frac{v}{c}\right)^{k}\right] \quad (2)$$

In the above equations $f(v)$ and $F(v)$ are PDF and CDF from Weibull distribution. V is the wind speed and k and c are Weibull distribution parameters. To estimate the Weibull Distribution parameters (k & c) the method of moments is used as following,

$$\bar{v} = c\Gamma\left(1 + \frac{1}{k}\right) \quad (3)$$

$$\sigma = c\Gamma\left[\left(1 + \frac{2}{k}\right) - \Gamma^2\left(1 + \frac{1}{k}\right)\right]^{1/2} \quad (4)$$

In the above equations, $\bar{v}$ is the mean velocity and σ is the standard deviation of wind speed data. The solution of the non-linear Eqs. (3) and (4), using MAPLE software, gives the parameter values.

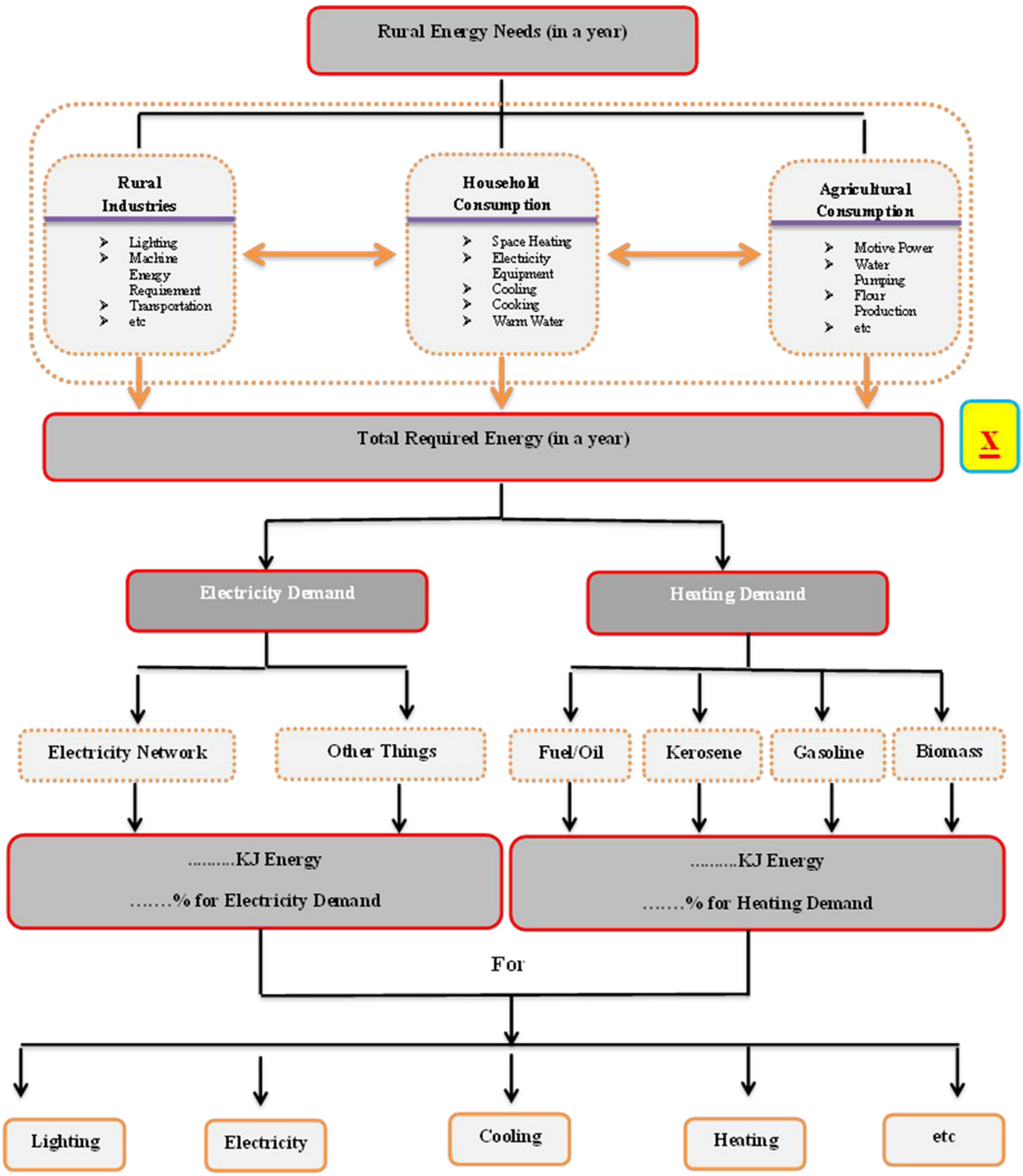

Fig. 12 – Rural Energy Needs in the Case Study (Framework 1).

5.3. *Solar estimation in the case study*

In analysis of the solar energy, from solarium recorded at meteorological stations, that provided from Chaharmahal VA Bakhtiari meteorological organization, the Angstrom method was used which modified Angstrom equation is as follows,

$$R_s = \left(a + b\frac{n}{N}\right)R_a \quad (5)$$

that In the above equation R_s is the Radiation reaches to the Earth's surface (MJ m^{-2} d^{-1}). R_a is the radiation outside of the atmosphere (MJ m^{-2} d^{-1}). '*a*' and '*b*' are the Angstrom coefficients. '*n*' is the solarium recorded (hour) and 'N' is the maximum sunshine [55].

FAO offered for '*a*' and '*b*' constants the values 0.25 and 0.50 (below formula):

Please cite this article in press as: Karami Dehkordi M et al. Implementing conceptual model using renewable energies in rural area of Iran. Info Proc Agri (2017), http://dx.doi.org/10.1016/j.inpa.2017.02.003

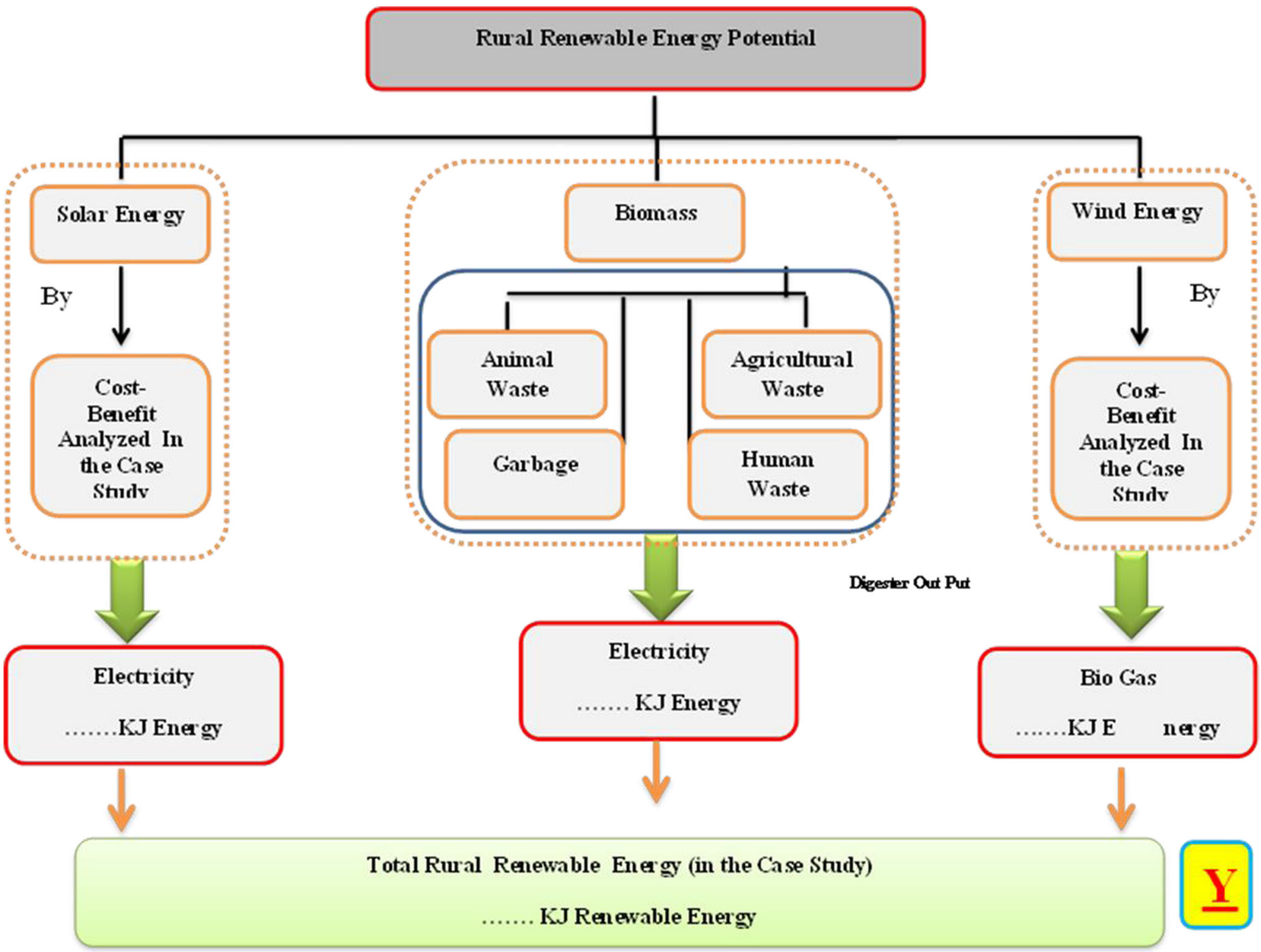

Fig. 13 – Rural Renewable Energy Potential in the case Study (Framework 2). Energy Saving in the Case Study (%) = (Y/X) * 100.

$$R_s = \left(0.25 + 0.5\frac{n}{N}\right)R_a \quad (6)$$

For calculation the '*a*' and '*b*' for each region the least squared method is as the following,

$$a = \frac{\sum \frac{R_S}{R_a} \sum \left(\frac{n}{N}\right) - \sum \frac{n}{N} \sum \frac{n}{N}\frac{R_S}{R_a}}{M\sum \left(\frac{n}{N}\right)^2 - \left(\sum \frac{n}{N}\right)^2} \quad (7)$$

$$b = \frac{\sum \frac{n}{N}\frac{R_S}{R_a} - \sum \frac{n}{N} \sum \frac{R_S}{R_a}}{\sum \left(\frac{n}{N}\right)^2 - \sum \left(\frac{n}{N}\right)^2} \quad (8)$$

In the above equation, "M" is the number of the month [56]. The Angstrom formula is calculated by programming in Matlab software (in Editor).

5.4. *Biomass estimation in the case study*

For estimation the biomass potential in case study, data were collected from Jihad organization, Environment organization and the questionnaire in 4 parts (crops, garden products, livestock, poultry and garbage). In order to energy measurement of biomass, it was needed to analyze the dry biomass that in the following the related formula is described [57].

Crops:

$$\text{Dry Biomass (ton)} = \text{E (ha)} \times \text{residue factor (ton/ha)} \times \text{Collection coefficient (\%)} \times \text{DM (\%)} \quad (9)$$

Garden product

$$\text{Dry Biomass (kg)} = \text{Yield (kg/ha)} \times \text{E(ha)} \times \text{index Waste harvest (\%)} \times \text{DM (\%)} \quad (10)$$

Livestock waste

$$\text{Biomass (kg)} = [\text{The number of sheep in the region} \times 365 \times 0.9 \times 0.75]/2.204\ \text{lbs/kg} \quad (11)$$

$$\text{Biomass (kg)} = \{[\text{The number of hen in region} \times 365 \times 0.53]/2.204\ \text{lbs/kg} + [\text{The number of chicken in the region} \times 56 \times 35 \times 6]/2.204\ \text{lbs/kg}\} \times 0.8$$

Method of rural waste analyze:

$$M(gr) = 365 \times R.P \times MSW \times \text{index of collection} \times \text{Recyclable materials} \times \text{Organic matter} \times \text{Index separation of biomass waste} \times DM(\%) \quad (12)$$

For conversion the dry biomass into energy, some specific processes can be used.

6. Results and discussion

the calculated information in the sections of the wind and sun potential measurements were used for generalization in the whole of the geographical area (Chaharmahal VA Bakhtiari province) shown in Figs. 7–10. The perform this, the GIS software and IDW interpolation method in that software have been used. Fig. 7 indicates the analysis of wind energy in the area with potential of productivity. Fig. 8 illustrates the rural dispersion area in yearly zoning. Figs. 9 and 10 show the zoning radiation and the rural dispersion area in yearly zoning radiation, respectively (see Fig. 11).

6.1. *Base of case study choice*

According to wind and solar energy analysis in the chaharmahal VA Bakhtiari province and rural area, Saman county and its rural area have the highest wind potential. The other counties and meteorology stations have highly significant with Saman county. The density of wind energy (EA) of Saman county station is 211.17 and the density of wind energy in capacity of Kohrang county, as the second level, is 61.67. After them, the Kohrang, Shahrekord, Farsan, Bourojen, Lordegan and Ardal are ranked respectively as shown in Table 2. In the other side, the analysis of the solar energy, which is obtainable from the calculated average of sunshine hours, showed that Bourojen county station, with 23.05 h, has the most solar energy during the census duration. After that, the stations of Saman, Shahrekord, Lordegan, Farsan, Ardal and Kohrang are leveled respectively that shown in Table 3. The Saman county has the highest level of garden and arable fields among the other counties which they can be used as biomass sources. So, regarding above viewpoints, the Saman county must be preferred. So, according to the interpolation maps, one of the villages of Saman county, which is entitled as Kahkesh is selected as the case study.

6.2. *Original of characteristic of Kahkesh village*

According to the final repartition country in 2011, Kahkesh village is in the Chaharmaahal VA Bakhtiari Province. Saman county is part of central and Shorabsaghir will have become located. Kahkesh village is located in high land and foot hill was in a centralized area. Environment of village restricted farmland and the air of this area is so handsome and healthy. This village is located between the two range that there are of wind into kennel most of the dry. There are views of the village in the below figure.

According to the present findings and the collected data through questionnaires, interviews and composed of focus group for rural energy needs were divided in household, agricultural and rural industries consumptions that the same results were reported in [43–45]. By analysis the information and according to the conceptual Fig. 12, the total of rural energy needs was divided into the electricity and heating parts [31,30]. It should also be noted that the total of rural energy needs in the present situation is computable from the conceptual model 1 according to the resources which they are listed. This portion of energy was named as "X". The optimum case study was identified. According to the conceptual Fig. 13, the recoverable energy from the sun and wind resources should be based on cost-benefit analysis so that it is effective and reasonable as it was mentioned in the results of 39, 43, 45. In biomass analysis, according to the sources of the case study which is included mostly of garden waste, the extracted energy from this section is calculated. These are specified as the Rural Renewable Energy Potential in the conceptual Fig. 13, which they are entitled as "Y". However, the reduction of the environmental pollution [34,45–48] and utilization of the sun resources (47, 48, 49, 50, 34), wind resource (35) and biomass resources (48, 20, 44, 52) require energy savings in the recent situation (31) and moving toward the use of renewable and clean energies. Approving the main goal of the present study leaded to extraction the frameworks for energy saving. Hence, with greater use of this resource, the energy saving and sustainable development are affordable. By dividing the value of "Y" to "X" energies the amount of energy saving can be calculated. Finally, it recommended that for utilizing the renewable energies in rural area the same process, as discussed in the present work and particularly using the presented conceptual frameworks, is performed.

REFERENCES

[1] Mainali B, Silveira S. Alternative pathways for providing access to electricity in developing countries. Renew Energy 2013;57:299–310.

[2] Hosseini SE, Mahmoudzadeh Andwari A, Abdul Wahid M. A review on green energy potentials in Iran. Renew Sustain Energy Rev 2013;11:533–45.

[3] World bank rural population indicators. World Bank, 2008. Washington (DC): c2011 [cited 2011 Sep 27]. Link: <http://data.worldbank.org/indicator/SP.RUR.TOTL>.

[4] SUNA (Iran Renewable Energy Organization). Renewable energy in Islamic Republic of Iran: Policy potential energy security private sector application. In: Energy security seminar, Salzburg, Austria; September, 21–24; 2010.

[5] Afsharzadeh N, Papzan A, Ashjaee M, Delangizan S, Van Passel S, Azadi H. Renewable energy development in rural areas of Iran, vol. 65; 2016. p. 743–55.

[6] Renewable energy policy network for the 21st century. Renewable global status report. France; 2014. p. 1–13 [In English].

[7] IEA (International Energy Agency). World energy outlook. Paris: OECD/IEA; 2010.

[8] Global trends in renewable energy investment. Bloomberg New Energy Finance; 2016.
[9] Energy Balances, Power and Energy Planning Department, Ministry of Energy of I.R.IRAN; 2011.
[10] Energy Balances, Power and Energy Planning Department, Ministry of Energy of I.R.IRAN; 2010.
[11] Zheng YH, Li ZF, Feng SF, Lucas M, Wu GL, Li Y, et al. Biomass energy utilizationinruralareasmaycontributetoal leviatingenergycrisisand global warming: a case study in atypical agro-village of Shandong, China. Renew Sustain Energy Rev 2010;14(9):3132–9.
[12] Dai J, Chen B, Hayat T, Alsaeidi A, Ahmad B. Sustainability-based economic and ecological evaluation of a rural biogas-linked agro-ecosystem. Renew Sustain Energy Rev 2015;41:347–55.
[13] Renewable energy policy network for the 21st century; 2016. Available at: <http://www.ren21.net/>.
[14] Majlis Research Center (MRC). Impact of energy price reform on energy and non energy demand in the household sector; 2012.
[15] Aslani AR, Naaranoja M, Antila E. The feasibility study of prior renewable energy alternatives to private sector investment. Int J Adv Renew Energy Res 2012;1(5):248–53.
[16] Hosseini SE, Andwari AM, Wahid MA, Bagheri G. A review on green energy potentials in Iran. Renew Sustain Energy Rev 2013;27:533–45.
[17] Fadai D, Esfandabadi ZS, Abbasi A. Analyzing the causes of non development of renewable energy-related industries in Iran. Renew Sustain Energy Rev 2011;15(6):2690–5.
[18] British Petroleum. BP statistical review of world energy June 2013. Extracted at <http://www.bp.com/content/dam/bp/pdf/statisticalreview/statistical> review of world energy 2013.pdf; 2013.
[19] Najafi G, Ghobadian B, Tavakoli T, Yusaf T. Potential of bio ethanol production from agricultural wastes in Iran. Renew Sustain Energy Rev 2009;13(6–7):1418–27.
[20] Ghobadian B. Liquid biofuels potential and outlook in Iran. Renew Sustain Energy Rev 2012;16:4379–84.
[21] Ghorashi AH, Rahimi A. Renewable and non-renewable energy status in Iran: art of know-how and technology-gaps. Renew Sustain Energy Rev 2011;15(1):729–36.
[22] http://www.suna.org.ir/.
[23] Global Energy Statistical, Yearbook; 2016. Available at: <https://yearbook.enerdata.net>.
[24] Kardowani P. Drought and ways to fight it in Iran. Tehran: Tehran University Press; 2001.
[25] Ministry of Energy (MOE). Development of renewable energy applications in power generation industry by environmental and economic approach; 2012.
[26] Wijayatunga P, Attalage R. Analysis of rural household energy supplies in Sri Lanka: energy efficiency, fuel switching and barriers to expansion. Energy Convers Manage 2003;44:1123–30.
[27] Ramachandra TV, Subramanian DK, Joshi NV, Gunaga SV, Harikantra RB. Domestic energy consumption patterns in Uttara Kannada district. Canada: Karnataka Press; 2000. p. 89–92.
[28] Reddy AKN. Rural energy consumption patterns: a field study. Biomass 1982;2:255–80.
[29] Sarmah R, Bora MC, Bhattacharjee DJ. Energy profiles of rural domestic sector in six un-electrified villages of Jorhat district of Assam. Energy 2002;27:17–24.
[30] Niti CF, Kemcha GM. Survey of fuel wood and service wood production and consumption in the Sudano-Sahelian region of Central Africa: the case of Garoua. Renew Energy 2003.
[31] Johnson NG, Bryden KM. Energy supply and use in a rural West African village. Energy 2012;43:283–92.
[32] Madubansi M, Shackleton CM. Changing energy profiles and consumption patterns following electrification in five rural villages: South Africa. Energy Policy 2006;34:4081–92.
[33] Zha DL, Zhou DQ, Zhou P. Driving forces of residential CO_2 emissions in urban and rural China: an index decomposition analysis. Energy Policy 2012;38:3377–83.
[34] Yao CS, Chen CY, Li M. Analysis of rural residential energy consumption and corresponding carbon emissions in China. Energy Policy 2012;41:445–50.
[35] Zhuang DF, Jiang D, Liu L, Huang YH. Renew Sustain Energy Rev 2011;15:1050–6.
[36] Department of Farm Machinery and Power Engineering. Energy requirements in agricultural sector. India: G.B. Pant University of Agriculture and Technology; 1998. p. 38–40.
[37] Gajendra S, Chancellor W. Energy inputs in agricultural production under various regimes of mechanization in North India. Am Soc Agricult Eng 1975;18(2):252–9.
[38] Giriyappa S. Technology in rural environment. J Rural Develop, Hyderabad 1998;6(4):414.
[39] Kulsherestha M. Energy requirement for paddy crop in three size of farms in Nainital Terai. Energy Manage 1979;3(1):27–35.
[40] Pathak BS. Energy demand growth in Punjab agriculture and the changes in agricultural production. Energy Agricult 1985;4:67–78.
[41] Pathak BS, Singh D. Energy returns in agriculture with special reference to developing countries. Energy 1978;3:19–21.
[42] Rao AR. Fertilizer use saved fuels in India. Energy 1985;10(8):989–91.
[43] Senapathi RN. Energy consumption in agricultural development in Punjab and Haryana. Indian J Agricult Econ 1976;31(3):173–9.
[44] Singh AJ, Miglani SS. An economic analysis of energy requirements in Punjab agriculture. Indian J Agricult Econ 1976;31(3):167–79.
[45] Santarelli M, Cal MM, Macagno S. Design and analysis of stand-alone hydrogen energy systems with different renewable sources. Int J Hydrogen Energy 2004;29(10):1571–86.
[46] Massarrat M. Iran's energy supply: capacities, requirements and options for the future. By order of Angelika Beerand the greens European free alliance in the European parliament; 2007.
[47] Contreras A, Guirado R, Veziroglu TN. Design and simulation of the power control system of a plant for the generation of hydrogen via electrolysis, using photovoltaic solar energy. Int J Hydrogen Energy 2007;32(18):4635–40.
[48] Paul B, Andrews J. Optimal coupling of PV arrays to PEM electrolysis in solar-hydrogen systems for remote area power supply. Int J Hydrogen Energy 2008;33(2):490–8.
[49] Meurer C, Barthels H, Brocke WA, Emonts B, Groehn HG. PHOEBUS an autonomous supply system with renewable energy: six years of operational experience and advanced concepts. Sol Energy 1999;67(1):131–8.
[50] Bilgen E. Domestic hydrogen production using renewable energy. Sol Energy 2004;77(1):47–55.
[51] Turner J, Sverdrup G, Mann MK, Maness PC, Kroposki B, Ghirardi M, et al. Renewable hydrogen production. Int J Energy Res 2008;32(4):379–407.
[52] Kardony R. Importance of renewable energies in Iran. Middle East Institute for Strategic Studies; 2013. <http://fa.cmess.ir/View/tabid/127/ArticleId/2066/.asp>.
[53] Noorollahi Y, Yousefi H, Ehara S, Itoi R. Geothermal energy development in Iran. In: Proceedings of the direct heating use of geothermal resources in Asia workshop. Tianjin, China; May; 2008. p. 11–8.

Please cite this article in press as: Karami Dehkordi M et al. Implementing conceptual model using renewable energies in rural area of Iran. Info Proc Agri (2017), http://dx.doi.org/10.1016/j.inpa.2017.02.003

[54] Seguro JV, Lambert TW. Modern estimation of the parameters of the Weibull wind speed distribution for wind energy analysis. J Wind Eng Ind Aerodyn 2010;85:75–84.

[55] Liu X, Xurong M, Yanquine Z. Choice of the angstrom – Prescott Coefficients: are time dependent ones better than fixed ones in modeling global solar irradiance? J Energy Convers Manage 2010;51:2565–74.

[56] Ramachandra TV. Solar energy potential assessment using GIS. Energy Educ Sci Technol 2007;18(2):101–14.

[57] Junfeng L, Runqing H. Sustainable biomass production for energy in China. Biomass Bioenergy 2003;25(5):483–99.

Please cite this article in press as: Karami Dehkordi M et al. Implementing conceptual model using renewable energies in rural area of Iran. Info Proc Agri (2017), http://dx.doi.org/10.1016/j.inpa.2017.02.003