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Socioeconomic Factors Affecting Household Energy Consumption in Qom, Iran

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Abstract: Petrol is heavily subsidized in Iran which has led both to very high consumption levels and a big smuggling problem as petrol is transported out of Iran's border areas for re-sale in neighboring countries, where petrol prices are much higher. Also, a shortage of refineries combined with wasteful consumption means that Iran regularly imports petrol despite being one of the world's biggest oil producers. To look at the different variables contributing to wasteful consumption of fuel in Iran and the effect of governmental gradual increase of fuel prices, this study questioned 600 family warden views in Qom, Iran. The results showed that more than two third of samples have heard or read at least one news about energy saving and quoted TV as main source of their information while 55% mentioned all fossils resources would be finish in near future and urged optimum energy consumption as the best way to tackle energy crisis (82%), with 85% asked for more media propagation to change wrong cultural behaviors in Qom. Nearly half of the people said that governmental plan to increase domestic price of high octane and regular gasoline annually had little or no effect on fuel consumption and majority of them mentioned cultural changes as the best tools and nearly the same rate were worried about air pollution as the immediate result of uncontrolled fuel consumption in Qom. The results also showed that with increase in each year education of family warden, decreases fuel expenses 11.2% in hot seasons and 1240000 Iranian Rials (IR-R) in cold seasons while increase in family members' size adds 288660 (IR-R) per member to base family size (2) and for each member of family which works outside the house, family energy expenses increase 234470 IR-R. And finally the results showed fuel (or energy) expenses in cold months in Qom is higher than other months and family warden education showed more effect to reduce those expenses during mild months but less during hot months. Therefore it is recommended that urgent actions should be done to change society behavior and teach more about new methods of energy saving while current actions such as increase in fuel price should be revised completely.

Key words: Energy, optimum consumption, Qom, IRAN

INTRODUCTION

Sustainable development is one of the main elements of national and international programming to ensure permanent and suitable development in each society (Anonymous, 2005; Tietenberg, 2006). One of the worrying issues not only being concerned at national level but also at international communities is rapid increase in energy demand and consumption (Anonymous, 2005, 2006). The rapid economic development based on more fossil energy has resulted in environmental problems (Lyster and Bradbrook, 2006; Tietenberg, 2006; Healey, 2007).

Iran is a major producer of oil, with the second largest reserves in the world. In 2005, its share of world production was 5.1% much less than its 11.5% share in world reserves (Farmaker, 1977). Iran has, after Russia, the second largest gas reserves in the world and is the 4th largest producer of gas in the world (Anonymous, 1996,

1998). As the economy and the population have grown, so has the demand for energy. Rapid urbanization has also contributed to the rise in demand, as has the system of massive energy subsidies (Pelletiere, 2004). The amount of crude oil available for export has been constrained by a growing domestic demand (Chubin, 2006; Wesley, 2006). Between 1995 and 2005, Iranian oil consumption rose by 28% production rose by 8.1% and exports fell by 2.5% (Akiner, 2004; Garver, 2006).

Despite the fact that between 2000-2001 and 2004-2005 the domestic price of high octane gasoline rose by 120% and regular octane prices increased by just over 100%, fuel prices in Iran remained a fraction of their world level. In early 2006, the price of gasoline was just $ 0.09 L^{-1} (or $ 0.34 per US gallon) (Bakhtiari and Shahbudaghlou, 2000; Jesper and Tarr, 2002). While subsidies are common in the Middle East, Iranian domestic fuel prices were among the lowest in the world. The cost of producing a liter of gasoline was estimated

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to be $ 0.22, implying a subsidy of 60%. The import price was $ 0.48, implying a subsidy of 80%. During the same period, domestic oil consumption rose by nearly 11%, but consumption of gasoline for vehicles rose by 72%. Implicit subsidies on energy cost some $ 7 billion, or 15.5%, of government spending (Tbernard *et al.*, 1987). These subsidies are a form of welfare payment that reduces the cost of living and helps maintain the popularity of the regime, especially among poorer sections of the population. Under the current five-year plan for the period of 2005-2009, energy subsidies are scheduled to be reduced to 1.7% of GDP (Akiner, 2004; Pelletiere, 2004).

Household energy consumption in Iran has been four times more than those in its industrial sector. However, it has been the other way around in industrialized nations, because of efficient production methods and modern equipment and technology (Boeker and Grondelle, 1995; Elliott, 1997, 2003; Jamasb *et al.*, 2006). The point is that most production lines in the Iranian industries consume too much energy and the huge difference in energy consumption in the household, trade and industrial sectors has resulted from inefficient allocation of energy resources and consumption methods (Verrinder, 2001). Poor public knowledge about the importance of energy, low energy price and poor management are the main causes of more than needed energy consumption in Iran (Jesper and Tarr, 2002). Changing miscultural behavior of consumers may be the first and the most important cause in this subject because cultural changes are more sustained. This study looked at household energy use and the view of people of Qom as an indicator of country's view about the energy consumption.

MATERIALS AND METHODS

Qom is one of the 30 provinces of Iran with 11,237 km^2, covering 0.89% of the total area in Iran. It is in the north of the country and its provincial capital is the city of Qom. This province has a population of approximately 1,400,000 out of which 91.2% resided in urban areas and 8.8% in rural vicinities. The province contains one city, four counties, nine rural districts and 256 villages. The climate of Qom province varies between a desert and semi-desert climate and comprises of mountainous areas, foothills and plains. Due to being located near an arid region and far inland, it experiences a dry climate, with low humidity and scanty rainfall.

Samples were taken (2006) from family units in Qom which estimated to be 235000 according to Programming and Planning Organization of Iran. Families were divided to three different categories (2 and less, 3 and 4 and more

than 5 person in each family) and 600 family samples were taken according to clustering method, questionnaires filled up by each family warden interview.

Many variable including the amount of electricity and natural gas consumption in three seasons (hot, cold and mild), total household energy consuming in different seasons, family size, family educations, number of working family members, their houses physical properties, average family income, optimum energy consumption, energy crisis, gradual fuel prices increase, environmental pollution, energy saving criteria and other background variables were questioned and data categorized and analyzed by SPSS (SPSS 13 for Windows software, SPSS Inc., 444 N. Michigan Avenue, Chicago, Illinois 60611, USA) statistical software (descriptive, non-parametric and analytical tests were employed to compare variables).

RESULTS

From 600 family samples interviewed 517 (86%) said they have heard or read at least one news about energy saving which 87% quoted TV as main source of their information and only 1.2% that they heard it through reading books (Table 1). Answering about their views about energy crisis occurrence time, more than half of family wardens (58.4%) said that it would happens now and in near future, 33% quoted future and 7% said it happens now (Table 2). Optimum energy consumption mentioned by 82% of interviewees to be the best way to tackle energy crisis (Table 3) and 85% asked for more media propagation to change unreasonable and uncontrolled cultural behaviors. Regarding annual increase in domestic price of high octane gasoline rose by 120% and regular octane prices increased by just over 100 %, 59% found its effect low or without any apparent effects on decreasing fuel consumption (Table 4) and majority of them said increase in price just adds to other consumable prices and nobody cares about fuel price and culture should be changed to reach to a sustainable development (Table 5). Seventy two percent mentioned that air pollution would be the immediate result of unreasonable consuming of fuel and 91% were worried about increase in medical expenses of Qom people.

Table 1: Different routs quoted by interviewees as main sources of their information about energy saving issue, Qom, Iran

Sources of information	%
TV	87.0
Radio	4.5
Media	2.5
Environmental bulletins	2.3
Books	1.2
Not mentioned	2.5
Total	100.0

Table 2: Interviewees' view about the time of energy crisis occupance in Iran

Time	%
Now	7.0
Now and future	58.4
Future	33.0
Not known	1.6
Total	100.0

Table 3: Different ways to prevent energy crisis in near future, results from interview by 600 family wardens in Qom, Iran

Ways	%
Right use	82.0
Less use	31.0
Ruled use	0.5
Investment	1.0
Not mentioned	3.0
Total	100.0

Natural gas is the main source of heating in Qom (in more than 98% of houses) and the rest use liquid gas and regular octane and 65% of them prefer natural gas as main heating source if the prices were the same. Although 95% of interviewee mentioned motorcycles as major air pollutants, 83% of them urged changes in car fuel from high octane to natural gas to reduce air pollution and nearly the same (86%) asked responsible organizations to speed up old car swap scheme with new and more efficient cars.

Less than half (43%) of families paid attention to energy saving criteria in building houses and even less than that rate (37%) said no attentions were paid to those criteria when they bought their homes, although 81% believed isolating the houses by different means to reduce energy lost is one of the main characteristic of a good and suitable house.

To determine the relationship between energy expenses in hot, cold and mild seasons three variables regression test employed and the results showed that with increase in each year education of family head, in average, 11.2% of fuel expenses decreases in hot seasons and 1,240,000 Iranian Rials (IR-R) in cold seasons which could be due to their awareness of energy saving methods and the importance of energy usage (Table 6). Increase in family members' size adds 288,660 (IR-R) extra charges to energy bills per member to base family size of two in average and for each member of family which works outside the house, family energy expenses increase 234,470 IR-R per month. This could be due to the warmer feeling of outsiders during hot season or could be due to increase in different types of other energy consumption (ironing, hair dryer, washing machine) by outside workers.

Comparing three different season variable showed that in Qom fuel (or energy) expenses in cold months is higher than other months and family warden education shows more effect to reduce those expenses during mild

Table 4: The effect of increase in fuel prices on fuel consumption, viewed by family wardens in Qom, Iran

Effect	%
Low	59.0
Some extent	27.0
High	5.5
Very high	5.3
Not know	2.7
Total	100.0

Table 5: Views of interviewees about different ways to promote reasonable energy consumption in Qom, Iran

Ways	%
Cultural changes	87.0
Making energy efficient appliances	4.5
Increase in energy prices	2.5
Applying new energy sources	2.3
Quota	1.2
Not mentioned	2.5
Total	100.0

Table 6: Regression table of energy consumption in hot months in Qom, Iran

Model	R	R^2	Adjusted R^2	SEE
1	0.164	0.027	0.022	7030.3427

SEE: Standard Error of the Estimate

months but this variable showed less effect during hot months which may be related to Qom's geographical location (hot and arid weather).

DISCUSSION

Since 91.2% of Qom's population are living in urban areas and regarding high immigration rates of Iranian from rural to urban areas, Qom can be assumed as a reliable model for Iran's energy consumption and even can be extended as a nice model to some other developing countries. Total final energy consumption in Iran amounted to 673.3 million barrels of oil equivalents in 2000 and since 1990 energy consumption has increased by 5.4% each year, faster than both population growth and GDP growth (Jesper and Tarr, 2002; Jensen and Tarr, 2003). Oil has been the most commonly used form of energy, followed by gas. Electricity and solid fuels each accounted for a much smaller share of total energy usage. Among the types of energy, gas has experienced the highest increase in usage since 90s, followed by electricity. Regarding rapid increase in energy consumption in Iran, the primary energy consumption per unit of GDP has nearly doubled since 80s (Hessari, 2005).

As Iranian energy prices are among the lowest globally, diesel prices in neighboring Turkey, for example, is nearly 60 times higher. Energy consumption in Iran is about seven times more than global average. Although attempts have been made to increase energy prices somewhat, there has never been a serious effort made to bring these to an economically defendable level and

cultural customs have been blamed as the main cause although other factors such as low efficient appliances made here also has been mentioned as another cause (Zimerman and Bohi, 1984; Jesper and Tarr, 2002; Hessari, 2005).

Energy consumption is heavily subsidized by the state; the total value of energy subsidies was $ 15.6 billion, some 16% of GDP at market prices in 2000, increased to $ 18 billion in 2004. The subsidies could be to provide 8.7 million Iranians with a job at a monthly wage of $ 150 or equipping all Iranian schools with a computer lab. Beneficiaries of the subsidies, however, are not equally distributed and nearly 40% of gasoline subsidies go the highest income sector, while the lowest income group of urban households only receives 0.1% (rural 0.2%) of the subsidies (Thail, 1966; John, 2001; Hessari, 2005).

Regarding our main finding in this study (which could be a suitable model to study energy consumption in Iran) which shows gradual increase in energy prices in recent years has no direct effect on energy consumption may explain why less than half of families pay no attention to energy saving criteria. In fact little information has been disseminated by media and governmental agencies on the issue of energy saving methods in constructing new buildings or buying new houses. Since there are no compulsory regulations on energy savings criteria in buildings of Iran, our findings clearly show the urgency of passing and implementing new energy saving laws such as using double glazing windows and heat insulators. This can be related to another miscultural behavior in Iran which little increase in fuel price sometimes doubles other household consumable prices and has been mentioned by majority of our interviewee as the main obstacle to energy price increase. The same problem has changed governmental policy in last two years to stop fuel price increase and to implement new method of fuel quoting (mainly high octane gasoline) (Hessari, 2005).

One of interesting finding in this study was the relation between family warden's education and energy bills, increases in each year education decreases fuel expenses more than 10% which shows academic subjects in Iran somehow increases students' awareness about the importance of energy, although no intentional plan has been made to add this subject to academic contexts.

Another interesting result of this study was about the effect of arid and hot climate of Qom on energy expenses of households during cold months (3 months). This could be due to this fact that people of this warmer climate have been accustomed to more warmer and hot weather than the cold one and use more energy to warm their houses than actual need or as been mentioned earlier could be due to using low efficient heaters (Jesper and Tarr, 2002; Jensen and Tarr, 2003). This urges home appliance producers to make more efficient productions.

Air pollution has been mentioned as an immediate result of unreasonable and uncontrolled use of fuel and nearly two third of Qom's people were worried about it and more 90% worried about increase in their medical expenses after that. The wariness about these two points can be employed by officials as a chance to improve and change energy consumption patterns of society (Davoudpour and Ahadi, 2006).

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, this study showed that people in Iran (Qom studied here as a sample) are not fully aware of energy saving issue and pay no attentions to it because they pay little on their energy bills and gradual increase in fuel prices has not effects on energy consumption but adds up to other household expenses in logarithmic scale, so governmental bodies should pay more attention to cultural causes of higher energy consumption in Iran and should try more and more to change social and cultural behavior of society to use energy efficiently and reasonably to get more from increase fuel prices.

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