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Rural households' knowledge and perceptions of renewables with special attention on bioenergy resources development – Results from a field study in Bangladesh

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HIGHLIGHTS

- Knowledge on various renewable has been evaluated.
- Attitudes towards domestic use of solar panels, improved biomass fuel and installment of improved stove have been investigated.
- Perceptions of different environmental facts related to bioenergy development was assessed.
- Statistical differences among study variables were found and highlighted.

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ABSTRACT

Understanding public knowledge, attitude, and perception towards energy and environmental issues is indispensible for achieving renewable energy targets. The main objective of this study is to investigate the level of knowledge and perception of renewables (especially biomass fuels) among rural households, and to analyze commonly held beliefs on environmental issues related to the development of bioenergy resources. A multi-stage stratified random sampling technique was applied in selecting 240 households from four *upazilas* of Bangladesh. Door to door questionnaire survey was carried out for this study. The results revealed that the majority of rural households had a high level of knowledge on traditional biomass fuels such as wood fuel, crop residues and cow dung. However, they possessed a relatively low level of knowledge regarding improved biomass fuels such as briquette, biogas and biodiesel. The analysis showed that the household's socio-economic status and their level of education plays a significant role in the promotion of knowledge on various renewable and adoption on renewable energy technologies. The rural households expressed negative perceptions towards sustainability aspects of current biomass fuel consumption. Perceptions of various interventions which may have influence on promotion of knowledge on renewables and promotion of sustainable use of bioenergy resource were discussed. The results of this study provide noteworthy information on renewable energy dynamics, which is useful in the development of microplans for forestry and energy sectors at a regional or national level.

1. Introduction

Energy is an integral part of our society and plays an important role in raising our living standard and promoting the quality of life. However, the supply and use of energy also contribute to climate change by emitting greenhouse gases (GHGs). Thus, the governments worldwide have stressed on the importance of restructuring of the country energy policy to reduce GHG emission and enhance energy efficiency [1]. Recently, the share of renewable energy is gaining high relevance on political agendas all around the world. Renewable Energy Sources (RESs) i.e. biomass, solar, wind, hydropower, and geothermal are being widely recognized as an effective mean to combat the global climate change issues, due to their contribution on greenhouse gas emission reduction [2]. In 2011, RES accounted for about 13.3% of the world's total primary energy supply, out of which the contribution of biomass amounted to 10% [3]. RES has been gaining importance amongst countries of the world for enhancing energy security, its low environmental impact and support for sustainable economic growth. For example, according to the 'Renewable Energy Road Map', the European Union is committed to achieve a target of at least 20% share to the total energy

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mix by 2020 [4]. Such target necessitates the adoption of low carbon and renewable energy technologies for generating energy. Examples include energy from wind, sun, biomass and ocean sources [5].

Bangladesh is endowed with vast RES such as biomass, solar, wind and hydro power [6]. The country has only one hydro power plant and a few wind power plants, which are in operation for harnessing energy [7]. Despite large potential of solar systems in Bangladesh, the utilization of solar energy has been limited [8]. Biomass is the dominant single source of energy supply in Bangladesh. Energy derived from biomass is called bioenergy i.e. energy of biological origin [9]. Bioenergy contributes about 60% of the total primary energy consumption in Bangladesh [7]. A recent study showed that rural people of Bangladesh meet more than 93% of their daily energy demand from different types of biomass [10]. Besides hydro, wind and solar harnessing energy from biomass could be a promising solution for improving the quality of life of rural villagers, who are unlikely to have access to modern form of fuels in the foreseeable future [7,11,12].

In order to mitigate increasing demand of energy and achieving energy security in rural areas of Bangladesh, the development and utilization of biomass sources are imperative [11,13]. Biomass has been identified as a promising contributor to renewable energy and rural development in Bangladesh [7,11]. Potential biomass resources for bioenergy include rice straw, rice husk, jute stalk, crop residues, sugarcane bagasse, animal waste, municipal waste, and wood fuel [13,14]. Biomass fuels are commonly used as 'cooking fuels' which is often inefficient and causes pollution in the environment. Due to lack of knowledge and information, biomass based energy technologies are still in embryonic stage in the country [12]. Public knowledge has been recognized as an important parameter for achieving the country energy policy targets and adoption of renewable energy technologies in Bangladesh [15,16].

It has been widely recognized that public acceptance and public responses encompass cognitive knowledge, perceptions, emotions, and behavioral responses, which are important issues towards development of renewable energy technologies and development of bioenergy technologies in particular [17–19]. The studies on local acceptance of renewable energy technologies in Europe and USA showed that the public knowledge has a great influence on energy policy decision-making [5,18]. However, recent studies from Finland [20] and China [21] emphasized that public knowledge, perception and attitudes towards bioenergy are important elements for future development of bioenergy resources. In addition, investigation of public understanding on various aspects of environmental and bioenergy issues are considered to be of high importance for addressing the concerns related to climate change [22].

In fact, a number of research efforts have attempted to clarify public attitudes and perceptions towards environment and renewable energy including bioenergy in many developed countries such as United States of America [23], United Kingdom [5,24], Ireland [25], Slovenia [26], Greece [27], Sweden [28], and Finland [20,29,30] with extension to some developing countries such as China [21], Jordan [31] and India [22,32]. Almost all of the studies recognized that public attitudes and perceptions are important elements in the development of renewable energy. Moreover, public knowledge and perceptions are crucial for adopting renewable energy technologies [33]. Although the rural people of Bangladesh commonly use biomass fuels for their daily energy need, however, their knowledge and perceptions on different renewable, especially on different environmental issues related to the development of biomass fuels are still poorly known.

Following the above context, the present study was undertaken to explore rural households' knowledge and perceptions towards RES and how their perceptions were relevant in developing bioenergy resources. The overall aims of this study were as follows:

1. To assess the level of rural households' knowledge on solar, wind, hydro and different biomass fuels.
2. To investigate rural households' attitudes towards acceptance of renewable energy technologies.
3. To identify rural households' involvement in installation of improved stoves as a response of biomass fuel efficiency and reducing of GHG emission.
4. To determine rural households' perceptions on different environmental facts related to bioenergy development.

This study appears to be an important avenue to inform energy policy decision-makers, technical experts, energy companies, and other stakeholders on means of promoting sustainable energy services in rural areas in Bangladesh and many other developing countries.

2. Material and methods

2.1. Study area

A field survey was conducted in four *upazila* (sub-district) located in different agro-ecological zones (AEZs) of Bangladesh. The purposively selected four *upazilas* were (1) Kalaroa *upazila* of Satkhira district, which lies in High Ganges River Floodplain region (AEZ ID 11); (2) Nachole *upazila* of Chapai-Nawabganj district, which mostly lies in Level Barind Tract (AEZ ID 25), (3) Nakla *upazila* of Sherpur district, which lies at Old Brahmaputra Floodplain region (AEZ ID 9), and (4) Chakaria *upazila* of Cox's Bazar district, which lies at the Chittagong Coastal Plain region (AEZ ID 21).

2.2. Instrument design

The study involved a socio-economic survey on rural households' understanding, perceptions and acceptance towards bioenergy in the selected four *upazilas* of Bangladesh. The survey instrument consisted of both open-ended and close-ended (multiple choice and 5-point Likert-type) questions. The questions were developed to give extra open space for the respondents where they can express their opinion in a case that a particular answer could not cover their accurate position. The questionnaire had six sections:

1. Socio-demographic data of the respondents.
2. Knowledge on different RES such as solar, wind, hydro and biomass.
3. Knowledge on different biomass fuels such as wood fuels, agricultural residues, cow dung, briquette, biogas, and biodiesel.
4. Attitudes towards domestic use of solar and improved biomass fuels such as biogas and briquette (mainly rice-husk briquette).
5. Attitudes towards installment of improved oven as a response to energy efficiency and climate change related issues (reduction of greenhouse gas emissions).
6. Perceptions related to different environmental facts and the development of bioenergy.

The questions related to knowledge were open-ended where the respondent could express their level of knowledge in their own words. Some of the items were further categorized into *low, medium* and *high* levels to measure the respondents' cognitive knowledge about RES and bioenergy in particular. A *'low'* level of knowledge is ascribed to people who have knowledge of basic facts, but who do not fully understand the scientific mechanisms of generating and using energies from RESs (solar, wind, hydro, biomass/traditional biomass fuels). A *'medium'* level of knowledge was comprised of some basic scientific knowledge about the RES