STUDENTS' AND TEACHERS' KNOWLEDGE, ATTITUDES AND PERCEPTIONS TOWARDS BIO-ENERGY RESOURCES

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The purpose of this study was to assess the level of knowledge, attitudes and perceptions of students and science teachers towards bio-energy resources (BER) and other renewable energy sources (RES) in two randomly selected government secondary schools (Harar and Abadir Secondary Schools) in the Harari regions. The sample consisted of randomly selected grade ten students (N=302), science (Biology, Chemistry and Physics) teachers (N=35) and school leaders (principals and unit leaders) (N=8). The analysis of the data revealed that teachers were found to have a low level of knowledge about BER and geothermal energy, while students have low-level of knowledge about BER and other RES. It was also found out that both students and teachers didn't have clear perception and attitude towards BER and RES. Document analysis revealed that issues related to BER and other RES were not integrated into the curricula of the schools. No school co-curricular activities were observed for issues related to BER and RES. This may be because of the resource limitations; low level of knowledge, attitudes and perceptions held by school community towards BER and RES, schools didn't play their roles disseminating and implementing concepts of BER and RES. Although the issue of BER and other RES is critical nowadays, the study revealed that due attention wasn't given to this issue in schools.

KEYWORDS: Knowledge, Attitudes, Perceptions, Bio-Energy Resources

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INTRODUCTION

Bio-energy is energy of biological and renewable origin, normally in the form of purposely grown energy crops or by-products from agriculture, forestry or fisheries. Examples of bio-energy resources include firewood, charcoal, sugar bagasse, sweet sorghum stalks, livestock manure, biogas, microbial biomass and algae (Gustavo et al., 2006). Bio-energy is the most widely used form of renewable energy in the world. It has been used in every country for centuries. In rural and remote areas, transmission and distribution of energy generated from fossil fuels can be difficult and expensive. Thus, producing and utilizing bio-energy can offer a viable and sustainable alternative. Bio-energy currently provides over 15% of the world's energy supply (Bio-Energy Resources Corporation, 2006). It is expected to become one of the key energy resources in the future because bio-energy maintained adequately is renewable and free from net CO2 emissions (Bio-Energy Resource Corporation, 2006). The gathering of firewood is so debilitating to women and children who also suffer serious health hazards when the firewood is burned in enclosed spaces for heating and cooking. It is also environmentally destructive. Burning of animal dung for heating homes and cooking foods also seriously affect the health of family. In view of these, producing and using RES is of great advantageous over the other fossil fuels.

Interest in renewable energies in many countries has increased in recent years due to environmental concerns about global warming and air pollution, reduced costs of renewable energy technologies, and improved efficiency and reliability (AAID, 2001). Its being natural source of energy and ability to replenish itself over short periods of time; non-pollutant of the environment (environmentally friendly); its affordability; and ability to reduce global warming (Christopher & Molly, 2005) are some of the advantages of using RES and makes it preferable to other sources of energy.

If countries aim at achieving the binding targets of renewable source development, emphasis should be given to the improvement of communication strategies as crucial factor for public acceptance of RES. In this context, education is the most effective way to construct an integrated knowledge and background to cultivate critical thinking for RES and its applications. Specifically, environmental education aimed at providing people with the appropriate knowledge and capabilities are crucial so that environmental issues can be understood (Liarakou et al., 2008).

Nevertheless, literature shows little or no evidence of researches done that investigates the conceptual framework, attitudes and perceptions of teachers and students towards RES in schools. In Ethiopia too, after reviewing the literature and through personal experiences of the researcher no research studies have been found to be carried out in secondary schools especially in

Harari region that assess teachers and students knowledge, attitudes and perceptions towards RES.

Thus, this study was intended to generate baseline information regarding the students' and teachers' knowledge, attitudes and perceptions about RES, particularly bio-energy resources in some selected secondary schools in the Harari region.

OBJECTIVES OF THE STUDY

The specific objectives of the study are:

1. To assess students' and teachers' level of knowledge about bio-energy resources in the study area.

2. To determine students' and teachers' levels of attitudes and perceptions about bio-energy resources in the study area.

3. To find out students' and teachers' levels of knowledge, attitudes and perceptions about RES

4. To examine the extent to which RES issues are addressed in the syllabi and students textbooks.

5. To study the schools' contribution towards understanding and utilization of RES.

RESEARCH METHODOLOGY

The study employed a cross-sectional descriptive survey research design. This method was selected because it helps the researchers to assess in detail the existing situations such as the level of knowledge, attitude and perceptions of students and teachers towards RES in the study areas.

SAMPLE

The target population of the present study was secondary schools (grade 10) science (Biology, Chemistry and Physics) teachers (N=43; F=4 & M=39) and students (N=1651; F= 710 & M= 941) in Harari region. In addition, 8 school leaders (school principals (N=4) and unit leaders (N=4)) were the target population of this study.

Sample sizes and sampling procedures followed to select the respondents of the present study are summarized in Table 1 .

Table 1
The Study Population, Sample Size and Sampling Techniques.

Population	Population Size	Sample Size	Sampling Techniques
Schools	3	2	Simple Random Sampling
Teachers	43	35	Stratified Random Sampling
Students	1651	312	Simple Random Sampling
Principals & Unit Leaders	8	8	Purposive Sampling
Total	**1688**	**355**	

The formula, $n = N\,SD^2 / (N - 1)\,d^2 + Z^2\,SD^2$, was used to determine the sample size of the students followed by simple random sampling. Where, n = Estimated sample size; Z = Students t-value for an expected confidence level (Z=10); SD = Expected standard deviation (SD=1.96); N = Population size (N=1651); and d = Selected accepted error (precision) (d=0.05). Accordingly, $n = 1651 \times (1.96)^2\,(10)^2 / (1651 - 1)\,(0.05)^2 + (1.96)^2\,(10)^2 = 312$. Thus, a total of 355 respondents were selected as the sample for the present study.

SOURCE AND TYPE OF DATA

Both primary and secondary sources of data were used. Primary data were collected from teachers and students using a questionnaire; and from unit leaders and school principals using interviews; and from teachers using focus group discussions. Secondary data were collected from the document analysis (curriculum and other related documents).

TOOLS USED

Questionnaires, interviews, observations, focused group discussions (FGD) and document analysis, were used to collect the required data for this study. A total of 57 questions were prepared in line with the research questions.

A five point Likert type scale was designed to explore the participants' agreement levels with the given statements and had the following five responses: (1) I strongly disagree, (2) I slightly agree, (3) I moderately agree, (4) I mostly agree and (5) I totally agree.

DATA ANALYSIS

Both quantitative and qualitative methods were employed to analyse the data.

The quantitative data were analysed using descriptive statistics such as means, frequencies and percentages, whereas qualitative data were analysed by using analytic induction and thematic approach to categorize analogous concepts and analysed them accordingly.

RESULTS OF THE STUDY

a) Teachers' Level of Knowledge about Bio-Energy Resources (BER) and Renewable Energy Sources (RES).

Teachers were requested to rate (by using likert-scale such as informed/not informed, agree/disagree, etc) their level of knowledge towards bio-energy and RES. Responses obtained in this regard are summarised in Table 2 below.

Table 2

Teachers' Responses About their Level of Knowledge (Awareness) Towards Bio-Energy Resources and RES.

Questions (items)	Responses						
	Totally not Informed	Almost not informed	Neutral	Somewhat Informed	Highly Informed	Unfavourable	Favourable
	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)
1. Bio-energy	-	20 (57.2)	5 (14.3)	6 (17.1)	4 (11.4)	20 (57.2)	10 (28.5)
2. Wind energy	1 (2.9)	3 (8.6)	2 (5.7)	20 (57.1)	9 (25.7)	4 (11.5)	29 (82.8)
3. Solar energy	1 (2.9)	-	2 (5.7)	16 (45.7)	16 (45.7)	1 (2.9)	32 (91.4)
4. Geothermal energy	2 (5.7)	17 (48.6)	5 (14.3)	6 (17.1)	5 (14.3)	19 (54.3)	11 (31.4)
5. Hydroelectric power	-	-	1 (2.9)	3 (8.6)	31(88.5)	-	34 (97.1)
6. Fuel can be obtained from processed biomass	2 (5.7)	17 (48.6)	12 (34.3)	4 (11.4)	-	19 (54.3)	4 (11.4)

As can be noted from Table 2 above, 20(57.2%), 19(54.3%) and 19(54.3%) of teachers responded that they were either little informed or completely not informed about bio-energy, geothermal energy and processing biomass to make solid, liquid and gas fuel respectively, whereas about 5(14.3%), 5(14.3%) and 12(34.3%) of teachers, respectively, seemed to remain neutral. On the other hand, 29(82.8%), 32(91.4%) and 34(97.1%) of teachers were well informed about the wind energy, solar energy and hydroelectric power respectively.

In addition, in the open ended part of the questionnaire, during the FGD and interviews, teachers revealed that they had limited knowledge regarding bio-energy resources and geothermal energy. This indicates that the most of teachers and school leaders lacked adequate knowledge about bio-energy resources and other RES. The analysis also justified that there wasn't any section in the textbook related to RES. This reflects that students were not also exposed to any knowledge of RES. Similar findings were also reported by Liarakou, et al. (2008). Lane (1994) in his study inferred that teachers who

didn't posses good knowledge in RES couldn't teach their students. This made them ineffective teachers in producing competent students who could potentially solve energy problems.

Table 3 below shows views of teachers about their level of knowledge towards the advantage of using BER and RES as compared to the non-renewable energy sources from the perspectives of environmental pollution.

Table 3

Responses of Teachers about their Level of Knowledge Towards the Degree of Severity of using BER and other RES and Non-RES from the Perspective of Environmental Pollution.

Items	Response						
	Very low	Low	Medium	High	Very high	Unfavourable Response	Favourable Response
	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)
A. RES							
1. Wind	25(71.4)	9(25.7)	1(2.9)	-	-	-	34(97.1)
2. Bio-energy	2(5.7)	6(17.1)	2(5.7)	15(42.9)	10(28.6)	25(71.4)	8(22.9)
3. Solar	31(88.6)	4(11.4)	-	-	-	-	35(100)
4. Geothermal	2(5.7)	5(14.3)	3(8.6)	13(37.1)	12(34.3)	25(71.4)	7(20)
5. Hydropower	25(71.4)	10(28.6)	-	-	-	-	35(100)
B. Non-renewable Energy sources							
1. Oil	2(5.7)	1(2.9)	4(11.4)	14(40)	14(40)	3 (8.6)	28(80)
2. Natural gas	1 (2.9)	3(8.6)	12(34.3)	13(37.1)	6(17.1)	4 (11.5)	19(54.2)
3. Coal	1(2.9)	2(5.7)	3(8.6)	17(48.5)	12(34.3)	3 (8.6)	29(82.8)
4. Nuclear	7(20)	3(8.6)	2(5.7)	15(42.8)	8 (22.9)	10(28.6)	23(65.7)

As can be observed from Table 3 above, 25 (71.4%) and 25 (71.4%) of teachers considered bio-energy and geothermal energy as a threat to the environment, respectively, whereas a relatively small proportion of teachers, about 8(22.9%) and 7(20%), thought them environmentally friendly. On the other hand, as indicated by 97%, 100% and 100% of teachers; wind energy, solar energy and hydroelectric power weren't considered as environmental pollutants respectively. Thus, teachers' level of knowledge about BER and other RES, as compared to the knowledge they have about wind energy, solar energy and hydroelectric power, was low.

As to the degree of environmental pollution by non-renewable energy sources such as oil, natural gas, coal and nuclear power, 80%, 54.2%, 82.8% and 65.9% of teachers, respectively, believed that using theses energy sources causes severe environmental contamination as compared to RES. These results go in line with the results obtained from FGD and interviews held with teachers.

In connection to the above discussions, in a study, "Teachers' ability to differentiate between the renewable and non-renewable sources of energy", Spiropoulous, et al. (2007) came up with similar findings in which he observed that there were confusions among teachers in making clear differentiation between renewable and non-renewable energy sources.

b) Teachers' Attitudes and Perceptions about BER and other RES

Table 4 indicates the items designed to assess teachers' attitudes and perceptions towards BER and other RES. Responses obtained are abridged in the same table. The rating scales such as Strongly Disagree (SD), Disagree (D), Uncertain (U), Agree (A), and Strongly Agree (SA) were provided to indicate the favourable/unfavourable attitudes and perceptions.

Table 4

Teachers' Responses about their Attitudes and Perceptions towards BER and other RES.

Items	Responses						
	SD	D	U	A	SA	Unfavourable Reponses (1 + 2)	Favourable Responses (4 + 5)
	1	2	3	4	5		
	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)
1. Renewable energy is good and clean alternative to fossil fuels.	3(8.6)	4(11.6)	17(48.6)	7(20)	4(11.4)	7(20)	11(31.4)
2. RES are the most preferred energy sources worldwide.	4(11.4)	5(14.3)	19(54.3)	4(11.4)	3(8.6)	9 (25.7)	7(20)
3.Concepts of BER & RES need to be incorporated into the science curricula	-	-	1(2.8)	8(22.9)	26(74.3)	-	34(97.2)
4. My individual efforts and actions can have an effect on the environmental cleanness	3(8.6)	2(5.7)	5(14.3)	13(37.1)	12(34.3)	5 (14.3)	25(71.4)
5.I think bio-energy/bio-fuels are safe and reliable; reduce global warming and don't pollute environment	5(14.3)	15(42.9)	8(22.8)	4(11.4)	3(8.6)	20(57.2)	7(20)
6. Knowing about the RES and BER helps in protecting the environment	-	-	10(28.6)	14(40)	11(31.4)	-	26(71.4)
7. The schools' environmental education helps to create awareness about BER and RES	-	-	2 (5.7)	7(20)	26(74.3)	-	33 (94.3)
8. The students need to learn about renewable energy issues and concepts	-	-	13(37.1)	15(42.9)	7(20)	-	22 (62.9)

It is evident from Table 4 that a relatively large number of the respondents, 17(48.6%), appeared to be uncertain that renewable energy is good and clean alternative to fossil fuel, whereas about 7(20%) and 11(31.4%) of them replied negatively and positively to the item respectively. Similarly, 19(54.3%) of the teachers indicated that they were unsure that the RES could be the most important energy source in the future in the world, while 9(25.7%) and 7(20%) of them revealed their agreement and disagreement with this idea respectively. From this, it can be inferred that most of the teachers didn't possess clear perception and attitude towards RES as an important source of energy in the

future worldwide.

Interestingly, a large proportion of the teachers, 20(57.2%), didn't think that bio-energy/bio-fuels are safe and reliable that reduces global warming and doesn't pollute the environment, whereas, 7(20%) of them revealed their positive perception and attitude. From this, it looks that majority of the teachers assumed low perception and attitude towards bio-energy/bio-fuel. Similar findings were reported by Liarakou, et al. (2008). On the other hand, majority of teachers unveiled their affirmative attitudes and perceptions about the items stated under 3, 4, 6, 7, and 8, in which they revealed their belief that incorporation of the issues about RES and BES into school curricula; individual efforts and strengthening environmental education helps create awareness about RES and BES and protects our environment from pollution, destruction and disaster.

c) Students' Level of Knowledge about BER and RES

In this section, students' level of knowledge about BER and other RES are assessed and results obtained in this regard are summarized in Table 5 below. Items were rated by using a rating scale depicting Very low (1), Low (2), Not Sure (3), high (4) and Very high (5).

Table 5

Responses of Students about their Level of Knowledge Towards BER and RES.

Items	Response						
	1	2	3	4	5	Unfavourable Responses (1 + 2)	Favourable Responses (4+ 5)
Knowledge about…	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)
1. RES	66(21.9)	154(51)	44(14.6)	30(9.9)	8(2.6)	220(72.9)	38 (12.5)
2. Bio-energy/bio-fuel	79(26.2)	162(53.6)	34(11.3)	20(6.6)	7(2.3)	241(79.8)	27 (8.9)
3. Wind energy	107(35.4)	104(34.5)	59(19.5)	18(6)	14(4.6)	211(69.9)	32(10.6)
4. Solar energy	34(11.2)	59(19.5)	38(12.6)	134(44.4)	37(12.3)	93(30.7)	171(56.7)
5. Geothermal energy	94(31.1)	131(43.4)	59(19.5)	10(3.3)	8(2.7)	225(74.5)	18 (6)
6. Hydroelectric power	36(11.9)	47(15.6)	29(9.6)	101(33.4)	89(29.5)	83(27.5)	190(62.9)
7. Products of processing of biomass	96(31.8)	172(56.9)	20(6.6)	8 (2.7)	6 (2)	268(88.7)	15(4.7)

N=302

As can be noted from Table 5 above, 222(72.9%), 241(79.8%), 211(69.9%), 225(74.5%), and 268(88.7%) of the students responded that they had either low or very low knowledge about RES, BER, wind energy, geothermal energy, and processing of biomass to make solid, liquid and gas fuels respectively, while

44(14.6%), 34(11.3%), 59 (19.5%), 59(19.5%) and 20(6.6%) of the students seemed that they were uncertain about the issue respectively. However, the majority of students, 171(56.7%) and 190(62.9%) appeared to have a high or very high knowledge about solar energy and hydroelectric power respectively.

In the open-ended part of the questionnaire, the students indicated that they had low level of knowledge towards BER and other RES except for solar energy and hydroelectric power. This result goes in line with the responses of school leaders. As the content analysis, observation and experiences of the researchers show, this low level of students' knowledge may be attributed to the lack of BER and RES topics in the students' textbooks and extra-curricular activities. This argument is also in harmony with the findings of Hausbeck (1992), Gambro and Switzky (1996) studies.

d) Students' Attitudes and Perceptions towards BER and other RES.

Below are 8 items designed to assess students' attitude and perception towards BER and other RES. The results obtained in this regard are summarized in Table 6 hereunder. Items were rated by using Strongly Disagree (SD), Disagree (D), Uncertain (U), Agree (A), and Strongly Agree (SA).

Table 6

Responses of Students (N=302) about their Attitudes and Perceptions Towards BER and RES.

Items	SD 1	D 2	U 3	A 4	SA 5	Unfavourable Response (1+2)	Favourable Response (4+5)
I believe/perceive that…	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)
1. Renewable energy is good and clean alternative to fossil fuel.	92 (30.5)	103(34.1)	86(28.5)	13(4.3)	8(2.6)	195(58.6)	21(6.9)
2. RES can be the vital energy sources in the future throughout the world.	54(17.9)	157(52)	64(21.2)	17(5.6)	10(3.3)	211(69.9)	27(8.9)
3. Concepts of BER & RES need to be incorporated into the science curricula	-	-	37(12.3)	159(52.7)	106(35)	-	265(87.7)
4. Individual efforts & actions can have an effect on the environmental protection	5(1.7)	8(2.6)	35(11.6)	134(44.4)	120(39.7)	9 (4.3)	254(84.1)
5. Bio-energy/bio-fuels are safe and reliable, reduce global warming and don't pollute the environment	51(16.9)	144(47.7)	52(17.2)	36(11.9)	19(6.3)	195 (64.6)	55(18.2)
6. Knowing about the RES and BER help in protecting the environment	51(17)	117(38.7)	20(6.6)	104(34.4)	10(3.3)	168(55.7)	114(37.7)
7. Schools' Environmental Education helps create awareness about BER and RES	8(2.6)	15(5)	40(13.2)	140(46.4)	99(32.8)	23(7.6)	239(79.2)
8. Students need to learn about renewable energy issues and concepts	-	-	37(12.3)	117(38.7)	148(49)	-	265(87.7)

As could be understood from Table 6 above, 195(58.6%), 211(69.9%), 195(64.6%) and 168(55.7%) of the students responded that they either disagreed or strongly disagreed about the statements stated under items 1, 2, 5 and 6 respectively, while 86(28.5%), 64(21.2%), 52(17.2%) and 20(6.6%) of the students, respectively, appeared to be uncertain about the issues. From this, it can be inferred that students have low perceptions about BER and RES issues. Similar responses were also obtained from the open-ended part of the students' questionnaire. However, the majority of students, 265(87.7%), 258(84.1), 239(79.2%) and 265(87.7%), revealed their agreement about the statements stated under items 3, 4, 7 and 8 respectively. These responses were in congruence with the responses obtained from the teachers' interviews and open-ended part of the questionnaire, as well as content analysis and school observations. This implied that students have had positive attitudes towards BER and RES issues.

Overall, results obtained from the FGDs with teachers, interview with school leaders, document analysis and school observations related to BER and RES revealed that the participants explained they had some knowledge about BER and RES though it was not adequate. Further, they disclosed that they get some information about BER and RES from media (such as broadcast and print). Although they had keen interest about BER and RES and believed that BER and RES are safe, as a result of the lack of adequate knowledge and encouraging environment, they made it clear that they didn't contribute a lot to the implementation of the BER and RES issues in their respective schools. The major barriers, according to them, were knowledge gap, financial and material constraints, and lack of curricular materials. Unanimously, all the participants divulged their consensus and believe that topics related to the BER and RES be integrated into the school curricula, funds should be raised, awareness creating trainings may be arranged for teachers and co-curricular activities related to BER and RES be organized in the schools. They all declared that the sole activity, in their respective schools, in which teachers and students have been participating was planting of trees in clubs.

SUMMARY

Teachers' responses about their level of knowledge towards bio-energy, geothermal energy, processing of biomass, wind energy, solar energy and hydroelectric power was 28.5%, 31.4%, 11.4%, 82.8%, 91.4% and 97.1%, respectively. From this, it can be observed that, except for solar and hydroelectric power, teachers' level of knowledge appears to be low. From environmental pollution perspectives, teachers' level of knowledge about bio-energy (22.9%) and geothermal energy (20%) was also low as compared to their level of knowledge about other RES.

The students' level of knowledge towards the products of biomass processing, geothermal energy, bio-energy, wind energy and RES, except for solar energy and hydroelectric power, also seemed to be low. In addition, responses/data from the interviews, FGDs, observations, open-ended parts of the questionnaires, and document analysis revealed that teachers', students and school leaders' level of knowledge (awareness) about BER and RES was low and inadequate. Still, most of the respondents didn't posses clear attitudes and perceptions about RES and BER. Thus, contributions of the schools for the disseminations and implementations of the concepts of RES and BER were limited.

CONCLUSIONS

Based on the results and discussions and summary made above, the following conclusions were drawn about the study. Most of the teachers, students and school leaders had low level of knowledge (awareness), attitudes and perceptions about BER and other RES. This was mainly attributed to the lack of exposure to any kind of training related to BER and other RES, low perceptions and negative attitudes were also held by some of the stakeholders (such as teachers, students, school leaders, etc.). As a result of this schools couldn't play their role in disseminating and implementing of the concepts of BER and other RES. In addition, the major barriers to the implementation of the BER and other RES activities in the schools were financial and material constraints, knowledge gap, shortage of time, lack of curricular material/orientation and attention by the concerned bodies including schools.

Thus, to properly address the issues of RES and BER and inculcate students and teachers with the essential knowledge, concepts, theories and practices of RES and BER, it is strongly recommended that schools in collaboration with the concerned bodies (such as policy makers and curriculum developers) should design RES and BER curricula and incorporate into school curriculum; awareness creating trainings (focusing on concepts, perceptions, and attitudes) should be organized for teachers as well as students; funds should be raised plus budget should be allocated to strengthen school co-curricular activities (clubs) that work on RES and BER.

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