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Perceptions and attitudes of tertiary level students towards wood and non-wood furniture and energy fuels in Bangladesh☆

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ABSTRACT

We aimed to investigate the perceptions and attitudes of tertiary level students in Bangladesh regarding wood and non-wood (fossil-based) furniture and energy fuels through a pre-tested semi-structured face-to-face interview. About 59% and 90% of students opined that wood or bamboo-based fuels and furniture can be used as a substitute for fossil fuels and non-wood furniture, respectively, while 96, 54 and 71% of students commented on storing carbon, lowering CO2 emissions, and reducing deforestation, respectively, by the use of wood and residues. This mitigation benefit of wood also depends on recycling and reusing of wooden furniture, and scientific use of wood residues (e.g., biomass gasification) and almost all students agreed with the post-use of furniture as fuels. About 78% of students showed a positive attitude to use and 72% to buy more wooden furniture compared to non-wood furniture and 78% to reuse or recycle post-use furniture. These positive attitudes toward using and buying wooden furniture and recycling wood in science students were significantly higher than those in non-science students. Our findings also show that students’ perceptions of wooden furniture and bioenergy were reflected in their positive attitudes to promote the use of these. However, peoples’ unawareness about environmental benefits of wood and bioenergy use and related policies, and post-use of wood products or recycling have been seen as the main challenges. Young generations’ positive attitudes could help society to overcome the challenges. The study concluded to incorporate environmental education along with formal education so that non-science and female students could easily perceive new ideas and conceptions at their youth stage to show positive behavior towards using wood-based products and bioenergy. The findings of this study could be applied to other regions of a similar environment in building up essential awareness and attitudes of tertiary level students towards environmental benefits and climate change mitigation.

1. Introduction

Replacing non-wood (fossil-based) materials (e.g., steel and plastic) and fuels (e.g., gas and oil) with wood could reduce emissions while promoting a forest-based bioeconomy and enabling environment and energy security (Knauf et al., 2015; Sanderson et al., 2016; Smyth et al., 2016; Leskinen et al., 2018). Harvested wood products (HWPs) can significantly contribute to climate change mitigation by gaining climate substitution benefits and keeping stored carbon dioxide (CO2) intact till their service life and thereby reducing the concentration of CO2 in the atmosphere (IPCC, 2018; Jordan et al., 2018). However, the creation of a wooden furniture market and establishing a viable forest-based bioeconomy requires societal, political, and institutional changes and actions for systematic transformation (Goen and Pavone, 2015; Dietz et al., 2018; Lewandowski, 2018). The transformation to a bioeconomy is a complex reality, but transformative education may empower learners and future generations to become familiar with a new understanding of bioeconomy and forest biomass based-climate change mitigation (Masiero et al., 2020).

To promote forest-based bioeconomy in Bangladesh, it is required that the production and consumption of HWPs and biomass energy are enhanced. With an increase in the consumption of wood and wood-based energy, a new dimension of an economy can be strategically developed which further may contribute to gross domestic product

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BBS (2019). However, inefficient use of traditional biomass fuels might lead to deforestation and forest degradation, thereby releasing again CO₂ into the atmosphere (Rüter et al., 2016).

To face such changes in society, stakeholders’ perceptions about the matter affecting decision-making processes at various levels need to be investigated (Mustalab, 2017). People’s perceptions and attitudes are two of the important factors that affect an individual’s pro-environmental behavior and awareness around them (Müderrisoglu and Alatanlar, 2011). A positive attitude towards the environment entails the protection of the environment and thus it changes one’s behaviors towards the environment and society (Sultana et al., 2017). Bulent et al. (2009) also found a positive attitude of people toward the environment; however, there is a gap between the conceptual knowledge of the environment and the enthusiasm to participate in environmental conservation (Halder et al., 2013). In addition, gender differences have been found in perceptions and attitudes towards the environment, renewable energy, and science (e.g., Boztepe, 2011; Wright, 2011; Karytsas and Theodoropoulou, 2014) and females appeared to be less positive towards science concerning the environment and renewable energy than males (Crne-Hladnik et al., 2009; Qin and Brown, 2007). Young people, for example, students compared to the old are aware of the importance of using renewable energy than fossil energy fuels (Greenberg, 2009). This is also driven by the discipline and education level of the students influencing their responses and attitudes to introducing or supporting environmentally beneficial measures in society (Stephens et al., 2009; Yapici et al., 2017).

Educational institutions contribute to creating awareness of society toward pro-environmental behavior (Halder et al., 2011; Micangeli et al., 2014). Higher Education Institutions (HEI), e.g. universities act as a center for transformational efforts by increasing one’s competencies, educating their graduates with interdisciplinary skills, and facilitating transition through effective, participatory processes and a close dialog among multiple disciplines (Masiero et al., 2020). However, students’ perceptions and attitudes are their intrinsic awareness and behavior that should be evaluated within the contexts they perceive to favor or disfavor (Nilfont, 2012). In this context, tertiary students’ perceptions and attitudes towards wood and non-wood materials are needed to understand for future policy implications as they are center-stage for the development of their thoughts as future policymakers and workforces.

Several studies conducted so far based on students’ perception of renewable energy and bioenergy emphasized that the educational institutes build up essential awareness and attitudes of students towards environmental benefits of using renewable energy (Halder et al., 2016, 2013, 2012, 2011, 2010; Radics et al., 2016; Zydin et al., 2014a). Studies on young people’s perceptions of wood products are very limited across the world (Toppinen et al., 2013), although their great potential is realized in their contribution to the amelioration of the environment (Tuncer et al., 2009). Lähtinen et al. (2019); Stout et al. (2020), and Toppinen et al., (2013) studied perceptions of the young generation (age 20–38 years) and consumers on environmental awareness of using wood but geographically their study focused on Europe.

Bangladesh has over 45 million youths aged between 18 and 35 (BBS, 2019), and is experiencing many environmental difficulties, such as deforestation and overuse of fossil fuels, for instance, due to unsustainable industrial growth. These youths would have potential if they could be utilized in raising awareness and motivating others regarding environmental issues in the country. It is also a prerequisite to understand how countries are fulfilling their emissions reduction target, and increasing the use of renewables in future material use (Halder et al., 2010; Hemstrom et al., 2011). Under such backdrops, our study aims to investigate university students’ perceptions, attitudes, and challenges towards using wood or bamboo-based furniture and bioenergy and how they vary with respect to their gender, disciplines, and academic levels. The findings of this study are expected to have implications for related policies in Bangladesh.

In the next section of the paper, the materials and methods employed are discussed. We have presented Results and Discussion under section three. Finally, conclusions and policy implications are drawn in the final section of the paper.

2. Materials and methods

2.1. Data collection

In Bangladesh, university-level education is considered the highest possible education, and therefore, graduates with tertiary education are expected to think and take decisions judiciously for environmental protection (Delakowitz and Hoffmann, 2000). We conducted this study on students in different disciplines at a public university in Bangladesh, the University of Chittagong, one of the top five public universities in the country. The graduates of this university hold their positions at the national level in decision-making processes of different government organizations such as high officials in the Ministries of Environment, Forests, and Climate Change, Finance, Planning, Energy and Natural Resources, and Bangladesh Bank, and NGOs including Grameen Bank. They can contribute significantly to policymaking in energy and environmental sectors, for example. Therefore, our study is crucial to understanding the decision-making abilities of the existing students because it is also directed by the values and attitudes people possess (Rennie, 2007). Moreover, the university, as well as the whole Chattogram region, is rich in forest resources compared to other regions of the country which could give the students of this university a better understanding of the importance of wood resources in climate change mitigation and bioeconomy. The university has 54 Departments or Institutes under 10 Faculties. No such study on the perceptions and attitudes of climate benefits of wood use or environmental awareness was conducted so far at the University of Chittagong. Previously, studies on environmental awareness were undertaken among students of Dhaka University, Jahangirnagar University, Stamford University Bangladesh, and State University of Bangladesh (Majumder, 2017). Another study was carried out on students’ perceptions about climate change at Bangladesh Shahjalal University of Science and Technology (SUST) in Sylhet (Haq and Ahmed, 2020). Moreover, studies about environmental knowledge, perceptions about climate change, and attitudes among secondary level students (Rahman et al., 2014; Sultana et al., 2017) were also conducted in Bangladesh.

The study was conducted through voluntary face-to-face interviews within a period of four months, from October 2019 to January 2020. In asking open questions, there is a need for rigorous discussion and clarification about the matters and issues raised. In addition, the new discussion was formulated by giving the interviewees opportunity to raise relevant issues or questions, which were not asked during the interview. Data were collected by using a pre-tested semi-structured questionnaire interview with selected 250 tertiary level students of the University of Chittagong, Bangladesh through stratified random sampling. The
University offers degree programmes in diversified disciplines including physical and biological sciences, arts and humanities, social science, law, and engineering. In the selection of 250 students, gender (male 116 and female 134), academic year (first and second year students 150 and third year or further 100), discipline (science students 82 and non-science 164), and permanent residing locations (urban 135 and rural 115) of the respondents were considered (Table A1). Science students consisted of students from physical, biological, and engineering disciplines while non-science students from arts and humanities, law, and social science disciplines. New students were considered those who were in the first and second year of their Bachelor’s degree while old students were considered in the third and final years and Master’s students.

As the University attracts students from all over the country, hence special attention was also given to respondents from rural and urban areas, representing heterogeneity. The questionnaire was first validated with five students from the first, second, third, and final year of Bachelor’s, and Master’s degrees for clarity, comprehensiveness, and acceptability. We also took 10 opinions from teachers; five from science subjects such as Physics, Geography and Environmental Studies, Botany, Mathematics, and Electrical and Electronic Engineering, and five from non-science subjects including Economics, English, Development Studies, Law, Human Resource Management on the preliminary questionnaire to check the understanding of terminologies or jargons. Teachers were aware of the course curricula of the faculty; therefore, they could guide us about the question patterns or terminologies which students of different disciplines were able to answer without any confusion or difficulties. They tested the questionnaire by filling it and providing feedback, based on which, we edited the questionnaire and restructured it. These pre-testing results and feedback and suggestions from the students and teachers helped to improve the content of the final version of the questionnaire. Moreover, scientific terms such as substitution impacts were defined at the end of the questionnaire in the list of glossaries as guidance for interviews. Those students were excluded from the final interview. The questionnaire included the students’ current status of studentship and perception-based questions about using wooden or bamboo furniture and bioenergy. The questions related to students’ studentship included gender, academic year, and discipline (science and non-science). The final section included 11 perceptions, 6 attitudes, and 9 challenges-based statements about using wood-based furniture and bioenergy. The questionnaire was structured through a rigorous literature review, studying available examples of perceptions on wood and bioenergy use and two brainstorming rounds among authors and students to include pertinent topical aspects including policy supports. Previous literature in relation to knowledge, perceptions, and challenges was compared in terms of the mean score of Likert scale values and Independent samples t-test was performed to determine the significant variation in the mean scores by gender, academic year, and discipline of the respondents. The Spearman correlation was performed to understand the relationship between respondents’ perceptions and attitudes towards using wood-based furniture and bioenergy.

3. Results and discussion

3.1. Respondents’ perceptions of using wood-based furniture and bioenergy

The University students were found aware of climate change mitigation benefits of wood since they (Agreement index (AgI) are 90, 96, and 59% for items i, ii, and vii, respectively; Table 1) believed that wooden or bamboo furniture and fuels (firewood and residues) can substitute for non-wood (fossil-based) furniture and fossil fuels and store carbon to lower CO2 emissions while reducing deforestation by more efficient and appropriate use depending on science-based evidence (e.g., ICS, biomass gasification) (AgI 54 and 71% for items ix and x, respectively; Table 1). The use of wood products in improving the environment has also been perceived by school and college students in a study by Stout et al. (2020). Since traditional use of firewood and wood residues as fuels have increased (AgI 96% and 98% for items v and vi, respectively) scientific use of these, for example, using ICS and gasification, needs to be ensured towards substituting for natural gas, LPG, and oil. The ICS was found to save fuel and generate lower emissions compared to traditional cooking stoves (TCS) (Begum, 2015). In Bangladesh, the use of ICS can save up to 50% firewood for the same amount of cooking (FD, 2017). Halder et al. (2011) also reported that 58–71% of school students agreed with using bioenergy in substituting for fossil fuels and lowering CO2 emissions. A previous study also found that university students in Bangladesh are aware of the degradation of the environment such as climate change and its mitigation (Mujumder, 2017).

This mitigation benefit of wood also depends on recycling and reusing, about which almost all students (item iv, AgI 95%; Table 1) agreed with the post-use of furniture as fuels, however, two-thirds were neither positive nor negative towards using recycled products from post-use furniture (item iii, AgI 69%; Table 1). Alternatively, wood or residues can also be used to manufacture wood composites instead of using as fuels, but around half of the students were ambivalent (item viii) since the technical issue of making composite wood appears more complex than that of bioenergy, for which they might be less aware. Halder et al. (2012) also pointed out a controversial proposition with students’ ambivalence in this respect. In addition to this, the manufacturing of recycled products from furniture at the end-of-life, a new concept in
Bangladesh, resulted in students’ minds with critical perceptions. Over half of the respondents perceived that the government policy (e.g., renewable energy policy 2008) is promoting the use of wood and renewable energy (item x, AgI 57%; Table 1).

Moreover, the Forestry Master Plan aims to increase the share of timber domestically (i.e. within Bangladesh) towards promoting furniture industries by reducing the imports of solid wood and processed wood (FD [Forest Department], 2017). However, the mean scores of the Likert scale in our study indicate that students’ perceptions were not significantly affected by their gender, academic level, and discipline of the degree program (Table 1). Similarly, Sultana et al. (2017) also noticed no significant differences in environmental awareness between male and female students in Bangladesh. On the other hand, some studies from UK, Germany, and Bangladesh revealed that females had higher environmental awareness and perception of climate change compared to males (Atigul Haq, 2013; Carlton and Jacobsen, 2013; Shi et al., 2016). This may be because of greater exposure of female communities to disasters than males, and this might be the reason why female students have higher awareness and perceptions than males. Whereas, in our study, both male and female students get familiar with environmental issues from university-level education; which might result in no difference in perceptions between male and female students.

### 3.2. Respondents’ attitudes towards using wood-based furniture and bioenergy

According to the attitude index, not only had 72–78% of the students revealed positive attitudes toward using and buying more wooden furniture and reusing or recycling post-use furniture but also a positive willingness to know more about the environmental benefits of wood or bioenergy (items i, ii, v, and vi; Table 2). From mean scores, it was also evident that the positive attitudes toward using and buying wood-based furniture and wood recycling (items i, ii, and vi; Table 2) in science students were significantly higher than those in non-science students. Students from Physics, and Geography and Environmental Studies disciplines, for example, are used to study courses related to material science, energy, and environmental benefits of bio-products, for which science students expressed more positive attitudes than non-science students. This may be due to the fundamental understanding of science students related to the environmental benefits of wood and bioenergy, such as substitution benefits and carbon storage in wood.

### Table 1

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Respondents’ perceptions (%)</th>
<th>Mean with SEM (Gender) t-test (p value)</th>
<th>Mean with SEM (Discipline) t-test (p value)</th>
<th>Mean with SEM (year) t-test (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Wooden furniture as good substitute for non-wood furniture</td>
<td>5</td>
<td>85</td>
<td>4.12±0.09</td>
<td>0.84</td>
</tr>
<tr>
<td>ii</td>
<td>Wood/bamboo furniture store carbon</td>
<td>4</td>
<td>92</td>
<td>3.89±0.07</td>
<td>0.78</td>
</tr>
<tr>
<td>iii</td>
<td>Wood/bamboo furniture can be recycled or reused at end-of-life</td>
<td>0</td>
<td>13</td>
<td>3.56±0.06</td>
<td>0.44</td>
</tr>
<tr>
<td>iv</td>
<td>Wood/bamboo furniture can be reused as fuel at end-of-life</td>
<td>21</td>
<td>75</td>
<td>3.97±0.07</td>
<td>0.62</td>
</tr>
<tr>
<td>v</td>
<td>Use of firewood is increasing in rural area</td>
<td>25</td>
<td>73</td>
<td>3.66±0.08</td>
<td>0.50</td>
</tr>
<tr>
<td>vi</td>
<td>Use of wood residues as traditional fuel is increasing</td>
<td>30</td>
<td>66</td>
<td>3.31±0.07</td>
<td>0.87</td>
</tr>
<tr>
<td>vii</td>
<td>Scientific use of firewood/residues as fuels can replace LPG, gas</td>
<td>28</td>
<td>34</td>
<td>3.55±0.09</td>
<td>0.63</td>
</tr>
<tr>
<td>viii</td>
<td>Wood/residues can be reused in manufacturing wood composites instead of using as fuels</td>
<td>15</td>
<td>34</td>
<td>3.61±0.08</td>
<td>0.38</td>
</tr>
<tr>
<td>ix</td>
<td>Scientific use of wood/residues lower CO2 emissions</td>
<td>28</td>
<td>34</td>
<td>3.55±0.09</td>
<td>0.63</td>
</tr>
<tr>
<td>x</td>
<td>Scientific use of wood/residues reduce deforestation</td>
<td>25</td>
<td>49</td>
<td>3.31±0.07</td>
<td>0.87</td>
</tr>
<tr>
<td>xi</td>
<td>Govt. policy is promoting the use of wood and bioenergy</td>
<td>21</td>
<td>42</td>
<td>3.75±0.09</td>
<td>0.81</td>
</tr>
</tbody>
</table>
Table 2
Respondents’ attitudes (%) and mean score of 5 points Likert scale (1=very unlikely, 2=unlikely, 3=neutral, 4=likely, 5=very likely) towards using wood-based furniture and bioenergy by gender, discipline, and academic year. VL: Very likely, L: Likely, N: Neutral, UL: Unlikely, VU: Very unlikely, AI: Attitude index. SEM: standard error of the mean. * Significant at p < 0.05 level.

<table>
<thead>
<tr>
<th>No</th>
<th>Items</th>
<th>Respondents’ attitudes (%)</th>
<th>t-test (p value)</th>
<th>t-test (p value)</th>
<th>t-test (p value)</th>
<th>t-test (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>VL</td>
<td>L</td>
<td>N</td>
<td>UL</td>
<td>VU</td>
</tr>
<tr>
<td>i</td>
<td>Would like to use wood/bamboo furniture</td>
<td>45</td>
<td>37</td>
<td>15</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>ii</td>
<td>Would like to buy more wood/bamboo furniture</td>
<td>42</td>
<td>35</td>
<td>18</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>iii</td>
<td>Would like to shift from non-wood to wood furniture</td>
<td>31</td>
<td>35</td>
<td>24</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>iv</td>
<td>Would like to use wood-based bioenergy</td>
<td>21</td>
<td>32</td>
<td>44</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>v</td>
<td>Would like to know more about the environmental benefits of wood/bioenergy</td>
<td>42</td>
<td>34</td>
<td>22</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>vi</td>
<td>Would like to recycle or reuse wood furniture at the end-of-life</td>
<td>35</td>
<td>46</td>
<td>17</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3
Correlation between respondents’ perceptions and attitudes towards using wood-based furniture and bioenergy.

<table>
<thead>
<tr>
<th>No</th>
<th>Variables</th>
<th>i</th>
<th>ii</th>
<th>iii</th>
<th>iv</th>
<th>v</th>
<th>vi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Would like to use wood/bamboo furniture</td>
<td>Would like to buy more wood/bamboo furniture</td>
<td>Would like to shift from non-wood to wood furniture</td>
<td>Would like to use wood-based bioenergy</td>
<td>Would like to know more about environmental benefits of wood/bioenergy</td>
<td>Would like to recycle or reuse wood furniture at the end-of-life</td>
</tr>
<tr>
<td>i</td>
<td>Wooden furniture as good substitute for non-wood furniture</td>
<td>0.11</td>
<td>0.14*</td>
<td>-0.05</td>
<td>0.04</td>
<td>0.02</td>
<td>0.11</td>
</tr>
<tr>
<td>ii</td>
<td>Wood/bamboo furniture store carbon</td>
<td>-0.09</td>
<td>-0.03</td>
<td>-0.01</td>
<td>0.11</td>
<td>0.13*</td>
<td>-0.01</td>
</tr>
<tr>
<td>iii</td>
<td>Wood/bamboo furniture can be recycled or reused at end of life</td>
<td>0.12*</td>
<td>0.12</td>
<td>-0.09</td>
<td>-0.03</td>
<td>0.23**</td>
<td>-0.05</td>
</tr>
<tr>
<td>iv</td>
<td>Wooden furniture can be recycled as fuel</td>
<td>-0.13*</td>
<td>-0.045</td>
<td>-0.09</td>
<td>0.28**</td>
<td>0.11</td>
<td>0.02</td>
</tr>
<tr>
<td>v</td>
<td>Use of firewood is increasing in rural area</td>
<td>-0.09</td>
<td>-0.08</td>
<td>-0.06</td>
<td>0.13*</td>
<td>0.16*</td>
<td>0.08</td>
</tr>
<tr>
<td>vi</td>
<td>Use of wood residues as traditional fuel is increasing</td>
<td>-0.06</td>
<td>-0.14*</td>
<td>0.03</td>
<td>0.03</td>
<td>0.12</td>
<td>-0.02</td>
</tr>
<tr>
<td>vii</td>
<td>Scientific use of wood fuel/residues as fuels can replace LPG</td>
<td>0.01</td>
<td>0.01</td>
<td>0.27**</td>
<td>0.11</td>
<td>-0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>viii</td>
<td>Wood/residues should be reused in manufacturing wood composites instead of using as fuels</td>
<td>-0.01</td>
<td>-0.05</td>
<td>0.04</td>
<td>0.05</td>
<td>0.08</td>
<td>-0.01</td>
</tr>
<tr>
<td>ix</td>
<td>Scientific use of wood/residues lower CO2 emissions</td>
<td>-0.06</td>
<td>-0.05</td>
<td>0.09</td>
<td>0.20**</td>
<td>0.26**</td>
<td>0.11</td>
</tr>
<tr>
<td>x</td>
<td>Scientific use of wood/residues reduce deforestation</td>
<td>0.05</td>
<td>0.08</td>
<td>-0.07</td>
<td>0.09</td>
<td>0.08</td>
<td>0.09</td>
</tr>
<tr>
<td>xi</td>
<td>Govt. policy in promoting use of wood and bioenergy</td>
<td>-0.02</td>
<td>-0.02</td>
<td>0.15*</td>
<td>0.07</td>
<td>0.01</td>
<td>0.17**</td>
</tr>
</tbody>
</table>

* Correlation is significant at p ≤ 0.01 level.
* Correlation is significant at p ≤ 0.05 level.

discipline (Haq and Ahmed, 2020).

The result of the study also depicts that around half of the respondents would like to shift from non-wood to wooden furniture and to use bioenergy (items iii and iv; Table 2). Similar results were also found elsewhere (Halder et al., 2012, 2011; Qu et al., 2011), where university and school students also showed positive attitudes toward bioenergy, with their willingness to use it in the future. University-level education plays a vital role in encouraging contemporary learning, such as green products and energy in today’s world, along with formal education so that non-science students could receive rapidly new ideas and
conceptions at their youth stage. Halder (2014) and Yapici et al. (2017) also emphasized the role of school to influence new attitudes positively and awareness of the environment.

### 3.3. Relation between respondents’ perceptions and attitudes

Our findings also show that students’ perceptions of wooden furniture and bioenergy were reflected in their positive attitudes to promote the use of these. Students’ perceptions on wooden furniture as a good substitute for non-wood furniture were significantly \( p \leq 0.05 \) and positively related to their willingness to buy more wooden furniture (Table 3). Students who agreed with the carbon storage and post-use recycling and reusing emissions reduction ability of wood would like to know more about related environmental benefits. Related to fuels, students who were interested to use wood-based bioenergy positively perceived the increased use of firewood and post-use of wood as fuels (Table 3).

Students’ perceptions direct their attitudes or behavior related to wood and bioenergy (Halder et al., 2013; Ozbag, 2016). Liarakou et al. (2009) also suggested that people’s perceptions and attitudes are important concerns to relate to environmental issues as they are interlinked. Pro-environmental education programs among students on the importance of using bioenergy and wooden furniture can be encouraged in the policy. There is a strong need not only for educational programs for students towards bioenergy use but related policies should also be introduced by consultation with educational institutes, government bodies, and users (Radics et al., 2015).

### 3.4. Respondents’ challenges towards using wood-based furniture and bioenergy

Table 4 depicts the challenges against using wood-based furniture and bioenergy and most of the respondents (items ii and v, AgI 70–72%) found apparent challenges such as insufficient forests and little development of composite wood furniture. Moreover, a ban on tree harvesting in the public forest (perceived by 23% of students) appeared as another challenge to develop wooden furniture industries. Otherwise, tree harvesting for furniture manufacturing industries and fuels was perceived (by 58% of students) to lead to deforestation of public forests. In this regard, existing wood-based furniture industries mostly depend on imported wood and local wood harvested, thus the risks of deforestation move to private woodlots and trees outside forests (e.g. roadside plantation, homestead forestry). In Bangladesh, the import of wood in 2019–20 was 0.22 million m³ (Division Forest Office, 2021a, b) and the annual consumption of wood in sawmills was 7 million m³ of sawlogs harvested from the homestead and private woodlot (FD, 2017). However, promotion of wooden or bamboo furniture can also be hindered by peoples’ unawareness of the post-use of furniture (recycling and reusing at end-of-life), inadequate knowledge of their environmental benefits, and related policies (items vi, vii, and ix, AgI 72–87%). This may be explained by peoples’ awareness of climate change but unconsciousness or reluctance for adopting mitigation strategies such as recycling and reusing.

### Table 4

Respondents’ responses on challenges (%) and mean score of 5 points Likert scale (1—strongly disagree, 2—disagree, 3—neutral, 4—agree, 5—strongly agree) towards using wood-based furniture and bioenergy by gender, discipline, and academic year. SA: Strongly agree, A: Agree, N: Neutral, D: Disagree, SD: Strongly disagree, AgI: Agreement index. SEM: standard error of the mean. * Significant at \( p < 0.05 \) level.

<table>
<thead>
<tr>
<th>No</th>
<th>Items</th>
<th>Respondents’ responses (%)</th>
<th>t test (p value)</th>
<th>Mean with SEM (Discipline)</th>
<th>t test (p value)</th>
<th>Mean with SEM (year)</th>
<th>t test (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
<td>t test (p value)</td>
</tr>
<tr>
<td>i</td>
<td>Ban on tree harvesting in forests</td>
<td>18</td>
<td>25</td>
<td>37</td>
<td>16</td>
<td>4</td>
<td>23</td>
</tr>
<tr>
<td>ii</td>
<td>Insufficient forest to manufacture wooden furniture</td>
<td>26</td>
<td>50</td>
<td>18</td>
<td>6</td>
<td>0</td>
<td>70</td>
</tr>
<tr>
<td>iii</td>
<td>Tree harvest for furniture manufacture and fuel would result in deforestation</td>
<td>26</td>
<td>33</td>
<td>38</td>
<td>0</td>
<td>2</td>
<td>58</td>
</tr>
<tr>
<td>iv</td>
<td>Ensuring scientific use of wood residues as fuels would be a challenge</td>
<td>14</td>
<td>26</td>
<td>53</td>
<td>6</td>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>v</td>
<td>Manufacturing of composite wood furniture is little developed</td>
<td>22</td>
<td>50</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>72</td>
</tr>
<tr>
<td>vi</td>
<td>Peoples’ unawareness of post-use of wood products</td>
<td>8</td>
<td>24</td>
<td>48</td>
<td>18</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>vii</td>
<td>Knowledge gaps about environmental benefits of wood/bamboo and bioenergy</td>
<td>31</td>
<td>54</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>viii</td>
<td>Increasing wood-based bioenergy production will decrease food production</td>
<td>32</td>
<td>43</td>
<td>23</td>
<td>2</td>
<td>0</td>
<td>72</td>
</tr>
<tr>
<td>ix</td>
<td>Inadequate knowledge and awareness about policy on wood and bioenergy</td>
<td>38</td>
<td>49</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>87</td>
</tr>
</tbody>
</table>
reuse of wood products. Zeeshan et al. (2021) found students being concerned about climate change by attending formal education were not involved in mitigation actions.

In our study, however, respondents’ ambivalence was clear on items i, iii, iv, and vii as a majority of them were neutral on the ban on forest tree harvest (37%), increased tree harvest would increase deforestation (38%), ensuring scientific uses of wood residues (53%), and the relationship of bioenergy with food production (48%) (Table 4). Hassan et al. (2014) found a majority of households in rural Bangladesh possessed a relatively low level of knowledge of ICS and improved technology of biomass fuels (briquette, biogas, and biodiesel). Therefore, ensuring scientific use and improved technology of biomass use would be a challenge in rural Bangladesh. Earlier studies also found that 41–62% of the respondents were undecided on the effects of bioenergy products on food crop production (Halder et al., 2011; Özbaş, 2016). This was also reflected when the gender and academic year of the students appeared to be statistically significant related to item viii, indicating male and new students were more neutral with the proposition that “increasing wood-based bioenergy production will decrease food production” than female and old ones (Table 4). Students’ ambivalence may be explained by their lack of awareness of these issues. This critical thinking of the students about the challenges could help them to be more conscious of the items (Halder et al., 2011, 2010). At the same time, environmental and energy-related education is of utmost importance to increase students’ awareness of bioenergy (Halder et al., 2016).

3.5. Limitations of the study

This study has some drawbacks, for example, we could not study the knowledge level of the students which could be useful in the interpretation of their perceptions and attitudes on the subject matter. We could not compare educated young vs uneducated young consumers, and young vs old consumers in perceptions and attitudes. Moreover, we might also consider conducting a comparative study in different universities in Bangladesh. Furthermore, a satisfactory level of consumers could be involved by performing an in-depth perception study solely. Further study could focus on the actual use of wood and non-wood furniture and energy fuels in the houses and the perceptions of young and old consumers on their uses and levels of satisfaction. In addition to perceptions and attitudes, students’ environmental knowledge of using wood products and energy fuels can be incorporated into the future study for linking with their behavior.

4. Conclusions and policy implications

Our study is one of the first in Bangladesh to study the perceptions and attitudes of tertiary level students regarding wood and non-wood furniture and energy fuels use with varying results and upholding most of the findings with similar studies in other countries (Halder, 2014; Halder et al., 2016, 2013, 2012, 2011, 2010; Micangeli et al., 2014; Özbaş, 2016; Qu et al., 2011; Yapidci et al., 2017; Zyadin et al., 2014a, 2014b). The university students perceived in favor of climate change mitigation benefits of using wood in substitution for non-wood furniture and fuels and storing wood carbon and thus lowering CO2 emissions. This mitigation benefit of wood also depends on recycling and reusing of wooden furniture, and scientific use of wood residues (biomass gasification, ICS) and almost all students agreed with the post-use of furniture as fuels. Most of the students (72–78%) showed positive attitudes toward using and buying more wood-based furniture compared to non-wood furniture and reusing or recycling post-use furniture. These positive attitudes toward using and buying wood-based furniture and recycling wood in science students were significantly higher than those in non-science students. Our findings also show that students’ perceptions of wood-based furniture and bioenergy were reflected in their positive attitudes to promote the use of these.

In Bangladesh, Nationally Determined Contributions (NDC) 2020 proposed a reduction in 21.85% Greenhouse Gas (GHG) emissions in 2041 by mitigation actions compared to the Business-As-Usual (BAU) scenario (MOEFC, 2020). Our results also relate to NDC commitment since most of the university students, amongst future stakeholders, perceived the emissions reduction benefits of using wood in substitution for fossil materials and fuels and reducing deforestation by promoting scientific uses of biomass fuels. Bangladesh Climate Change Strategy and Action Plan 2009 aims to build low carbon development along with the country’s growing economy (MoEE, 2009), which is in line with, as future decision-makers, students’ willingness to use and buy more wood products and shift to wooden furniture from non-wood furniture that could contribute to the reduction in atmospheric CO2 while developing and implementing a bioeconomy in the country. To attain the target of increasing the share of renewable energy up to 10% of the total energy supply by 2041 (Power Division, 2016), students’ willingness to use wood-based bioenergy instead of fossil fuels and to recycle wood products are crucial for mitigating climate change. Moreover, the use of biomass fuels and dissemination of potential technologies such as ICS, biomass gasification, and improved fuels, and the promotion of clean energy under the clean development mechanism (CDM) were emphasized in the Renewable Energy Policy 2008 of Bangladesh (GOB PD, 2011) as students also perceived. However, peoples’ unawareness about environmental benefits of wood and bioenergy use and related policies, and post-use of wood products or recycling have been seen as the main challenges, which can be overcome by students’ intention to know more about environmental benefits of wood and bioenergy and knowledge transfer to the people.

Traditional use of firewood results in overharvesting of biomass which may lead to deforestation since the share of firewood constituted over 80% of all wood consumed in the country and the majority of the demand comes from natural forests (FD, 2017). Therefore, trees outside forests are prioritized since they meet the demand for around 80% of the firewood and timber of the country (FD, 2016, 2017), which can release pressure on natural forests. In the current draft forest policy 2016, the use of modern and efficient wood processing technologies and plants and research in wood processing are encouraged to minimize wastage (FD, 2016). Using HWPs and biomass energy from sustainably managed forests has the potential in mitigating climate change in the long term (Gustavsson et al., 2017; Chen et al., 2018). To avoid deforestation due to overutilization of wood, the balance between conservation and utilization of forest resources should be clearly articulated in the forest policy of Bangladesh. Existing climate change mitigation and renewable energy policies could promote recycle and reuse of wood while protecting forests, and these policies should focus on the economic and environmental benefits of using wood-based products and bioenergy as well as carefully consider human health issues as sometimes the end-use of wood for energy purposes is not possible due to treatments of furniture. It is suggested that university-level education should incorporate environmental education related to green products, energy, and bioeconomy, along with formal education so that non-science and female students could easily perceive new ideas and conceptions at their youth stage while turning to positive behavior towards using wood-based products and bioenergy. The young generation would play a vital role to generate awareness among people about their environment and forest-based bioeconomy based on sustainability in forest management.

This study will help both educators and policymakers to formulate strategies for hovering societal awareness of wood-based products and bioenergy and their utilization. The future study will particularly help the Ministry of Environment, Forest and Climate Change (MoEFC) in making related policies and mechanisms, for example, to consider emission reduction benefits of wood use in the forestry sector in carbon accounting. Young generations’ positive attitudes in this regard could help the society to overcome the challenges and in any mitigation policies or projects integration of the society as a whole to take part in the process of mitigating climate change is inevitable. Since education helps in the broader understanding of the young generation, therefore, further
study should focus on students’ level of knowledge of wood-based products and bioenergy along with the quantities of their actual uses. The findings of this study could be applied to other regions or countries of a similar environment to get insight into the role of educational institutes in building up essential awareness and attitudes of students towards environmental benefits and climate change mitigation of harvested wood.

Declarations

We declare that the manuscript has not been published in any journal/book or proceedings or in any other publication, or offered for publication elsewhere in substantially the same or abbreviated form, either in print or electronically.

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CRediT authorship contribution statement

Tarit Kumar Baul: Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing. Mahin Ahmed Khan: Data curation, Formal analysis. Anirban Sarker: Data curation, Formal analysis. Anashuwa Chowdhury Atri: Data curation, Formal analysis. Mohammed Mashimuddin: Visualization, Investigation, Validation, Writing – review & editing. Ashraful Alam: Visualization, Investigation, Validation, Writing – review & editing.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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Supplementary materials

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References

Divisional Forest Office, 2021a. Forest Utilization Division, Chittagong, Bangladesh. Divisional Forest Office, 2021b. Cox’s Bazar South Forest Division, Chittagong, Bangladesh Forest Department, Bangladesh.