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Bamboo Biomass for Bioenergy Production in Mauritius

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Abstract

Bamboo, globally renowned as being one of the fastest-growing plants in the world with versatile applications, has gained increasing attention during the past decades. It is being used by millions of people around the globe as a biomass resource for energy production, as timber for furniture making, in the food industry and many more. So far, on the Island of Mauritius, little to no consideration has been given to this fascinating plant. This paper presents the physical and chemical properties of two species of bamboo—*Bambusia vulgaris* and *Bambusia bambos*, compared to sugarcane bagasse for bio-energy production. Ten samples of each species were tested for gross calorific value (GCV), moisture, ash and chloride content. The results show that both species have a very good potential for energy recovery with a GCV of 16.77 MJ/kg for *Bambusia vulgaris* and 17.44 MJ/kg for *Bambusia bambos*, and are valuable sources of biomass with an average energetic yield of 717.8 GJ/ha/yr and 1587.1 GJ/ha/yr respectively. In comparison, the GCV for sugarcane bagasse was found to be 18.33 MJ/kg with an energetic yield of 824.9 GJ/ha/yr. Simultaneously, a research survey on community acceptance and perception of the Mauritian citizens towards the utilisation of bamboo biomass as an alternative to fossil fuels for bio-energy production was conducted via semi-structured questionnaires. The questionnaires were administered to a total of 54 respondents. 3 women and 3 men were randomly interviewed in each of the 9 districts of the island. The results show that the participants are very much aware of the many issues related to the exploitation of fossil fuels and support the use and implementation of renewable sources of energy for bio-energy production. Eighty percent of the participants supported the implementation of bamboo biomass in the overall energy generation mix in a bold move to lessen their ecological footprint.

Keywords

Bamboo, *Bambusia vulgaris*, *Bambusia bambos*, Biomass, Renewable Energy,

Gross Calorific Value, Community Acceptance

1. Introduction

1.1. Background

The Island of Mauritius is situated about 800 km off the east coast of Madagascar at latitude 20˚ south and longitude 58˚ east. As a result of the general improvement in the standard of living and sustained economic growth, the overall energy consumption of Mauritius has risen sharply during recent years. In 2017, the Total Primary Energy Requirement (TPER) and the Total Energy Consumption (TEC) added up to 1603 ktoe and 982 ktoe respectively. The TPER for the year 2017 was mainly comprised of 57% petroleum products, 29.4% coal and 13.6% renewables [1]. The Republic of Mauritius has no known oil, coal or natural gas reserves, and therefore depends heavily on imported fossil fuels to meet most of its energy requirements.

On an annual basis, the island imports some 900,000 tonnes of petroleum products and 225,000 tonnes of coal which together account for 75.4% of the primary energy demand. In 2017, 2531 ktoe of fossil fuels comprising 35% coal, 24.6% fuel oil, 13.8% diesel oil 12.8% dual purpose kerosene, 7.3% gasoline and 6.4% Liquefied Petroleum Gas (LPG) were imported. Compared to data from 2016, imports in petroleum products have seen an increase of 11.6% (from 1474 ktoe to 1645 ktoe). This conclusively had an impact on the import bills of both petroleum products and coal, where from 2016 to 2017, an increase of 36% (from Rs 21,610 million to Rs 29,406 million) was noted [1] [2].

1.2. Electricity Generation

In 2017, some 3157 GWh of electricity was generated. Around 79% (2496 GWh) of electricity was generated from non-renewable sources, mainly from coal and fuel oil. The remaining 21% (661 GWh) was generated from renewable sources, mostly from sugarcane bagasse (**Figure 1**).

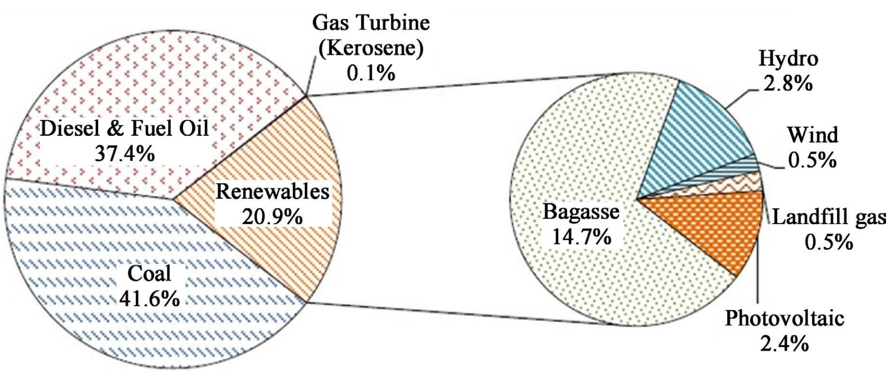

Figure 1. Percentage share of energy sources in electricity generation, 2017 [1].

Compared to data from 2016, the total electricity generated in 2017 increased by 3.8% (from 3042 GWh to 3157 GWh). Electricity generated from coal increased by 3.6% (from 1267 GWh to 1312 GWh) and fuel oil and diesel by 6.4% (from 1110 GWh to 1181 GWh). On the other hand, however, electricity generated from renewable sources stagnated between the period 2016 and 2017 with 664 GWh and 661 GWh respectively. This was mainly due to a decrease of 6.8% (from 497 GWh to 463 GWh) in electricity generated from sugarcane bagasse [1] [2].

This decrease in sugarcane bagasse can be explained by virtue of the substantial land abandonment by sugar cane cultivators. The nature of these abandonments is mainly due to the fact that the price of sugar on the world market has had a negative impact on the local sugar industry since 2005, forcing farmers to discontinue traditional crop cultivation. In addition, the last decade has been marked by a shift in traditional sugar cane growing activity to other agricultural and non-agricultural activities by farmers following the new economic conditions prevailing over the island. Land abandonment island-wide by farmers has occurred at an average rate of 500 ha per year [3].

This change in land use provides, however, the availability of thousands of hectares of land that could possibly be used for other biofuel crop productions in order to ensure and safeguard the economic return of these abandoned plots of land [4]. Here, bamboo could be an interesting fuel crop to be considered for reducing the dependency on imported fossil fuels for energy production. The potential of bamboo as a suitable biomass feedstock has never been explored before in Mauritius but has proven to be successful in many other countries worldwide.

1.3. Bamboo

Bamboo is a term used to describe a large group of woody grasses belonging to the family *Poaceae* and subfamily *Bambusoideae.* They consist of about 1250 species that grow in warm and humid conditions. Bamboos are mostly distributed in the tropic and subtropical regions (including Mauritius Island) and are known for being distinct plants with a wide range of uses. They play a major role in biodiversity conservation and contribute to soil and water management [5]. They require little to no chemical fertilisers and pesticides to thrive and grow, they can tolerate poor soil conditions, grow in degraded plots of land, and self-regenerate themselves at a fast rate, which makes them an important source of biomass [6].

During the past decades, several studies have investigated the energetic properties of the various species of bamboo worldwide in India, Indonesia, Thailand, China, Chile, Brazil and Africa [7]-[13]. These sources report that the various species of bamboo have a good potential to be used as biomass feedstock in combustion power plants as they possess desirable fuel characteristics such as low moisture content, low ash content, low chloride content and a higher gross calorific value (GCV) compared to other wood species (eucalyptus, spruce and beech) and most agricultural residues such as straw and grass.

In Mauritius, since the 19th century, many efforts and research work have been invested in finding effective and sustainable supplies of renewable energy. Energetic properties of fuel crops like sugarcane and *Arundo donax* have been investigated [4]. But it is very surprising that bamboo, which is locally available and renowned for its fast-growing rate and high-production yield, has never been considered as a viable source of biomass for bio-energy production.

1.4. Aims and Objectives

The main aim of this study is to determine the suitability of two species of bamboo; *Bambusia vulgaris* and *Bambusia bambos* for bio-energy production based on their fuel characteristics. Their relative moisture content, GCV, chloride and ash content are compared to sugarcane bagasse (a by-product from the sugar industry which is currently being used for bio-energy production on the Island) and other agricultural and non-agricultural residues mentioned in literature.

In addition, based on literature data, studies have shown that in some cases even where appropriate technology and raw biomass resource were available, some biomass projects still face resistance due to community opposition [14] [15]. However, up to date, there is a substantial lack of literature on community acceptance of biomass projects and to our knowledge; no study has been conducted on local Mauritian community perceptions of bamboo biomass projects. In this retrospect, this study will also shed light on the general Mauritian community's acceptance and perception of bamboo biomass as a potential source of renewable energy. Local perceptions of the Mauritian citizens were gathered throughout the study using semi-structured questionnaires.

2. Materials and Methods

2.1. Bamboo Sampling

Two bamboo plantations located in Mauritius were investigated during this study. The climate prevailing over the island during the study period was mild tropical maritime winter with a mean precipitation of 364.4 mm and a mean temperature of 20.4˚C [16].

Bambusia vulgaris culms of 2.5 years of age were obtained from Mare-La-Chaux located in the eastern region of the island at a latitude of 20.198˚S and a longitude of 57.749˚E; and *Bambusia bambos* culms of 5 - 6.5 years of age were obtained from the experimental site of Omnicane Milling Operations Limited located in the southern region at Savannah at a latitude of 20.485˚S and a longitude of 57.609˚E.

Both plantations were grown in furrowed pits of around 30 cm × 30 cm × 30 cm with a spacing of 5 - 6 m inter-row and 2.5 - 3 m intra-row with total plant density of around 560 plants per hectare. 10 plots, each 1 m × 1 m at spacing of 25 m inter-row and 25 m intra-row were established in both fields. The number of shoots per plot varied from 16 - 28. Three shoots were randomly selected per plot and culm ranging from 500 - 2500 g were randomly cut per shoot irrespective of the height (bottom-middle-top), amounting to a total of 60 culms for the two plantation fields (n = 60) (n = 30 per field).

2.2. Sugarcane bagasse Sampling

Fresh sugarcane bagasse was obtained from Alteo Milling Limited located in the eastern region of the island in Union Flacq. Ten samples weighing 350 - 500 g were collected at five collection points (n = 50).

2.3. Fuel and Residue Characterisation

The bamboo and sugarcane bagasse samples were transported to the laboratory in sealed polythene bags where they were oven dried at a temperature of 100˚C ± 5˚C for 24 hours for moisture content determination. The dried samples were then pulverised and sieved to particle size of about 5 mm. The raw samples were homogenized through thorough mixing and 10 sub-samples weighing 175 - 350 g were taken randomly for each species: *Bambusia vulgaris* (n = 10); *Bambusia bambos* (n = 10); sugarcane bagasse (n = 10).

Fuel and residual characteristics including GCV, chloride content and ash content of the samples were then determined based on standardised test methods (Table 1).

Table 1. Standard test methods used for fuel and residual characterisation.

Parameter	Standard Test Method
Moisture content	ASTM E871-82 [17]
GCV	ASTM D2015-00 [18]
Chloride content	Mohr's Method [19]
Ash content	ASTM E1755-01 [20]

2.4. Community and Acceptability Perception

Throughout this study, a research on community acceptance and perception of the Mauritian citizens towards bamboo biomass was conducted using semi-structured questionnaires. Several questions regarding energy generation from fossil fuels and alternative biomass sources of energy, more specifically from bamboo were proposed. A randomly produced sample of 54 respondents (n = 54) with reference to gender difference, age groups and area of residence in Mauritius, and who were willing to participate in the study were approached to visualize their overall perspectives towards green biomass. All the participants were approached on an arbitrary basis.

The target survey group was selected within the nine districts of the island (Figure 2) and the respondents of the questionnaires were both women and men. On a random encounter basis, three women and three men aged between 18 and 65 years residing in the district of visit and irrespective of their knowledge towards renewable sources of energy and literacy level were chosen. The languages used during the interviews were Mauritian Creole, English and French. While the chosen sample of 54 respondents did not necessarily represent the Mauritian population as a whole, the survey contributed in furtherance to obtaining a first general impression on acceptance of bamboo biomass for bio-energy production locally. This methodological choice was adopted from a previous study on community acceptance of biomass resources [15].

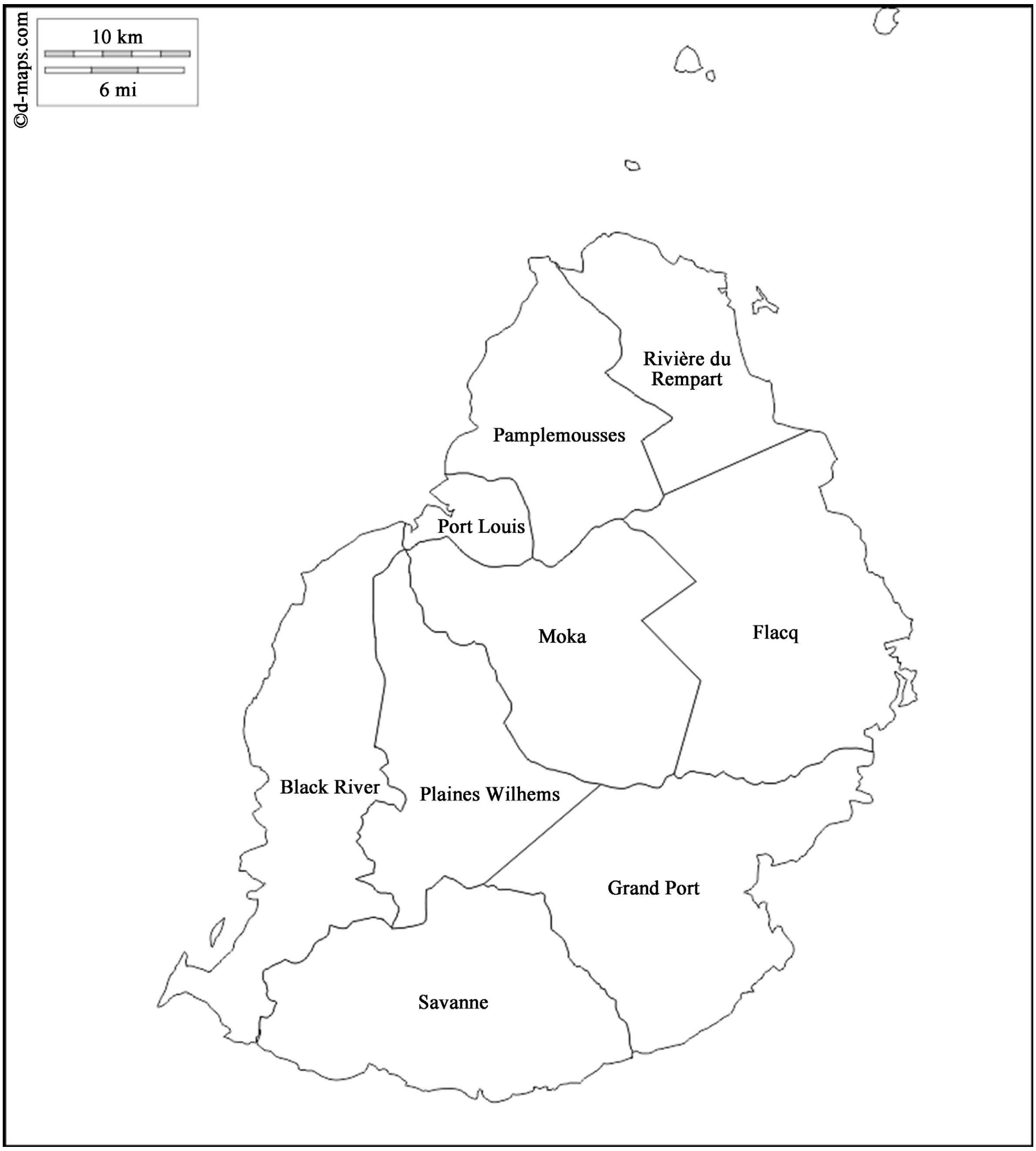

Figure 2. Districts of Mauritius [21].

2.5. Statistical Analysis

The raw data collected was translated to English language and analysed using a thematic analysis. The six-phase framework proposed by [22] was used for themes' coding so as to identify relevant patterns or themes that are important to the research. The empirical data were computed and are presented using matrix display and graphical representations.

3. Results and Discussion

In this section, the main findings from the laboratory testing regarding physical and chemical characteristics of the tested samples of *Bambusia vulgaris, Bambusia bambos* and sugarcane bagasse are presented. The respective fuel characteristics of the two species of bamboo are compared to that of sugarcane bagasse and other agricultural/non agricultural residue from literature to determine their suitability for bioenergy production. Also, the results of the survey carried out on community acceptance and perception of the local citizens regarding the utilization of bamboo biomass is summarised.

3.1. Physical and Chemical Characteristics

Table 2 below illustrates the sample arithmetic means of analysis including moisture content, GCV, chloride content and ash content for *Bambusia vulgaris* culms of 2.5 years old, *Bambusia bambos* culms of 5 - 6 years old and sugarcane bagasse.

Table 2. Sample arithmetic means of physical and chemical analysis of the 10 sub-samples of *Bambusia vulgaris, Bambusia bambos* and sugarcane bagasse.

Species	Age (yrs)	Moisture content (%)	Gross calorific value (MJ/kg)	Chloride content (%)	Ash content (%)
Bambusia vulgaris	2.5	46.3	16.77	0.079	1.34
Bambusia bambos	5 - 6.5	54.6	17.44	0.062	1.57
S. bagasse	N/A	46.7	18.33	0.054	3.36

3.1.1. Gross Calorific Value

The calorific value of any fuel source is the most eminent parameter to be taken into consideration in the determination of its suitability for energy generation. It provides an indication of the energy chemically bounded in the fuel source, which can be converted into heat energy in combustion systems [23]. Fuel sources with higher calorific values are the most desirable for energy generation [24]. During this study, the mean GCV of the two tested species of bamboo; *Bambusia vulgaris* and *Bambusia bambos* were found to be 16.77 MJ/kg and 17.44 MJ/kg, respectively. These two values are slightly lower compared to the GCV of locally available sugarcane bagasse (18.33 MJ/kg), but higher than that of other species of bamboo or agricultural/non agricultural sources that are being used worldwide for energetic purposes. For instance, from a study conducted by [12] in Thailand in 2012, the GCV of the species *Gimsung bamboo* was found to be 15.70 MJ/kg. In another study conducted by [25] in 2016, the GCV of Poplar (*Populus eu-*

roamerica) and rice straw were measured; and their respective values were 14.43 MJ/kg and 16.48 MJ/kg. In this perspective, the GCV of the two tested species of bamboo seem to be valuable enough and could be considered for energy production.

3.1.2. Approximate Biomass and Energy Yield from Bamboo and sugarcane bagasse

The results obtained from the GCV testing showed that both tested species of bamboo (*Bambusia vulgaris* and *Bambusia bambos*), when compared to locally available sugarcane bagasse and other biomass feedstock (poplar, rice straw and *Gimsung bamboo*) from relevant literature [25], have an interesting potential for energy recovery. Based on their relative GCV, the plant density on the collection sites, the average height of each shoot, the average weight and length of each culm, the average number of culms per shoot and the average number of shoots per plot, an estimation of the yield on dry biomass basis (excluding moisture content) and energy yield per hectare per year was calculated. For sugarcane bagasse, based on an estimation that 210 tonnes of sugarcane could be harvested per hectare, and that for each ten tonnes of sugarcane an approximate amount of 3 tonnes of wet bagasse could be yielded [26] [27], its relative GCV and moisture content, an estimate yield of dry biomass and energy per hectare per year was also calculated.

The average biomass yield per hectare per year for *B. vulgaris* and *B. bambos* were found to be 42.8 t/ha/yr and 91.4 t/ha/yr, with respective energy yield of 717.8 GJ/ha/yr and 1587.1 GJ/ha/yr. For sugarcane bagasse, the biomass and energy yield were found to be 45.2 t/ha/yr and 824.9 GJ/ha/yr (**Table 3**). On comparing these values, it can be deduced that almost the same amount of biomass and energy can be yielded from *B. vulgaris* when compared to sugarcane bagasse, and that twice as much biomass and energy can be harvested from *B. bambos* when compared to sugarcane bagasse on a spatio-temporal (hectare/year) basis. This also clearly underlines that both tested species of bamboo have a very good potential to be used as biomass feedstock for bio-energy production.

Table 3. Biomass and energy yield per hectare per year for *Bambusia vulgaris, Bambusia bambos* and sugarcane bagasse.

Species	Biomass yield (t/ha/yr)	Energy yield (GJ/ha/yr)
B. vulgaris	42.8	717.8
B. bambos	91.4	1587.1
S. bagasse	45.2	824.9

3.1.3. Chloride Content

Chloride content present in biomass is another important factor of interest for industrial combustion processes as it may cause adverse effects on the combustion system. Chloride is a naturally occurring element present in biomass and is non-favorable for energy purposes as it enhances the formation and accumulation of deposits, which have corrosive effects on metal surfaces of boilers and furnaces. High chloride concentration is, therefore, not desirable in fuel sources as they may cause slagging of the combustion system [11] [13] [28]. From the results obtained from the laboratory testing, on average, the chloride content on absolute dry matter basis for both *Bambusia vulgaris* and *Bambusia bambos* were 0.079% and 0.062% respectively. In comparison, both values are slightly higher than the chloride content of sugarcane bagasse which was found to be 0.054%, but lower than that of other agricultural/non agricultural residues that are currently being used in combustion systems from literature. Both tested species of bamboo showed a chloride content much lower by 32.9% - 69.4% when compared to Miscanthus (0.105%), a perennial grass which is widely sought and used in combustion systems for bio-energy production [29].

3.1.4. Ash Content

Another important factor, but this time after combustion of fuel sources in combustion systems is the production of solid residue also known as “ashes”. The chemical breakdown of biomass fuel source for energy generation, by either thermo-chemical or bio-chemical processes, produces large amount of ashes. As stated by [30] [31], the volume of residual matter produced in combustion system is expected to increase over time due to the increasing demand of energy from biomass sources. However, in the long-run, this may result in challenges regarding efficient management of the ashes in terms of storage, disposal and further alternative uses. From the laboratory testing, the respective ash content for *Bambusia vulgaris*, *Bambusia bambos* and sugarcane bagasse were found to be 1.34%, 1.57% and 3.36%. The two tested species of bamboo produce 2 - 2.5 times less residual ashes than sugarcane bagasse. They also have much lower ash content than other perennial grasses used in combustion systems. Following a study carried out in 2002 [32], the relative ash content of Miscanthus and switch-grass were found to be 2.8% and 4.5%. This clearly underlines that harnessing bio-energy from bamboo biomass will result in much lower amounts of residual ashes being produced in combustion systems.

3.2. Community Acceptance and Perception

The first general intention of the survey questionnaires was to assess the initial assumption that Mauritian citizens are aware of the various issues related to the exploitation of fossil fuels, and the little dissent in their belief towards finding alternative sources of energy that are more environmental-friendly for energy generation.

The great majority of the 54 respondents were very much aware of the significant adverse impacts that mining, transportation and burning of fossil fuels have on the environment, the various well-established ecosystems and human health (**Figure 3**). The main points of concern that emerged during the analysis of the questionnaires were; atmospheric carbon dioxide emission, loss of aquatic species due to oil spill, rising of sea levels due to global warming, and health related issues like asthma and lung cancer due to air pollution.

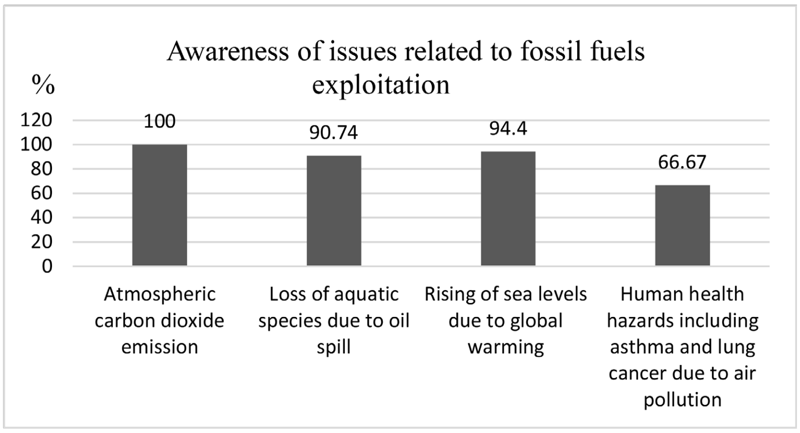

Figure 3. Awareness of the issues related to fossil fuels' exploitation of the 54 respondents.

Furthermore, to draw out the general support towards the usage of renewable energy sources (RES), the participants were asked how willing they were to accept RES in the overall energy generation mix at national level. Results show that there is a high level of acceptance towards the usage of RES. In fact, 91% of the respondents were in favor of the usage of RES (Table 4). One possible reason behind this acceptance could be that the participants are very much concerned about the various adverse impacts attached to the utilisation of fossil fuels, and are willing to make a shift to RES in a view to lessening their ecological footprint.

Table 4. Need of finding Renewable Energy Sources (RES) as alternatives to fossil fuels.

Need of finding alternatives to fossil fuels that are environmental-friendly for bio-energy production (n = 54)				
	In favour: 49 (90.74%)		Against: 5 (9.26%)	
Age(yrs) \ Sex	Female	Male	Female	Male
18 - 40	21	17	0	0
41 - 65	5	6	1	4

In addition to estimating the respondents' acceptance towards RES for energy generation, we wanted to draw their attention on bamboo biomass as a potential RES. The respondents were asked questions about their awareness of the potential of bamboo as a biomass feedstock and how willing they were to accept bamboo biomass for bio-energy generation locally.

Results show that 81% of the respondents (21 out of 27 females and 23 out of 27 males) were aware of the suitability of bamboo as a potential biomass feedstock (Table 5). The vast majority of them, especially the 59% aged between 18 - 40 years were apprised of, in one way or another of the suitability of bamboo as a potential biomass feedstock for bio-energy production and the various advantages attached to it. This is very interesting as they are aware that they have an abundantly untapped raw renewable resource which is naturally available, cheap, environmentally friendly and which can lead to inclusive societies on their doorsteps.

Table 5. Awareness of the potential of bamboo as a biomass feedstock by the 54 respondents.

Awareness of the potential of bamboo as a biomass feedstock (n = 54)				
	Aware: 44 (81.48%)		Not aware: 10 (18.52%)	
Age(yrs) \ Sex	Female	Male	Female	Male
18 - 40	17	15	2	3
41 - 65	4	8	4	1

From the above responses, we have seen that the respondents are very much conscious about the various adverse effects that the exploitation of fossil fuels have on the environment and human health, they support RES and are aware of the capabilities of bamboo as a potential biomass resource. This could probably mean that there would be a positive response in terms of community acceptance towards the implementation of bamboo biomass for bio-energy production locally. As illustrated in Table 6, we can see that 80% of the respondents (20 out of 27 females and 22 out of 27 males) were in favour of implementing bamboo biomass for bio-energy production locally. They even provided us with some interesting testimonies in support of their decisions and two of them which sum up their general opinion are presented below:

1) "Bamboo is a naturally occurring species and it can be found everywhere on the island. Many African countries like Ethiopia or even Ghana have already started implementing interesting projects where bio-energy is being produced from bamboo so as to support underprivileged areas with electricity. This is also helping the local communities to increase their house-hold revenues as numerous jobs are being created. People can live a decent life and children can to go to school. Here in Mauritius, we have the appropriate technologies and the raw resource, why don't we capitalise on it?"

2) "It is sad to say but I think that bamboo is a completely under-looked raw resource in Mauritius. In the quest of finding cleaner sources of energy, empowering local societies, providing the poor with electricity, restoring degraded and marginal plots of lands, restoring areas affected by soil erosion, restoring biodiversity or even just countering effects of deforestation, bamboo has proven to be very effective worldwide. Here, we are a tropical Island and all the conditions are ideal for them to grow. As a matter of fact, they can be found almost everywhere around the Island, be it in the Eastern, Western, Northern and Southern regions. Still, we don't exploit them."

On the other hand, the 20% of respondents who were not in favor of the implementation of bamboo biomass for bio-energy production evoked reasons such as:

1) Inefficiency of biomass fuels (in general) compared to fossil fuels;
2) Bioenergy competition with food and land security;
3) Possible loss of biodiversity due to monoculture; and
4) Insufficient land availability for mass culture.

Table 6. Appreciation of bamboo biomass for bio-energy production by the 54 respondents.

Appreciation of bamboo biomass for bio-energy production by the 54 respondents				
	In favour: 43 (79.63%)		Against: 11 (20.37%)	
Age (yrs) \ Sex	Female	Male	Female	Male
18 - 40	17	15	2	4
41 - 65	3	7	5	1

Finally, the respondents were asked, irrespective of their appreciation for bamboo biomass to be used for bio-energy production locally, their general expectations if any in case of a possible implementation of such projects. 67% of the participants were in favor of a much lower cost of electricity, 63% of providing youngsters with job opportunities, 66% for respecting and ensuring environmental protection, and 40% for the preservation of the heritage landscape (also in Figure 4).

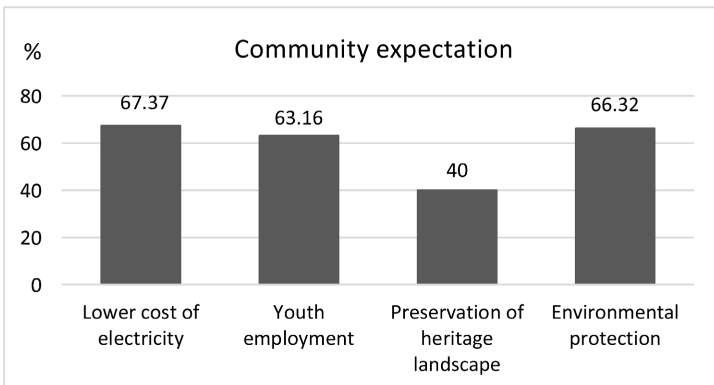

Figure 4. General expectations of the 54 respondents in case of a possible implementation of bamboo biomass for bio-energy production.

4. Conclusion

The study shows that both tested species of bamboo; *Bambusia vulgaris* and *Bambusia bambos,* are potentially suitable for bio-energy production. They share desirable fuel characteristics when compared to locally available sugarcane bagasse and other agricultural/non-agricultural species which are currently being used for energy production worldwide. They possess interesting gross calorific values (16.77 MJ/kg for *Bambusia vulgaris* and 17.44 MJ/kg for *Bambusia bambos*) which make them valuable fuel sources to be considered for bio-energy production. Their relatively low chloride content (0.079% for *Bambusia vulgaris* and 0.062% for *Bambusia bambos*) make them appropriate for combustion systems as this can reduce the formation and accumulation of deposits on metal surfaces of boilers and furnaces, hence reducing the risk of slagging of the combustion systems. They also possess a relatively low ash content (1.34% for *Bambusia vulgaris* and 1.57% for *Bambusia bambos*) which means that harnessing bioenergy from these two species may result in a much lesser amount of residual ashes being produced, stored and disposed of. In addition, their average biomass and energy yield per hectare per year (42.8 t/ha/yr and 717.8 GJ/ha/yr for *B. vulgaris,* 91.4 t/ha/yr and 1587.1 GJ/ha/yr for *B. bambos*) when compared to sugarcane bagasse (45.2 t/ha/yr and 824.9 GJ/ha/yr) is very interesting as approximately the same amount of biomass and energy can be yielded from *Bambusia vulgaris* and sugarcane bagasse, and twice from *Bambusia bambos* on a spatio-temporal basis. In terms of community acceptance, when it comes to making a shift towards renewable sources of energy that are more environmentally friendly compared to fossil fuels, and in a view of lessening their ecological footprint, we have seen that acceptance is relatively high. 91% of the respondents supported the implementation of more RES in the energy generation mix at a national level. Regarding the utilisation of bamboo biomass, we can ratiocinate in general from the survey that the awareness of its suitability and the willingness to accept it as a potential bio-fuel source is present. Here, we have seen that 80% of the respondents were in favour of its utilization for bio-energy production locally.

4.1. Personal Perspective

Bamboo is globally renowned as being one of the fastest-growing plants in the world and is capable of achieving full maturity in only a few years when compared to trees which need decades to grow. They can tolerate poor soil conditions, grow in a wide range of environments, need little to no chemical pesticides and fertilisers to grow, require little to no irrigation to thrive, and self-regenerate at a very fast rate after being harvested. This fascinating plant has a myriad of applications ranging from producing biomass for energy generation, charcoal, timber, high-quality textile fabrics, furniture, flooring, musical instruments, kitchen utensils, scaffolders, food and many more. They are also used to counter soil erosion, and afforest areas severely affected by deforestation, and due to their fast-growth rate, they produce about 35% more oxygen than other trees and sequester carbon dioxide at a very high rate. These multiple uses have helped in providing people with many job opportunities and have led to social, economic and environmental stability.

In the context of Mauritius, we have seen sustained economic growth over the past decades which has led to an increase in overall energy consumption. It might be very interesting to consider bamboo plantations on abandoned plots of land by sugarcane planters for energy production so as to meet the overall energy demand. Also, the plantations could be used in many other ways. Since the island has been severely affected by deforestation ever since the visit of the Dutch in the year 1598, they might play a vital role in afforesting many areas over the island. They could also help in sequestering carbon dioxide and prevent soil and wind erosion due to their dense root system. Part of the plantations could even be used to produce timber, plywood, furniture, and textile fabrics thus opening doors to many job opportunities. Considering the manifold advantages that bamboo offers, its use as a source of renewable energy would definitely be beneficial to Mauritius in terms of framing inclusive societies and building economic as well as environmental growth.

4.2. Recommendations

Since bamboo has never been exploited before in a bio-energy prospect in Mauritius, no studies have been conducted on its social, economic and ecological feasibility. Recommendations would thus be to pursue further investigations on the production and management of bamboo plantations in terms of what species would be best suited for bio-energy production. The identification of potential areas where bamboo could be planted and harvested is also recommended. An in-depth life cycle analysis including the cost of production, maintenance of the bamboo plantations, harvest, storage, transportation, processing of the bamboo biomass and disposal of ashes would also be needed. Finally, studies on profit margins and return on investment especially for farmers who would like to embark on bamboo cultivation could also be very interesting and useful.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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