

Sustainable Entrepreneurship and Renewable Energy Implementation in the Agriculture Sector of Trinidad and Tobago

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ABSTRACT

As Trinidad and Tobago (TT) transitions to a higher dependence on renewable energy technology (RET) and increased sustainability, the agricultural sector and more specifically, agripreneurship is identified as a key area that would fuel this transition. In this paper, agripreneurship will be investigated to determine what barriers prevent the practices from being completely sustainable, as well as the opportunities for new sustainable entrepreneurship (SE) through the use of RET in this sector in TT. Studies on the status of agripreneurship locally and regionally, especially as it pertains to entrepreneurship and sustainability, are limited. Through the literature review on foreign jurisdictions and the identification of relevant factors unique to TT, a survey instrument was developed and validated. The survey instrument was administered to stakeholders in the small-scale agricultural sector, and the data was collected and analysed. The unique drivers for SE and RET implementation by small-scale farmers in TT were identified as education, economic, environmental, and social. The findings showed significant interest by farmers in learning about and implementing RET to benefit their farms. However, without direct incentives, training, education, financial support and investment by the government in RET for the sector, there is reluctance for utilisation. To begin RET implementation and increase SE, the systems in place for the dissemination of incentives and economic compensation must be fixed

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to run efficiently to build trust with farmers, so that they will utilise these incentives. Infrastructure for education and training designed specifically for small-scale farmers to learn about RET and SE must be put in place and utilised by farmers to tap into the potential in the technology industry. These findings inform policy development for the future RET implementation in the agricultural sector in TT.

1 INTRODUCTION

A renewable natural resource is naturally replenished. The term Renewable Energy Technology (RET) can be broadly described as technology that enables the harnessing of energy from renewable natural resources such as biomass, geothermal, solar, wind and hydropower, which are all considered to be free and readily available¹.

Small Island Developing States (SIDS) are islands recognised by the international community as the least responsible for climate change but the most likely to suffer from its consequences². Fossil fuels are the main drivers of power production, water purification and transportation³. For many SIDS fuels must be imported and these costs are usually the largest foreign exchange expenditure. SIDS in the Caribbean, such as Grenada spends on average USD 159 million (18% GDP), Montserrat USD 12 million (29% GDP) and St. Lucia USD 225 million (16% GDP) annually on this fossil fuel imports⁴. This makes them very vulnerable to fluctuating oil prices. Therefore, SIDS must build the capacity for future resilience, by gradually reducing dependence on imported fuels to meet power production needs. Countries may do this in a sustainable manner by implementing RETs to produce power. Some islands may have a higher potential for specific types of RET than others due to their geography and topography. Countries that are heavily agriculturally based may have large amounts of biomass resources that can be used sustainably to reduce fossil fuel reliance^{5,6}.

Sustainable business practices can increase the longevity and robustness of an organisation. The use of RET in businesses such as farms can increase sustainability. Entrepreneurship is a process through which an organisation builds mindset and skills, ultimately generating jobs and opportunities that lead to economic development⁷. Agricultural entrepreneurship, also known as agripreneurship is a practice that is very prevalent in Trinidad and Tobago (TT) as many persons subsist on growing crops and rearing livestock. In this paper, agripreneurship is investigated to determine what barriers prevent the practices from being completely sustainable and the future market opportunities that exist for new sustainable entrepreneurship (SE). Future opportunities and the status of RET will also be identified to establish how the technology may be incorporated into agripreneurship in TT. This is especially important since TT is a signatory to the 2015 Paris Agreement, which aims to ensure that the maximum increase in average temperature is well below 2°C, preferably below 1.5°C, above preindustrial levels². Also, TT is aiming to achieve 30% of its electricity supply from renewable sources by 2030. SE can be enhanced by incorporating RET in new farms and the agricultural techniques of the modern-day farmer.

The profile of small-scale farming in the Caribbean, found from a census, shows that the small-scale farmer age ranges from 41-54 years and on average farms are on less than 5 acres of land⁷. The Census of Agriculture data 2012-FAO/ESS Website reveals that approximately 66% of the farmers in TT fall into the small-scale farming category of farming under 10 acres. Demographic data on the population of TT put the median age at 38 years with 61.8% of the population falling between the age 20 and 64. Small-scale farmers are the demographic that lack access to electricity, proper roads, pipe borne water supply and generally reside in rural areas⁸. The government of TT is currently stimulating the agricultural sector having recently activated a Youth Agricultural Homestead incentive program, with the intention of increasing the interest of modern entrepreneurs and growing the sector by introducing a younger demographic.

TT is an oil-based economy and is privileged to have subsidised oil prices which lead to low energy prices. This may prove to be a barrier to renewable technology since start-up costs would be prohibitive, if not subsidised. Access to compensation for losses due to praedial larceny (loss of crops and equipment due to theft) and natural disasters add to factors that make TT unique when compared to other countries investigated in the literature review. As a SIDS with a high amount of industrialization, the factors that affect agriculture and sustainability in TT would be unique. Results obtained from studies done in other countries would not accurately represent the status of agripreneurship and the use of RET in the small-scale farming industry. Low oil prices, unique climate conditions and differences in farming practices and farm sizes when compared with, for example, Nigeria and Jasmine growers of coastal Karnataka in India set TT apart. In those regions, farm sizes were well over 5 acres for small-scale farmers.

The National Agriculture Marketing and Development Company in TT as of 2021 served approximately 78,000 agripreneurs to improve knowledge and awareness and make their practices robust and more sustainable⁸. Ideally, the sustainable agripreneur would improve resilience to weather extremes, minimize pollution, have good water management skills, and adopt practices for the longevity of the resources. The incorporation of RET can achieve these principles.

Since scientific papers on the status of small-scale agripreneurship locally and SE within the Caribbean are relatively sparse⁹, the drivers that influence sustainability in agripreneurship along with RET in TT have not been identified. For this field to flourish, this gap in knowledge must be addressed appropriate policies can be engineered. Through literature review, it was realised that sustainable agripreneurship and the potential for implementing RET share very similar Critical Success Factors (CSFs).

Work done by Chel¹⁰ explained the role of RE in farming by connecting all aspects of agronomy with ecology, the environment and economics. They found that major CSFs that affect SE and the use of RET included the need for improved access to education, reduced dependence on fossil fuels, reduction of greenhouse gases and improved efficiency and sustainability in agriculture. Other CSFs identified were the affordable cost of the RET and the existence of incentives for its use. A stakeholder's impact assessment in Central Nigeria conducted by Agri¹¹ further identified CSFs that affect SE and the use of RET. These included the lack of environmental protection laws, lack of technical skill and societal awareness of RET, the increase in urban-suburban sprawl reducing the supply of arable land, land ownership problems, access funding and incentives for innovative and efficient technology to boost agribusinesses, inherent wastage in the manufacturing process due to obsolete technology and praedial larceny.

Previous research findings showed that small and medium-scale farmers and entrepreneurs face the brunt of economic, cultural, environmental, and political challenges preventing sustainability and growth^{11,12}. The research methodology involved surveys using questionnaires and percentage statistical techniques to generate charts representing the results. Specific economic factors influencing entrepreneurial enterprises in Nigeria included business cycles, GNP trends, interest rates, imports/exports, money supply, inflation rates/interest rates/exchange rates policy, unemployment levels and disposable incomes as well as savings and investment.

These factors are similar to those faced in TT despite there being differences in geographic location and agricultural practices. Economic factors such as the price of oil or fuel, access to disposable income and capital, interest rates for import or export, and inflation affect the sustainability of these enterprises and limit their ability to access and experiment with new technologies and skills that would increase efficiency and other aspects of the business.

The objectives of this research are to identify the drivers that influence sustainable agripreneurship and the use of RET among small-scale farmers in the agricultural sector in TT, through the review of relevant literature; develop and validate a research instrument using the identified drivers in the reviewed literature and factors that are unique to TT; administer the survey instrument to targeted agripreneurs;

collect raw data, analyse the data and therefore identify the specific drivers of RET and agripreneurship for TT; use the results of the study to inform policy development and make recommendations that would facilitate a transition to RET in the sector that is consistent with the development objectives of TT.

2 METHODOLOGY

The flow chart shown in Fig. 1 describes the research methodology used in this study to identify the drivers for SE and implementation of RET in agripreneurship in TT. The methodology utilised in this study is consistent with other research^{11,13}.

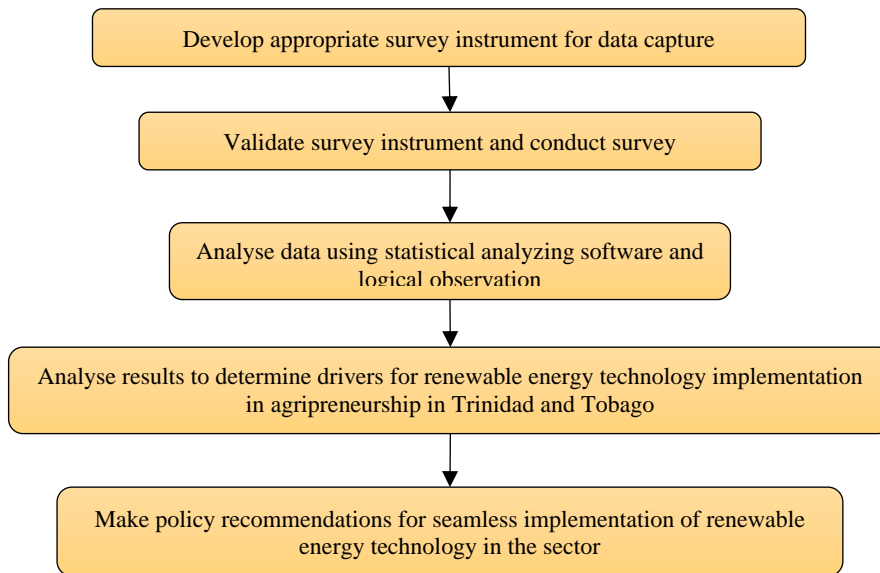


Fig. 1. Methodology flowchart.

Through the literature review, the drivers for SE and the use of RET in agripreneurship were explored. This research and consideration of the unique characteristics of TT, provided the basis for the development of the survey instrument (see Appendix 1) to identify the Critical Success Factors (CSFs) for RET implementation in agripreneurship in TT.

Validation of the survey instrument occurred through peer review, experts in the field and tested with a small sample group of agripreneurs to maintain quality and integrity. Eighty individuals from various geographic locations in TT within the agriculture or small-scale farming sector, (see Fig. 2) were identified, and the survey instrument was administered over the period of October-November 2022. Data was collected through face-to-face interviews and analysed to identify the unique factors that affect SE and the use of RET in TT. The survey instrument was divided into four sections. Section I captured demographic data; Section II required 'yes' or 'no' responses to determine knowledge and understanding of key concepts; Sections III and IV used the Likert-type scale to investigate barriers to RET adoption and respondents' views on challenges to agripreneurship in RET in TT, respectively. Because of the mix of response types, the data was analysed by section with the aid of statistical software. The findings were reported and represented in tables and graphs.

3 RESULTS AND DISCUSSION

To determine the applicable CSFs for RET implementation in agripreneurship in TT, a survey instrument was developed containing possible CSFs obtained from the literature review and considering the unique characteristics of TT. The questionnaire was validated and administered to small-scale farmers who farm less than 5 acres of land in TT. This was the key stakeholder group for the study. Sampling was done in a manner that was consistent with other research¹¹⁻¹³.

The survey was conducted over the period of October-November 2022 through face-to-face individual sampling. A total of 57 completed responses were captured with a response rate of 71%. Section I of the instrument was designed to capture demographic data. Sections II, III and IV were designed to determine knowledge levels and awareness, barriers to RET adoption, and challenges to agripreneurship in RET in TT, respectively.

These farmers represented areas of Macoya, Pasea, Rio Claro, Penal, Caroni and Grande Riviere (see Fig. 2) and farmed either livestock or crops (permanent or short). The results showed that the participating farmers represent a large area across Trinidad from remote rural areas to easily accessible rural areas that are adjacent to sub-urban areas as well as areas that are transitioning from rural to sub-urban, as a result of sub-urban sprawl.

All the farmers in the sample group farmed less than 1 acre, with some owning more land but only actively farmed less than 1 acre. The age ranges of the farmers represented in Table 3 are generally consistent with findings⁸ where from a census taken, the ages of most small-scale farmers ranged from 41–54 years. The acreage farmed was also consistent with the census finding, where on average farms are on less than 5 acres of land. About 70% of the farmers employed between 3 to 5 persons, and 30% with 2 or less employees (see Table 1).

Table 1. Demographic data received from farmers based on education, farming style, age and number of years farming

| Demographic data | | Percentage (%) |
|------------------|---------------|----------------|
| Education | Primary | 42 |
| | Secondary | 47 |
| | Tertiary | 11 |
| Farming style | Short crop | 77 |
| | Tree farming | 7 |
| | Livestock | 16 |
| Age | 26 – 35 | 37 |
| | 36 – 45 | 46 |
| | 46 – 50 | 18 |
| Years farming | < 10 years | 16 |
| | 10 – 20 years | 58 |
| | > 20 years | 26 |

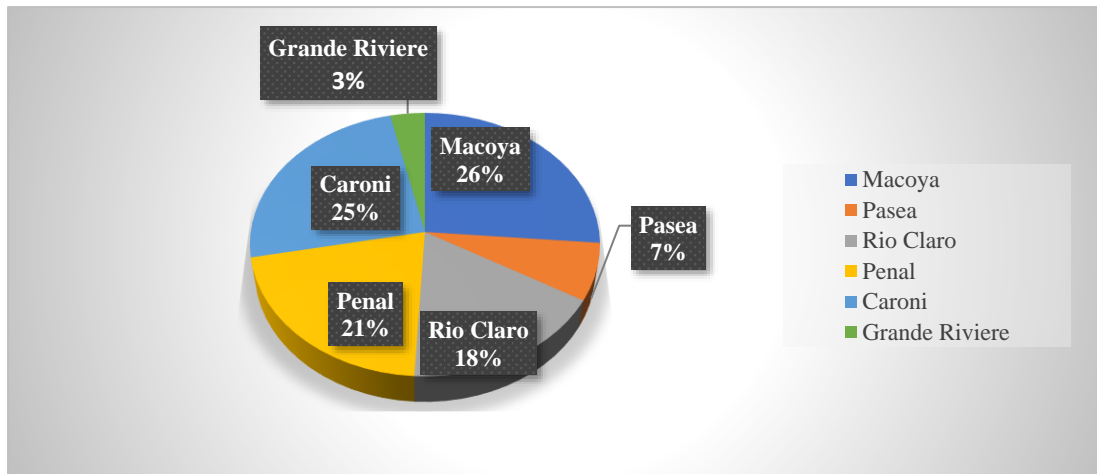


Fig. 2. Distribution of farmers across the country.

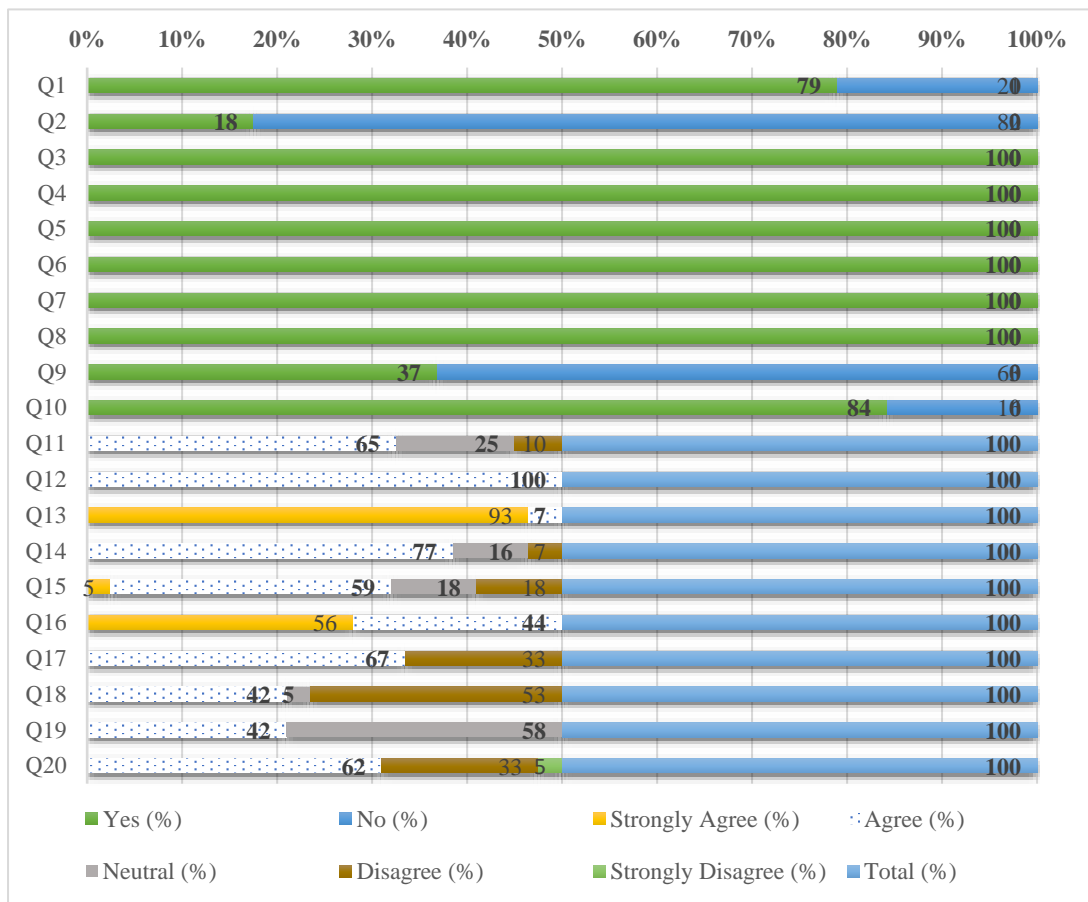


Fig. 3. Representation of responses for Section II and Section III.

The sample group of participants was assessed for their understanding of the key concepts of Climate Change (CC), Global Warming (GW) and TT's approach to dealing with CC. This was done through questions 1, 2, 5, & 14. Results revealed that 79% of respondents are aware of CC and GW. Of this 79%, the entire 11% of respondents who have received tertiary education are represented. 82% are unaware of the country's strategy to deal with the RE issues identified in the Vision 2030 document or the National Environmental Policy (NEP), as well as TT's stance on meeting the UN's sustainable development goals (SDGs). Of the remaining 18% who indicated their awareness of these strategies, 100% of the participants who received tertiary education were represented in this statistic. The tertiary level respondents represented the minority that was aware, showing that higher levels of education are consistent with greater conceptualisation and awareness of the pathway to sustainability.

Table 2. Representation of grouped questions associated response % and inferences

| Question numbers | % Affirmative responses Agree, Strongly Agree and Yes | Determination made |
|---------------------|--|---|
| 1, 2, 5, 14 | 79; 18; 100; 77 | There is a basic understanding of climate change and global warming and farmers have experienced its effects. There is limited knowledge of Trinidad and Tobago's policy approach to reduce its effects. |
| 3, 4, 10 | 100; 100; 84 | Interest in renewable energy technology exists among farmers, and it is perceived to be a beneficial technology for farming applications. |
| 9 | 37 | There is no firm understanding of Sustainable Entrepreneurship from farmers in the sample group. |
| 6, 21e, 21f | 100; 100; 100 | Limited education and awareness of renewable energy technology and sustainable entrepreneurship are attributed to a lack of knowledge dissemination. |
| 8, 20, 21g | 100; 62; 100 | There is a high amount of interest from farmers if the infrastructure is put in place to provide training and seminars on sustainable entrepreneurship and renewable energy technology. |
| 7, 12, 18 | 100; 100; 42 | Awareness of policies and incentives exist but there is little to no confidence in them due to lack of efficiency in the process and long waiting periods. |
| 13, 15, 16, 17, 21b | 100; 64; 100; 67; 100 | Economic factors are at play for the lack of renewable energy technology uptake; lack of compensation, slow payback periods, the opportunity cost of clean energy over alternatives and the country's economic instability. |

All 100% of respondents indicated that they had experienced flooding and extended dry seasons attributed to CC. They further elaborated that this resulted in financial hardship through lower yields as well as crop and equipment loss and damage. This result is consistent with statements from literature review about SIDS and CC².

There was unanimous agreement among participants that the threat of natural disasters and damage to equipment and property discourages their investment in new technologies such as RET. 77% of respondents indicated they were discouraged from investing in RET because of natural disasters and 7% disagreed. This serves to establish that discouragement to sustainability and RET implementation is fuelled by negative consequences of environmental factors due to extreme weather conditions. Another discouraging factor to RET implementation is praedial larceny or loss of crops and equipment due to theft. This together with the environmental factors mentioned previously causes substantial economic loss. 90% of farmers in the study indicated that they live 'paycheck to paycheck' and therefore, cannot absorb these

losses. Also, most farmers have no insurance and cannot access government assistance. These results align with research¹¹ which noted that environmental factors can limit farmers' and agripreneurs' ability to run sustainable businesses. The consistent views from research show small-scale farmers and entrepreneurs are the demographic facing the brunt of economic and environmental challenges preventing sustainability and growth¹².

Questions 3, 4 and 10 were designed to evaluate the respondents' awareness of RET and its benefits as well as their willingness to implement RET. 100% of respondents are aware of various types of RET and they believe that it can and will benefit their farms. 84% have also actively thought of ways to implement RET in their agriculture enterprises, with the main suggestions being solar cameras, and solar lights, with consideration given to hydropower from nearby rivers to generate electricity. There is a keen interest in and a basic understanding of some aspects of RET among farmers and a positive opinion of the technology has already been established within the group.

Questions 9 and 11 investigated the understanding of SE and sustainable agricultural practices. Only 37% of respondents understood what SE was, while 67% indicated that they had no idea. Additionally, 100% of the respondents who received tertiary education are represented in the 37% statistic. Findings from the literature review identify the importance of education¹³ as a tool to increase awareness and understanding of SE and sustainability in agriculture and¹¹ as a determining factor for the readiness and ability of farmers to move forward with SE.

65% of the respondents agreed that poor regulation of unsustainable agricultural practices discourages sustainability because of a lack of accountability for violators. It is clear, therefore, that the farmers are able to understand the concept of an unsustainable practice and to identify that proper regulation can be a solution to the problem. This is consistent with the lack of enforcement of environmental protection laws as a factor affecting SE and RET uptake by farmers¹¹.

The question of whether farmers in rural areas have a greater need for RET and sustainable entrepreneurship skills than those in sub-urban areas was posed to the sample group. 42% agreed that rural farmers are in greater need of these skills. Rural farmers in TT generally farm in remote areas with limited access to utilities compared to those from sun-urban areas, who gain easier access. RET, which can be used off the grid in remote areas, will greatly benefit rural farmers. Also, training rural farmers in SE skills and the use of RET would promote more sustainable practices. 58% took a neutral stance on the question citing that all farmers need RET as they are all on the same playing field and are affected by the same challenges.

The farmers were also asked about the types of sustainable practices they implement on their farms to ensure continuity and increase longevity. The results are displayed in Fig. 4. Crop rotation and natural pest control were the most common forms of sustainable practices implemented.

The farmers' opinions on education, awareness and knowledge were investigated through questions 6, 21e and 21f. The data collected revealed that 100% of respondents agreed that there is a need for more education on RET and its benefits. All participants also identified a lack of access to information on RET and RET implementation as a challenge to entrepreneurship and sustainability in TT. 100% of participants also agreed that the same was true for an absence of RET education in schools' curricula at the secondary and primary levels. This lack of access and dissemination of information on RET therefore, appears to be a barrier to RET implementation in the agripreneurship sector in TT and is consistent with the findings of both^{11,12}.

Questions 8, 20 and 21g sought to identify the farmer's perception of the infrastructural support available for RET and SE and determine the challenges in this area. 100% of farmers agreed that greater availability of RET information and RET products would generate more interest from farmers. 62% of respondents agreed that more private support and businesses for RET would encourage uptake and

utilization, while only 38% disagreed with this. 100% of the sample group also agreed that they would be interested in skills training for sustainability in business if it was made available for farmers. They indicated that there are no workshops and training available for farmers in RET and no plans for improvement in infrastructure for training, which would make farmers more experienced and hands-on with RET to improve SE.

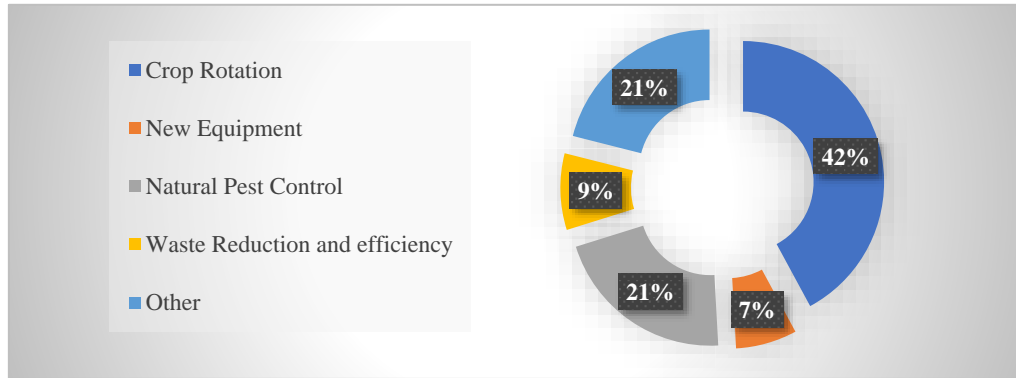


Fig. 4. Types of sustainable practices farmers implement on their farms to have continuity and increase the longevity of their practices.

Questions 7, 12 and 18 captured the opinions of the farmers on policies for RET. 100% of respondents were aware of local policies and incentives for the use of RET. The farmers also agreed unanimously that the lack of efficiency in the processing of financial support through incentives discourages them from accessing it. When questioned if they would be willing to invest in RET if incentives from the government for increased RET use are provided to the agriculture sector, 42% agreed; 53% disagreed, while 5% chose not to answer. The 42% who agreed made suggestions on the type of incentives they would prefer to see. This is represented in Fig. 5 below.

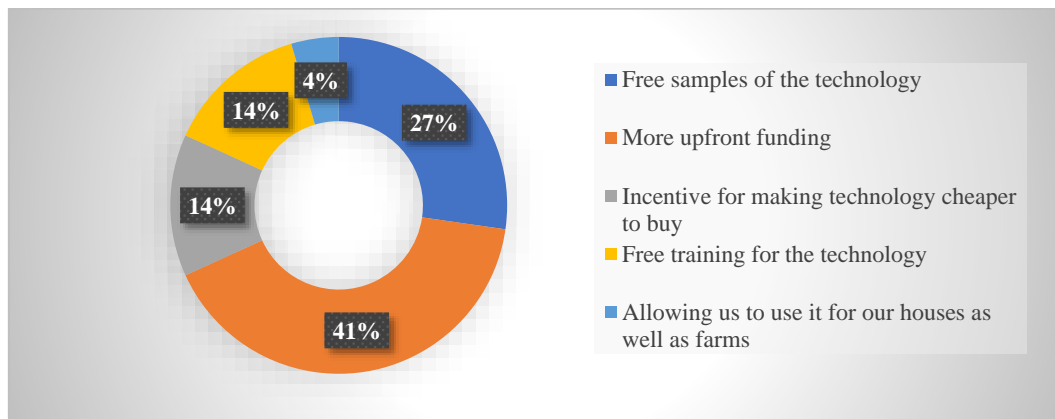


Fig. 5. Types of government incentives farmers suggested.

Direct economic and financial factors that influence farmers' decisions to utilise RET and increase farm sustainability were investigated using questions 13, 15, 16, 17 and 21b. 100% of the farmers found that praedial larceny discourages them from using newer technologies in their farms. 64% of farmers agreed that if proper compensation for praedial larceny as well as for floods and natural disasters was available,

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they would be more inclined to incorporate RET in their farms. 18% of respondents chose not to respond and remained neutral, while only 18% indicated that this would not encourage them to use RET. 100% of the farmers found the slow payback period for RET to be discouraging.

As TT is an oil-based economy, gas prices at the pump and for electricity generation are subsidised, making the already premium cost of clean energy through RET appear even more inflated. Farmers were asked if this was a factor preventing them from implementing RET. It was found that it discourages 67% of the farmers from choosing renewable power, while 33% found it to not be a significant discouraging factor. 33% also cited that the prices of fuel are already increasing, and electricity subsidies are carded to be removed in the future. When asked if economic instability and lack of stimulation discourage new farmers, 100% of the respondents agreed. This indicates overall agreement that a limited amount of stimulation and compensation is preventing uptake in RET from farmers because of the high cost and risk involved. This is an opportunity for increased investment and stimulation in the sector for RET as there is interest among farmers but discouragement due to limitations in the existing infrastructure.

Farmers' opinions on factors that are challenges to agripreneurship in the sector were found through questions 21a, 21c and 21d. 96% of respondents agreed that difficulty in accessing land for farming is a challenge to agripreneurship as a farmer, while 4% disagreed. 100% of the respondents found that the loss of prime agricultural land due to urban sprawl is also a challenge to agripreneurship in farming. Besides that, 65% of respondents indicated that imported produce is causing lowered profit margins for the farmers and thus stifling the ability of new farmers to enter the market, while 35% disagreed.

Question 21h served to identify the farmers' understanding of the usefulness of shared RET. They were asked if they would be interested in pooling their decaying harvest to create a biofuel-powered cold storage or milling plant. 67% agreed that they would be interested in such an idea for their community, and 33% indicated that they were not. Community entrepreneurship and participation among farmers tend to create avenues that will help benefit the disadvantaged¹⁴.

From the data analysed, it was seen that many drivers are at play in influencing sustainable agripreneurship and RET use in the small-scale farming sector of TT. Farmers identified that the lack of access to education and training for RET and SE is a major challenge for RET awareness and implementation. Farmers are also keen on educating the younger generation in RET through inclusion in the schools' curricula. Small-scale farmers showed great interest in being trained in RET, to gain a better understanding of the technology and be equipped to implement it themselves. It is clear, therefore that a great opportunity exists in this farming sector to train a group of individuals who demonstrate a keen interest in RET. This will serve to boost sustainability in the sector and bring the country closer to meeting its sustainable development goals.

These specific challenges can be addressed through workshops and free training courses, with free samples of small RET items such as solar lights and cameras, and an increase in the amount of land available for farming to encourage younger farmers to introduce SE.

4 CONCLUSION

The survey results administered to small-scale farmers in the TT agricultural industry identified the unique drivers that influence sustainable agripreneurship and the use of RET in this sector. The major drivers of RET and SE in TT are education, economic, environmental, and social. These inferences are backed up by data showing that 100% of respondents agree that education and economic stimulation are needed for further growth in the sector. It should also be noted that 100% of tertiary level respondents responded favourably to SE, GW, and CC questions.

Such data cements the importance of education in agriculture. Prædial larceny and flooding are the most prevalent and unique socio-economic drivers for TT, serving as the most defining drivers against RET and SE investment with 100% of respondents affected. The findings showed that there is a significant interest by farmers to learn about and implement RET to benefit their farms with more than 84% of respondents in agreement. Without direct incentives, training, education, financial support and investment by the government in RET in the sector there is reluctance for utilization. To begin RET implementation and increase SE, the systems in place for dissemination of incentives and economic compensation must be fixed to run efficiently to build trust. Infrastructure for education and training designed specifically for small-scale farmers to learn about RET and SE must be put in place as 100% of farmers through questions 8 and 21g showed interest. These areas can provide meaningful growth in awareness, understanding and use of RET and SE practices, and further research can guide the infrastructure design. Future work on the topic should include a wider range of participants as well as more demographic information, such as economic data. The findings from this study can inform policy development for the future of RET implementation in the agriculture sector in TT.

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CONFLICT OF INTEREST

The author declares that there was no conflict of interest.

AUTHORS' CONTRIBUTIONS

Conceptualization: S. Maharaj, R. Maharaj, D. Boodlal, & J. Francis

Data curation: J. Francis

Methodology: S. Maharaj, R. Maharaj, & J. Francis

Formal analysis: J. Francis

Visualisation: Not applicable

Software: Not applicable

Writing (original draft): S. Maharaj, R. Maharaj, D. Boodlal, & J. Francis

Writing (review and editing): S. Maharaj, R. Maharaj, D. Boodlal, & J. Francis

Validation: Not applicable

Supervision: S. Maharaj, R. Maharaj, & D. Boodlal

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APPENDICES OR SUPPLEMENTARY MATERIAL

A. Survey Instrument for Academic Research

Purpose: To identify the drivers that influence sustainable agripreneurship and the use of renewable energy technology (RET) among small-scale farmers in the agricultural sector in Trinidad and Tobago (TT)

Details: My name is Joshua Francis, and I am in the Thesis stage of my MSc in Energy Engineering with a focus on Renewable Energy (RE) at the University of Trinidad & Tobago (UTT). My research paper is on the topic Sustainable Entrepreneurship (SE) in small-scale farming TT.

From my literature review, it is apparent that the entrepreneurial perspective of renewable energy is missing in emerging countries like TT. Within recent times, even pre-COVID-19 pandemic, TT has been experiencing a downturn in economic activity. The energy and petroleum sector has faced economic trials

as oil production is steadily decreasing, international commodity prices are falling with increasing competition worldwide.

TT now has to re-engineer and reorient operations to achieve competitiveness, sustainability, inclusiveness, and resilience. The implementation of projects related to renewable energy can produce meaningful economic, environmental, and social benefits to TT.

The survey is divided into three sections:

Section I: Gathering of general demographic information from participants.

Section II: Exploration of the levels of knowledge and understanding of key concepts.

Section III: Investigation of barriers and challenges to the adoption of RET and SE.

Section IV: Identification of challenges to agripreneurship in RE in TT.

This project targets small scale farmers of any type (livestock, short crop or otherwise) in TT and investigates the use of SE practices and their interest in RET. The agricultural sector is significant due to meaningful increases in productivity and economic gain that RET and SE can bring. Benefits also span other areas such as environmental, with the reduction of carbon footprints of farms and social with increased quality of life from the use of such technologies.

The opinions of farmers on the ground will allow for a vital assessment of how prepared and interested the industry is for RE and sustainability and give an outline of the most effective approach for implementation.

I thank you in advance for your support in completing this survey which should take no more than 10-15 minutes to complete. Your information will be treated with the strictest confidentiality and will be used solely for academic research purposes.

A.1. Section 1: Gathering of general demographic information

As a member of Management in your Organization, please answer the questions by ticking the appropriate boxes.

- Name (optional): Click or tap here to enter text.
- Age: Click or tap here to enter text.
- How many years have you been a farmer? Click or tap here to enter text.
- Type of Farming (eg Livestock, Short crop, Tree Farming): Click or tap here to enter text.
- Location of Farm (General): Click or tap here to enter text.
- How many persons work on your farm?
Micro (1 to 3 employees) Small (4 to 6 employees) Medium (7 or more employees)
- How many acres of land do you farm?
Less than 1 Acre 1 to 2 acres 3 to 5 acres
- Average income of Farmer (monthly): . Click or tap here to enter text.
- Highest level of education: _____

A.2. Section II: Knowledge and Understanding of Key Concepts

| As a member of Management in your Organization, please indicate your answer by choosing yes or no for the following questions. Please comment further if required. | | YES | | NO | Comments |
|---|--|------------|--|-----------|-----------------|
| 1 | Do you know what Climate Change (CC) and Global Warming (GW) is? | | | | |
| 2 | Are you aware of Trinidad and Tobago's (TT) approach to dealing with climate change issues, through the vision 2030 plan? | | | | |
| 3 | Do you know what renewable energy technology (RET) is? Such as solar panels, wind turbines, biomass fuels etc. | | | | |
| 4 | Do you think that RET can benefit your farm? If no, please comment why? | | | | |
| 5 | Have you experienced the negative effects of GW & CC, for example flooding or extended dry seasons? | | | | |
| 6 | Do you think there is need for more education of the benefits of RET to farmers and the environment? | | | | |
| 7 | Are you aware of any local policies and incentives such as tax incentives for use on renewable energy technology? | | | | |
| 8 | If information on RET and products were more easily accessible to you through workshops, and seminars it would make you more inclined to try renewable energy? | | | | |
| 9 | Do you understand the term sustainable entrepreneurship? | | | | |
| 10 | Have you thought of using Renewable Energy in your agriculture enterprise? If yes, comment on what ways you have thought of. | | | | |

A.3. Section III: Investigation of barriers to adoption

| | | Scale | | | | | Comments |
|----|---|-------------------|----------|---------|-------|----------------|----------|
| | | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | |
| 11 | Do you think the lack of regulation of unsustainable agricultural practices discourages good practices? | | | | | | |
| 12 | Does the lack of efficiency in the process to receive financial support through incentives limit farmers from accessing the incentives? | | | | | | |
| 13 | Does praedial larceny lead farmers to opt out of using newer technology on their farms? | | | | | | |
| 14 | Are farmers discouraged from investing in technology such as RET because of flooding and other natural disasters? | | | | | | |
| 15 | If farmers were fairly compensated for 13. and 14. would they be more inclined to use RET? | | | | | | |
| 16 | Does the slow payback period of the RE discourage you as a farmer from considering its use? | | | | | | |
| 17 | Does the subsidized cost of electricity from the grid as well as gas, discourage you from choosing to use renewable energy power? | | | | | | |
| 18 | Would government incentives increase the use of renewable energy technology in the agricultural sector? If you agree what types of incentives, you would like to see? | | | | | | |
| 19 | Do you believe that small scale farmers in rural areas are more in need of RET and sustainable entrepreneurship skills than those in sub-urban areas? | | | | | | |
| 20 | If more private businesses and access to technical support for the technology were readily available, it would encourage farmers to utilize RET in their businesses? | | | | | | |

A.4. Section IV: How do you rate the following challenges for agripreneurship in renewable energy in TT? (Please tick appropriately)

| | Challenge | Strongly Agree | Agree | Disagree | Strongly Disagree |
|-----|---|--------------------------|--------------------------|--------------------------|--------------------------|
| 21a | Difficulty to access land for farming | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21b | Economic instability and lack of stimulation from the government discouraging new farmers | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21c | Continuous loss of arable lands for housing (urban sprawl) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21d | Imported produce lowering the profit margins for farmers. Thus, stifling new upcoming entrepreneurs | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21e | Lack of access to information/education on how RET work and can benefit farmers as groups and individually | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21f | Absence of Renewable Energy education and sustainable entrepreneurship at an introductory level of the curriculum in non-tertiary schools. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21g | If there are workshops and skills training on how to increase the sustainability of your business as an entrepreneur would you be interested? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21h | Do you think if finished crops, rotten harvest, and other forms of dead plant matter from farms could be used to generate electricity for the benefit farmers to run a shared cold storage unit or milling plant be of interest to you as a farmer? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

End of Questionnaire. Thank you for your time!

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