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From hinterland to heartland: Knowledge and market insecurity are barriers to crop farmers using sustainable soil management in Guyana

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In Guyana, the coastal plains dominate agricultural production, while the hinterland is an emerging agricultural frontier. The coastal and hinterland regions have differing agro-climatic conditions, but share immediate climate change and environmental degradation pressures, including soil degradation. Even though climate change adaptation is prioritized over greenhouse gas mitigation in Guyana, soil-focused farming, otherwise known as sustainable soil management (SSM), can provide a system that creates synergies between these two facets of climate-smart agriculture and, also, promotes soil security. This article proposes a bottom-up planning process for SSM in Guyana by assessing its underlying psycho-social and physical facilitators and barriers. The main questions addressed are: what are the attitudes of Guyanese farmers to climate change? What are their capabilities for SSM, in terms of education, technology and government support? In answering these questions, inductive-derived thematic analysis of transcripts derived from in-depth telephone interviews with seventeen (17) farmers, from coastal and hinterland regions, provides an initial basis for ground truthing on the local appropriateness of SSM. Results show that hinterland farmers are more emotive and value-driven about their environment, while coastal farmers, instead, prioritize access to markets and gaining favorable prices for their commodities. Additionally, the lack of education and training are identified as severe limitations to the capabilities of farmers to practice SSM. In conclusion, a weak marketing environment is seen as a binding constraint of sustainable intensification as surplus goods attract low prices. Stronger linkages to dynamic markets, as well as increased investment opportunities are needed for sustainable farming to become economically feasible. Therefore, psychosocial capital must be strengthened before any natural capital is improved under Guyana's various agro-environmental policies.

KEYWORDS

sustainable soil management, adaptation, greenhouse gas mitigation, marketing, climate change, climate-smart agriculture, agro-ecology, Guyana

1. Introduction

1.1. A contradictory agro-environmental status quo

Historically, Guyana is an agrarian society with abundant natural resources, which stand as the bedrock of its economic activities. Crop farming is very important to Guyana's agricultural identity and rural development. It is the largest agricultural sector and is a major income and employment generator (Ministry of Agriculture, 2013). However, the country is acutely vulnerable to climate change impacts, such as sea-level rise and flooding, particularly along its coastline that is below sea-level (Government of Guyana, 2016). Additionally, Guyana's exploitation of natural resources is being increasingly scrutinized. The country is a new oil-producing state but it wants to implement sustainable development policies. At this juncture, natural resource management is coming under a more responsible and accountable dispensation. Greenhouse gas inventorying, which accompanies UNFCCC National Communications, has identified the agricultural sector as a significant contributor of local greenhouse gas (GHG) emissions—∼33% of GHGs—and is the single largest source of two major GHGs, methane and nitrous oxide (Government of Guyana, 2012).

Similarly, environmental damage can also be attributed to agriculture, in addition to the traditionally culpable extractive industries. Guyana's use of conventional practices in crop farming contributes to erosion, toxicity to flora and fauna, and water contamination, which all degrade both soil and water quality. Consequently, agro-ecosystems that face environmental pressures are more vulnerable to climate change impacts (Danny, 2017).

Crop farming must, therefore, take on a "climate-smart agriculture" (CSA) approach. Climate-smart agriculture is a set of practices that allows farmers to adapt and be resilient to climate change, sustain productivity and income generation, while also contributing to international climate action goals through the reduction of greenhouse gas emissions. CSA gains greater contextual appropriateness in light of the promotion of diversification and expansion of the sector by the "National Strategy for Agriculture" (NSA; Ministry of Agriculture, 2013). The non-traditional crop sector (fruit and vegetable crops) stands to serve as a main route of diversification as its product base is lower in production volume but more varied than traditional rice and sugar sub-sectors (Ministry of Agriculture, 2013). Geographic diversification and expansion are key to decentralizing farming that is mostly done on the coast, and shifting it toward the hinterland where only 10% of agricultural activity (mostly subsistence farming) is done (New Agriculturist, 2004; ECLAC, 2011; Ministry of the Presidency, 2015). The Low Carbon Development Strategy[1] (LCDS) buttresses the NSA's aims with its vision for sustainable, productive, and climate-resilient agriculture (Bynoe, 2012; DECC, 2022). The LCDS and NSA identify agriculture as a high-priority sector to implement CSA but policy, environmental, financial and institutional barriers can counteract the facilitators of CSA co-benefits (production, adaptation, and mitigation) in Guyana.

In Figure 1, the current barriers tend to hinder GHG mitigation. Guyana has the status of being both a Non-Annex I country[2] and a net carbon sink (Government of Guyana, 2016). This status, together with civil society consultations that were formative in the creation of Guyana's revised Intended Nationally Determined Contributions[3] (INDC), are perhaps substantial justifications[4] for the exclusion of agriculture in the emissions reductions programme. Agriculture is purely treated as an adaptation issue in this policy (Government of Guyana, 2016). Also, neither financial incentives for mitigation nor the formidable institutional shortcomings, in the form of limited dispensation of environmental education, research, science and technology, offer a sufficient basis for sustainable development in any sector according to the RIO+20 Report (Bynoe, 2012).

On the other hand, facilitators of CSA tend to be of the future and directly counter the current barriers. The LCDS and NSA run counter to the INDC's position on agriculture, as all aspects of CSA are endorsed. As there will be more environmental pressures from expanded agriculture under the NSA policy, a nascent but expanding oil and gas industry, and the construction boom that is financed by oil revenues, Guyana may become more obligated to increase its emissions reduction efforts across the economy. Concomitantly, oil revenue can be a source of state finance for robust implementation of adaptation and mitigation (Lucas, 2017). The oil revenue together with the LCDS can be powerful financial and policy instruments to shift the paradigm from conventional to sustainable.

Whichever policy, environmental and economic contingencies lie ahead, there can be a sustainable agricultural paradigm if farming's most important resource is sustainably managed, i.e., the soil. The soil provides ecosystem services that help protect food security, water quality, human health and the basis for a range of socio-economic activities; concepts that are subsets of soil security (Ball et al., 2018). However, climate change (CC), land degradation and biodiversity losses have caused soil to become one of the world's most vulnerable resources (FAO and ITPS, 2015a,b). Addressing soil and land degradation, and improving soil management are some key technical pathways to a sustainable, diversified and expanded agriculture in Guyana. According to Ball et al. (2018), soil-focused farming can increase soil security, which is relevant to Guyanese farmers and stakeholders. It is relevant because soil management can improve marginal soils of the hinterland, which are earmarked for novel crop cultivation, and even the fertile coastal soils that are constantly degraded by conventional farming practices (Richardson and Menke, 2018a,b).

1 The LCDS is the national development strategy for the development of a low-carbon economy that fosters sustainable and climate-resilient development, while also leveraging incentives to promote Guyana's ecosystem services (DECC, 2022).

2 Non-Annex I status belongs to developing countries, which do not have obligatory GHG emissions reductions targets under the Kyoto Protocol (Solomon Islands Meteorological Service, 2015).

3 An INDC identifies which policies and actions a country will conduct for GHG emissions reductions; all UNFCCC parties were required to publish this as part of the 2015 Paris Agreement for post-2020 GHG mitigation action (International Labour Organization, 2017).

4 Guyana's INDC document identifies climate change shocks as severe threats to agriculture. It does not give an explicit reason for agriculture's exclusion but adaptation is prioritized over mitigation (Government of Guyana, 2016).

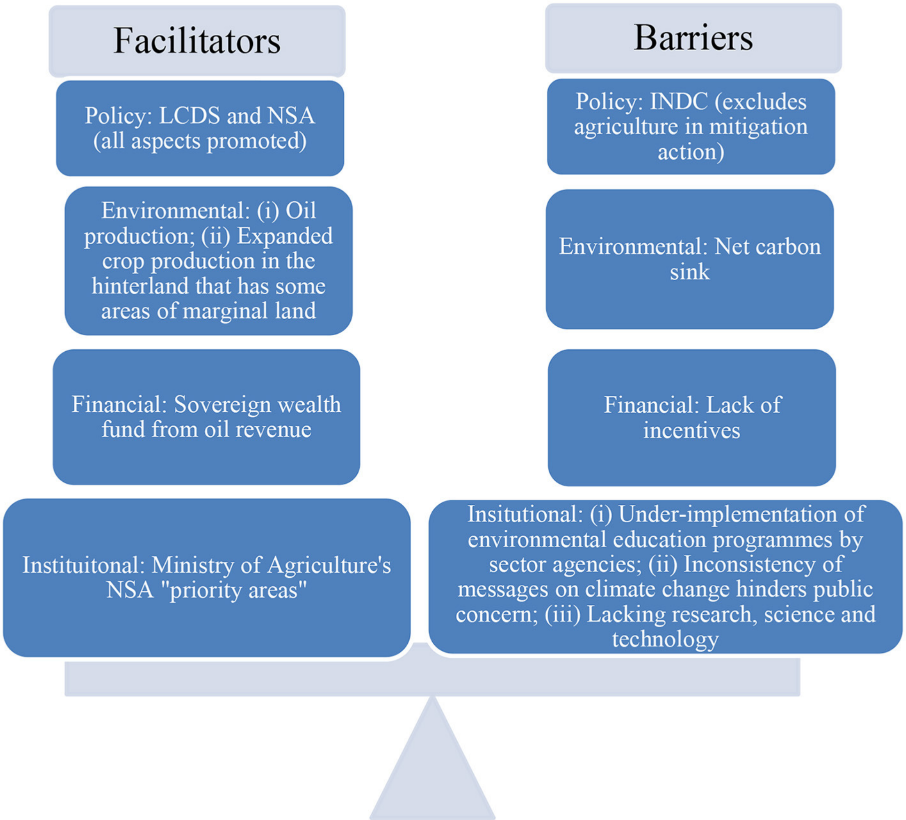

FIGURE 1
Facilitators of and barriers to CSA in Guyana.

1.2. Adopting sustainable soil management

Sustainable soil management (SSM) practices that are adapted to local biophysical and socio-economic conditions can provide options for CC adaptation and GHG mitigation, and build the resilience of agro-ecosystems for the sustainable production of food (FAO, 2017). SSM, therefore, is a form of CSA that can overcome Guyana's contradictory agro-environmental policies and financial barriers faced by its small-scale farmers especially because they are autonomous but inexpensive interventions compared to other land management practices, which require high capital and technological investments. Furthermore, SSM has the highest mitigation potential (Smith et al., 2008; Benbi, 2013).

The SSM practices[5] in Table 1 are soil management practices that are used to shift from a high-input system toward an ecosystem approach. SSM reduces the need for external production inputs, like inorganic fertilizers, and their associated GHG emissions, while also diversifying farm outputs, sustaining yields and reducing the vulnerability of agro-ecosystems to the impacts of CC (FAO, 2017). SSM shows that Guyana's agriculture does not need to be treated only as an adaptation issue, as it is possible for synergies to exist between adaptation and mitigation in tropical agriculture (FAO, 2010; Harvey et al., 2013). This counters views, from Smith (2013), Hasegawa et al. (2015), and Herrero et al. (2016), who posit that mitigation disrupts agriculture's ability to sustain food security and rural livelihoods. It must be stressed that SSM is not a single technological solution to sustainable farming but it is a viable starting point for low-income farmers, as Benbi (2013) states that it has relatively low technological and financial requirements.

SSM requires quality management of soil health as much as quality training of its stewards, i.e., farmers. SSM should and can be facilitated by the National Agricultural Research and Extension Institute's (NAREI) extension arm as well as other agencies of the

TABLE 1 Sustainable soil management practices for GHG mitigation.

Mitigated GHG	Practices
CO_2	(1) Biochar, (2) no-till/reduced tillage, (3) mulching, (4) manure application, and (5) setting aside land to store CO_2
CH_4	(1) Increasing productivity of the farm, (2) improving degraded or barren lands, (3) crop rotation, and (4) incorporation of crop residues
N_2O	(1) Cover cropping

Adopted from IPCC (1996), Paustian et al. (1998), and Benbi (2013).

5 Only SSM practices were selected from a range of mitigation techniques that focus on soil, fuel and fertilizer management compiled by Benbi (2013), IPCC (1996), and Paustian et al. (1998).

Ministry of Agriculture especially because educating and training farmers for sustainable farming, inclusive of soil management, is one of the many NSA "priority areas" (Figure 1), otherwise known as Priority Area 18 (Ministry of Agriculture, 2013). However, some of its outcomes are underreported (Appendix A—Table 5), which includes efforts to train farmers in practices such as biochar[6] (Danny, 2017). Though promising, adoption of sustainable, low-input practices, such as biochar, are not widespread compared to conventional practices (Austin, 2023).

The government of Guyana is creating an untenable and inconsistent position on agricultural development; a lot of the literature on this issue is from the perspective of policy-makers: a top-down approach for agricultural development. Excluding the goals and needs of local stakeholders leads to the failure of most policies (Ducrot et al., 2011). Moreover, policies that support conventional agriculture often prevail over those that support sustainable practices (Mattison and Norris, 2005). According to Sayer et al. (2013), stakeholder involvement is important to the achievement of CSA objectives. They show that implementing new practices must be done at the level of the landscape because it takes this "complex system with mutually interacting social, biophysical, human ecological and economic dimensions" into account (Farina, 2000).

Therefore, there is great justification for a bottom-up approach for sustainable agricultural development; one that considers the experiences, challenges and opinions of farmers when conducting the planning process for local agriculture. Like all stakeholders at any level, farmers need to possess the 3 Cs: concern, capability and contracts (financial incentives) for climate change action in agriculture that includes mitigation (Suzi and Dorner, 2013). While capital constraints currently render financial incentives impossible, limited education and training (Figure 1) are direct barriers to farmers' concerns for, and capabilities to implement CSA and further still, SSM. Concern is the most important of the 3 Cs, as it is the measure of SSM's relevance to persons who are the actual practitioners of farming, i.e., farmers. To the best of the researcher's knowledge, ground-truthing on these gaps for SSM has never been done before. Therefore, this research will assess the concern i.e., the attitudes of Guyanese farmers to CC, as well as their capabilities (in terms of education, technology and government support) for SSM practices (Table 1) and their actual use of them. This process may then help to reveal practical approaches to promote SSM because actual implementation should only be done after assessing agro-climatic features, social appropriateness and economic feasibility, which then inform the selection of the most appropriate management practices (Benbi, 2013).

Even though the NSA will place greater emphasis on large-scale private investment in the cultivation of non-traditional crops in the hinterland, small-scale farmers (<5 ha), who make up most of this sub-sector, should not be overlooked (Ministry of Agriculture, 2013; Ministry of the Presidency, 2015). Therefore, this research is a qualitative analysis to explore the variation of facilitators of and barriers to SSM between the coast and the hinterland of Guyana, especially for smallholder farmers.

6 Biochar is a form of charcoal that is pyrolyzed from biomass. When applied to the soil, it increases nutrient use efficiency, which in turn, reduces N_2O emissions. It is also sequesters carbon (FAO, 2013).

TABLE 2 Collected primary and secondary data as it relates to Guyanese crop farming.

Primary	Secondary
Data type	
Psycho-social attributes: e.g., Education, awareness, and attitudes to CC, CSA, SSM, and government policy and support for SSM and CSA in general	Socio-economic attributes: e.g., GDP contribution, employment generation, and export earnings (crop farming)
Agro-climatic attributes: e.g., Experience with and perceptions of the farm's weather, climate, soil quality, nutrient management, crop yield, and the biggest challenges	Agro-climatic attributes: e.g., Climate, soil, and features of the crop production systems
Technological attributes: e.g., Features of crop production systems, and level of access to training and inputs for mitigation	Policy attributes: e.g., Government policy and support for SSM and CSA in general

2. Materials and method

2.1. Overview

The research employed a 2-fold approach: (1) a literature review to evaluate and analyze secondary data and, (2) qualitative analyses of primary data. Secondary data was collected using articles, reports and other relevant sources, and thus formed the literature review component of the methodology. Review of the gray literature provided an overview of international and local policies that Guyana has adopted for climate change action as well as agricultural development, CSA and SSM. This was complimented by primary data on farmer awareness and attitudes to these policies to evaluate their shortcomings. Primary data on farmers was collected through telephone interviews.

2.2. Sampling technique and sampling frames

Maximum variation purposeful sampling (MVPS) was employed to sample information-rich "informants" i.e., farmers of both coastal and hinterland areas (Patton, 2002). MVPS was used to capture diverse responses related to the psychosocial, agro-climatic and technological attributes of cropping practices (Table 2). MVPS was applied to a Microsoft Excel (version 2017) farmer database provided by NAREI's extension department. This database consists of non-traditional crop farmers located in the administrative regions 1, 2, 3, 4, 5, 6, 7, 9 and 10, who the extension department work with. The database had already been divided into separate directories (spreadsheets) for coastal (2, 3, 4, 5, 6) and hinterland (1, 7, 9) administrative regions. Potential respondents were purposefully selected based on:

TABLE 3 Final sample frames of coastal and hinterland cohorts.

Directory	Total entries	Total no. of called farmers	Final sample number	Scale
Coast	60	37	10	Small-medium; Large
Hinterland	605	71	7	Small-medium; Large

1) Geographic location (coast vs. hinterland) and inherent soil quality (fertile vs. marginal).
2) Scale (small-medium: <5 ha; large: >5 ha).[7]

Iterative sampling and re-sampling were done until theoretical saturation occurred (Miles and Huberman, 1994). In other words, the sample numbers for both cohorts were determined on a posteriori basis; when no new information was acquired, sampling was stopped and the farmers who were already interviewed formed the sample frame (Glaser and Straus, 1967). However, as several administrative regions comprise the coastal and hinterland directories, efforts were made, as much as possible, to ensure each region had equivalent response rates. For each administrative region, selection of potential respondents commenced from the first name entry on the list and telephone interviews were done until two to three farmers had been interviewed. If a region had a very long list, care was also taken not to select farmers from a previously selected sub-location that already had an interviewed respondent. Though Region 10 is contained within the coastal directory, it was not sampled because it is neither classified as coastal nor hinterland; Region 10 is dominated by the "Hilly, Sand and Clay" natural region (Reece, 2012). A total of 37 and 71 farmers were called in the coastal and hinterland directories (Table 3). Region 4 (coast) had a 0% response rate. Therefore, the coastal and hinterland directories provided 27% and 9.9% response rates respectively from the total number of farmers called. Failed telephone calls, due to wrong or invalid numbers, unanswered calls and, in a few instances, unwillingness to participate, contributed to non-responses.

2.3. Telephone interviews

From June 29 to July 27, 2018, 17 telephone interviews were conducted. Due to the diversity of geographic locations of farms, farmers' schedules, and a potential inclination to preserve individual privacy, which may reduce the response rate, semi-structured interviews (consisting mostly of open-ended, with a few close-ended questions) were used to collect primary data from farmers (Table 2). The interview consisted of 20 main questions[8] that were themed according to the (primary data) attributes in Table 2 (full interview in Appendix A—Interview questions). Open-ended questions were used to make respondents feel more relaxed to add depth to responses. Questions were related to the farm characteristics and targeted their awareness and attitudes toward climate change, GHG mitigation in farming, CSA, and an extended section on SSM practices (Appendix A—Interview questions) to determine the reasons for using them or not. The researcher also asked respondents to identify any government resources which have been made available to them for SSM, and constraints to adopting SSM practices. Within the interview, when speaking about "sustainable soil management," "climate-smart agriculture" was used as a substitute as it was assumed that the latter is a more popular and, hence, familiar term. The aim was to help to increase comprehension and response rates. The researcher took cognizance of different communication abilities, appropriately rewording questions and phrases in the interview. All interviews were electronically recorded using an in-phone call recorder application, Call Recorder—ACR (version 29.6).

Naturalized transcripts of the recorded interviews with each respondent were produced within Microsoft Word (version 2017) using paralinguistic transcription notation based on Poland (2001; Appendix A—Table 6). Three pilot interviews of farmers not within the farmer database were conducted to assess question comprehension, and interview flow and length. Notable difficulties caused by specific questions informed appropriate reconstruction of these questions.

7 Scale classification based on description of dominant farming scales in crop sector (small-land holders <5 ha) by NSA document (Ministry of Agriculture, 2013).

8 There are twenty (20) main ("themed") questions and some have several sub-questions. Therefore, the total number of questions is sixty-three (63).

2.4. Inductive-derived thematic data analysis

The analysis was based on a grounded theory approach that included coding and comparison, which was elaborated in the seminal work of Glaser and Straus (1967). This study of emerging concepts surrounding sustainable behavior of farmers is similar to that of Namdar (2018), who established "primary" and "subsidiary" factors influencing farmers' environmental behavior.

The software, NVivo (version 11.0.0.317), was integral in conducting inductive-derived thematic analysis of transcripts. Interviewee responses were thematically coded using the "node" function within NVivo to identify the barriers of and facilitators to CC concern, and capability for and use of SSM. Different nodes that contain excerpts from transcripts that substantiate a particular theme are related to barriers to and facilitators of CC concern, and SSM capability and use. Related themes were, therefore, connected within the hierarchical system of nodes. Separate work sessions were created for coastal and hinterland cohorts, but constant comparison was still done between these two groups, as well as within them.

3. Results and findings

Theoretical saturation was the principle that helped to determine how many interviews should be carried out for the coastal and the hinterland cohorts. After theoretical saturation

TABLE 4 Major facilitators of and barriers to SSM in coastal and hinterland cohorts.

	Psycho-social	Physical
Concern for GHG mitigation and the environment	1. Perceptions of the environment 2. Understanding of environmental issues 3. Beliefs	1. Agro-climatic characteristics
Capability to implement SSM	1. Knowledge (education and training)	1. Farm inputs
Use of SSM	1. Awareness of and Attitude to CSA and SSM 2. Perceived compatibility of SSM practices 3. Willingness to adopt SSM	1. Agro-climatic characteristics 2. Time 3. Market access

was reached in the coastal and hinterland cohorts, 10 and seven farmers had been interviewed, respectively (Appendix B—Map 1). This numerical disparity somewhat intimates the agricultural dominance of the coast.

3.1. Inductive-derived thematic analysis of the facilitators of and barriers to SSM in coastal and hinterland cohorts

Table 4 shows the major factors that can either be facilitators of or barriers to SSM in both cohorts. They can also be categorized as either psycho-social or physical in nature.

3.1.1. Concern of farmers for GHG emissions from crop farming

Only a minority of farmers from both cohorts is not concerned about GHG emissions from their farms (Appendix B—Table 8). There are several underlying motivations for this, including no perceived climate threat, religious belief and lack of understanding. However, for the majority of interviewees (11/17), GHG emissions are a concern since they have an environmental awareness. However, this sentiment is expressed stronger in the hinterland cohort:

> *"… we believe that we helping to make the climate change. That's our belief... and WE THINKING THAT at our level, H-H-HOW WILL WE BECOME AS A COMMUNITY? We were thinking about those (..) to see how to conserve and protect the area … AND ALSO WE NOTICE THAT WHEN WE AS INDIGENOUS PEOPLE in the Amerindian community, when we SLASH AND BURN, when we, although we are friendly with the wildlife … like it get the, the wildlife OFF from our communities…"* [H7]

3.1.2. Capabilities of farmers for SSM

Question 14 (see Appendix A—Question 14) was key in revealing whether the farmer is capable of practicing SSM. This was answered mostly in the affirmative for both cohorts. For example:

> *"YES! As I told you before, the ability is there. You understand? But I would need the other expertise. As I told you, I need the fertilizer and the different things."* [H3]

However, like many farmers of both cohorts, H3 reveals that he also needs support for expertise and farm inputs to implement the SSM practices; but his regard of fertilizers as a necessary component of SSM shows that he did not fully understand the interview component on SSM and its principles. Both cohorts of farmers tended to misunderstand CSA and SSM. Most farmers said that they were unaware of the CSA term and the names of SSM practices but further questioning revealed that they do use some SSM practices (see Appendix B—Table 8). This shows that most farmers dissociate SSM from CSA, i.e., they do not think that SSM is CSA. Furthermore, farmers tended to reveal, at various points in the interview, that they lacked the knowledge to adopt some of the techniques:

> *"Yeah, we are trying all the time but ummm, we don't know what to use to get more produce"* [C4]

A lack of education and training opportunities for CSA and SSM was identified by farmers in questions 16–19 (Appendix A—Interview questions). Furthermore, in response to question 20, which asks farmers to suggest government policies to support CSA, some farmers suggested material support in terms of fertilizer and pesticides, which yet again shows that they did not fully understand the principles of SSM discussed during the interview (Appendix A—Interview questions). Farmers' capabilities for adopting SSM is hindered by a lack of knowledge, which can only be overcome by education and training as H3 highlighted above, when he stated his desire for expert help. In both cohorts, C7 is the only farmer that is being trained by NAREI to practice CSA (Appendix B—Table 7) and he has heightened knowledge of not only general CSA but SSM practices as well. Thus, he uses the highest number of SSM practices across both cohorts (Appendix B—Table 8). The lack of education presents itself as a common and major barrier between the two cohorts. Some farmers in both cohorts even directly cited this as a hindrance to enabling farmers to practice SSM:

> *"… MOST farmers here … what must I say … let us call it backward.?"* [H3]
> *"One of thing that I would like to add to your stuff, in Guyana, the farmers that we have are not the type of educated people in that field."* [C6]

However, both cohorts have farmers that show a desire to learn about SSM:

> *"YES, BUT WHAT I WOULD LIKE, THAT IF YOU ALONG WITH SOME OTHERS CAN PL-L-L-LEASE COME AND ARRANGE A WORKSHOP FOR US. Like we can gather some of the residents in here BECAUSE MOST OF US IN HERE DO FARMING."* [H5]

H5's emotive response highlights her need and desire, like many others, to receive training. Lack of certain farm inputs can also present a barrier to capabilities. Both cohorts had farmers desirous of incorporating crop residues into the soil, but they do not have machinery to do such:

> *"Well as I tell you before, I don't HAVE the machinery..."* [H3]

3.1.3. Use of SSM by farmers

Lack of concern about the farm's GHG emissions does not necessarily mean that farmers do not use CSA and SSM practices (see Appendix B—Table 8 for full tabulization of SSM usage). Farmers who are not concerned about CC and GHG emissions (C1) or do not believe that it occurs in Guyana (C9) still think that CSA is relevant to them and even use some SSM practices.

No farmer uses all the SSM practices and reasons for the use and non-use of different practices vary from farmer to farmer. However, there are common determinants of whether a farmer may or may not use an SSM practice, i.e., mainly the willingness or motivation of farmers to use it.

Farmers use practices if they recognize that they confer a benefit to the soil and/or crop, i.e., an agronomic benefit, and thus, increase yield and earnings.

However, even though some farmers recognized the agronomic benefits of the SSM practices, certain physical barriers prevented them from using them, which are summarized in Appendix B—Table 9. These physical barriers reduce the willingness to adopt SSM practices. Furthermore, farmers who have a conducive cropping environment tend not to see the benefits of SSM practices and they would indeed not be motivated to use them. While this trend did exist for some SSM practices in the coastal cohort, such as C2 in Appendix B—Table 8, it was far more evident in the hinterland cohort where there were two farmers (H4 and H6) who used no SSM practices at all. This was due to their shifting cultivation patterns, which utilized slash and burn techniques to prepare their land each season (Appendix B—Table 10). These types of farmers would, therefore, have no need for any kind of soil amendment, natural or artificial, as the virgin land was sufficiently fertile to the extent that they never had to make any direct efforts to increase their yields:

JM: "*How would you talk about the quality of your soil? How would you rate it?*"
H4: "*... IT'S GOOD, YES ... WE DON'T USE FERTILIZERS. We cut the big bush just so.*"

Therefore, just as a conducive cropping environment is a barrier to the use of SSM for some farmers, a deteriorating one would be a facilitator for others whose lands are decreasing in fertility such as C9, who has observed depletion of the fertility of his once fallowed soil (Appendix B—Table 10). Therefore, like other physical resources (Appendix B—Table 9) certain environmental attributes, such as soil quality, can be either a facilitator or barrier to SSM use depending on the level of scarcity.

In addition to level of resource scarcity, farmers also consider the compatibility of SSM practices with their farm system, such as C2, who cannot use crop rotation because of his farm layout, or the large-scale farmers, C5 and C10, who cannot use biochar and mulch respectively, as they see it as impractical for a big farm (Appendix B—Table 8).

While physical barriers present major hindrances to SSM use, there are psychosocial barriers that preclude any inclination to use it. Appendix B—Table 8 shows that certain SSM practices are hardly used, such as biochar and cover cropping, or not used at all, i.e., setting aside land to store CO_2. The main reason for both instances is that farmers simply do not know about them, as they many times revealed:

> *'I've never heard anything about all these things that we have talked about here."* [C6]

Thus, lack of awareness is a major recurring psychosocial barrier revealed throughout the interviews of both cohorts. Other psychosocial barriers include negative attitude to SSM, as evidenced by H4 and H6. They steadfastly believe in proven farm practice. For H4, learning how to farm from others has influenced her mode of farming:

H4: "*I see people plant, just like how people plant, that's just how I plant. I plant how I have to plant (laugh) (..) plant how I know.*"
JM: "*... Ok, so for you, the things that you, the things that you do is because they are things that you have learnt from them and that is the right way to go?*"
H4: "*Yeah (chuckles).*"

In both cohorts, there were both positive and negative perceptions of the agro-climatic environment, especially in terms of crop yield/and or soil quality (Appendix B—Table 10), which also influenced the level of willingness to adopt SSM. In both cohorts, farmers that have negative perceptions tended to be not only willing but very interested in adopting SSM practices. C7 and C9 were particularly interested in biochar:

C9: "*Can you assist with some information on this biochar?*"
JM: "*... So, is it that you want a lot or you just would like to know how to make it?*"
C9: "*Well, I would like to know how to make it ... like the diagram of the kiln.*"

In contrast, farmers who have positive perceptions of the agro-climatic environment, even when they had experiences with weather disasters (Appendix B—Table 8), were less enthused by SSM practices:

> *"Ahhh, why I'm not concerned really is that where we planting, the part where we are doing farming, we don't get too much disaster. The only disaster we really get is like, not selling, not selling and things like that ... So, we can't do those things, we can't do those things, like ho-o-ow (..) we can't afford to do those kinds of things, those kinds of things that you are talking about."* [C10]

While positive perceptions of the environment are important psychosocial barriers to SSM, the last excerpt by C10 above shows the effect that considerations for marketing have on SSM use.

C10 is not the only farmer to reveal his reservations about SSM because of market concerns. Other farmers, both in the coastal and hinterland cohorts, reveal that market access and crop prices are much larger underlying problems for any kind of farming. Initial indications of being motivated to use SSM practices were often followed by reservations about the lack of markets for goods, periodic low prices and incurrence of losses. While this is true for both cohorts, only the coastal cohort tended to identify this as their biggest challenge, especially C6 and C10, as they are both large-scale farmers who have more cost concerns (Appendix B—Table 7). While C10 is not very enthused by SSM, C6, on the other hand, recognizes the benefits of SSM because he wants to run a more sustainable farm in relation to improving soil quality (Appendix B—Table 10). However, at the end of the interview he revealed that he is reluctant to adopt SSM as his main concerns are trying to generate income in the face of low prices and inconsistent market opportunities and, hence, security. Additionally, in contrast to most farmers, who think that the government should provide training or farm inputs (in response to question 20; Appendix A—Interview questions), C6 stresses that markets for goods must be found before any kind of sustainable practice can be done. Thus, SSM may not be feasible for him:

> "*…Because, like (chuckle), if they do these stuff here, whatever we have been talking about and you will have an increase in yield, where will you put all of this increased yield … You are just going to flood the market down again, then nothing will be selling … You know, if you understand what I'm saying. I think that before they get into all these SMART umm, farming and whatever and so, you need to somewhere where or get somebody that can take some produce. Why we will invest millions and billions and then when we go out into the market we have to throw it away.*" [C6]

Attitudes to CSA and SSM as well as financial considerations are closely inter-related. H3 and H5 were very enthusiastic about SSM and sustainability throughout the interview as requests were made to not only explain CSA and SSM concepts in detail but also for SSM training. Through responses to various questions on climate change and SSM use, it was revealed that H5 has as much concern for the environment as she does for cassava farming on which her living depends. H7 also has a similar attitude but is more selective of practices that he could possibly adopt. In general, hinterland farmers, apart from H4 an H6, were very emotive about the environment; and though highly invested in their farm business, they were not very concerned about market issues:

> JM: "*If I am to say that your farm also releases these greenhouse gases, would you be concerned?*"
> H5: "*I would be concerned, yes (tone of slight worry) but I need an explanation …*"

On the other hand, in the coastal cohort, marketing issues are usually prioritized above the environment for both environmentally concerned (e.g., C6 and C7) and unconcerned farmers, such as C10, who is very emotive about the lack of markets and cost of production, which he frequently stated throughout the interview:

> "*The thing is, it doesn't make sense in Guyana here right now, because people are spending MORE money than they are making … it won't make any sense, because markets are not there for the goods …*" [C10]

3.1.4. Farmer typologies

Environmental conditions as well as financial, logistical, and marketing barriers invariably produce farmers whose operations are either market-driven, sustainable or a hybrid of being market-driven and sustainable.

3.1.4.1. The Market-driven

Farmers of this category are exclusive to the coastal cohort and have varying farm sizes. They have been farming for a lengthy land tenure, during which, crop yields are invariably affected by the climate. Nutrient and, pest and disease management are necessary to support cropping cycles because satisfactory plant growth requires substantial fertilizer inputs while they are also affected by pests and diseases. These farmers experience climatic and agronomic pressures, are aware of SSM, practice it to an extent and are willing to adopt more. However, they are acutely aware of marketing pressures, such as the lack of markets that C6 talked about (Section 3.1.3). Therefore, SSM is not feasible for them because they prioritize accessing markets and good prices for their commodities, and they tend to employ a more conventional and intensive mode of farming.

3.1.4.2. The sustainable

This kind of farmer is exclusive to the hinterland cohort and occupies small land. These farmers sell their crops, but they do not cite marketing as a significant issue. Instead, it is the farm environment and management that stand as their greatest challenges. Pests and bad weather damage crops, while marginal soils increase the difficulty of crop cultivation. However, SSM practices, especially mulching and manure application, are used to improve the fertility and workability of the soil.

Though lack of conventional inputs makes farming management a bit difficult for these farmers, they still reveal a strong preference to continue using SSM practices, such as manure, because they recognize its benefits i.e., increased soil fertility and workability, and quality and shelf-life of crops.

Their farming practices are not only shaped by their poor farm environment but also by their strong sentiments for the surrounding natural environment, as stated before by H7 (Section 3.1.1), and strong beliefs in traditional farm practices:

> '*And I was listening to my grandparents, my grandfather … And they USED TO BELIEVE ON THE STARS. When the seven stars get up in that area that means the rain is ready to start. When it going down, that means it ready to start … YES, Y-Y-YES, WE HAVE, WE HAVE OUR BELIEF … how to plant our cassava.*" [H7]

3.1.4.3. The Market-driven and Sustainable

This group of farmers can be found in both cohorts. The "sustainability" of the farms is either a product of ideal farming conditions or deliberate and informed efforts to employ a host of

SSM practices to improve soil fertility such as C7 (see Appendix B—Table 8).

Ideal farming conditions are enjoyed by other coastal, as well as hinterland farmers of this group. The coastal farmers (C1 and C10) do not have climatic pressures (see Appendix B—Table 8) and cultivate on fertile soil (Appendix B—Table 10).

On the other hand, the hinterland farmers (H4 and H6) within this group employ shifting cultivation and, slash and burn every season (Appendix B—Table 10), which improve soil fertility (Boucher et al., 2011; World Agroforestry Centre, 2018). Thus, their crops benefit from a conducive cropping environment because of the lack of environmental pressures or the use of traditional land preparation techniques that benefit the soil. They are unwittingly sustainable farmers because they tend not to have environmental concerns:

> JM: "*You just don't see them. Do you think you have a part to play in solving climate change?*"
> H6: "*N-n-n-no, no.*"

These farmers have no need for conventional inputs, such as fertilizers and, hence, their farm systems can be classed as low-input. The lack of environmental pressures and environmental concern means that they prioritize the marketing aspect of farming, especially C10:

> "*Well the biggest challenges right now for the farm is not the cropping, is to sell the produce.*" [C10]

4. Discussion

Even though there is a wide range of concern for the environment and capability for SSM, apart from H4 and H6, all farmers of both cohorts use SSM practices but at varying degrees (Appendix B—Table 8). Therefore, in general, concern for climate change, GHG mitigation and sustainability do not determine whether farmers of both cohorts use SSM practices or not, as this is clearly demonstrated by the environmentally unconcerned farmers C1, C10, H4, and H6 (Appendix B—Table 8). Instead, it is the environment that the farm occupies as well as farming beliefs and experience with the environment that influence rates of adoption. Studies show that economic, socio-demographic and environmental factors shape farmer considerations when changing agricultural management practices. However, the entire decision-making process is mostly influenced by personal attitudes and perceptions (Pannell et al., 2006; Kragt et al., 2014; Morgan et al., 2015). Therefore, the extension agency (NAREI), other support organizations and policymakers should recognize and leverage the complex humanistic factors at play within the farming landscape to encourage a dynamic and inclusive policy and practice of not only government-driven sustainable agriculture but also autonomous sustainable interventions by farmers. The following sub-sections elaborate the most relevant humanistic factors, revealed from the interviews, which encourage autonomous decision-making by farmers for SSM.

4.1. Farmers' experiences with the environment

In general, hinterland farmers are far more emotive about sustainability and SSM use because most of these farmers occupy marginal lands compared to the coastland (Richardson and Menke, 2018a,b). This trend is similar to that of Dumbrell et al. (2016), who show that environmental conditions influence the attitude and willingness of farmers to adopt sustainable practices. H4 and H6 are the only hinterland farmers that are anomalous to this trend. They enjoy fertile soil and satisfactory production because shifting cultivation uses the "slash and burn" technique, which generates fresh and fertile land every season. This method of farming is commonly practiced by tropical subsistence farmers who occupy nutrient poor soils (Boucher et al., 2011; Filho et al., 2013).

Additionally, many forested areas within the hinterland are under conservation, which include sites of spiritual importance to Amerindian communities (IFAD, 2016). This might also explain the greater environmental concern that hinterland farmers tend to express in comparison to the coastal cohort, which means that they are more likely to adopt sustainable practices.

Adoption of innovative practices depends on farm and farmer characteristics, such as their ability to be easily integrated into the current management system (Dumbrell et al., 2016). Practices such as mulching and manure tended to be incompatible for large-scale coastal farmers simply because of the difficulty in procuring large quantities of these amendments.

4.2. Farmer typologies and social context

Higher rates of SSM adoption, i.e., the further adoption of other SSM practices that are not currently used (demonstrated by question 12 in Appendix A—Interview questions), are also significantly influenced by farmer typology, which in turn, is influenced by the social environment of the farmer. According to Kragt et al. (2017), the social environment in which a farmer operates can also influence the likelihood of adoption of farming practices with GHG mitigation co-benefits, as well as participation in supporting policy programs. In this scenario, trusted colleagues who have experience with these practices serve as valuable sources of information to farmers who are interested in adopting them as well. All three farmer typologies (see Section 3.1.4) include farmers who demonstrated how farmer peers helped shape their farming beliefs and, hence, mode of farming. For example, "market-driven and sustainable" farmers, such as H4 and C10 (both environmentally unconcerned), cited lack of environmental pressures for their non-adoption of some SSM practices. However, their belief in proven practices learnt from other farmers could be the underlying reason for their reluctance to adopt alternative ones. On the other hand, sustainable farmers, such as H3 and H7, who have strong environmental concerns that are fostered by knowledge transfer of traditional and sustainable farming from friends and family, are more open to adopting SSM practices (see Appendix B—Table 12 for summary of supporting excerpts). Learning from farmer peers is an invisible but strong factor that shapes farming systems. Therefore, farmer networking is an important route for information dissemination. This means that NAREI should encourage farmers trained in CSA, such as SSM, to serve as information nodes within their communities e.g., C7. They can provide information to their farming peers, which might encourage them to also adopt SSM.

4.3. Differing economic conditions

Economic disparities exist between the coast and the hinterland. Poverty is highest in the rural hinterland (Region 1, 8, and 9; IFAD, 2016). Additionally, based on their subsistence farm scale, hinterland farmers will be more economically vulnerable than their coastal counterparts. This is evidenced by responses to question 13 (Appendix A—Interview questions), which reveal that most hinterland farmers are unwilling to bide time for sustainable revenue generation, in contrast to coastal farmers. Many coastal farmers are large-scale and because they are more concerned with profit-making, they would have a stronger entrepreneurial drive than their hinterland counterparts. They would be willing to adopt SSM and wait 5 years if the ensuing income is consistent. This opposes research findings by Suzi and Dorner (2013) that show farmers may be reluctant to switch production methods since farms are seen as long-term investments.

Even though the SSM practices assessed are low-input and low-cost, in comparison to intensive-conventional farming systems, consideration still must be made for the inherent capital requirements for any of these SSM practices e.g., biochar, which attracted a fair amount of interest from farmers in both cohorts (see Appendix B—Table 13). Researchers are paying significant attention to biochar because it has the potential to deliver CSA benefits complimented by improved soil fertility especially in developing countries where there is a lot of marginal or degraded soils (Scholz et al., 2014). Life-cycle assessment case studies of biochar use in Kenya, Vietnam, and Senegal show that it can reduce GHG emissions and be economically viable (Scholz et al., 2014).

4.4. Research needed to tailor SSM practices, like biochar, to farms

However, the complexity of biochar systems means that there are diverse effects on soil and, climate impacts, which warrants consideration of the farm system design that it is being integrated into (Scholz et al., 2014). While compatibility issues and other agro-climatic factors mean that further research is needed to understand the associated opportunities and risks from biochar application, it is of greater importance to assess the socio-economic environment in which this technology is being researched (Scholz et al., 2014). The success of biochar systems in developing countries, where farmers have limited start-up capital and other funds, hinge on the economics of these systems, which in turn are dependent on several factors. Quantifiable factors include the cost of the feedstock, kiln and transportation, as well as the price of biochar and surplus crops, and the reduced expenditure on conventional agricultural inputs (Scholz et al., 2014). However, the economics of biochar projects, analyzed by Scholz et al. (2014), is mostly decided by the price farmers receive for surplus crops due to biochar applications. This shows the importance of the economics of alternative practices; if it is favorable to farmers, then it will be adopted (Scholz et al., 2014).

Though biochar has the potential to improve soil fertility and increase crop yields, and is endorsed for developing-country contexts, not all farmers, even the environmentally-concerned ones, readily embrace these potential benefits, e.g., farmer C6. He regards increasing yields as inappropriate for local markets that cannot absorb extra production (see Section 3.1.3). Furthermore, environmentally unconcerned farmers, especially the large-scale coastal farmers (C1, C4, and C10), were reluctant to further adopt other SSM practices because the potential production benefit is regarded as insignificant in the face of marketing issues, such as low prices, that threaten the viability of farms. This opposes the findings from Morgan et al. (2015) and Page and Bellotti (2015), who show that adoption of new practices by farmers are encouraged if there are perceived production benefits.

4.5. The need for improved marketing

Brady (1990) and Pretty (1995) state that the immediate concern of farmers in developing countries is to increase income and food security, and reduce crop failure. This is echoed by the prioritization of marketing issues by coastal farmers, which meant that they were less enthused by SSM compared to their hinterland counterparts.

Many farmers of both cohorts invariably highlight the low prices and even lack of market access for their goods, which defeats the purpose of any type of farming practice, even SSM.

Hinterland farmers may be less market-motivated due to being unaccustomed to ready markets.

The hinterland has many remote areas that lack infrastructure, which causes high transportation and production costs, and low productivity. This limits market access and the integration of hinterland activities in the national economy (IFAD, 2016). Therefore, low prices and difficulty in accessing markets, especially in the hinterland, stand as the greatest barrier to sustainable intensification (promoted by the NSA); not the environment, nor attitude and concern that farmers have toward it. Under this restricted market environment, SSM appears to be irrelevant. Though C6 highlights this problem very clearly, he does not identify where the source of the solution is, even though the he was asked to suggest government policy for supporting SSM (question 20 in Appendix A—Interview questions). The NSA recognizes the need for effective marketing; "successfully facilitating and supporting efforts to link small farmers to dynamic markets" are integral to agricultural and rural development (Ministry of Agriculture, 2013). This is the mandate of the Guyana Marketing Corporation (GMC)[9] and has been supported by several NGO projects, such as IFAD's Hinterland Environmentally Sustainable Agricultural Development project (IFAD, 2016). It aims to strengthen the investment planning of hinterland communities and producer groups, and to help them implement these investment

9 GMC is mandated to offer marketing services to the non-traditional crop sector (Guyana Marketing Corporation, n.d.).

plans. While government and NGO initiatives are crucial to improving the marketing of agro-produce, some amount of autonomous (farmer) intervention is required as well. This can include cultivation of specialty crops and/or agro-processing. Both are examples of diversification and value-added production, which can reduce the financial impact of climate and economic shocks. H2's intention to grow coffee is an example of diversification with a specialty crop that will attract premium prices. C9 and H5 are the only agro-processors of the entire sample frame. Their processing also attracts premium prices compared to raw products. All three farmers exploited market niches and adjusted their business models accordingly. These autonomous marketing decisions are good examples of bypassing stagnant market growth (see Appendix B—Table 14 for summary of supporting excerpts).

4.6. The need to shift commodity support

In 2017, the Inter-American Development Bank (IDB) measured the level of public sector support for Guyanese agro-producers in terms of Producer Support Estimate (PSE[10]) from 2010 to 2014. This is comprised of two elements: market price support (MPS[11]) and direct budgetary support (DBS; Derlagen et al., 2017). Of the two, MPS is the main form of support and it affects both production decisions and terms of trade (Derlagen et al., 2017). Levels of PSE are generally positive for Guyana's agro-producers (Appendix C—Figure 2), and fruit and vegetable commodities, such as coconut, beans and tomatoes, received positive or neutral MPS (Appendix C—Figure 3). Positive MPS levels mean that crop producers are ensured higher prices compared to those not subject to policy and an efficient value chain environment (Derlagen et al., 2017). According to Barreiro-Hurle and Witwer (2013), positive MPS reflects "market infrastructure deficiencies, information asymmetry, lack of storage, and excessive market power in the value chain," which is applicable to Guyana. DBS played a very secondary role to MPS (Appendix C—Figure 4) during the review years. DBS included subsidized loans to farmers, variable input use payments, fixed capital formation and on-farm services. While grants to an ailing sugar industry greatly increased fixed-capital formation expenditure since 2012, on-farm services expenditures only partially covered extension service expenditure (Derlagen et al., 2017). This shows that more budgetary transfers must be made to support non-traditional crop sectors. Additionally, increasing the competitiveness of the agricultural sector requires improvement of the structural factors that increase marketing margins and reductions in its MPS (Derlagen et al., 2017). This can be done by using trade policy that enables farmers to "better respond to price signals in the international market and sell more of the product at the international market price" (Derlagen et al., 2017).

10 PSE measures the effect of policy actions on the earnings and spending of agro-producers and consumers (Derlagen et al., 2017).

11 MPS measures how producer prices change according to price control policy. This creates a gap between local and reference prices of an agricultural good measured at the farm-gate level (OECD, 2003).

4.7. The need for SSM education and training

Lack of education and training opportunities is a common complaint by both cohorts (Appendix B—Table 11), which creates another significant hindrance to SSM use. The hinterland lacks access to the information, technology and energy that are needed to enable farms to adapt to "changing economic and environmental contexts" (IFAD, 2016). Thus, hinterland farmers are more resource disadvantaged. C7 was the most empowered farmer in this regard. His training allowed him to use the most SSM practices within any cohort. This shows how integral education and training are for overcoming the knowledge barrier to the use of SSM and even other CSA practices. Farmer-extension relationships are integral to increasing the knowledge and capability of farmers to manage their soil as demonstrated by Ball et al. (2018). Demonstrations, field visits and training to conduct soil tests can help farmers feel a stronger desire to better manage their soil and other natural capital. This is a very important step in facilitating an agro-ecological approach to farming, whereby the social capital underlying the non-traditional crop sector must be empowered to improve the natural capital (FAO, 2015).

4.8. From hinterland to "heartland": Increased development requires a shift in cultivation style

Though the hinterland's terrain and thick forests limits infrastructure and communication development, they have helped to maintain relatively intact to pristine ecosystems, such as in Region 9 (IFAD, 2016). It has the largest area and proportion of land under conservation, while large proportions of arable lands are under mixed forest cover. Only about 1.1% of the forest in the region is used for subsistence and shifting agriculture, where 10–20 year cycles are completed before returning to the same plot; this means that the practice is sustainable (IFAD, 2016). It allows farmers (e.g., H4 and H6) to negate common agronomic pressures, such as soil degradation, and protracted pest and disease incidence (Boucher et al., 2011; Filho et al., 2013). However, low deforestation rates (and forest carbon emissions) experienced in Guyana might not continue in the future, as several development poles demand increased infrastructural development (World Bank, 2009). These include the burgeoning oil and gas industry, mining and, diversified and expanded agriculture. There is already evidence that increased road access has caused indiscriminate and illegal collection, hunting and fishing (Gregory et al., 2012). Because shifting cultivation is only sustainable for low-density areas, it would become inappropriate if hinterland development brings population growth and conflicting land usage (Filho et al., 2013). For example, government reclamation of farmlands in H5's case, limits her farm scale:

> "... *right now we have been stopped by the government. We cannot cut anymore farm in this area.*" -H5

Thus, fixed land tenure may become more pertinent in a more developed hinterland. The culture of shifting cultivation would need to be transformed to sustainable intensification as posited by Lal (2015). In this scenario, hinterland farmers would be more hard-pressed to improve the quality of marginal soils by using SSM. Biochar merits relevance in this discussion yet again because it offers a reasonable alternative to slash and burn i.e., "slash and char," which aims to reduce cycles of slash and burn by incorporating char rather than ash to newly cleared fields (Scholz et al., 2014).

Regardless of the differences in the agro-climatic and socio-economic conditions of the coast and hinterland, climate change is reducing the sustainability of established production patterns (IFAD, 2016). Transitioning to new production patterns that are supported by innovative practices would foster better adaptability to changing climatic and economic conditions (IFAD, 2016). Uptake of innovative technology, which include SSM, by Guyanese farmers can only be increased if the gaps highlighted by the RIO+20 report are seriously addressed. Farmer concern and capabilities can be strengthened through increased education and, research, development and demonstration (RD&D). Generally, positive PSE indicators show that there is a large divide between the traditional and non-traditional sub-sectors (Derlagen et al., 2017). The Government of Guyana's use of trade and fiscal measures, and public investment in infrastructure, research, extension services and marketing must be revised to better support the expansion of the non-traditional crop sub-sectors (Derlagen et al., 2017).

As this kind of research is only exploratory, these results are far from sufficient to assess the extent of work done as per Priority Area 18 under the NSA policy that seeks to educate and train farmers in sustainable practices, including GHG mitigation and soil management (Appendix A—Table 5). More in-depth country-wide surveys would be required to assess the impacts that these projects are having on farming communities and the proportion of farmers that have benefitted. If possible, a collaborative arrangement between NAREI and our research group can be formed, and the findings from these studies can help guide education and training outreaches for SSM practices.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

JM conceived the main conceptual ideas, implemented the research, and conducted the analysis and findings. JF and SK supervised the research, gave critical feedback, and helped to shape the research, analysis, and manuscript. JF reviewed the initial proposal and led iterative discussions on the appropriate theoretical premise and design of the research. SK reviewed, verified, provided feedback for the analytical methods used, and encouraged JM to use inductive derived thematic analysis to process the qualitative data. All authors discussed the results and contributed to the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2023.1037368/full#supplementary-material

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