ambition for biodiversity
BIODEV
2030

GUYANA NATIONAL REPORT

PHASE TWO

AMBITION FOR BIODIVERSITY

Prepared by
Aurore Malapert,
Seon Hamer, Fabien Quetier,
César Delnatte

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BIODEV
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Integrating Biodiversity into Development -

Guyana National Report

Phase Two

BIODEV 2030

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2022

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WWF-Guianas - Head Office

Henck Arronstraat 63 Suite E
Paramaribo, Suriname
Phone: + (597) 422 357
Mobile: + (597) 08232167
Email: info@wwf.sr
<www.wwfguianas.org>

WWF-Guianas - Guyana Office

121 Duncan Street,
Bel Air Park
Georgetown, Guyana
Phone: + (592) 223 7802
<www.wwfguianas.org>

Consultants: BIOTOPE SIÈGE SOCIAL

Concept: PREEYA RAMPERSAUD, WWF-GUIANAS, GUYANA OFFICE (2021)

Reviewed by: DEVON DUBLIN, WWF-GUIANAS, GUYANA OFFICE

Editorial Services: ROXANA KAWALL

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CONTENTS

List of Figures

List of Tables

Acronyms

ASGM: Artisanal and Small-scale Gold Mining

CBD: Convention on Biological Diversity

CSR : Corporate Social Responsibility

DPI: Department of Public Information

EPA: Environmental Protection Agency

EEZ: Exclusive Economic Zone

ERM: Environmental Resources Management

EU-FLEGT: European Union Forest Law Enforcement, Governance and Trade

FSC: Forest Stewardship Council

GAWU: Guyana Agricultural and General Workers Union

GBTI: Guyana Bank for Trade and Industry

GDP: Gross Domestic Product

GEF: Global Environment Facility

GENCAPD: Guyana Environmental Capacity Development Project

GFC: Guyana Forestry Commission

GGMC: Guyana Geology and Mines Commission

GNFO: Guyana National Fisherfolk Organization

GoG: Government of Guyana

GRDB: Guyana Rice Development Board

GRPA: Guyana Rice Producers' Association

GUYSUCO: Guyana Sugar Corporation

IBAT: Integrated Biodiversity Assessment Tool

IP: Indigenous Peoples

IPLCs: Indigenous Peoples and Local Communities

IUCN: International Union for the Conservation of Nature

LCDS: Low-carbon Development Strategy

MRVS: Monitoring Reporting & Verification System

MSC: Marine Stewardship Council

NAREI: National Agricultural Research & Extension Institute

NBSAPs: National Biodiversity Strategies and Action Plans

NDIA: National Drainage and Irrigation Authority

NGO: Non-Governmental Organization

NTFP: Non-timber Forest Product

PTCCB: Pesticide and Toxic Chemicals Control Board

STAR: Species Threat Abatement and Recovery

SWM: Sustainable Wildlife Management

TFPs: Technology Foresight Programmes

WWF: World Wildlife Fund

Introduction

1 Introduction

BIODEV2030 is an experimental approach implemented in sixteen pilot countries, including Guyana, which have multiple socio-economic, environmental, and geographical contexts. It aims to provide the governments of each country with the means to identify and lead, together with the private sector and civil society, profound changes in the sectors of the economy that have a strategic impact on development and on the biodiversity of the country. The preservation of biodiversity is a prerequisite for sustainable development. To achieve responsible development, limiting pressures and restoring degraded ecosystems, taking biodiversity into account, must be systematic and integrated throughout production and value chains. In order to halt the loss of biodiversity, the BIODEV2030 project proposes an innovative approach to integrating biodiversity (and the services it provides) into the economic sectors of these 16 pilot countries by involving all the players in society. It does so through *Diagnosis*, *Dialogue* and *Commitment*. Diagnosis establishes a scientific assessment of threats to biodiversity at the national level, and analyses the potential for reducing impacts and restoring ecosystems, in order to identify priorities for action. Dialogue then favours the emergence of a common vision through multi-stakeholder dialogue, and an arrival at voluntary commitments from the various sectors. Commitments, which accompany the emergence of a common vision, are made in key sectors of the economy in favour of biodiversity, and the encouraging of their integration into action plans.

The Biodev2030 project partners are Agence Française de Développement (AFD) (funding), Expertise France (coordination), the International Union for Conservation of Nature (IUCN) (implementation), and WWF (implementation). The consulting firm was Biotope Siège Social.

1 Previous work: Phase 1

In Guyana, ecosystems are **unevenly affected** by economic development. The population is concentrated on the low coastal plain, where 90% of the population is located. As a result, commercial **agriculture** (rice, sugar cane) is developed on the coast, and along with **fishing** (artisanal) activities generate the most employment in the country. In May 2015, offshore oil was announced to have been discovered in the sea, close to the coast, which has added a source of pressure on this geographical area. This oil boom promises a considerable **development opportunity**, given the financial windfall that oil extraction will generate. Nonetheless, the government foresees the limitation of oil resources as well as a potential future change in international paradigms which may favour greater taxation on fossil fuels. The government therefore aims to **diversify agriculture** in parallel, especially in the interior of the country. Guyana's ambition to both become the **breadbasket of the Caribbean and reduce its food import bill** is real, and indeed, intensive and mechanized soybean and maize farming are among other established projections.

Further inland, the forests (more or less hilly to mountainous) and savannahs are disturbed by other extractive activities, **mining and logging**, which impact biodiversity even though the country's deforestation rate is one of the lowest in the world, with 0.07% annual deforestation. Indeed, **the lack of an extensive road network** has long 'saved' the country from forest degradation, with logs and minerals mainly transported by river. However, infrastructure development projects, such as the proposed road between Lethem and Linden, could have a considerable impact on biodiversity **by facilitating access to the south of the country**. Opening the forests via this road might provide privileged access to loggers and miners (both formal and illegal) as well as facilitate the development of ecotourism. It will also allow Brazil to access these areas, and the sea, by opening up to Boa Vista. The savannahs might thus become more accessible, and the development of mega farms (which have already started) is a likely scenario. Finally, the recent re-approval of the **Amaila Falls Hydropower Project** risks generating significant impacts on the continuity of hydraulic ecosystems, and opens the door to other projects of this type.

To underpin these economic activities, the banking sectors (along with the insurance sectors, often linked) are crucial and have an indirect effect. For the past 30 years, Guyana has not had a development bank, only commercial banks. So-called '**green' loans** aim to finance renewable energy projects, but do not have low interest rates, making the name more cosmetic than meaningful. Guyana remains very dependent on the investment of international banks or foreign companies for its development, which could have a determining role on the degradation of biodiversity, through the projects they choose to finance.

1 Introduction

Explanations for the choice of priority sectors for Phase 2

Given their **historic presence in Guyana**, and **the scale of their activities**, it is not surprising that the **mining sector, the agricultural sector, and the forestry sector were listed as the priority sectors** for this project through the scoring process used in Study 1, combining as it did both quantitative and qualitative analysis. Furthermore, as regards mining and agriculture, there are no projections which predict the decrease of these activities; on the contrary**, mines will prosper and expand, through both the opening of new roads to the south of the country, and the modernization of the port infrastructure, which will be the corollary of the development of the oil industry. Agriculture is also set to diversify and expand,** both in favour of more vegetable production, with the construction of mega-farms, and intensive and mechanized farming of soybeans and corn (Brazilian model), especially to achieve independence for livestock feed. Finally, in terms of organization, the actors in these economic sectors are relatively accessible and identifiable, and their ministries are well structured. Initiatives in favour of a better consideration of biodiversity issues have been identified, and past initiatives can also be recycled and modernized.

In **agriculture**, for example, there is a willingness to form a national plan for organic agriculture, to integrate aquaculture with rice crops, to recover the practice of kitchen gardens, and to regulate and control inputs.

Regarding **mining**, opportunities for off-setting, improving practices through new techniques and technologies to ensure greater recovery efficiency of abandoned sites, and the creation of collaborative platforms on best practices to adopt are ideas for development, either at the national level or the wider ecoregional level (Guiana Shield).

As regards the **forestry** sector, it is well organized and has already made successful commitments in the past (Reduced Impact Logging (RLI), REDD+ etc.), which makes it the 'easiest' partner to work with to create commitments.. This can also be explained by the agreement linking the state to the Norwegian REDD+ fund, for which the allocation of funds for conservation is conditional on a minimum of forest exploitation. This is a reward mechanism for good forest management, which is based on an avoidance scenario of projected deforestation. However the opening of new roads and the end of the ban on log exports suggests that a revival of forestry activity is to be expected. Nonetheless, good practices are becoming more widespread, and in the forestry sector, the associated requirements of the sector such as transportation and road access are more damaging than logging per se, and thus fall into the economic sector of infrastructure construction and the political area of land use planning.

Concerning **other sectors**, explanations can be offered to justify their non-prioritization. The country's other historical sectors are **fishing**, rice and sugar. However, since fishing is mostly artisanal, with the exception of a few industrial actors, it would be challenging to bring these smaller artisanal players together around the same consultation table in order to reach a common agreement on a potential voluntary commitment by this sector. There is no organization representing all artisanal fishing activities (which are in the majority) as a collective, and practices are very diversified throughout the sector. It must be noted however, that the Department of Fisheries is working to revive fishing co-ops. As for **aquaculture**, this is often practiced in conjunction with agricultural activities. However, there are few studies on the evolution of stocks. In this sector, the damage to biodiversity is mainly indirect, identifiable upstream, via the pollution of waterways (particularly with the bioaccumulation of heavy metals).

The **oil sector** will clearly be **a determining factor in the evolution of the country in the future**, and a potential **driver of the erosion of marine and coastal biodiversity**. Nevertheless, since the sector is very new to the country, historical impact had to be counted as nil under the scoring process, and the sector is as yet too young to make sectoral commitments at this time. Moreover, private actors operate in a climate of **fierce competition**, which is not conducive to the establishment of sectoral consultations. In addition, political support will be low, as the degree of independence of the state in the development of the oil industry is low. The **World Bank** is financing the development of the legal and institutional framework aimed at maximizing the economic and social benefits of the sector's development. While the contracts signed between the oil companies and the state have been criticized as being lopsided, the Local Content Act (2021) attempts to maximize the level, quality, and benefits of participation in the petroleum sector.

The impact of **renewable energy and tourism** is minor compared to the impacts generated by the extractive industries. However, particular attention should be paid to the construction of hydroelectric dams and other renewable energies, which contain their share of environmental damage despite the guise of the green image

1 Introduction

they project. As for **tourism, load capacities** exist to protect tourist sites. Ecotourism allows tourists to experience traditional culture, which provides informal environmental education on topics related to biodiversity conservation.

Finally, the **banking sector is indirectly the sector with the greatest impact on biodiversity** and the one most likely to be an **agent of change**, as it allocates the funds necessary for economic activity. Indeed, several initiatives could be arranged to mitigate the impact of economic activity on biodiversity. For example, **loan allocation processes** could be conditioned on environmental impact assessments, or, with the integration of clauses dedicated to the protection of biodiversity, loans with **preferential interest rates** could be granted to sustainable development projects. To do this, Guyana could, for example, rehabilitate a **national 'green development' bank**, to capture international funds specifically allocated to biodiversity protection. However, this sector did not emerge as a priority sector for several reasons. First its impact on biodiversity is not quantified, and difficult to quantify. Banking networks are international and structured in complex associations, which generally conceal the exact origin of funds, making it hard to seize. Second, Guyana remains very dependent on the international banking sector, and engaging donors for the second phase of this project may be complex. Nevertheless, it would be advisable to organize a **multi-donor meeting** in order to take these issues into account and optimize the financing of biodiversity.

Eventually, agriculture (the rice and sugar cane industries) and mining were the two sectors selected for Phase 2 as the pilots to test engagement in voluntary commitments regarding biodiversity.

1 Introduction

Table 1 **Summary of the main impacts on Guyana's ecosystems from its economic sectors**

Ecosystems	Characteristics	Main impacting sectors	Consequences
Coastal	Endemic phenomenon (mud) High bird diversity Ecotone contributing to Ecosystem resilience (buffer zone) Filter Blue carbon sink Nursery Protective barrier against disasters High structural importance	**Oil and gas** (development of offshore bases) **Agriculture** (agrochemical, polders, tillage)	Soil degradation and contamination Pollution Destruction of mangroves and bird habitats Loss of coastal protection Saline intrusion Plant infestation Contamination of waters
White sand plateau		**Mining** (sand and bauxite: suspended solids in the water) **Agriculture** (agrochemicals)	Elevation of the concentration of various heavy metals in surface and groundwater resources
Forests	Niche refugia Functional and taxonomic diversity Ecosystem of high importance (Guyana lowland floristic province, Essequibo alluvial plain, endemism) Carbon storage High connectivity Protection of watersheds Use and non-use value	**Mining** (especially the gold industry with discharges of tailings) **Forestry** (conventional logging but also reduced impact logging)	Habitat loss and fragmentation Increased turbidity of waters Erosion Landslides Removal of fertile topsoil hindering natural regeneration) Deforestation Contamination of freshwaters
Highlands, Mountains, Plateaux		**Renewable energy** (potential)	Few consequences as accessibility is low

Savannahs	Subtle equilibrium (frequency/intensity of fires) Flooded savannahs of the Rupununi hosting gallery forests, wetlands, bush islands, rocky outcrops Cleaning waters, with high water connectivity Refuge zone NTFP Indigenous territory	**Agriculture** (especially in the Rupununi: use of agrochemicals, irrigation systems, growing threat of megafarms) **NTFP** (wildlife trade, tibisiri extraction) **Tourism**	Reduction of habitats Modification of waterflows Reduction of ecological functions Future risk of extensive ecological damage Eutrophication/contamination of both surface and groundwater resources Erosion and loss of topsoil Reduction of population Contamination from wastes Disturbance of wildlife
Freshwaters	High connectivity Special habitat Importance of Essequibo rivers Refuge zone Regulatory, provisioning, supporting and cultural services	**Mining** (gold mining practices) **Industrial agriculture** (pesticides, fertilizers)	Increased turbidity and mercury Contamination of freshwater ecosystems (bioaccumulation) Aquatic contamination
Marine	Complex food web and high connectivity Maintains global climate Climate regulation. Deep water corals Coral adaptation to turbid waters High productivity	**Oil and gas** (sonar disturbance, oil spill risk) **Fisheries**	Disruption of mammalian species Massive die-off of wildlife (macro and micro flora and fauna) Decline in fisheries stock

2 Towards the definition of concrete, ambitious and realistic sectoral biodiversity commitments and stakeholder engagement: Phase 2

The objective of Phase 2 of the Biodev2030 project was to conduct an in-depth analysis of the Agriculture and Mining sectors which had been identified during the previous Phase 1 prioritization process, during a national sectoral assessment,, and to identify opportunities and challenges to develop voluntary commitments from these sectors to reduce biodiversity loss.

1 Introduction

More specifically, the goals of the Phase 2 study were:

- To execute an in-depth analysis of the two prioritorized sectors
- To characterize each sector impacting biodiversity, including their ecological footprint
- To identify good practices and possible actions for each sector, including any sector commitment, and
- To propose a strategy to mobilize stakeholders across the two (2) priority sectors to facilitate a multi-stakeholder process throughout the assessment, including discussions on a transitioning of the two sectors towards a low carbon, nature-positive future through strengthening efforts to reduce these sectors' impacts on biodiversity.

Methodology

2 Methodology

1 Global approach

The Phase 2 implementation was based on the following inputs:

- The data gathered during Phase 1
- A participative approach with key stakeholder through workshops and bilateral meetings

This followed the process below.

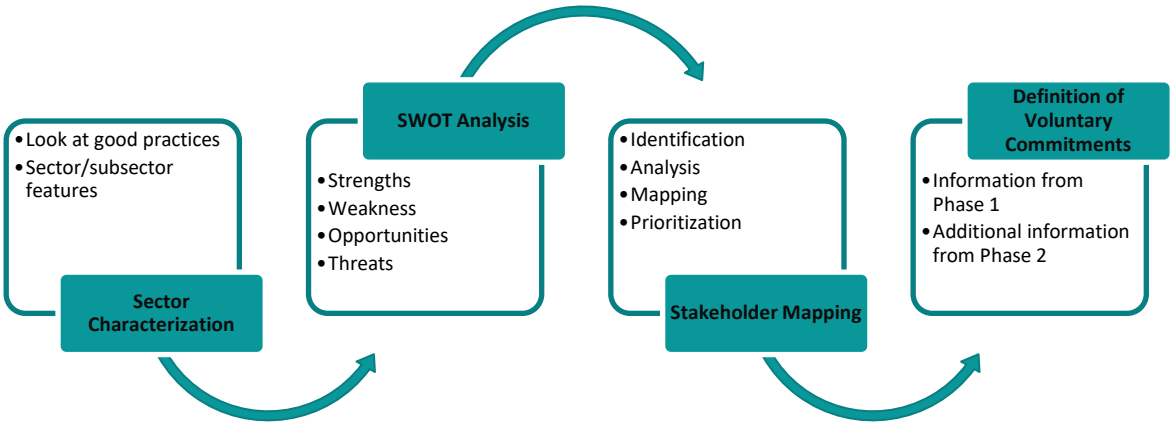


Figure 1 **Process used for Biodev2030 Guyana Phase 2.**

2 Characterization assessment of the two priority sectors

The detailed assessment of the two priority sectors in Phase 2 was executed through a further analysis of data gathered during Phase 1, and through an updated literature review to feed-in the following subsections:

- Policy and legislative framework
- Socio-economic and cultural characteristics.

3 SWOT analysis

A SWOT analysis was used to analyse the agriculture and mining sectors in terms of biodiversity integration (mainstreaming) and conservation. Four parameters were explored as follows:

1. **Strengths:** these are aspects that the sectors excel at, which will help to enhance current or future biodiversity integration, and conservation efforts/strategies to be implemented

2. **Weakness:** events or characteristics of the sectors that will be obstacles to biodiversity integration and conservation efforts

3. **Opportunities:** these are favourable openings that can be used as leverage for the sector and its stakeholders to move towards biodiversity integration and conservation

4. **Threats:** Factors that can 'potentially' cause harm within the sector in the near future or on a long-term basis, which would prevent any biodiversity integration and conservation goals from being realized or operationalized within the sector.

Strengths and weaknesses are internal in origin to the sectors. Opportunities and threats are external in origin to the sectors being analysed, using the SWOT analysis approach. The information collected from the sector stakeholders from the agriculture and mining sectors was inputted into a SWOT matrix which helped with each sector analysis.

4 Stakeholder mapping, analysis and engagement

In the first step, the stakeholders within the sectors were all identified, but the number of stakeholders were not limited to the list that was first compiled. The second step was a stakeholder analysis to figure out how relevant the various stakeholder were within the two sectors of agriculture and mining. Step 2 also identified how these stakeholders contributed to the sector, if they were willing to engage, and how much influence they had within the sector.

In the third step, stakeholder mapping, a matrix was created with x (horizontal) and y (vertical) axes. On the y axis, a scale showing the level of interest of the stakeholder (from low to high) was created. On the x axis, a scale showing the level of influence of the stakeholder (from low to high) was created. Using the stakeholder list for each sector and the analysis, this was then plotted accordingly.

Figure 2 **Process for the stakeholder mapping**

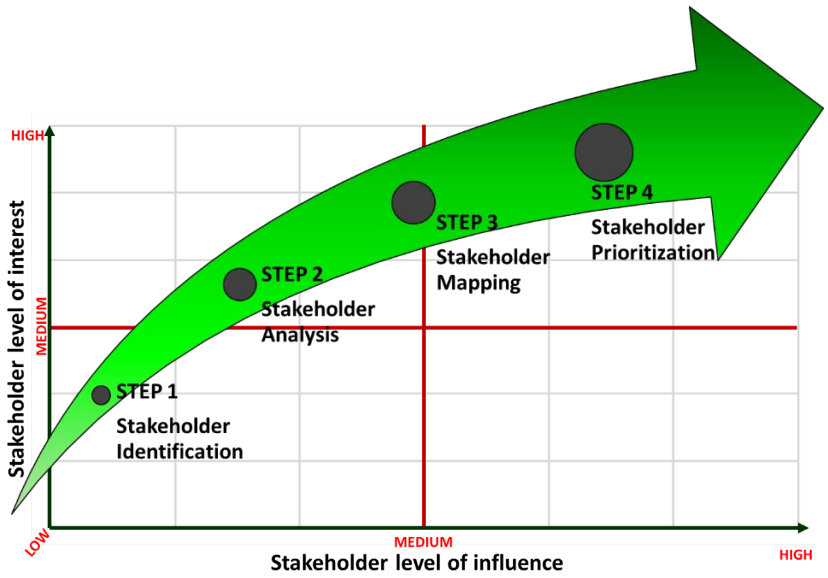


Figure 3 **Matrix used for the stakeholder mapping.**

After Steps I to 3 were completed, stakeholder engagement approaches were planned for the different categories of stakeholders, prioritized according to their level of interest and their level of influence within their respective sectors.

5 Definition of voluntary commitment

A voluntary commitment (VC) is defined within the framework of BIODEV2030 as “an agreement whereby one or several stakeholders undertake in order to mobilise and set up a series of prospective and strategic actions, which are shared and science-based, and which will bring about a positive and measurable change in biodiversity health.”

A VC can be undertaken by an individual or a group of stakeholders. The VC includes an action plan detailing how it will be implemented.

The VC process was led by the local stakeholders but guided by the consultants to keep the stakeholders focussed. The engagement approach employed to get the relevant information from the stakeholders was via a participative workshop approach, with the value chain as a red thread (i.e. a clear linkage to achieve goals).

More precisely, the voluntary commitments path followed these steps:

1. **Sectorial participative workshops** (Mining and Agriculture) to identify opportunities and best practices to reduce pressures on biodiversity:
    a. **The first round of workshops** was held 100% online and consisted of a series of activities and questioning segments which were all administered through the Klaxoon platform. The activities were stakeholder-centred and

2 Methodology

were kept as interactive as possible. Participants were asked to reflect on the value chain, identifying potential opportunities to address threats on biodiversity all along the value chain, and proposing concrete actions for implementation by key stakeholders.

b. **The second round of workshops** followed a hybrid setting (remote for the French team of Biotope, and on site for WWF and the local consultant Seon Hamer), in order to increase local stakeholders' participation and facilitate their engagement. A list of all the actions proposed by the stakeholders during the first workshop had been previously established, and the participants were invited to select actions through voting (on the Direct Poll website on their phones). The three subsequent questions submitted to vote on were as follows[1]:

   i. Select 4 actions that have the highest potential to reduce threats to biodiversity
   ii. Select 4 actions which are the most cost-efficient according to you
   iii. Select 4 actions for which there are existing technical capacities (human resources to execute)

Finally, a prioritization of these actions was been made in real-time through the completion of the matrix shown in Table 2.

Table 2: **Assessment matrix for prioritizing actions to develop** (Last workshop of Biodev2030 Phase 2)

Table 2 **Matrix filled in by participants for prioritization of actions**

Actions	1.Threats	2.Cost-efficiency	3.Technical and human ressources	Global Note
• Action A	%	%	%	%
• Action B	%	%	%	%
• Action C	%	%	%	%
• Action D	%	%	%	%
• Action …	%	%	%	%

Following the voting, the four highest ranked actions were selected for the participants to work on in sub-groups. The objective of these sub-groups was to develop the voluntary commitments (VC), and the associated engagement plan and monitoring system.

To do this, the participants had to fill in a table for each of the four actions selected, with details of the actions to implement, and associating these with relevant stakeholders and their respective roles:

Source of the financing to facilitate the action implementation

Scalability (small scale to medium scale to large scale)

Implementation time (short, medium or long term)

2 Methodology

SMART indicators, and targets at 5 and 10 years to monitor the evolution of the actions implemented, eventual location of the action, etc.

The list of participants is presented in Appendix 2.2

2. **Targeted interviews with key stakeholders** to formulate and detail operational, adequate and satisfactory commitments for the respective stakeholders, in order to ensure a sustainable engagement.

The list of interviewed people can be found in Appendix 2.1.

Given that there is a lack of baseline data necessary for making quantified voluntary commitments, some of these were left as qualitative only, but were still stated in order to outline options for voluntary biodiversity commitments in the future, and to serve as a reference for further steps.

Sectoral analysis

3 Sectoral analysis

1 Agriculture

In Guyana there is an ongoing paradigm shift in agricultural production away from the traditionally grown crops (rice and sugarcane) towards a more diversified agricultural sector which encompasses the traditionally grown crops along with non-traditionally grown crops (cereal grains, legumes, root provisions, spices, fruits, and vegetables) (Guyana Ministry of Agriculture, 2013; Moonilall et al. 2020).

Several studies show that climate sensitivity indicates that agricultural output will be harmed (Rosenzweig and Parry, 1994; Mendelsohn and Dinar, 1999; Tang and Hailu, 2020; Suresh, et al. 2021). This is a product of warmer future temperatures, changing rainfall patterns and increased frequency and/or severity of extreme weather events, all of which are forecast to reduce average crop yield (Weerasekara et al., 2021a, 2021b; Khanal et al., 2021). This in turn produces greater volatility in yields and poses a challenge globally in terms of food security for smallholder farmers in developing countries (Wheeler and Von Braun, 2013), Guyana inclusive. In this context, when considering agricultural adaptation linked to climate change, the risk of increased impact on biodiversity is real; however, this threat to agriculture should be taken instead as an opportunity for change, including consideration of biodiversity.

1.1 Legislative framework

The legal framework that governs the agriculture sector of the Cooperative Republic of Guyana is presented in Figure XX and summarized in Table 3.

3 Sectoral analysis

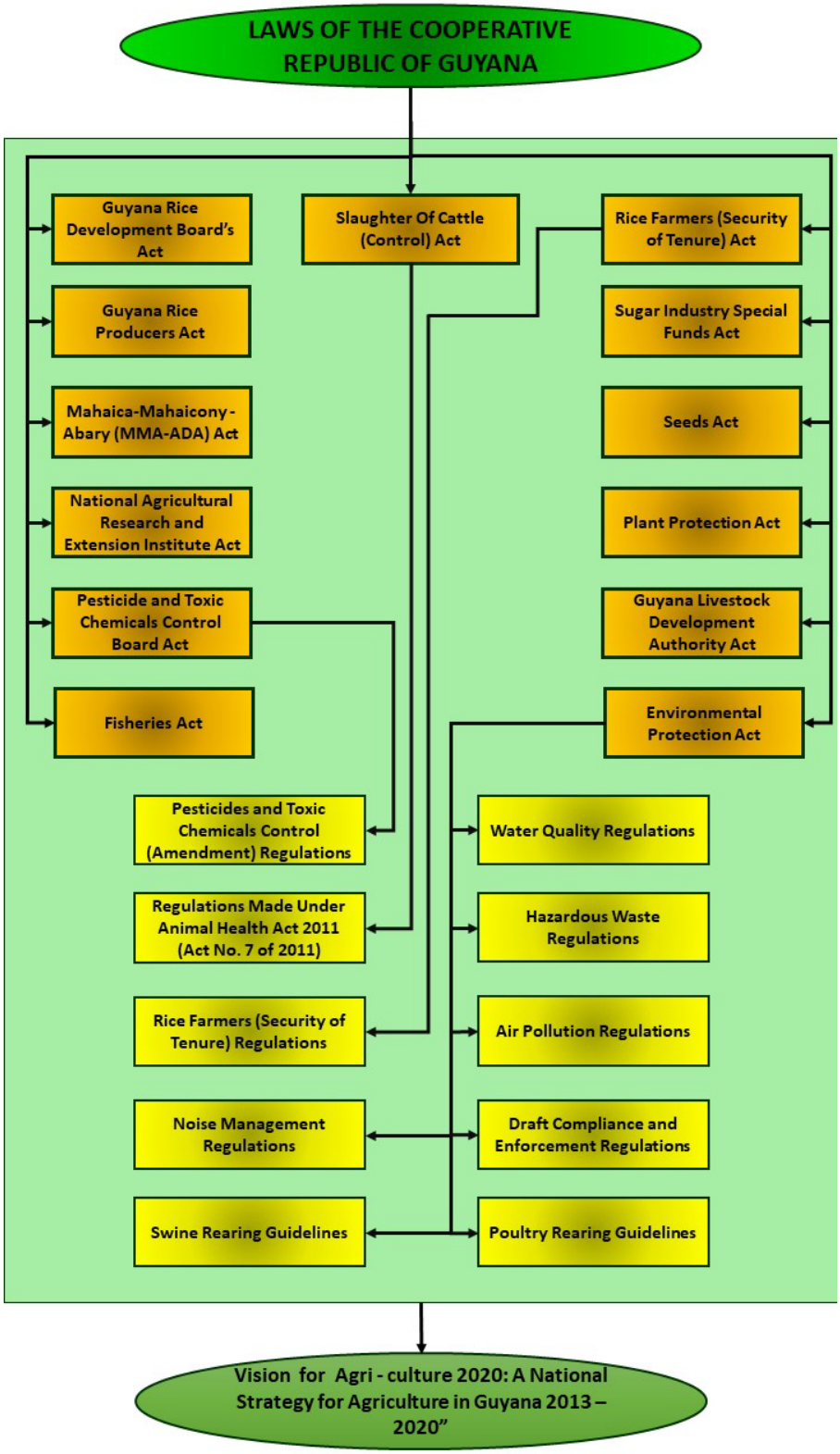


Figure 4 Legal **framework of agriculture in Guyana.** (Source: Seon Hamer.)

3 Sectoral analysis

Table 3 **Synopsis of legal framework that governs Guyana's agricultural sector and related policies**

LEGISLATION		Rice	Sugar
Guyana Rice Development Board Act	An Act to provide for the regulation of the manufacture and marketing of rice, for securing effectively the development of the rice industry through the establishment of the Guyana Rice Development Board, and matters connected therewith (Guyana Rice Development Board Act, 1994)	✓	×
Guyana Rice Producers Act	An Act to provide for the establishment of the Guyana Rice Producers Association and for purposes connected therewith (Guyana Rice Producers Association Act, 1946)	✓	×
Mahaica-Mahaicony - Abary (MMA-ADA) Act	An Act to make provision for the establishment and functions of the Mahaica-Mahaicony-Abary Agricultural Development Authority and purposes connected therewith (Mahaica-Mahaicony -Abary Agricultural Development Authority (MMA-ADA) Act, 1977)	✓	✓
National Agricultural Research and Extension Institute Act	AN ACT to promote greater efficiency in the crops and agricultural product industry, to provide enhanced services in Agricultural Research and Extension and Crop Protection and to establish the National Agricultural Research and Extension Institute, to make provision for effective administration and regulation of trade, commerce and export of crops and agricultural products and for the matters related or incidental (National Agricultural Research and Extension Institute Act, 2010)	✓	✓
Pesticide and Toxic Chemicals Control Act	An Act to regulate the manufacture, importation, transportation, storage, sale, use and disposal of pesticides and toxic chemicals, and to provide for the establishment of the Pesticides and Toxic Chemicals Control Board, and for matters connected therewith or incidental thereto (PESTICIDES AND TOXIC CHEMICALS CONTROL ACT, 2000)	✓	✓
Pesticides and Toxic Chemicals Control (Amendment) Regulations	These Regulations amend the Pesticides and Toxic Chemicals Control Regulations 2004 in regulation 95 and the Sixth Schedule and by adding a new Part (VIA) on the importation and exportation of pesticides or toxic chemicals. A person who wishes to import or export a controlled product must go to the Registrar for a license. Forms for (an application for) an export license is set out in the Sixth Schedule (Pesticides and Toxic Chemicals Control (Amendment) Regulations, 2007).	✓	✓
Fisheries Act	An Act to regulate fishing in the waters in Guyana (FISHERIES ACT, 1957)	×	×
Slaughter Of Cattle (Control) Act	This Act regulates the slaughter of bulls, oxen, steers, cows, heifer or calves (Slaughter of Cattle (Control) Act, 1974)	×	×
Regulations Made Under Animal Health Act 2011 (Act No. 7 of 2011)	An Act to control the movement of animals into and within Guyana and to prevent the introduction and spread of animal diseases within Guyana and from other countries, and to ensure the safe and humane movement of animals to and from Guyana and to regulate the importation and production of animal products and livestock feeds and other matters related thereto and connected therewith (Animal Health Act, 2011)	×	×
Rice Farmers (Security of Tenure) Act	This Act provides for further regulation of land tenure contracts between rice farmers and landlords to strengthen the position of the former. The Minister may establish committees that shall perform several duties in	✓	×

3 Sectoral analysis

	relation to the assessment of rents and the observance of conditions of contracts of tenancy in a specified area (Sects. 8 to 26). The Minister may make regulations to implement provisions of this Act (Sect. 55). (59 sections and 5 Schedules) (Rice Farmer (Security of Tenure) Act, 1956)		
Rice Farmers (Security of Tenure) Regulations	These Regulations implement provisions of the Rice Farmers (Security of Tenure) Act. They regulate the procedures of application for the ascertainment of maximum rent with an Assessment Committee under section 12 of the Act. (5 regulations and 4 Forms) (Rice Farmers (Security of Tenure) Regulations, 1956)	✓	×
Sugar Industry Special Funds Act	An Act to make provision for the establishment in respect of the sugar industry of a Price Stabilization Fund, a Rehabilitation Fund and a Labour Welfare Fund and for purposes connected therewith (Sugar Industry Special Funds Act, 1947)	×	✓
Seeds Act	AN ACT to regulate the production, sale, import, export and quality of certain seeds for sowing; to provide for certification of seeds and for related matters (Seeds Act, 2011)	✓	✓
Plant Protection Act	An Act to regulate the importation and exportation of plants, planting material and objects derived from them, to protect from the introduction of exotic pests and diseases to Guyana and to control and eradicate diseases and pests within the country (Plant Protection Act, 2011)	✓	✓
Guyana Livestock Development Authority Act	An Act to promote greater efficiency in the livestock and livestock product industry and to provide enhanced services in livestock husbandry, livestock health and research and to establish the Guyana Livestock Development Authority to make provision for effective administration and regulation of trade, commerce and export of livestock or livestock products and for matters related or incidental (Guyana Livestock Development Authority Act, 2010)	×	×
Water Quality Regulations	The water quality regulations regulate discharges from various industries that include agriculture (GoG, 2000)	✓	✓
Hazardous Waste Regulations	Regulates hazardous waste disposal from various industries that include agriculture (Hazardous Waste Regulations, 2000)	✓	✓
Air Pollution Regulations	Limits and monitors atmospheric emissions from various industries (Air Pollution Regulation, 2000)	✓	✓
Noise Management Regulations	(EPA, 2000)	✓	✓
Draft Compliance and Enforcement Regulations	(Housty, 2014)	✓	✓
Litter Enforcement Regulations	(EPA, 2012)	✓	✓
GUIDELINES			
Poultry Rearing Guidelines	(EPA, 2013)	×	×
Swine Rearing Guidelines	(EPA, 2011a)	×	×
PLANS AND STRATEGIES			
Vision for Agriculture 2020:	This policy has five areas of focus:		

3 Sectoral analysis

A National Strategy for Agriculture in Guyana 2013 – 2020	• Food Security – consolidating the end of hunger in Guyana, ensuring everyone has enough food in every community. • Fibre and nutritious food accessible by citizens – nutrition security for all. • Fuel production – helping to develop alternative fuel sources, reducing dependency on fossil fuel and creating a bio-energy industry in Guyana. • Fashion and health products – An agro-process industry that creates a new industry in Guyana. • Furniture and crafts – an industry which we expect to grow in importance in Guyana. The goals of the strategy are: • Reducing imports of foods such as corn, soya, and potatoes. • Increasing exports of rice and sugar, as both bulk and value-added commodities. • Increasing exports of non-traditional crop products. • Meeting local demand for milk and dairy products with local production.

1.2 Socioeconomic overview of the agriculture sector in Guyana

The agriculture sector accounted for 16.8% of the gross domestic product (GDP) in 2020. The sectors also directly employ 30-33% of the country's labour force in both the urban and rural settings. The sector is dominated by small farmers (>60%) that have land holdings that are 5 ha or less, but there are a number of large private and public sector enterprises (BoG, 2020; Bubbico et al., 2020; GO-Invest, 2018; ITA, 2020). The rice and sugar cane activities are mainly located on the low coastal plain, as shown in Figure 5, the Summary Landuse map.

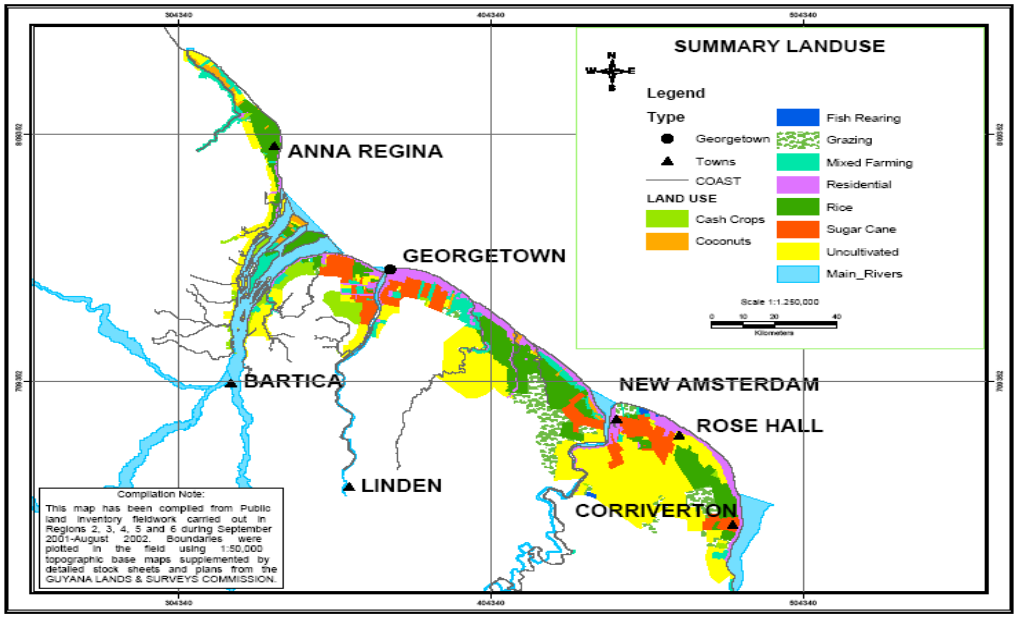


Figure 5 **Map showing the extent of rice and sugarcane cultivation along Guyana's low coastal plain.** (Source: Guyana Lands & Survey Commission.)

The sector is divided into five subsectors, namely the rice industry, the sugar industry, fisheries, livestock (including apiculture), and the non-traditional crop industry (Figure 6.). Agro-processing is also an emerging and ever-growing activity in the agricultural sector.

3 Sectoral analysis

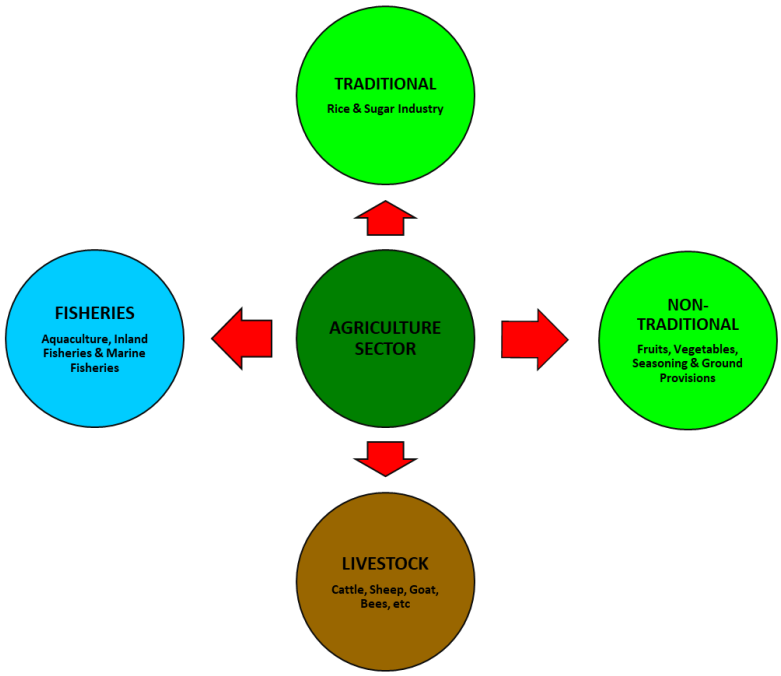


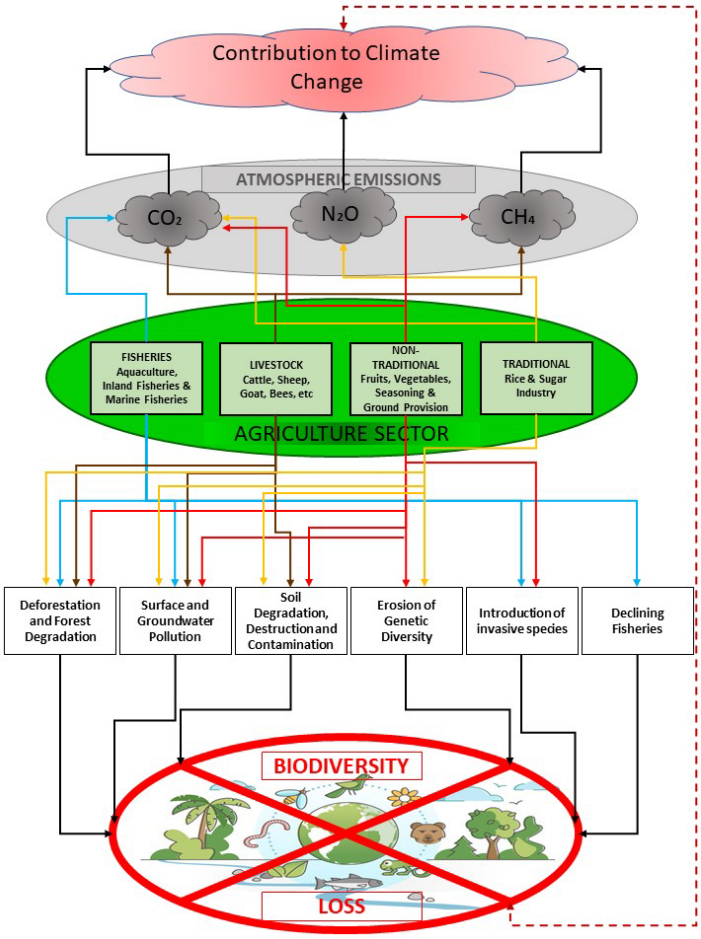
Figure 6 **Agriculture sector structure showing sub-sectors with industries.**

1.3 Main impacts of the agriculture sector on biodiversity

The agriculture sector has had negative effects on Guyana's ecosystems and ecological processes. These negative effects have grown along with the sector over the years.

3 Sectoral analysis

Figure7 **Main impacts on biodiversity of the agriculture sector in Guyana.** (Source: Seon Hamer.)



3 Sectoral analysis

1.4 In-depth analysis of the rice industry in Guyana

1.4.1 Key characteristics of the rice sector in Guyana

Rice cultivation in Guyana is done predominantly in the heavy wetland soil of the low coastal plain in Regions 2, 3, 4, 5 and 6 (Figure 8). Some amount of highland rice is also cultivated in Region 9 at the Santa Fe Farm. Rice cultivation in Guyana is done using a predominantly irrigated cultivation system. **More than 100,000 hectares of land is cultivated with rice annually.**

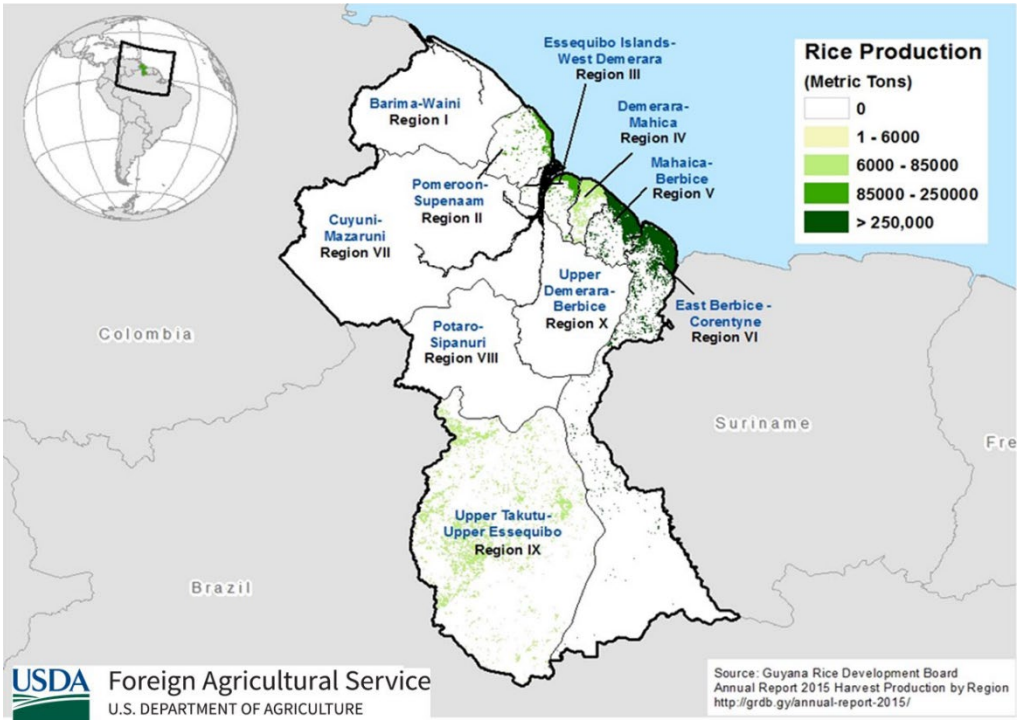


Figure8 **Rice cultivation area distribution in Guyana and production levels in 2015.** (Source: USDA.)

Description of the value chain

The rice value chain is illustrated in Figure 9, and listed step by step in detailin the section following (source: GRDB).

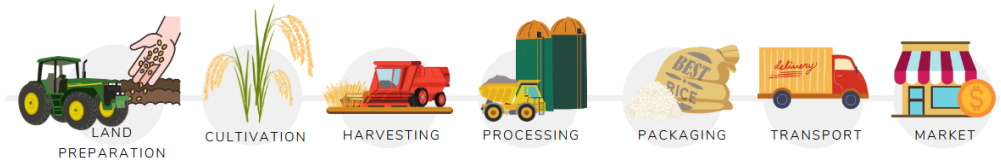


Figure 9 **General value-chain for rice in Guyana validated through consultation with local stakeholders.** (Source: WWF and authors.)

3 Sectoral analysis

1. Land preparation

The object of land preparation is to reduce weeds, incorporate fertilizers and improve the soil structure, to enable easy crop growth. Land preparation consists of the following operations:

I. Primary tillage—first and second cut (Rome plough or disc) to a depth of 10 to 15 cm and harrowing (Rome).

II. Secondary tillage—if rainfall is inadequate, fields are irrigated to allow for the secondary tillage operations. Harrowing (disc) also referred to as puddling. Raking and levelling. Back blade and henga (levelling) (one operation).

Figure10 **Tractor ploughing rice field in Berbice, Guyana.** (*Jamaican Gleaner*, 2013)

2. Cultivation

I. Seed treatment: the seeds are treated with an insecticide or pesticide to prevent infestation by pests once sown into the field.

II. Seeding: the seeds are soaked for a period of 24 to 30 hours and then drained. The seeds are then allowed to incubate for a period of 36 to 48 hours to facilitate germination The field is sowed at a rate of 45 kg to 64 kg of seeds/ha, depending on the seed source, via broadcasting (either manually or by plane).

III. Drainage after sowing: the field is drained 2-5 days after sowing to encourage uniform establishment.

IV. Weed control: early post-emergent weed control should be undertaken to prevent crop weed competition. Weed control is done using herbicides and in some cases, it is done manually.

V. Fertilizer application: half a bag of triple super phosphate (TSP) and murate of potash (MOP) is then incorporated dry or broadcast at 18-21 days after sowing. Urea is also applied at a rate of 3.7 bags to 4.9 bags/ha at 18 to 21 days, 42 days and 60 days after sowing.

VI. Water management: the water level is adjusted as the height of the plants increase over time, and the field is never allowed to be drained dry before grain filling is complete. The final drainage is done to facilitate harvesting.

3 Sectoral analysis

3. Harvesting

This commences when the crop is physiologically mature (depends on the variety). To obtain best head rice recovery, the grain is harvested at around 18-21 % moisture. Harvesting is done mechanically.

Figure11 **A combine harvester in the process of reaping the fourth rice crop at the Wales Estate**. © Delano Williams, 2019.

4. Processing

Processing is done in a paddy mill which has specialised machinery that performs various functions:

I. Pre-cleaning: in order to attain high milling recoveries, pre-cleaning of the rice is necessary. De-stoning is done to remove undesired stones present in the rice using a gravity separator or a de-stoner. The process includes passing the rough rice through a series of sieves and a closed-circuit aspiration system.

II. De-husking: the process of removing the husk from rice grains is referred to as de-husking.

III. Paddy separation: the surface of a rice grain is smooth, whereas the surface of paddy is rough. Paddy Separator uses this difference in texture to spate brown rice from paddy.

IV. Whitening and polishing: a humidified rice polisher is used to polish the surface of the rice. The factors which determine the extent of whiteness are the radial velocity of the stone wheels, the grid size of the stones, and the external pressure on the outlet chamber of the whitening machine.

5. Packaging

Weighing and bagging machines are then used to pack and weigh the rice accurately to be sold in the market.

6. Transport

The packaged rice is loaded and transported to the market. Transportation can be done via land, air and water.

Socio-economic and cultural

The rice sectorcomprises mainly of a group of private farmers, as well as the Guyana Rice Milling and Marketing Authority. The rice industry has been one the main agriculture-related earners for Guyana's economy for decades (as much as 3% GDP contribution).

3 Sectoral analysis

1.4.2 On a socioeconomic level, the industry provides both steady and seasonal livelihoods to approximately 10,000 individuals, with just over 6,000 being farmers. Key stakeholders of the rice sector in Guyana

The flagship agency of Guyana's rice industry is the Guyana Rice Development Board (GRDB). The GRDB is primarily supported by the Pesticide and Toxic Chemicals Control Board (PTCCB) and the hydrometeorological department. The three agencies coordinate with the rice farmers who are supported by the Guyana Rice Producers' Association (GRPA). Farmers employ seasonal workers, for whom rice cultivation is a part of their regular livelihood activities. The input suppliers are critical stakeholders, since they provide important inputs such as pesticide, weedicides, fertilizers, etc. The rice millers process and market the rice to various consumers, supported by the Guyana Rice Exporters and Millers Association (GREMA). The organizational chart below presents the links between the different stakeholders.

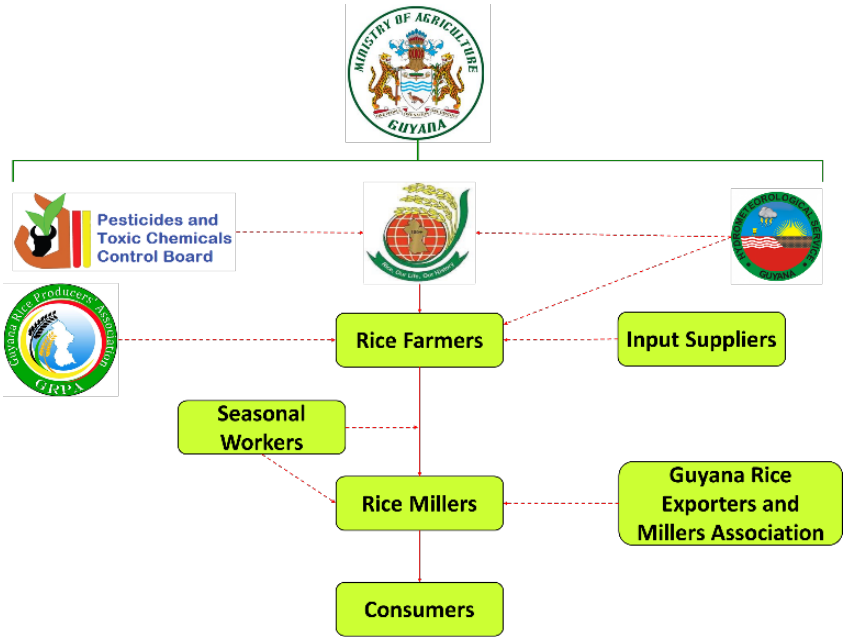


Figure12 **Organizational chart of rice sector stakeholders in Guyana.**

The stakeholder mapping process revealed that most of the stakeholder in the rice industry of Guyana have a high interest in the industry and can also exert a high level of influence. These stakeholders are the regulating bodies which have a statutory mandate to manage the industry. There are also the non-governmental stakeholders such as the rice farmers, input suppliers, GREMA and GRPA, all of which have a high level of interest and can also significantly influence the industry (Figure 13)). The Hydrometeorological Office also has a high level of interest within the industry since it is the sole source of hydrometeorological data which is used to build climatic resilience within the industry.

The seasonal workers who depend on the industry for a livelihood also have a high level of interest in the rice industry, but only have a medium level of influence within the industry. The consumers are another important stakeholder who have a high level of interest in the rice industry, since rice is the main staple in Guyana, but their level of engagement is very low.

In terms of implementing and maintaining any biodiversity integration (mainstreaming) and conservation measures within the rice industry, the rice farmers, rice millers, input suppliers and seasonal workers will need to be managed closely by the statutory coordination and management bodies, GRDB and PTCCB. Support will also have to come from GREMA and GRPA to encourage their members to participate.

3 Sectoral analysis

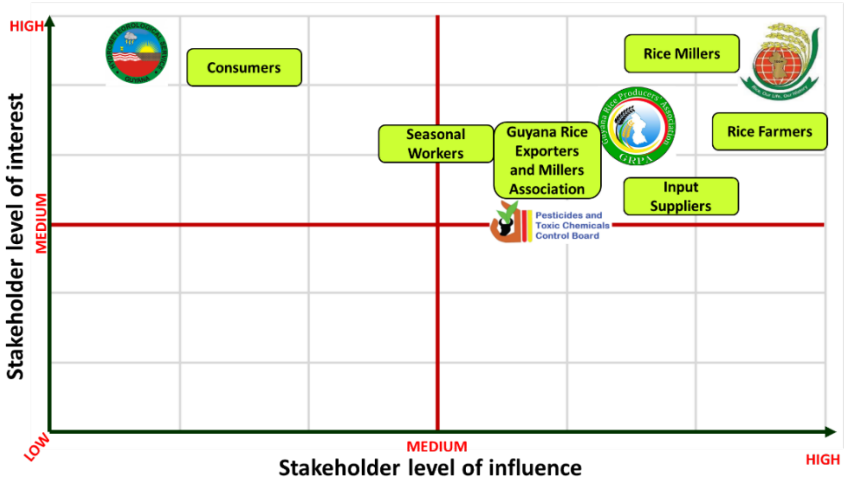


Figure 2 **Stakeholder mapping of the rice sector in Guyana**

1.4.3 Main impacts on biodiversity

In terms of the ecological impacts from the rice industry, this includes clearing away mangrove stands for rice to be planted. Effluent which is produced by the industry is also discharged in mangrove stands, which may be upsetting various ecological processes (Conservation International, 2018; NAREI et al., 2010).

Figure 3 **Rice cultivation encroaching on mangrove stand.**

Agrochemicals are commonly overused in rice cultivation, which results in discharge from the rice fields with chemical residue. The rice cultivation process can also emit significant amounts of greenhouse gases into the atmosphere such carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) that contribute to climate change. When the rice is harvested, the straw is left behind, then burnt, and this has negative effects on air quality and soil biota, and releases CO_2 into the atmosphere. Other issues such as traffic disruptions also arise (Figure 15).

3 Sectoral analysis

Figure 4 **Smoke from burning West Coast rice fields disrupts traffic.** (*Stabroek News*, 2015.)

1.4.4 SWOT analysis of the rice sector in Guyana relating to biodiversity

Strengths

- There is a long-term strategic plan in, and another one planned for the near future, and this will be for ten years instead of five years.

Some of the stakeholders indicated that a lot of work needs to be done within the rice industry, although it is heading in the right direction. Many of the plans that are proposed to develop the industry are ambitious and realistic A five-year management period is too short a period in which to implement those plans when the estimated times for doing so are medium to long term, so a longer plan period is needed.

Weaknesses

- There is a lack of regulatory mandates for the use of biochemicals.

The majority of the chemicals used in Guyana's rice industry is toxic,l and can cause negative environmental effects. Even at low levels, these are being used often in large quantities.

Some of the insecticidal chemicals used and their rates are as follows:

- Fastac/Pestac – 60-100 ml/acre
- Actara – 39g/acre
- Pronto – 10-15 g/acre
- Relevo – 100-140 ml/acre
- Admire – 40 ml/acre
- Pilarking – 40 ml/acre
- Admister – 10-30 ml/acre

There are also a number of synthetic fertilizers that the rice industry is heavily dependent on in order to maintain a high level of production:

- Triple Super Phosphate (TSP)
- Murate of Potash (MOP)
- Urea

Opportunities

- Training programmes and demo programmes are in place.

There have been training opportunities that are extended to the staff of the Guyana Rice Development Board (GRDB), the Guyana School of Agriculture (GSA) and the University of

3 Sectoral analysis

Guyana (UG). Scholarships are also given to staff to further their study at universities abroad to complete postgraduate and certification programmes. There are also initiatives that are implemented to give farmers the opportunity to be trained in various aspects of rice cultivation such as agrochemical handling, application, and storage, etc.

- A trial is currently on-going for organic rice production.

Realising that the rice industry is heavily dependent on agrochemicals and that there is a market worldwide for organically grown rice, the GRDB is currently conducting trials to see how best organic rice can be produced here in Guyana. There are some incentives for this.For instance, there is a high price per tonne for organic rice, so there would be a financial incentive for Guyana to shift completely to organic rice production. Another major incentive is that Guyana's rice industry will be far more environmentally sustainable compared to how it is presently, and will not be as dependent on synthetic chemicals which put human health at risk from the continuous exposure to the residues.

Threats

- There are little to no incentives to use green agrochemicals.

There are currently no initiatives in place that would encourage the rice farmer in the industry to shift to using green agrochemicals. There is also a perception that the green agrochemicals are not as effective as the harmful synthetic chemicals which are traditionally used for pest, disease and weed control.

- Expansion is on the horizon, and this can increase the risk of deforestation.

The ultimate goal of the industry is to increase overall production over time, especially with the demand for Guyanese rice on the world market increasing. There is a real possibility that new lands will have to be cleared in order to increase annual production. This would be especially true if the industry shifts to producing organic rice, which has a lower yield per hectare.

- Use of low grade and broad-spectrum pesticides

The chemicals that are used for pest control in the rice industry are broad-spectrum, and in eliminating the pest which is affecting the rice crop, all of the other beneficial organisms in or near the cultivation area also die, which in turn causes the pest population to increase. Increased pest populations result in more chemical usage, which increases consumers' exposure to chemical residues, with the environment also contaminated.

- Pest resistance

Due to the frequent usage of synthetic chemicals in Guyana's rice industry, there are instances where the pests eventually become resistant to the effects of the chemicals.

- There are no penalties in place for overusing agrochemicals.

Many farmers have the perception that if they use chemical doses above the recommended dose, they would be ensuring that the pest will not get the chance to destroy their crop. However, this is not so. They are only creating pest resistance, while putting more harmful chemicals into the surrounding environment, and there are no policies/laws in place which penalise farmers for such practices.

- Problematic chemicals are still in use.

There are a number of dangerous chemicals that are still widely used in Guyana's rice industry. For example, Fastac/Pestac which has been proven to be highly toxic to both aquatic (vertebrates and invertebrates) and terrestrial organisms. The active ingredient is alpha-cypermethrin (mixture of (S)-α-cyano-3-phenoxybenzyl (1R,3R)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate and (R)-α-cyano-3-phenoxybenzyl (1S,3S)-3- (2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate). Research has also shown that this chemical is also harmful to bees, resulting in a threat to pollination in the rice field, which can then cause a reduction in production over time. Organisms also do not have to be directly exposed to the chemical in order to be negatively affected. Other chemicals that are in use by the rice industry which act in a similar way are Actara, Pronto, Relevo, Admire and Pilarking (Adil Ansari & Bibi Waleema, 2009; David, 2010; Gerasimova & Topashka-Ancheva, 2009; Yordanova et al., 2014).

3 Sectoral analysis

Aside from pesticides and herbicides, the chemical fertilizers that are heavily used within the rice industry can also have negative effects on the soil after prolonged and indiscriminate use, such as hardened soil, decreased fertility, strengthened pesticides, polluted air and water, and released greenhouse gases (particularly nitrous oxide in the rice industry), thereby bringing hazards to human health and to the environment as well. Synthetic fertilizers have also been proven in multiple studies across the world and on different soil types to negatively affect (since it does contribute to soil fertility) and significantly reduce the soil microbial diversity which is essential in both maintaining and improving soil fertility (Ghosh & Bhat, 1998; Irawan & Antriyandarti, 2020; Jirapornvaree et al., 2022; Kai et al., 2020; Shukla et al., 1998; Tayefeh et al., 2018). Aerial spraying is also conducted, and nearby residents are affected as a result of chemical drift (Camacho & Mejía, 2017; Certini et al., 2021; Debano & Debano, 1991; Gordon & Richter, 1991; Pressler et al., 2018).

- There is no farm certification in place.

There is no certification programme in place, so farmers cannot benefit from such a programme. Organic certification might also be difficult, since there might be spillovers from nearby farms that would still be using synthetic fertilizers. Such a programme however can be developed and led by the Guyana Rice Development Board (GRDB) and incorporated into their regulations. There must also be financial and technical support available to help farmers achieve organic certification if proposed.

- There are no incentives in place for good environmental practices.

Farmers are constantly encouraged to use good environmentally practices in the cultivation process, but some farmers found that to do so, they need to expend some amount of financial resources. For example, the green agrochemicals such as neem oil etc cost significantly more than their synthetic counterparts, and there are no mechanisms in place to subsidize even a part of the cost of purchasing green agrochemicals. However, farmers can get relief to purchase the synthetic agrochemicals. For example, the president of Guyana, His Excellency Dr. Mohamed Irfaan Ali, announced on 16 May 2022, that there will be GYD$1 billion worth of fertiliser support for farmers, and the rice industry will benefit. The fertiliser will be distributed free of cost among farmers across the country and the fertiliser will be the synthetic type traditionally used in the industry (Eleazar, 2022; *Guyana Chronicle*, 2022).

- There is increasing usage of synthetic agrochemicals.

There has been an increased use in agrochemicals, especially insecticides, in an attempt to solve the current paddy bug situation which has been affecting many rice fields across the country and causing significant economic losses for farmers.

- Useage of non-recyclable packaging

A large amount of plastic is used throughout the value chain which contributes to the pollution situation.

3 Sectoral analysis

1.5 In-depth analysis of the sugar cane industry in Guyana

1.5.1 Key characteristics of the sugar cane sector in Guyana

After rice, sugar cane is the second largest agricultural crop in terms of production. The sector is 100% dominated by the government-owned Guyana Sugar Corporation (GuySuCo). Sugarcane cultivation in Guyana is done on the heavy wetland soils of the low coastal plain in Regions 3, 4, 5 and 6. Sugarcane cultivation in Guyana is implemented using a system of canals that can irrigate and drain the fields. **More than 15,000 Hectares of land is cultivated with sugarcane annually.** The sugarcane is harvested manually and loaded into punts which are then towed through the canals to the factory, where they are then loaded to be processed into sugar.

Figure 5 **Manual sugarcane harvesting and loading at the Uitvlugt Sugar Estate, West Coast Demerara** (Source: *Newsroom*, 2022)

Description of the value chain

The sugar cane value chain is represented in Figure 17, and then detailed step by step in the section following.

Figure 17 **General value chain for sugar cane in Guyana validated through consultation with local stakeholders.** (Source: WWF and authors.)

1. **Land preparation**

3 Sectoral analysis

The first ploughing occurs immediately after harvesting the previous crop, using a mould board plough, and the land is then left exposed for a period of two months. The land is then ploughed about three to four more times to a maximum depth of 60cm, using a disk plough. The field is then harrowed to a depth of 15cm, using a disc plough to break up the large soil clods left behind by the first ploughing operation. The land is then levelled, using a tractor-drawn leveller to ensure uniform growth of the sugarcane when planted.

2. Cultivation

Before sugarcane is planted, the fields may be flooded for months. This kills weeds and deposits minerals and nutrients in the soil. It also helps to control pests. This lessens the need for weedicides, pesticides and fertilizers. Parasites such as the Amazon fly (*Metagonistylum minense*) and *Cotesia* spp are used to control pests.
The planting of sugarcane is usually done by hand. Cane is planted in beds to aid drainage. There are many canals which cross the sugarcane fields. Almost one-eighth of the area of the average sugarcane field is taken up by canals.

3. Harvesting

Sugarcane is harvested manually. After the cane is harvested, the roots are sometimes left in the ground to produce new plants. This is known as ratooning. This is done up to four times. Then the fields are ploughed and replanted.

4. Transportation

The elaborate system of canals used for irrigation, are also used for transporting the harvested sugarcane to the factory. Sugarcane is transported in small flat-bottomed boats (known as punts) from the fields to the factories.

5. Processing

Extraction: The cane is usually shredded before crushing, using two or three 3-roll mill tandem arrangements.

Clarification: Chemical clarification, based on modern cold lime sulphitation, is carried out to remove impurities which inhibit the formation of the crystals and can discolour the final product. The addition of lime also has the advantage of reducing the natural acidity of the cane juice, limiting the formation of invert sugars. Batches of juice are treated simultaneously with milk of lime (CaO) and sulphur dioxide (SO2) (by air forced through a sulphur furnace), after which the juice is transferred to an open boiling pan and quickly heated to 90ºC or above. The lime and heat treatment form a heavy precipitant that flocculates, carrying with it most of the suspended impurities in the juice. The juice is then filtered and allowed to settle. The clear juice is decanted and transferred to the boiling furnaces.

Boiling: The boiling operation uses cascade type furnaces of various configurations. The massecuite is removed from the final boiling pan at about 84ºBrix, at a temperature of around 112ºC.

Crystallisation: The massecuite is placed in U-shaped vessels where it is slowly rotated and allowed to cool for up to 48 hours. This technique is often referred to as crystallisation in motion. Rotation promotes even cooling of the massecuite which helps to achieve uniform crystal growth.

Seeding can also be carried out: that is granulated massecuite from a crystalliser in which grains have already been developed are placed into the crystalliser before it is filled with fresh massecuite. This helps to promote uniform crystal growth. The massecuite, now consisting of crystals suspended in molasses, is transferred to the centrifuge.

Centrifuging: The centrifuge, a scaled-down version of those used in large-scale factories, consists of a perforated inner drum located inside a larger drum. The perforated drum is rotated rapidly, forcing the molasses to separate from the crystals. Water is sprayed into the spinning drum to assist in the removal of the molasses. The crystals of sugar are then removed from the centrifuge and transferred for drying. The molasses is collected and can be re-boiled, crystallised and re-centrifuged to produce a second, lower quality, crystal sugar known as number two or B-sugar.

3 Sectoral analysis

6. Packaging

The packaging is done mechanically, and the main material used for packaging is plastic. Packaging is done at the various estates under different product names.

Figure18 **Product packaging used by GUYSUCO**. (Source: GUYSUCO.)

7. Transport and Marketing

The sugar is transported to the market in various forms and marketed under brand name sugar as Demerara Gold, Berbice Crystals, etc. The sugar is also exported to other countries in CARICOM, North America and Europe.

Socio-economic and cultural

Socio-economically, the sugar industry employs over 16,000 individuals, which include both the state and private cultivation activities. The sugar industry has been one the main earners for Guyana's economy for decades (as much as 4% GDP contribution) until it started to decline in the late 90s due to various economic changes. The sugar industry accounted for 18% of Guyana's agricultural production at one point.

1.5.2 Key stakeholders of the sugar cane sector in Guyana

The flagship agency of the sugar industry is the Guyana Sugar Corporation (GUYSUCO) and it is supported by the Pesticide and Toxic Chemicals Control Board (PTCCB) and the hydrometeorological department. GUYSUCO coordinates the sugar industry, cultivates sugar cane, and manufactures and markets finished sugar to the local and international markets. GUYSUCO also provides employment for the majority of the sugar workers who are also employed by contract sugar cane farmers as needed. The private sugar cane farmers produce sugar cane to feed GUYSUCO's factories. The Guyana Agricultural Workers' Union (GAWU) serves as representation for the sugar workers. The finished sugar is then marketed to the customer base by GUYSUCO. The organizational chart below presents the links between the different stakeholders in the sugar cane sector.

3 Sectoral analysis

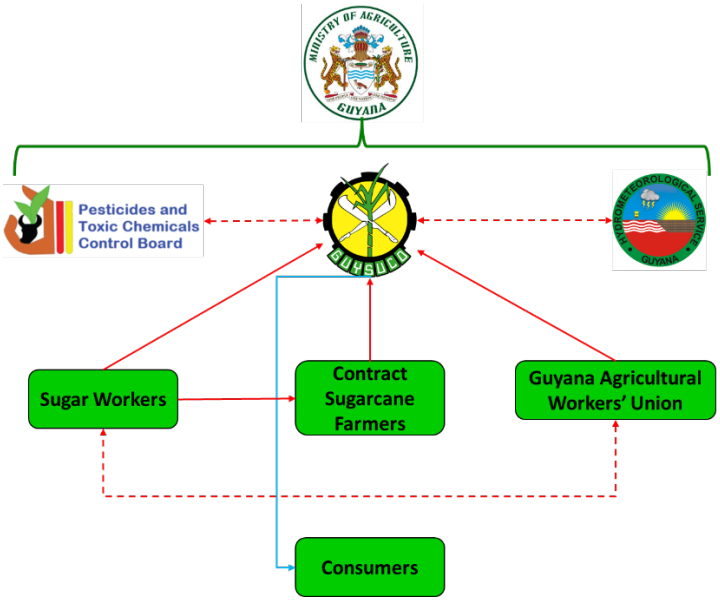


Figure 19 **Organizational chart of stakeholders in the sugar cane sector in Guyana.**

The stakeholder mapping process revealed that the stakeholders who have the highest interest and influence are the sugar workers, contracted sugarcane farmers and the Guyana Agricultural Workers Union. GUYSUCO and the PTCCB also have a high influence and interest, since these are statutory regulatory agencies which are responsible for managing different aspect of the sugar industry (Figure 22.).
The sugar workers, contracted sugarcane farmers and the Guyana Agricultural Workers Union therefore need to be managed closely, especially in relation to the formulation, implementation and maintenance of biodiversity integration and conservation measures in the sugar industry. GUYSUCO and the PTCCB can also be supportive in this regard by implementing policies or incentives which can help to facilitate biodiversity mainstreaming and conservation in the sugar industry.

There are also the consumers who have a high interest in the sugar industry, but who do not have a high level of influence. The Hydrometeorological Department falls into the same category as the consumers, with their prime function being to provide hydrometeorological information to the sugar industry.

3 Sectoral analysis

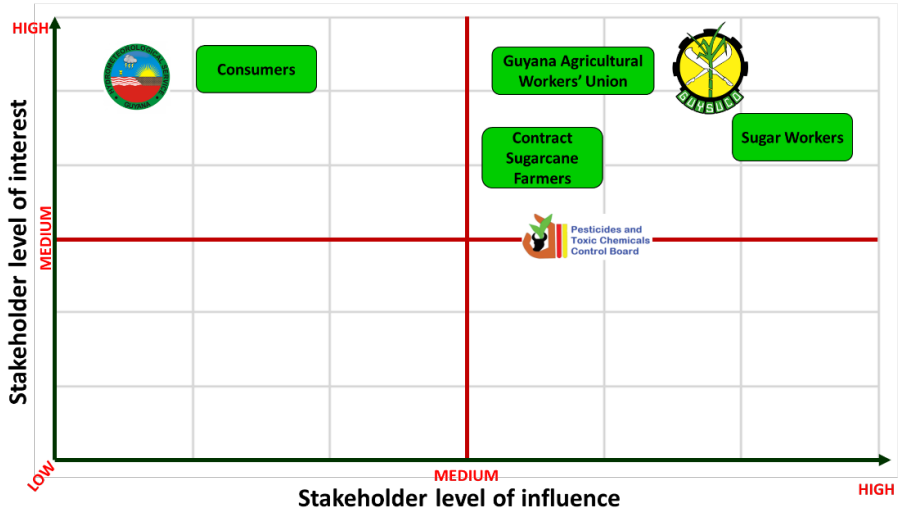


Figure 6 **Stakeholder mapping for the sugar cane industry in Guyana.**

1.5.3 Main impacts on biodiversity

There are also various negative ecological effects from the sugar industry such as particulate matter and greenhouse gas emissions from burning when harvesting, nutrient depletion due to intensive and continuous cultivation, and the related soils acidification and eutrophication potentials of waterways. The freshwater aquatic environment near sugar cane cultivation is often changed by the runoff from sugar cane fields which is laced with silt and agrochemical residue. These negative effects are commonly observed in Guyana, but relevant studies have not been done.

1.5.4 SWOT analysis of sugar cane sector in Guyana relating to biodiversity

Strengths

- There is a well-established network of scientific support institutions.

The scientific support which is provided to the sugar industry extends to both local institutions such as the University of Guyana (UG) etc., and overseas institutions, for example collaborations between Guyana and Brazil sharing research on biological control.

- Use of integrated pest management (IPM)

Pest and disease management in the sugar industry is done through biological, cultural and artificial means which make up the IPM programme, but biological control is used the majority of the time. The biological control is done using various species of insects that help to keep insect pests such as the sugarcane stalk borer (*Diatraea* spp) populations in check and reduce damage to the crop. Cultural control is also done to complement the biological control; for example trees are left in specific areas to function as perches for predatory birds which consume the rats in the field; various species of grasses are also left at the edges of the beds to function as alternate habitats for beneficial insects that naturally occur in the field and for those released into the field from the insectary such as the *Cotesia* spp.) and the Amazon fly, (*Metagonistylum minense*). *Cotesia* spp. is a braconoid parasitic wasp that injects the *Diatraea* spp. larvae with eggs, and when these hatch, the *Diatraea* larvae are eaten from the inside out. The the Amazon fly acts in a similar manner.

3 Sectoral analysis

Weaknesses

- Harmful chemicals are still used in the integrated pest management (IPM) programmes.

Although chemical use only makes up a very small percentage of the IPM programme which is used in the sugar industry, when these are used the toxicity class is very high. Such chemicals are zinc phosphide, Klerat and Storm, which are used as rodenticides, since there are no financially feasible alternatives. However, they are only used when the rodent population goes above a set threshold, above which the rodent population can cause significant damage to cane stalks. The chemicals are however geo-restricted, meaning that they are only used in certain areas within the field. The active ingredients in Klerat and Storm are brodifacoum and flocoumafen which are both anticoagulants that are acutely toxic to both aquatic and terrestrial animals (Lund, 1988; Patocka et al., 2013). Zinc phosphide is extremely toxic to both terrestrial and aquatic organisms (Thurston, 2011; USEPA Office of Pesticide Programs, 1998).

Although there are stringent protocols in place for using the aforementioned rodenticides, there are still significant negative impacts on the biodiversity in the cane field. One of the main indicators of the negative effects are dead animals of various species that would be found in the canfield when the rodenticides were used in the field, particularly predator species at various trophic levels. Brodifacoum and flocoumafen are known to bioaccumulate and biomagnify throughout the food chain. However, although zinc phosphide is highly toxic, there is little risk in secondary positioning unless the zinc phosphide bait is directly consumed by non-targeted species, which sometimes happen (Ayala et al., 2007; Gray et al., 2011; Gupta, 2018; Lefebvre et al., 2017; Lund, 1988; Murphy, 2007; Nakayama et al., 2019; Richard et al., 2021; Rodenberg et al., 1989; Spiller, 2014; USDA-APHIS-Wildlife Services, 2017).

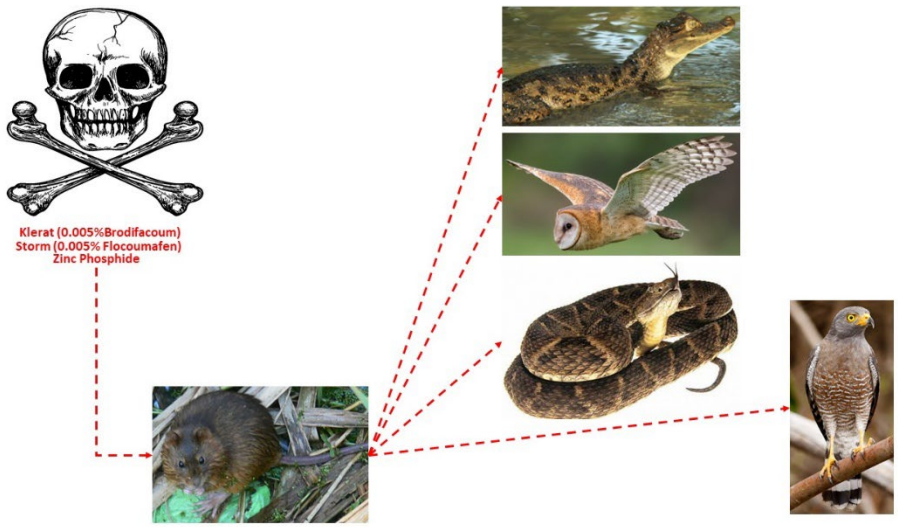


Figure 7 **A flow chart of how the rodenticides move through the food web in the sugar cane field.** (Source: Seon Hamer.)

When the rodenticides are consumed by rats (the target species), the rats are then consumed by caimans, owls, snakes and birds of prey, which are then also fatally affected by the rodenticide. There are other species besides the ones illustrated in Figure 23 which are affected because of consuming the zinc phosphide bait directly. Since the zinc phosphide is mixed with paddy, seed-eating birds and other species with similar habits are affected.

Opportunities

- High price for sugar made from organically grown sugar cane

It is estimated that organic sugar is priced 20-30% higher per ton on the global market, especially in the European market where organically produced products are in high demand. This is a demand that Guyana's sugar industry can work towards satisfying.

3 Sectoral analysis

- Huge scope for diversification into value-added streams

As it stands currently, the only by-products the industry profits from are the energy produced from bagasse and molasses. There is however a huge potential on the world market for other sugarcane by-products such as fibres, biodiesel, etc., which would improve the sustainability and profitability of the industry, as well as reduce waste production and negative externalities from the sugar industry.

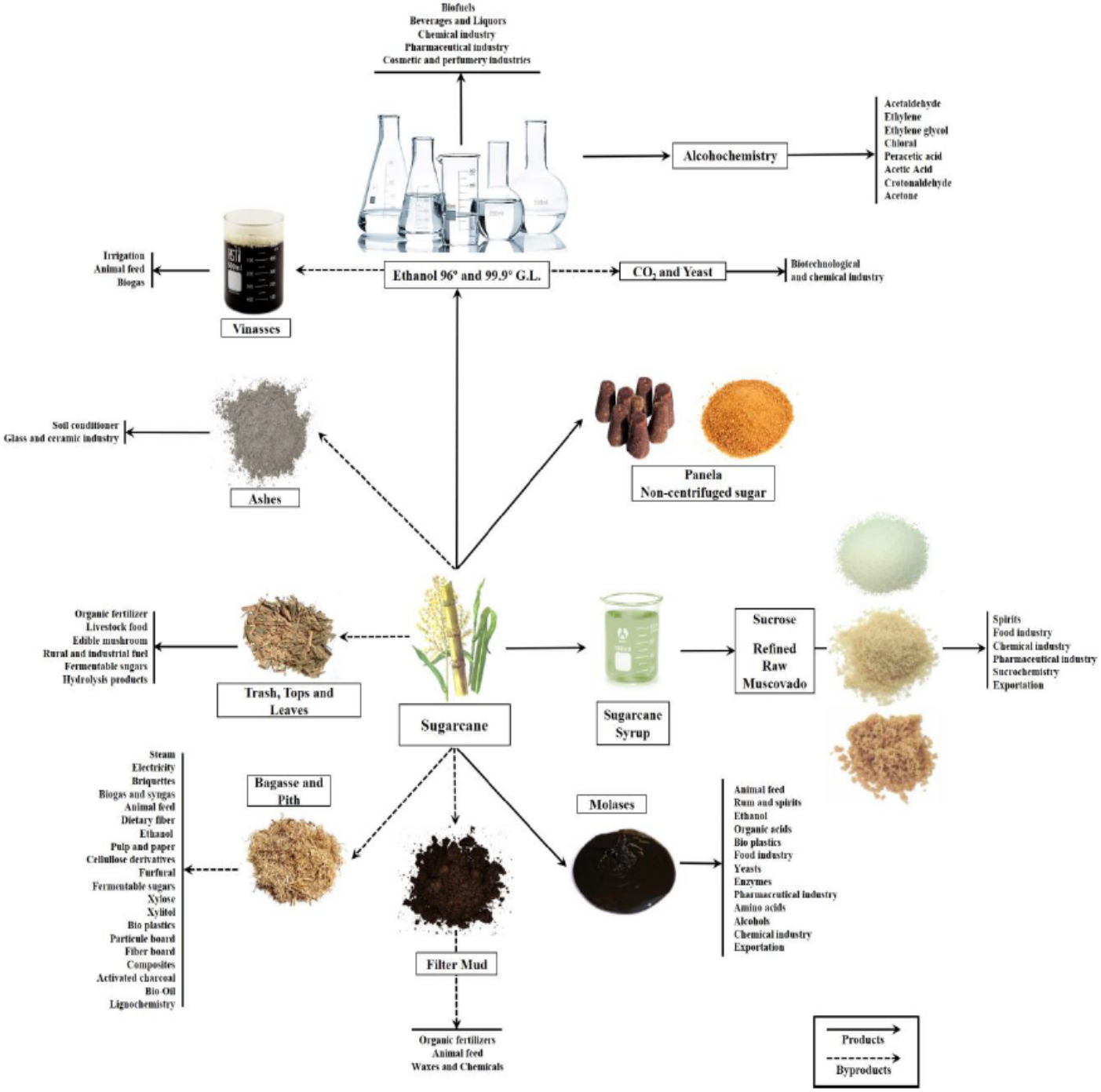


Figure 8 **Sugarcane biorefinery based on cane, products and byproducts**. © García-Bustamante et al., 2018.

Threats

- Uses non-recyclable packaging

The most common form of packaging that is used in the sugar industry in Guyana is plastic, which contributes to a lot of pollution; furthermore plastic waste is also difficult to manage.

- Unsustainable practices such as burning and aerial spraying

Burning causes significant effects on the macro- and microbiodiversity in the cane field. Fire destroys the organic matter in the topsoil and reduces the microorganism population and diversity in the soil. With aerial spraying, nearby residents are affected as a result of chemical drift (Camacho & Mejía, 2017; Certini et al., 2021; Debano & Debano, 1991; Gordon & Richter, 1991; Pressler et al., 2018).

- High dependence on synthetic agrochemicals

In order to maintain a high level of production, the sugar industry still have to depend on synthetic agrochemicals, mostly herbicides, fertilisers and soil amendments such as lime.

- Reduced genetic variability due to industrial scale monoculture

If there is a pest or disease outbreak, the industrial scale monoculture makes the sugar industry very susceptible to attack. Numerous models have already shown that instances of pest and disease outbreaks are projected to increase, and will be more severe than they were in the past (Bebber et al., 2014; Luck J. et al., 2010; “Scientific Review of the Impact of Climate Change on Plant Pests,” 2021; Skendžić et al., 2021; Zayan, 2019).

- There is inadequate environmental and ecological efficiency.

1.6 Proposition of transformative trajectories and actions to be developed into voluntary commitments for agriculture

1.6.1 Actual trajectories for agriculture in Guyana

The main actual trajectories for agriculture in Guyana are:

- Increased aquacultural production promoted by the current government
- Continuous efforts to right-size sugar
- Agriculture is set to diversify, both in favour of more vegetable production, with the construction of mega-farms and large scale intensive and mechanized farming of soybeans and corn (Brazilian model), especially to achieve independence for livestock feed.

1.6.2 Expected trajectories for the reduction of the impact from the agricultural sector on biodiversity in Guyana

A National Strategy for Agriculture in Guyana 2013-2020 was based on 25 priorities which were seen as necessary for the sustainable development of the sector. None of the 25 priorities were specifically tied to biodiversity mainstreaming, but there are priorities that can be seen as linked to biodiversity mainstreaming. The 25 priorities are as follows:

1. Sustaining and expanding Guyana’s agrodiversity policy and programme
2. New focus on farming systems and techniques, biotechnology and precision agriculture
3. Reaffirmingthat water security and therefore water management is crucial for success.
4. Strengthened focus on infrastructure development (other than drainage and irrigation structures) for the agricultural sector
5. Establishing soil health as a major priority in the development of a modern and effective agricultural sector, assuring food security, economic benefits and environmental protection

3 Sectoral analysis

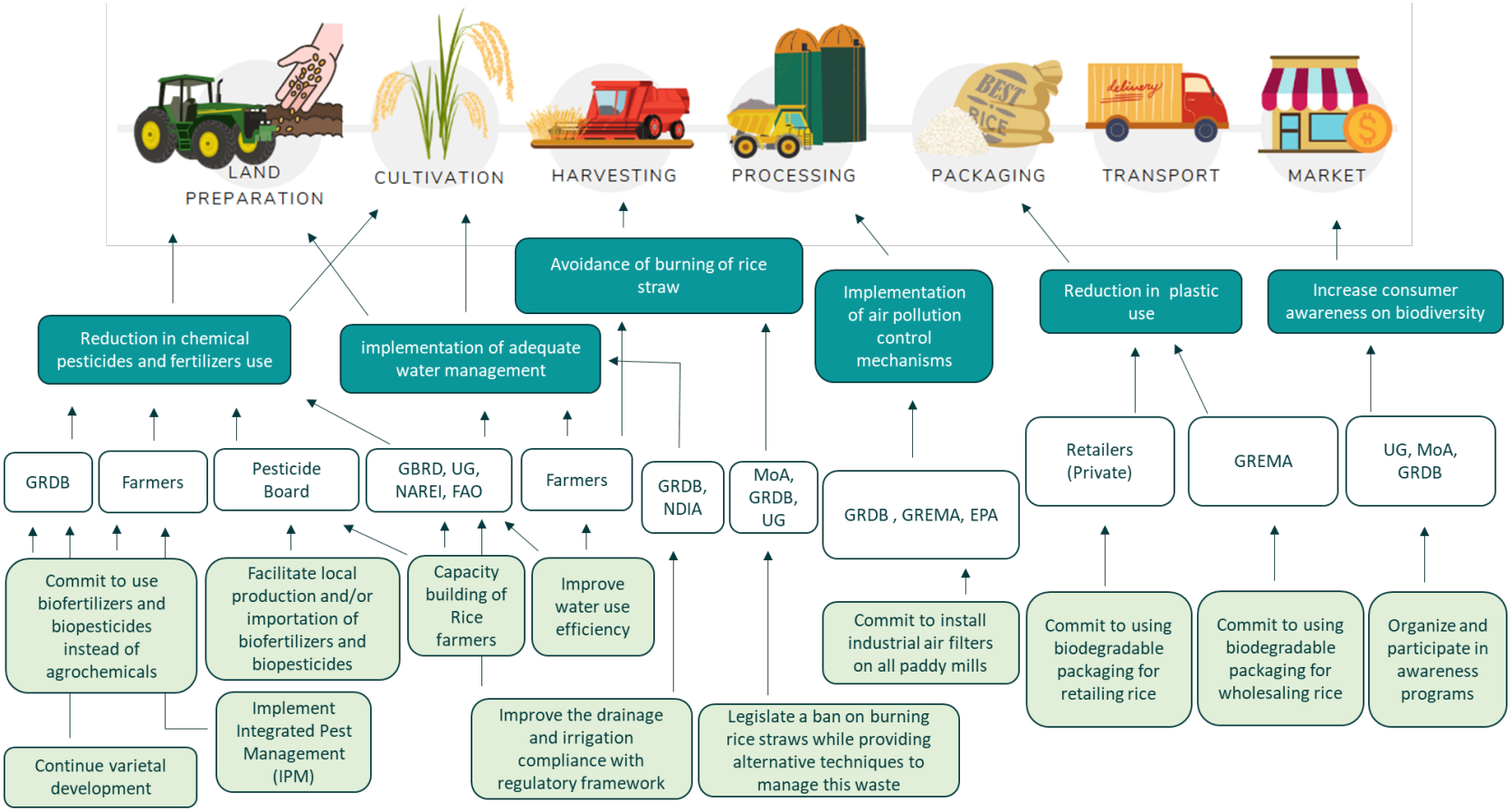
6. Plant and Livestock Health and Protection as a platform for modern agriculture practices in Guyana
7. Committing to an increased livestock production as a priority in the agriculture strategy and in the diversification of Guyana's agriculture portfolio
8. Increasing the production of fish products
9. Sustaining high production of rice is critical to maintaining annual growth increase in the agriculture sector and in maintaining high export earnings from agriculture
10. Increasing sugar production to 450,000 tonnes per year
11. Increasing production and diversification of crops, other than sugar and rice
12. Agroprocessing and value-added will become a new growth pole for agriculture
13. Recognising marketing as an important area for realizing the vision of an agricultural sector being the vehicle for economic and social prosperity in Guyana
14. Recognizing the importance of transportation, packaging, storage and cargo Sspace facilities as crucial elements to support a modern and more effective agricultural sector
15. Reiterating the imperative of a secured agriculture workforce through human resource development as part of the strategy to accelerate agricultural development in Guyana
16. Addressing food and nutrition security and safety as fundamental imperatives for agricultural development in Guyana
17. Orienting Guyana's agricultural sector to build capacity for agrofuels (bio-fuels)
18. Environmental sustainability through the agricultural sector
19. Commiting Guyana to further develop its agriculture risk reduction and disaster management programme
20. Identifying hydrometeorology and weather forecasting as part of the lives of the farmers
21. Seeking to make land availability, land zoning and land tenure for agriculture easier for farmers and entrepreneurs
22. Significant long-term investment in research and development as an important pre-requisite to raise productivity, improve profitability and enhance competitiveness
23. Strengthening the organizational structure within the agriculture sector
24. Formulating policies and the legislative framework which will help in developing and supporting agriculture
25. Encouraging a programme of financing mechanisms for agriculture.

1.6.3 Action plan for the reduction of the impact from the agricultural sector on biodiversity in Guyana

The following proposed action plan, developed by stakeholders in the Biodev2030 consultations conducted, needs to be contextualized in relation to the Low Carbon Development Strategy (LCDS) and Green State Development Strategy: Vision 2040 (GSDS), as well as with the other policies of the Government of Guyana to facilitate possible implementation.

Sectoral analysis

Figure 9 **Illustration of potential commitments and action plan through the value chain for integrating biodiversity into the rice industry in Guyana.**



Sectoral analysis

Table 4 **Proposed way forward for implementation in order to reduce impacts from the rice industry on biodiversity in Guyana**

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means and potential targets
Trajectory: Reduction in chemical pesticide and fertilizer use					
Increase the use of biopesticides by farmers by 50% in 5 years, and by 100% in 10 years	Regulate and mandate the use of biopesticides and biofertilizers by farmers	• Existing Regulation • Regulation implemented • Mandate to the farmers • Amount of funding allocated to organic rice cultivation	Short/medium term	GRDB, Government	Regulation, incentives
	Facilitate local production and/or importation of biofertilizers and biopesticides	• Existing facilitation of local production of biofertilizers and biopesticides • Amount of biofertilizers and biopesticides imported	Short/medium term	PTCCB	Taxes, incentives, lower quotas for synthetic agrochemical imports
	Capacity building of rice farmers regarding alternatives to agrochemicals such as biopesticides, biofertilizers and	• Number of farmers trained • Number of training sessions implemented	Short term	GRDB, UG, NAREI, FAO, PTCCB	Capacity building

Sectoral analysis

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means and potential targets
	Integrated Pest Management (IPM), including the presentation of the economic benefits in the long-term due to the product marketing improvement and added value				
	Commit to use biofertilizers and biopesticides instead of synthetic agrochemicals	• [Units] of synthetic agrochemicals used • [Units] of biofertilizers and biopesticides • Extent of land under organic rice cultivation	Short/medium term	Farmers, farming groups	Good practices implementation (by 50% of the farmers in 5 years and by 100% in 10 years) through a scale-up design: implement small-scale pilot projects then extend to large scale
Integrated Pest Management (IPM) implemented by 30% of the farmers in 5 years, and by 100% in 10 years	Provide incentives to allow the farmers to shift to organic rice cultivation and start Integrated Pest Management	• Amount of funding allocated to organic rice cultivation	Medium/long term	Government	Incentives
	Commit to use IPM instead of synthetic agrochemicals	• Number of farmers implementing IPM	Short/medium term	Farmers, farming groups	Implementation of good practices

Sectoral analysis

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means and potential targets
Continue varietal development to adapt to climate change while ensuring yield optimization and pest resistance	Continue ongoing development to varieties that will be resistant to pests, to reduce the industry's dependence on pesticides	• Existence of varieties resistant to pests and climate change evolution (varieties less water-demanding)	Medium/long term	GRDB	Research
Trajectory: Decrease the greenhouse gas emissions and air pollution by 70% by the end of 2030					
Avoid the negative multiple impacts of burning of rice straw on air quality, soil biota, greenhouse gas emissions and traffic disruption	Legislate a ban on burning rice straw along with providing guidelines on alternative techniques to manage this waste	• Ban legislated • Guidelines available	Medium term	MoA, GRDB, UG	Legislation Guidelines (edited by 2025) Law enforcement Monitoring
	Implement recommended alternative techniques by the Government to rice straw burning (e.g. turning it into silage to feed animals, ploughing it into the soil, composting it and then using it as a source of nutrients for the next rice crop, ferment it and use it to produce biogas, etc.)	• Ha of rice straw burnt • Implementation of alternative techniques	Short/medium term	Farmers, farming groups	Implementation of good practices (0 ha burnt/year by 2030)

Sectoral analysis

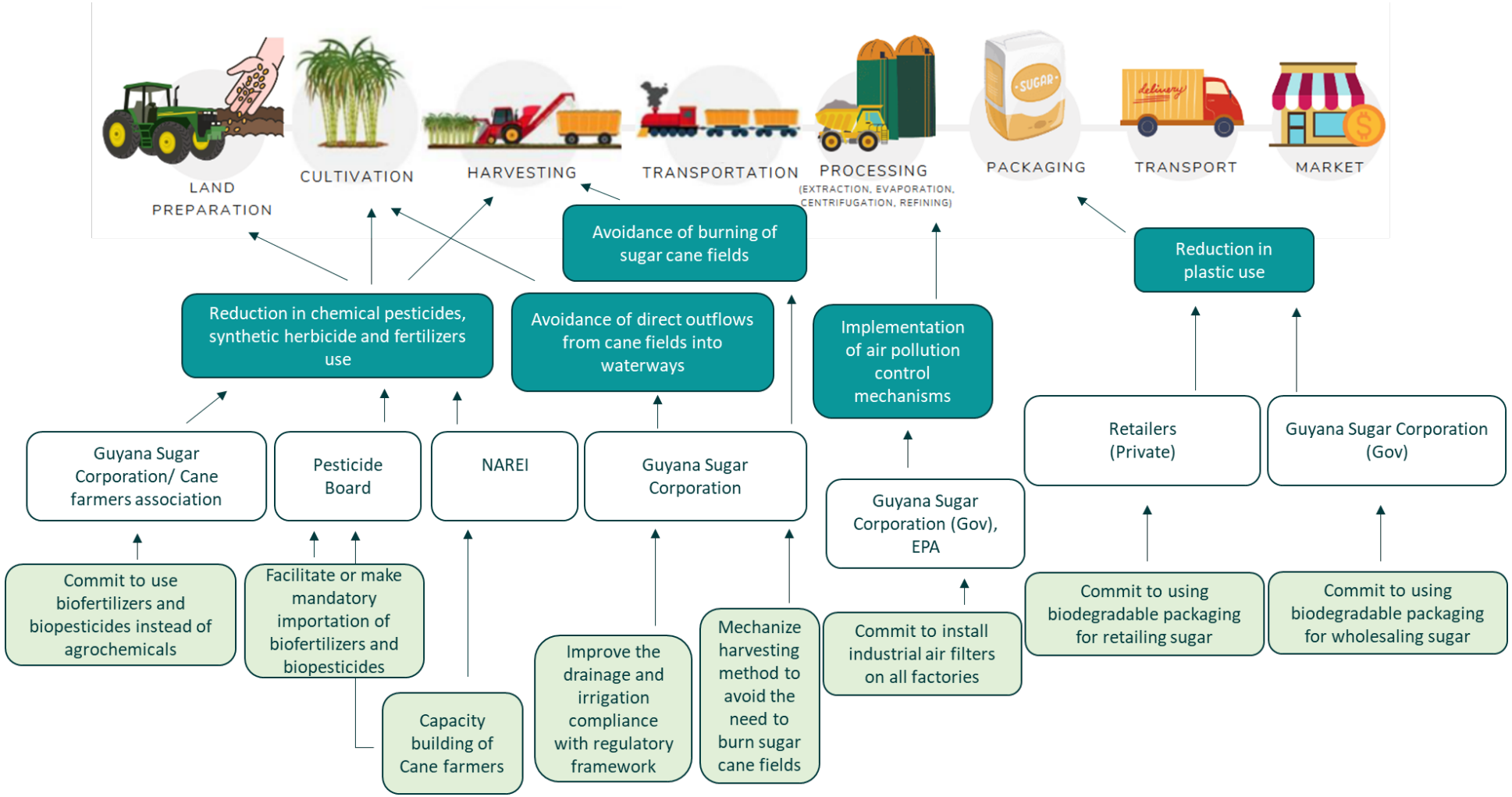
Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means and potential targets
Implementation of air pollution control mechanisms at the mills	Commit to install industrial air filters on all paddy mills	• Number of paddy mills equipped by air filters • Decrease in GHG emissions	Medium/long term	GRDB, GREMA, EPA	Air filter installation (100% of paddy mills equipped by 2030)
Trajectory: Improve water use efficiency and sustainability by 2030, taking into consideration all the influencing factors such as pest management and climate change					
Improve drainage and irrigation compliance with the regulatory framework	Compile a baseline of the state of the drainage and irrigation system and restore the infrastructure where needed	• Baseline of the state of the drainage and irrigation system • Restoration of non-functional infrastructures	Medium/long term	GRDB, NDIA	Law enforcement Monitoring
	Improve monitoring of compliance with the regulatory framework	• Number of control visits	Short/medium Term	GRDB, EPA	Law enforcement Monitoring
	Capacity building of rice farmers regarding efficient and sustainable water management	• Number of farmers trained • Number of training sessions implemented	Short term	GRDB, UG, NAREI, NDIA, FAO	Capacity building
Improve water use efficiency by implementing national regulations or recommendations	Implement national regulations or recommendations regarding drainage and irrigation	• Reduction of water used for cultivation • Implementation of national	Short/medium term	Farmers, farming groups	Implementation of good practices

Sectoral analysis

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means and potential targets
		regulations or recommendations			
Trajectory: 100% ban on single-use plastics by the end of 2030					
Use biodegradable packaging	Commit to using biodegradable packaging for retailing rice and for wholesaling rice	• % of biodegradable packaging used for retailing rice • % of biodegradable packaging used for wholesaling rice	Short term	Retailers, GREMA	Implementation of good practices
	Organize and participate in awareness programmes	• Number of awareness programmes	Short term	UG, MoA, GRDB	Campaigns to increase consumers' awareness about biodiversity

Sectoral analysis

Figure 10 **Illustration of potential commitments and action plan through the value chain for integrating biodiversity into the sugar industry in Guyana.**



Sectoral analysis

Table5 **Proposed way forward on implementation in order to reduce impacts from the sugar industry on biodiversity in Guyana**

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means and potential targets
Trajectory: Reduction in chemical pesticide, synthetic herbicide and fertilizer use					
Increase the use of biopesticides and biofertilizers instead of agrochemicals	Regulate and mandate the use of biopesticides and biofertilizers by farmers	• Existing Regulation • Regulation implemented • Mandate to the farmers	Short/medium term	GRDB, Government	Regulation
	Facilitate production or make mandatory the importation of biofertilizers and biopesticides	• Existing facilitation of local production of biofertilizers and biopesticides • Amount of biofertilizers and biopesticides imported	Short/medium term	PTCCB	Taxes, incentives, lower quotas for synthetic agrochemical imports
	Capacity building of cane farmers regarding alternatives to agrochemicals such as biopesticides, biofertilizers and Integrated Pest Management (IPM), including the presentation of the	• Number of farmers trained • Number of training sessions implemented	Short term	NAREI, PTCCB	Capacity building

Sectoral analysis

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means and potential targets
Increase the use of biopesticides and biofertilizers instead of agrochemicals	economic benefits in the long-term due to the product marketing improvement and added value				
	Commit to use biofertilizers and biopesticides instead of synthetic agrochemicals	• [Units] of synthetic agrochemicals used • [Units] of biofertilizers and biopesticides • Eco-friendly production	Short/medium term	GUYSUCO/Cane Farmers' Association	Good practices implementation through a scale-up design: implement small-scale pilot projects then extend to large scale
	Phase out harmful chemicals still being used (such as zinc phosphide, anticoagulants, etc.)	• % of reduction in the use of toxic chemicals • Frequency of toxic chemical used • Frequency of secondary poisoning	Medium/long term	GUYSUCO, sugar cane farmers, UG, GSA	Incentives, capacity building, proposition of efficient alternatives
Trajectory: Decrease the greenhouse gas emissions and air pollution by 70% by the end of 2030					

Sectoral analysis

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means and potential targets
Avoid the negative multiple impacts of burning of sugar cane fields on air quality, soil biota, greenhouse gas emissions and traffic disruption	Mechanize harvesting method to avoid the need to burn sugar cane fields	• % of mechanisation in sugar cane sector • Ha of sugar cane fields burned	Short/medium term	GUYSUCO	Financial investment to mechanize and train farmers Implementation of good practices (0 ha burnt/year by 2030)
Implementation of air pollution control mechanisms at the mills	Commit to install industrial air filters on all factories	• Number of factories equipped with air filters • Decrease in GHG emissions	Medium/long term	GUYSUCO, EPA	Air filter installation (100% of all factories equipped by 2030)
Trajectory: Improve water-use efficiency and sustainability by 2030, taking into consideration all the influencing factors such as pest management and climate change					
Improve drainage and irrigation compliance with the regulatory framework	Compile a baseline of the state of the drainage and irrigation system and restore the infrastructure where needed	• Baseline of the state of the drainage and irrigation system • Restoration of non-functional infrastructure	Medium/long term	GUYSUCO, NDIA	Law enforcement, Monitoring
	Improve monitoring of compliance with the regulatory framework	• Number of control visits	Short/Medium Term	EPA, GUYSUCO	Law enforcement Monitoring

Sectoral analysis

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means and potential targets
	Capacity building of sugar cane farmers regarding efficient and sustainable water management	• Number of farmers trained • Number of training sessions implemented	Short term	GUYSUCO, Cane Farmers' Association	Capacity building
Trajectory: 100% ban on single-use plastics by the end of 2030					
Use biodegradable packaging	Commit to using biodegradable packaging for retailing sugar and for wholesaling sugar	• % of biodegradable packaging used for retailing sugar • % of biodegradable packaging used for wholesaling sugar	Short/medium term	Retailers, GUYSUCO	Implementation of good practices
	Organize and participate in awareness programmes	• Number of awareness programmes • Number of consumers' positive attitude change towards biodiversity protection • Average level of awareness	Short term	UG, MoA, GRDB	Campaigns to increase consumers' awareness about biodiversity

1.6.4 Voluntary commitments

A certain number of recommendations could be followed as regards integrating biodiversity into agriculture:

1. Zone planning for agricultural districts so as to not upset the existing biodiversity or so as to have minimal impact on it
2. Reducing the use of agrochemicals
3. The agricultural sector can formulate and implement the necessary policy framework to mainstream biodiversity into day-to-day agricultural activities. Also, the necessary legislation should be developed
4. Drainage and irrigation compliance with the regulatory framework
5. Using more bio-friendly pest control methods
6. It is crucial to focus on the conservation and use of biodiversity, and also on the sharing of the benefits derived from such resources
7. Implementing capacity building for the staff in charge of monitoring compliance with regulations, and for farmers, implementing capacity building on regulations, evolving techniques, and good practices for biodiversity protection within the framework of climate change.

More specifically, the stakeholders proposed initial directions for engagements as described below.

Rice Industry

As an alternative to agrochemicals:

- **Increase the use of biopesticides by farmers by 50% in 5 years, and by 100% in 10 years**
- **Integrated Pest Management (IPM) implemented by 30% of the farmers in 5 years, and by 100% in 10 years.**

In order to attain these goals, the following means could be employed:

- *Facilitate local production and/or importation of biofertilizers and biopesticides (Pesticide Board)*
- *Provide incentives to allow the farmers to shift to organic rice cultivation and start Integrated Pest Management (Government, International donors, FAO, GRDB)*
- *Regulate and mandate the use of biopesticides and biofertilizers by farmers (GRDB)*
- *Capacity building of rice farmers regarding alternatives to agrochemicals such as biopesticides, biofertilizers and Integrated Pest Management (IPM), including the presentation of the economic benefits in the long-term due to product marketing improvement and added value (GBRD, UG, NAREI, FAO)*
- *Commit to use biofertilizers, biopesticides and IPM instead of synthetic agrochemicals (Farmers, farming groups (RPA))*
- *Continue varietal development to adapt to climate change while ensuring yield optimization and pest resistance (GRDB)*
- *Promote, support, sell products and assist in implementation (millers/exporters)*

Avoid the negative multiple impacts of burning of rice straw on air quality, soil biota, greenhouse gas emissions and traffic disruption.

In order to attain these goals, the following means could be employed:

- *Legislate a ban on burning rice straw along with providing guidelines on alternative techniques to manage this waste (MoA, DRDB, UG)*

- *Implement recommended alternative techniques by the Government to rice straw burning (farmers, farming groups).*

Improve water-use efficiency and sustainability taking into consideration all the influencing factors such as pest management and climate change.

In order to attain these goals, the following means could be employed:

- *Improve drainage and irrigation compliance with the regulatory framework (GRDB, NDIA)*
- *Improve water-use efficiency by implementing national regulations or recommendations (farmers, farming groups)*
- *Capacity building of rice farmers regarding efficient and sustainable water management (GBRD, UG, NAREI, FAO).*

Sugar Industry

Reduction in chemical pesticide, synthetic herbicide and fertilizer used.

In order to attain these goals, the following means could be employed:

- *Expansion of current biocontrol program (GUYSUCO, NAREI)*
- *Formulation of biopesticides (GCF, UG, NAREI)*
- *Facilitate production or make importation of biofertilizers and biopesticides mandatory (PTCCB)*
- *Development of mechanization to increase the financial viability of the industry and avoid the need to burn sugar cane fields (GUYSUCO, Cane Farmers' Association)*
- *Use of alternative means of ripening cane and diversifying cane accessions (UG, NAREI, MoA, GUYSUCO, GOG, GCF)*
- *Incorporate byproducts such as filter press mud as soil additives*
- *Implementation of cultural methods (e.g. intercropping)*
- *Commit to using biofertilizers and biopesticides instead of synthetic agrochemicals (Farmers, GUYSUCO, Cane Farmers' Association)*
- *Capacity building of sugar cane farmers regarding alternatives to agrochemicals such as biopesticides, biofertilizers and Integrated Pest Management (IPM), including the presentation of the economic benefits in the long-term due to product marketing improvement and added value (PTCCB, NAREI, GUYSUCO)*
- *Phase out harmful chemicals still being used (GUYSUCO, Cane Farmers' Association, GSA).*

Increase consumer awareness about the sugar industry and how it affects biodiversity.

In order to attain this goal, the following means could be employed:

- *Development of consumer education and awareness programmes on the sugar industry and how it affects biodiversity (UG, GSA, MoA, GUYSUCO)*
- *Participate in education and awareness programmes and commit to buy sugar in bulk or only when it comes in a biodegradable packaging (consumers).*

Reduce plastic use in sugar packaging.

In order to attain this goal, the following means could be employed:

- *Development of education and awareness programmes targeting the different professionals at each stage of the value chain (farmers, retailers, GUYSUCO) on the sugar industry and how it affects biodiversity (UG, GSA, MoA, GUYSUCO)*
- *Commit to using biodegradable packaging for wholesaling sugar (GUYSUCO)*
- *Commit to using biodegradable packaging for retailing sugar (retailers).*

2 Mining

2.1 Legislative framework

2.1.1 Institutional provisions for mining in Guyana

Executive authority and oversight for the mining sector in Guyana are overseen by the Guyana Geology and Mining Commission (GGMC) headed by the Mining Commissioner who reports to the Ministry of Natural Resources (MNR). The GGMC was established in 1979 under the Guyana Geology and Mines Commission Act (1979) and supersedes the Department of Geological Surveys and Mines and the Geological Survey of British Guiana. Presently, the GGMC technical divisions include the Geological Services Division, Mines Division, Environment Division, Petroleum Division and Land Management Division (Thom 2020). The roles and functions of the GGMC are presented in Appendix III.

To deliver on its mandates, the GGMC regularly partners with national and non-governmental agencies on several joint projects.

- The GGMC collaborates with the Protected Areas Commission (PAC) of Guyana to monitor and penalize illegal mining activities operating in the protected areas of Guyana.
- The GGMC is currently partnering with the Environmental Protection Agency (EPA) of Guyana on addressing the issues of mercury importation and the transition to mercury-free gold mining. The GGMC and EPA are also conducting joint monitoring exercises for hydro-Ssedimentology with assessments conducted in the tributaries and main branches of the Cuyuni and Mazaruni rivers in 2021.
- In 2019, the GGMC and Guyana Forestry Commission agreed to establish a joint committee to address the issue of deforestation caused by mining, and land reclamation. The focal points of the committee included the forest rehabilitation programme, rehabilitation and maintenance of hinterland roads, the use of technology for enhanced resource management, data sharing, and monitoring and enforcement operations.
- In 2013, the GGMC and the World Wildlife Fund (WWF) signed a grant agreement where the WWF provided the GGMC with financial and technical support for national capacity building, baseline studies and training of stakeholders.
- Stemming out of this grant, Conservation International alongside the Guyana Gold and Diamond Miners Association (GGDMA) worked with the GGMC to implement a programme that enhances green development and sustainable mining.

Institutionally, the mining sector in Guyana has multiple agencies working alongside the GGMC to improve the modus operandi of mining in Guyana. This is because mining is an important economic sector, but its culture, history and geography create numerous challenges in efficiently managing it. If one only looks at it from the lens of monitoring mining activities in the hinterland, the sheer size of the hinterland regions and accessibility of the mining terrains are a challenge for the GGMC to monitor, especially with limited resource capacity. This, in addition to all their other mandates including research, education, licensing, and policy development, stretches the resources of GGMC to deliver on these mandates. To develop the mining sector for the future sustainability of Guyana, continued institutional and stakeholder collaborations are essential.

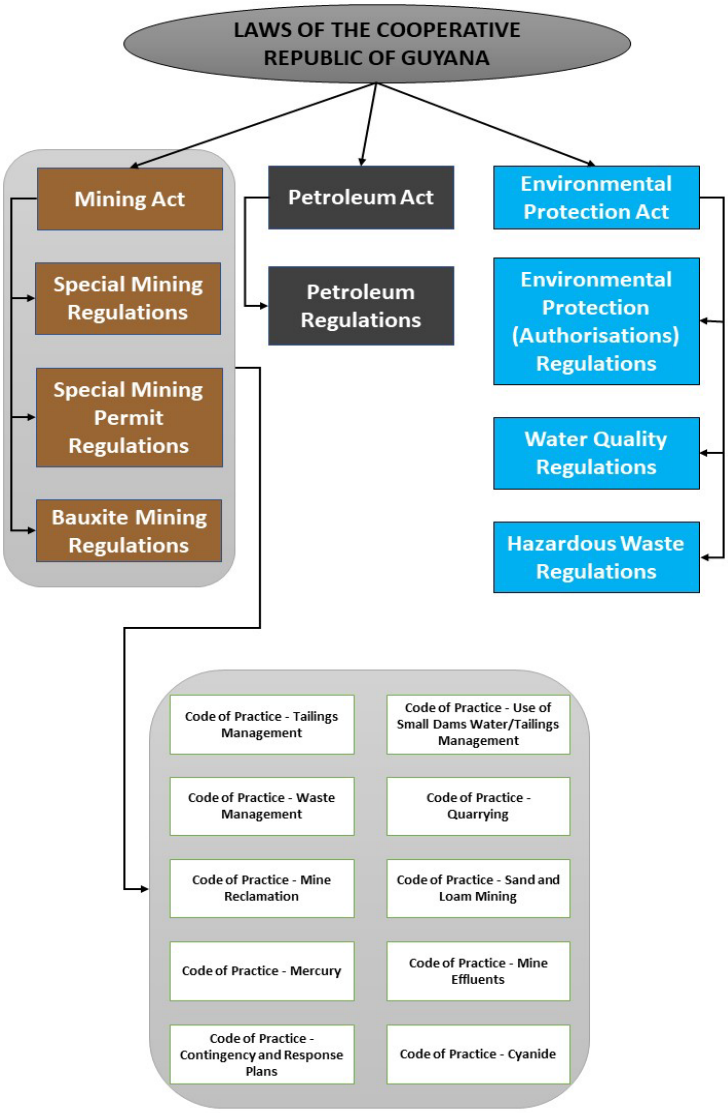


Figure 11 **Diagram of the regulations linked to mining sector in Guyana.** (Source: Seon Hamer.)

2.1.2 Community rights issues and the mining sector

Across the hinterland of Guyana, indigenous groups have disputes with the inhabitants of the coast ('coastlanders') over control of the gold resources found on indigenous lands. The coastlander–indigenous peoples division has been a long-standing national issue going back to the 1950s, a perpetual division occurring both geographically and in social ideology (Hilson & Laing, 2015). According to Bulkan (2013), the coastlanders' approach the interior lands in an

extractivist manner, both exploitive and rent-seeking without regard for the environment or the cultural resources of the hinterlands, which are often damaged in the process.

With the growth of the mining sector, especially gold mining, an argument of the coastlanders', which presently fuels the division with the indigenous peoples, is that the indigenous villages have benefited tremendously from employment in gold mining.-However, reports from Colchester et al. (2002) reveal that from the indigenous people's perspective, mining has created an unhealthy dependence on the industry and a demoralizing impact on indigenous livelihoods, through the neglect of traditional indigenous customs, especially by the younger generations. Indigenous communities argue that the indigenous way of life is being eroded and is in danger of going extinct, due to activities in the hinterland such as mining. The conflicts between coastlanders and indigenous peoples primarily are centred on the rights to the use of indigenous lands for mining and forest concessions, which have fuelled a racial and ethnic divide that has led to the discrimination and negative stereotyping of the indigenous peoples (Gavin & Hilson, 2015). In 1976, the Burnham Administration pioneered the Amerindian Act (1976) which provided a measure of entitlements for people in the indigenous lands, with the trust of the minerals remaining with the state. The Amerindian Act (1976) resulted in the homogenization of this dichotomy, where the indigenous peoples are treated as a racially and spatially distinct demographic in the country, but their entitlements and rights to public goods and state benefits are undifferentiated from the rest of the country.

The Amerindian Act (2006) now provides the entitlements and demarcation of boundaries done by the state, to the indigenous communities in the hinterland. According to the Ministry of Amerindian Affairs of Guyana, there are currently 169 Amerindian Communities, with 96 of these communities having legal recognition to the lands they occupy and use. To address indigenous land claims under the Amerindian Act (2006), the Government of Guyana adopted a procedure based on occupancy, unlike many other countries that require indigenous peoples to show their ancestral connection.

Despite the progress in legislation and demarcation of indigenous lands, the issues of resource use on indigenous lands have not been adequately addressed yet. The coastlander and indigenous division over mining resources still prevail. Even under the Amerindian Act (2006), the International Working Group for Indigenous Affairs (2021) identified that the forest resources/timber on government-titled indigenous lands are fully managed by the indigenous title holders, whereas the minerals for mining are still controlled by the state. According to the Guyana Mining Act (1989), the indigenous peoples are deemed as lawful occupiers of the lands demarcated as indigenous, but they are prohibited from extracting minerals and resources unless they possess a license from the GGMC. In cases where they do have licenses, extracted resources can be sold on behalf of the indigenous communities by the GGMC. This means that mining concessions and licenses can be granted by the government for companies to operate on indigenous lands with minimal accountability to the indigenous communities, and the resources on indigenous lands are the affairs of the GGMC as the lead state agency overseeing the mining industry.

2.2 Socio-economic overview of the mining sector in Guyana

Guyana has a long-standing and deep-rooted history with mining, which started in the country since its pre-colonial era, and with the bauxite mining industry celebrating 100 years in operation in 2016. Mining is woven into the economy and culture of Guyana, being a main source of foreign exchange, foreign direct investment, employment, and national wealth for the past century. Guyana's mining industry has expanded and evolved over the years. The industry predominantly exports bauxite, gold and diamonds, but the country has a variety of mineral deposits including silica sand, kyanite, feldspar, copper, tungsten, iron and nickel, just to name a few (International Trade Administration, 2020). According to the Mining Amendment Regulations (2005) for Guyana, mining operations generally occur on three scales:

1) Large scale mining classified as an operation whereby a minimum volume of 1000m3 of material is excavated or processed as aggregate for 24 hours

2) Medium-scale operations where the volume range for materials excavated or processed in a day is 200m3 to 1000m3

3) Small scale operations where the volume range for materials excavated or processed in a day is 20m3 to 200m3 (Thom, 2020).

There are six mining districts in Guyana, demarcated as the (1) Berbice Mining District, (2) Potaro Mining District, (3) Mazaruni Mining District, (4) Cuyuni Mining District, (5) Northwest Mining District, and the (6) Rupununi Mining District (Figure 26 below).

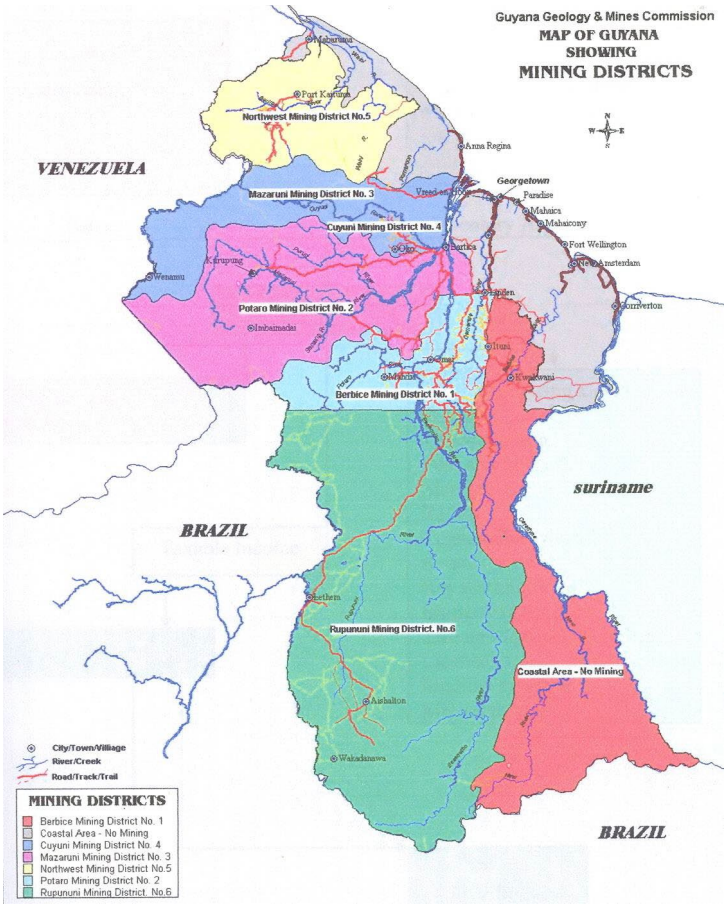


Figure 12 **Demarcation of Mining Districts in Guyana.** (Source: GGMC.)

The mining industry is segmented into a number of broad-based activities. The industry presently consists of bauxite mining by large multinational companies, mining of gold by medium-sized and large-scale foreign companies, small and medium-size local gold miners, and aggregate and other mineral mining by small local companies. The mining districts outlined in the figure above shows a distribution of mining activity throughout the hinterland regions of the country, with operations utilizing the many river tributaries that traverse the country.

Mining activities in Guyana occur within the vicinity of forested lands and indigenous lands which has perpetuated several land-use issues and conflicts. Despite this, the mining sector is still valued as an important economic contributor to Guyana's development, and will be part of the country's outlook for a while. The key for policymakers and stakeholders is to comprehensively assess the positive and negative impacts of mining on the social and environmental facets of Guyana, in order to have a deeper understanding of the necessary measures, strategies and policies needed to shift the industry to one that is sustainable. The information prepared for this report looks at several of the pertinent impacts on the economy, society and the environment of Guyana that hinders the sustainability of the contribution of mining to the country.

3 Sectoral analysis

Prior to Guyana's oil industry, the mining sector in Guyana was viewed as the key driver of economic growth, and the primary source of foreign exchange (Thomas, 2009). For the period 2012 - 2019, the mining sector of Guyana contributed an average of 12% to total GDP, with the gold industry contributing an average of 8.9%, the bauxite industry contributing an average of 1.2%, and all other mineral mining activities contributing an average of 1.5% to total GDP. For the year 2019, contributions due to mining production peaked for this period with a total of 15% of GDP. (Table below). Within the gold mining industry, small-scale miners accounted for more than 70%, and large-scale miners for less than 10%..

Table 6 **Mining sector's contribution to Gross Domestic Production (GDP) for 2012-2019** (Source: The Guyana Bureau of Statistics)

	2012	2013	2014	2015	2016	2017	2018	2019
Mining and Quarrying Aggregated	12.2%	10.3%	9.2%	9.3%	14.9%	12.4%	12.8%	15.0%
Bauxite	1.6%	1.3%	1.3%	1.2%	1.1%	0.8%	1.0%	1.0%
Gold	9.9%	8.2%	6.7%	6.6%	11.7%	9.6%	8.5%	9.9%
All other mining activities	0.6%	0.8%	1.2%	1.2%	1.8%	1.5%	2.4%	2.4%

Finally, the mining sector accounts for 4-6% of the country's labour supply, with its downstream industries benefiting approximately 33% of the population (The Guyana Office of Investment, 2021).

2.3 In-depth analysis of the gold mining industry in Guyana

2.3.1 Key characteristics of gold mining in Guyana

Description of the value chain

The mining value chain is illustrated below in Figure 27and then listed step by step in detail in the section following.

Figure 13 **General value-chain for gold mining in Guyana validated through consultation with local stakeholders**. (Source: WWF and authors.)

1. **Mineral exploration**

3 Sectoral analysis

Mineral exploration is done in different ways depending on the scale of the operation. Small- and medium-scale miners rely on their traditional knowledge, as well on the detection of minerals. For small-scale mining operations, mineral exploration is done by traversing the claim in a particular pattern, conducting sweeps using a metal detector. Once minerals are detected, small test pits are opened to confirm whether or not the mineral detected is gold, but in many cases, inferences based on experience are made. In medium-scale operations, the exploration process is similar to that of the small-scale operations, but in some cases the operators enlist the help of geologists to do a more detailed exploration. In the large-scale operations, more sophisticated technologies are used, such as satellite telemetry in combination with ground truthing.

2. **Mineral recovery**

In the small- to medium-scale operations, the mineral is recovered using mercury. When the mining area is selected, the overburden is removed, and a pit is opened. The soil is then jetted away using a high-pressure hydraulic jet, which turns the soil into a slurry. The slurry is then pumped out of the pit and passed through a sluice box which contains special mats that trap the gold particles. Mercury is then added to the sediment to amalgamate the gold. After amalgamation, the mercury is then burnt away in a retort. In the large-scale operations, the ore is transported and fed into a crusher, and the coarsely crushed ore is then conveyed to a vibrating screen by a belt conveyer, where the fine particles are separated and the large particle are sent back to be crushed. Cyanide 'vat leaching' mixes finely crushed ore with a cyanide salt in water. The cyanide binds to the gold ions, and makes them soluble in water, thereby allowing separation from the rock. This process takes place inside a mill or other mining facility.

3. **Trading/dealing**

Gold trading (buying and selling) is carried out by individuals who are licensed by the Guyana Gold Board (GGB). Miners are also obligated to declare all of the gold that they extract to the Guyana Gold Board as well.

4. **Jewellery making/goldsmith**

5. **Distributors/shops**

Socio-economic and cultural

The data demonstrates that the gold industry in Guyana is the main economic activity within the mining sector, with gold production accounting for 66% of the mining output in 2019. The gold industry in Guyana is dominated by Artisanal Small-Scale Mining (ASM) operations, which account for 70% of gold production in the country (McRae, 2014, Pasha et al., 2017). In 2019, gold exports accounted for 55% of all export value and foreign exchange in the country, which amounted to US$411,214,600.00 (Laing & Moonsammy, 2021). As of 2021, the dominant export for Guyana is now the country's oil industry, with 68% of the export value and foreign earnings, and the gold industry is now second, with 20.7% of the country's export value, and foreign earnings which amounted to US$205,609,300.00 (Guyana Bureau of Statistics, 2021). In terms of public revenue from mining, taxes and royalties from mining have increased by 86% from US$1,500,000.00 in 1998 to US$14,000,000.00 in 2008 (Thomas, 2009).

Table 7 **Number of people employed in the gold and mining sector** (Source: GGMC in IDB, 2017)

Table 6: Number of People Employed in the Gold and Mining Sector

	2007	2008	2009	2010	2011	2012	2013
SMS miners	7,662	8,124	9,410	10,781	11,672	15,078	15,696
Large scale	1,241	1,282	1,112	1,073	1,072	1,127	1,249
Quarries	267	267	267	316	338	374	418

Source: GGMC.

Gold and diamond mining is an important part of Guyana's culture, with former slaves starting the 'pork knocking' culture after emancipation, which they had learnt from the activities of the indigenous peoples (Forte, 1999). The expansion of mining in the country has caused varying effects in the communities across Guyana. While many communities prosper from economic activities, an increase in the number of miners, especially foreign miners, has also caused conflicts between miners and indigenous communities (Hilson & Laing 2017). The culture of mining in Guyana, particularly the ASM sector at the community level, has a myriad of social issues. Mining activities are often associated with drug abuse, the prostitution of indigenous and immigrant women, narcotics and human trafficking, and the prevalence of infectious diseases, including malaria and STDs.

2.3.2 Key mining stakeholders in Guyana

Figure 28 illustrates the stakeholders within the mining sector in Guyana.

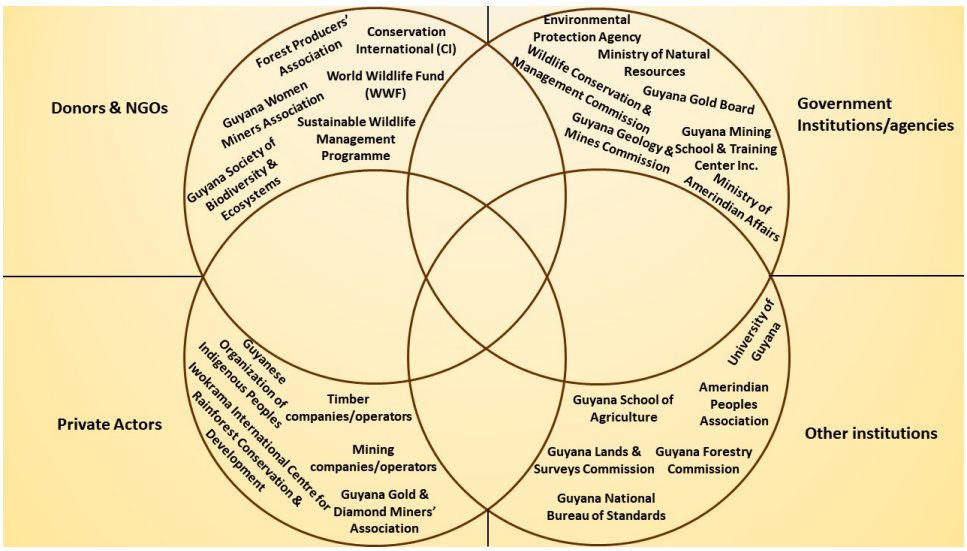


Figure 28 **Key mining stakeholders in Guyana.**

2.3.3 Main impacts of mining on biodiversity

Globally, mining of any type has garnered a reputation for activities that have deleterious environmental impacts. Environmental impacts from mining include land clearing, sedimentation, noise pollution and chemical discharge. The majority of the mining activities in Guyana occur in interior areas, along river courses or within the dense forest areas of the country. According to Pesha et al. (2017), ASM is the largest type of mining operation in Guyana, with the biggest ecological impacts. Two broad areas of concern have been identified: 1) land and soil clearing and 2) chemical pollution, particularly heavy metals. Several varying ecological effects occur as a result of these two broad areas of impact.

Land and soil clearing

The mining sector in Guyana is the leading cause of deforestation in the country. According to Bholanath and Cort (2015), **approximately 90% of the country's deforestation is caused by mining mainly from the ASM sector** (see Figure below). The large bauxite and gold mining operations clear large sections in a concentrated area, whereas the vast number of small-scale gold miners clear small pockets of forested areas over a wider spatial range. Miners clear forested areas for mining pits, tailing ponds, the building of mining camp facilities, and use wood for fuel. Pesha et al. (2017) reported that approximately **45,000 hectares of forest were cleared for small mining in Guyana.** There are several ecological disturbances associated with forest clearing in the mining sector. The loss in forest areas also affects the flow of ecosystem services associated with the habitat. **Forested cover for instance provides habitat, shelter, hydrology regulation, erosion protection, sequestration services and potential bioprospecting.**

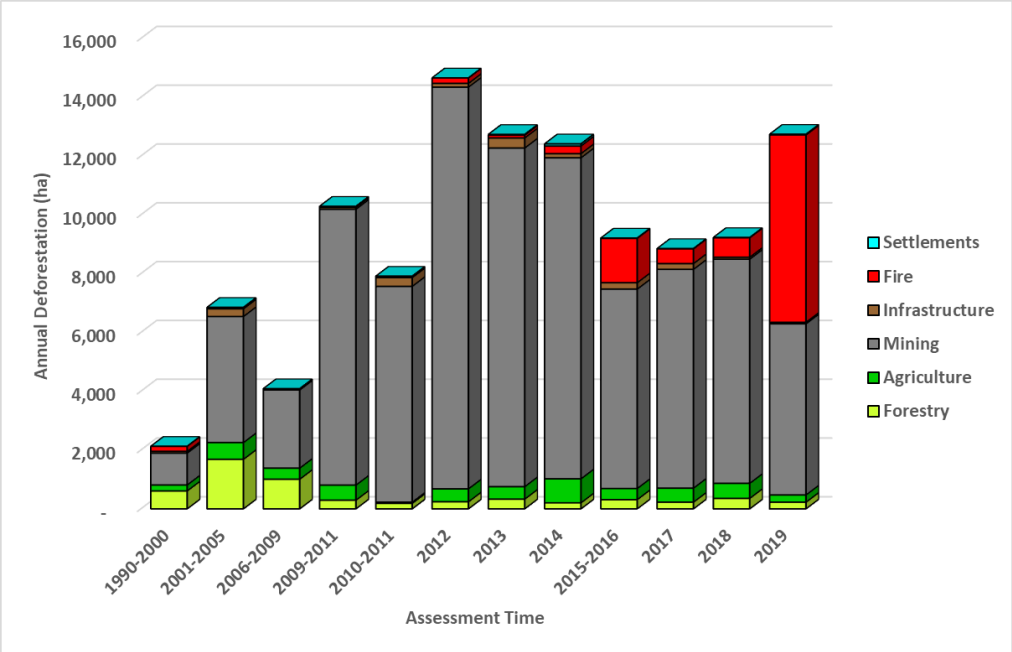


Figure 29 **Annual deforestation by sectorial industries**. (Source: GFC 2020.)

The data presented in Figure 29 were sourced from the GFC, and shows the rapid increase in deforestation rates caused by mining. Empirical evidence shows a rapid expansion of the mining industry, particularly the small-scale gold mining industry, with **deforestation rates from mining increasing from 1,500 hectares in 1990-2000 up to 12,500 hectares in 2012**. From 2015-2018, deforestation rates from mining have stabilized, partially due to stricter forest policies and stabilization of new mining operations, but the range still represents a significant increase when compared to the years before 2000.

The surge in deforestation rates due to mining has sparked a national debate as to whether the present operation of the industry can be part of the country's low carbon, low deforestation development strategy for Guyana (Lowe, 2014). This is also a contradiction for the National Determined Contribution (NDCs) agreed upon by Guyana to the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP) at the Paris Agreement. Guyana committed to the maintenance of its low deforestation rates, which is challenging to maintain if the mining sector maintains or increases its current operations. Of recent, Guyana's forest policies all target mining as its biggest hindrance, sparking the formation of a joint committee between the GGMC and GFC, which studies show is a key component missing in managing the mining-deforestation conundrum, as outlined by Dezécache et al. (2017).

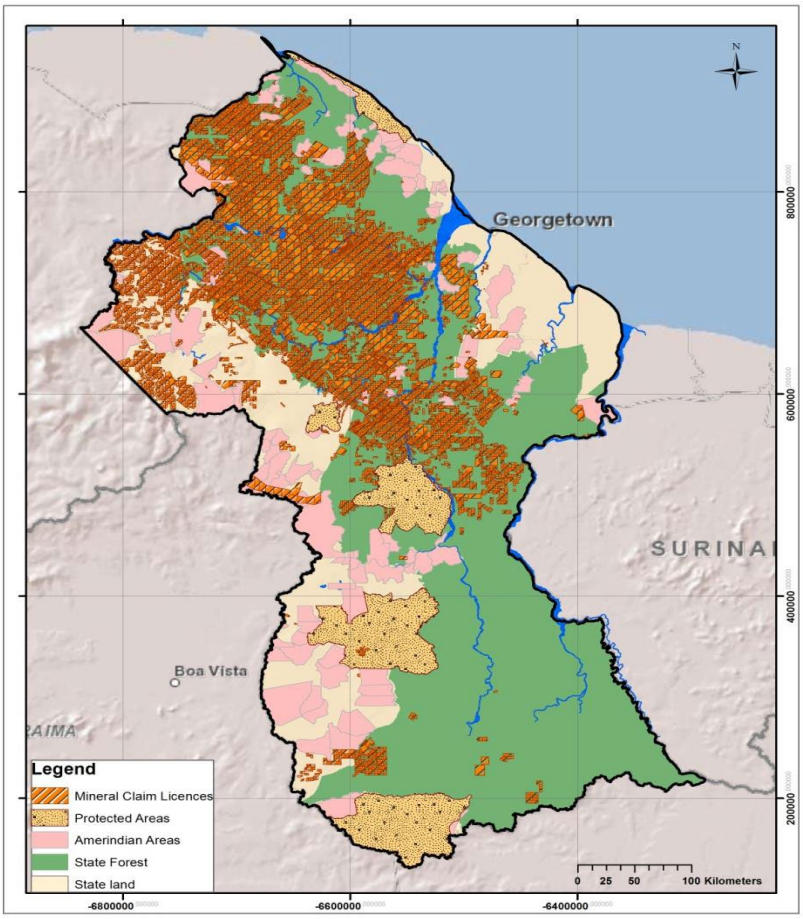


Figure 14 **Map showing mining activities within the forested areas of Guyana**. (Source: The Diggings, 2021)

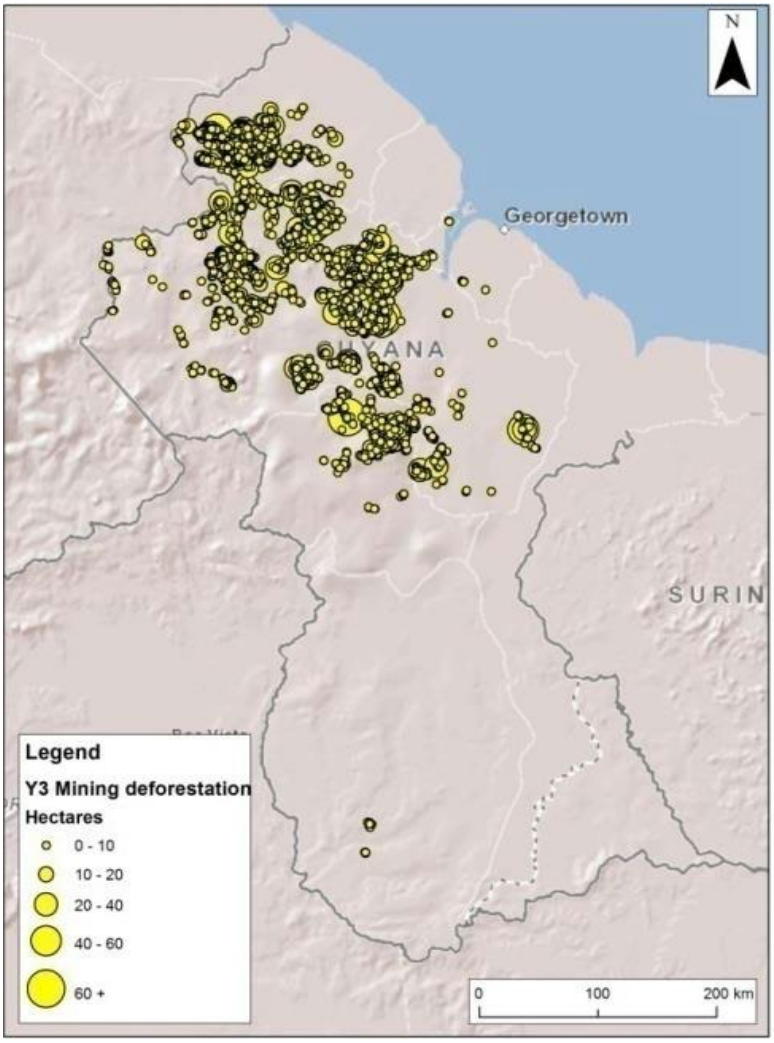


Figure 31

Chemical pollution

The most documented environmental issue relating to the mining sector is the chemical discharge into the ambient environment, particularly the discharge of heavy metals. **Mercury pollution from gold mining** is a well-documented issue in Guyana p(Hilson and Laing, 2017a; Lowe, 2006; Pasha, Wenner and Clark, 2017; Roopnarine, 2002; Singh et al., 2013). Mercury is used in the amalgamation process of gold mining, and as of 2015, Guyana imported between 7.5 - 22.5 tonnes of mercury annually (Legg et al., 2015) for the gold mining sector. The country also has an undocumented volume of mercury that is smuggled into the country mainly by the illegal mining operators in the country. **The volume of mercury used in gold mining as a heavy metal pollutant in Guyana exceeds the global ecological standards for safe use.** Guyana's *Minamata Initial Assessment Report* (2016) estimated that **total mercury emissions for air, water and land are 28,790 kg annually**. Howard et al. (2011) estimated mercury loadings in the sediment at gold mining sites in Guyana at **226 ± 171 ng/g** with some sites showing values up to 527 ± 92 ng/g and mercury levels in the water levels across Guyana ranging between 0.053 to 0.301 ug/g. The GGMC in 2001 surveyed carnivorous freshwater fish and found that 57% of the sample exceeded the World Health Organization (WHO) guidelines. Singh et al. (2000) reported the concentration of methyl mercury found in fish specimens across Guyana ranging between 0.24 – 1.81 ug/g with 39% of the specimens exceeding WHO guidelines. The estimated

values since this report by Singh et al. (2000) is expected to increase, as mercury usage in the country has steadily increased since then. **The mercury contamination in the air, water and soils as heavy metal is persistent in the environment and accumulates over time. The accumulation eventually enters the biological system either through direct contamination or through bioaccumulation in the food system.** Mercury pollution in Guyana has entered the food system as is shown in the report by Singh et al. (2000), and this contaminates the wildlife and people that use the rivers to catch fish, or as a source of potable water. While no studies have been sourced which look at mercury levels in megafauna in Guyana such as the jaguar, caimans or river otters which could assess the contamination of mercury on biodiversity, studies have been done with indigenous people. Colchester et al. (2002) reported findings of 2 – 22 ug/g of mercury in hair samples from communities along the Barima River in Guyana. Singh et al. (2013) showed estimates from various indigenous communities across Guyana ranging up to 70.8 ug/g in hair specimens, some of which included nursing and pregnant women. **The values reported by Singh et al. (2013) were up to five times more than the WHO safety level.**

The direct use of mercury in mining activities also exposes another vulnerable group to mercury contamination. The miners who directly contact the mercury in the amalgamation process iare the demographic in the country most vulnerable to mercury poisoning. While no research was sourced explicitly looking at mercury levels in miners, several reports have indicated the susceptibility of miners working with mercury as the majority of mining operations in Guyana, particularly the small operations, do not have appropriate safety equipment or safety measures. Miners are exposed to the methyl mercury directly, or from the mercury vapour. According to Hays and Viera (n.d.), policymakers recognize the issue of mercury exposure on miners, but the country has a culture of dangerous, vague and complex concepts about the dangers of being exposed to mercury. The Guyana Environmental Capacity Development Project (GENCAPD) attempted to address the issue of education and awareness amongst miners by distributing a variety of mercury-awareness materials to miners across various mining communities. WWF-Guianas also developed programmes to increase awareness on health issues pertaining to gold mining in the hinterland areas, with varying results. Despite many institutional efforts, the issue still prevails in the small-mining sector. Reports from the GGMC for their assessment for the Minamata Convention often cite this customary culture of practice developed in the gold mining sector with the use of mercury. As the country has ratified the Minamata Convention, its biggest challenge is having to untangle a deep-rooted operational practice, in order to truly see the adoption and implementation of a mercury-free gold mining sector.

Non-compliance with the mining regulations that govern the sector has also been a major source of chemical pollution emanating from the mining sector. There have been instances where mercury has been emitted because of improper storage methods. The impact per miner might be small, but the cumulative effect is significant. Accidents in the sector have also resulted in large-scale contamination events in the past, the most notable in Guyana's history being the Omai cyanide spill which occurred 19 August 1995, when the retaining wall of a tailing pond at the Omai Mine broke and released an estimated 3.03 billion litres of cyanide-laced material into the Omai River (at a rate of 59.43 million litres/hour), which then travelled to the Essequibo River. The event caused widespread aquatic contamination which resulted in massive fish kills which were sighted 13 km downstream of the spill. Herds of peccaries (wild hogs) also fell victim to the spill, since they depended on the river for water as well (Associated Press, 1995; Buffalo News, 1995; Chatterjee, 1997; Spokesman, 1995).

Overall, the mining sector in its present operation is the most prominent source of ecological destruction in terms of habitat removal and pollution in Guyana. The effects to Guyana's ecology include impacts to forest ecosystems, soil ecosystems, water ecosystems, and the ambient air environment. There have been quite a number of studies done looking at the impacts of mining on ecosystems, particularly those looking at the land-clearing issue (Laing, 2015), soil contamination (Williams et al. 2019), and water contamination (Roopnarine, 2002; Singh et al., 2013). The country still needs to do further research on the systemic impacts on ecosystem functions, such as the level of heavy metal infiltration into the food chain, contamination of trees from the substrate levels, and the vulnerability of endangered megafauna in Guyana, particularly arapaima fish, jaguars and river otters which are viewed as ecosystem indicator species.

3 Sectoral analysis

2.3.4 SWOT analysis of mining in Guyana relating to biodiversity

Strengths

- **Relatively sound mining code (large-scale mining)**

The rate of compliance by large-scale miners with the mining code is exceptionally high, and there are hardly any negative incidences in large-scale mining operations being reported to the GGMC.

- **High awareness of social and environmental issues within the mining community (industry-wide)**

There have been many studies and surveys that were carried out over the years in the various mining districts, which documented the various social and environmental issues at various levels.

- **Demo site already set up for no-mercury mining using shaking table and borox**

There are various demos that were set up for miners to see how no-mercury technology works, since many of the operators were not aware about how they could go about doing so. Demos were also done using borox, which is a less environmentally harsh and less environmentally persistent reagent that can be used to extract gold.

- **Compliance with mining regulations**

Compliance with the mining regulations among large-scale miners is very high.

- **Large-scale operations willing to adapt best practices and the management is better**

Large-scale operations are far more feasible than small- and medium-scale operations. They also have better capacity for environmental management and are always implementing various best practices, which help the operation to increase its financial and environmental sustainability.

- **Strong commitment of the GGMC, and miners have been historically involved in many initiatives for integrating biodiversity into mining activities in Guyana**, especially in gold mining (e.g. GEF; Planet GOLD…; Guyana Extractive Industries Transparency Initiative – GEITI; involvement in the framework of REDD+, UN's Minamata Convention on Mercury, etc.).

Weaknesses

- **The monitoring and security challenges so generated can only be met through better transportation (industry-wide)**

Monitoring and security challenges eventually become a recipe for mining regulations to be ignored.Compliance would then be low, and low compliance means that the operation would then not adhere to environmental safeguards, but negatively affect the environment and wildlife. In areas where there are monitoring and security challenges, there is also the possibility of an increased number of illegal mining activities.

- **Inadequate geodata in terms of quantity, quality and accessibility (large-scale and small-scale mining)**

Lack of access to the appropriate quantity and quality of geodata encourages a hit and miss mining approach, which has proven to be environmentally unsustainable in small-scale mining operations. Large-scale operations are also affected, but these would fill this gap by accessing appropriate technologies to gather the necessary data, but this is however financially intensive.

- **Unreported gold and diamond production (small-scale mining)**
- **Limited incentives due to poor regulatory framework**
- **Mercury-free equipment is very expensive.**

Artisanal, small- and medium-scale mining in most case do not have the financial resources and the know-how to get into mercury-free mining.

- **Inadequate training**

Mercury-free mining can be considered new to Guyana's mining industry, and to date, the knowledge of such an approach has not been adequately disseminated among the operators of the industry at the various levels.

- **Little to no baseline data to put a proper monitoring programme in place**
- **Inadequate technical and financial assistance by the government**

Small- and medium-scale operators have complained that the government has not been making adequate concessions available to them.

Opportunities

- **Developed mining-related legislation (mining, environment, OHS, land, etc) (industry-wide)**
- **Established mining institutions with separate mandates (industry-wide)**
- **Long experience in mining administration (industry-wide)**
- **Availability of numerous international guidelines and best practices (industry-wide)**
- **There is room for improvement in exploration methods**
- **The GGMC, in collaboration with the Ministry of Natural Resources (MNR), is supporting a process of integrating land reclamation into Guyana`s extractive industries. The Commission has incorporated an approach for increased education and awareness with respect to mine reclamation and closure. A land reclamation programme was also initiated. Sites were selected for piloting and demonstrating land reclamation activities (6th National Biodiversity Strategy and Action Plan (NBSAP, CBD).**

Threats

- **Difficult access to mining districts in terms of poor roads, especially for supply trucks during rainy seasons, high air fares (industry-wide)**
- **Location and vast spread of mining activities (industry-wide)**

Mining occurs in every ecological zone that can be found in Guyana. In southern Guyana, there are instances where mining is taking place in or near threatened forest, which significantly increases the threats to especially sensitive species.

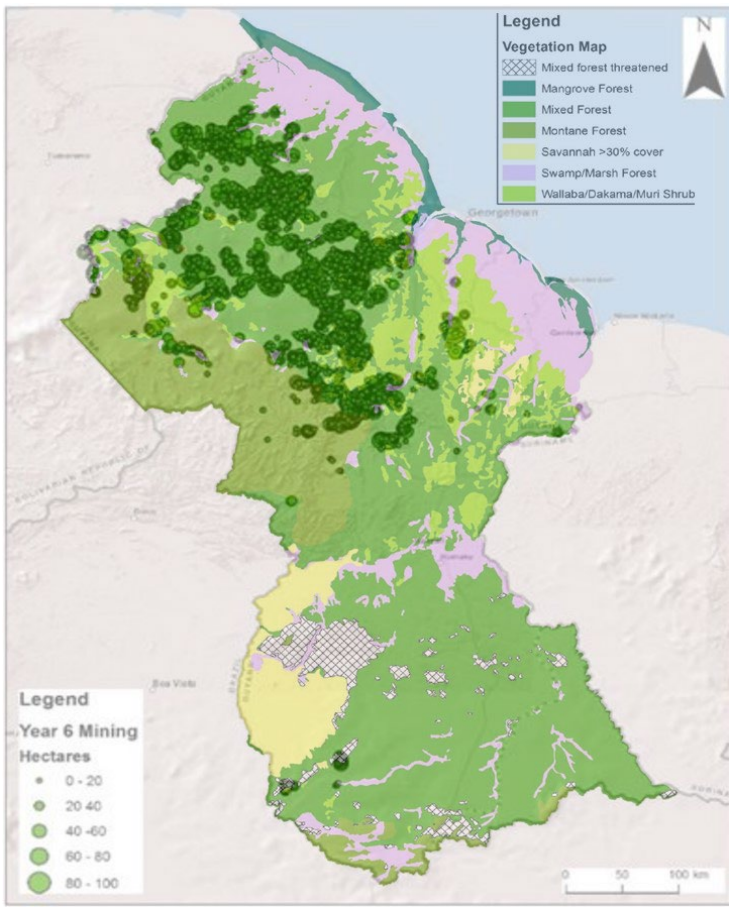


Figure 15 **Map showing the locations of mining operations in the different ecological zones across Guyana.** (Source: Guyana Forestry Commission, 2018.)

- **Inadequate deposit study and mine planning. Unsystematic mining (small-scale mining)**

The small-scale miner cannot afford to conduct deposit studies and mine planning, since the process is very financially intensive and this is pushing the majority of the small-scale miners into unsystematic mining.

- **Not being able to meet the Minamata commitments on mercury use (small-scale mining)**

The small-scale miners will not be able to meet the commitments of the Minamata Convention that Guyana has signed on to, because the equipment to conduct mercury-free mining is expensive, and they cannot afford to acquire the equipment.

- **There is added pressure on the fisheries (from oil and gas extraction)**

There might be some effect on the fisheries resources as a result of oil and gas extraction activities in the exclusive economic zone (EEZ). There are many fisherfolk who are reporting that since the oil and gas extraction activities started, their catch has significantly reduced even though they are putting in more effort and time. Some fishers have also reported that they have not been able to gain access to areas where they normally fish, because of the oil and gas extraction activity.

- **Little to no incentives for positive impacts**

- **Habitat disturbance and destruction due to establishment of associated infrastructure**

Mining has been found to be the number one economic activity that disturbs and degrades habitats in both the terrestrial and aquatic ecosystems, and causes many species of biodiversity to be lost.

- **Miners do not currently see the benefits of mercury-free mining**

Miners have indicated that mercury-free mining would be more costly to conduct, since the equipment is very expensive and they do not have access to the capital needed to transition into mercury-free mining.

- **Too much emphasis on penalties**

There is a heavy focus on penalties within the mining legalisation currently implemented in Guyana. The legislation outlines in many instances the penalties that miners would be subjected to for not following the mining regulations or not being in compliance. The legislation must be adjusted to include incentives which would entice the miners into maintaining or improving compliance with the legislation.

- **Sub-optimal recovery rates (small-scale mining)**

The technology currently used by small-scale miners has very low recovery rates, and the majority of miners in this category cannot afford to access better extractive technologies because of financial constraints. This would be one of the drivers for small-scale miners seeking out more areas to mine when their maximum recovery is achieved in a particular area, and cumulatively, this contributes to even further habitat destruction and degradation which causes biodiversity loss.

- **Expensive to do restorative work. Especially true for small-scale miners**

Miners have reported that the action necessary to prepare a mined-out area for restorative work is very expensive, and small-scale miners cannot afford to carry out these financially intensive activities. Hence, they find it more beneficial to forfeit the GY$200,000 (US$957.09) environmental bond lodged with the Guyana Geology and Mines Commission (GGMC), and the area is often not restored. Figure 33 lists the SWOT findings.

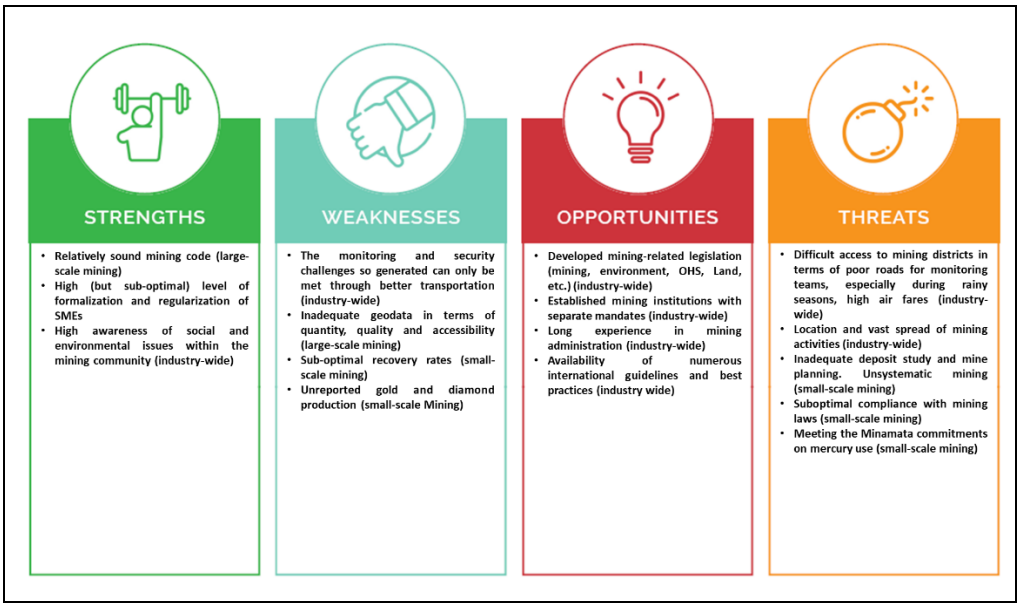


Figure 33 **List of SWOT findings**

2.4 Proposition for transformative trajectories and actions to be developed into voluntary commitments

2.4.1 Actual trajectories of mining in Guyana

The main actual trajectories of mining in Guyana are:

- Mines will prosper and expand, through both the opening of new roads to the south of the country, and the modernization of the port infrastructure, which will be the corollary of the development of the oil industry.
- Deforestation which will lead to habitat destruction or degradation and fragmentation is going to continue and increase, along with the other impacts of mining on biodiversity and local communities (pollution, soil erosion, etc.)
- Although the mining sector has widespread negative effects on biodiversity, there are some positive practices that are carried out in the sector:

  ⇨There is a current programme implemented which is designed to encourage miners to move away from the use of mercury in the gold extraction process, and there is also the responsible mining initiative which is aimed at reducing or eliminating the use of haphazard gold mining approaches (hit and miss approach) which cause significant negative environmental and ecological effects. Demonstrations were also set up to exhibit the effectiveness of using no-mercury technology, in order to encourage miners to invest in the alternative technology

  ⇨The GGMC has also mandated the use of retorts, which reduce the emissions of mercury vapour into the atmosphere, and helps in recycling the mercury

  ⇨ Reforestation is also done (in some cases) when a mining site is being closed. In lieu of reforestation, miners are mandated to appropriately restore the topsoil from the area when it is removed. Then when the area is mined out, it is backfilled, and the topsoil is put back and the area reforested by natural means

2.4.2 Expected trajectories for the reduction of the impact of the mining sector on biodiversity in Guyana

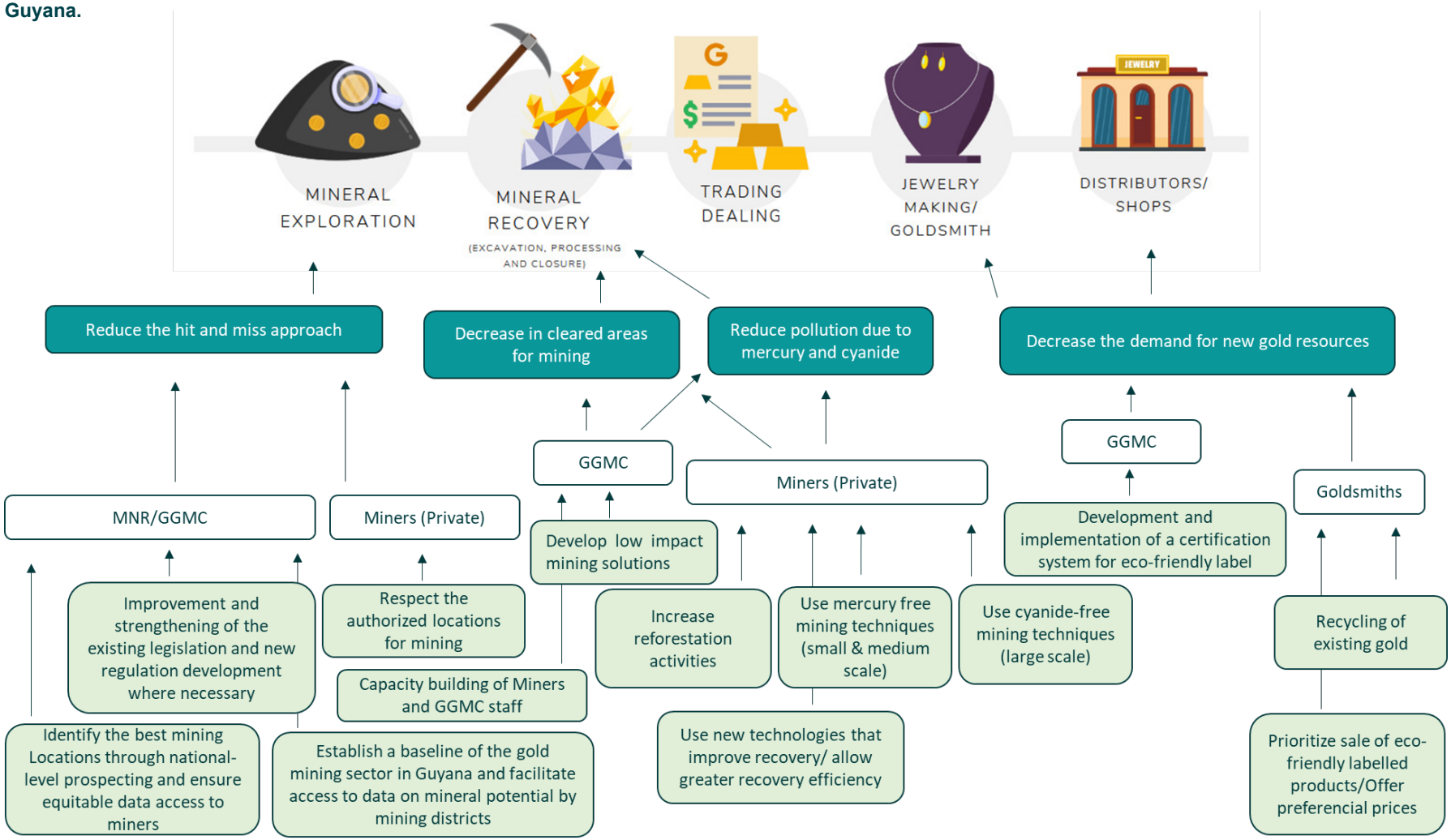
- **Low-impact mining, rehabilitation and restoration of mined-out areas/ responsible mining**
- **Implementation of the Minamata Convention**
- **Increasing compliance especially among small- and medium-scale miners.**

2.4.3 Action plan to reduce the impacts of the gold mining industry on biodiversity in Guyana

The following proposed action plan, developed by stakeholders themselves in the Biodev2030 consultations which were conducted, needs to be contextualized in relation to the LCDS and GSDS Vision 2040, but also with the other policies of the Government of Guyana, in order to facilitate possible implementation.

Sectoral analysis

Figure 16 **Illustration of potential commitments and action plan through the value chain to integrating biodiversity across the gold mining industry in Guyana.**



3 Sectoral analysis

Table8 **Proposed way forward for implementation in order to reduce the impacts of the gold mining industry on biodiversity in Guyana**

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means
Trajectory: Increase of understanding within the gold industry in order to monitor the evolution of the practices and uses by the different categories of miners					
Improve baseline data for the gold mining sector in Guyana and facilitate access to data on mineral potential by mining districts, in order to improve productivity while slowing deforestation	Establish a baseline of the gold mining sector in terms of detailed practices and miners monitoring	• Number of licensed miners at different scales (ASM, large-scale)	Short term	GGMC	Study
	Institute and/or update mineral mapping for the different districts	• Availability of updated mineral mapping by districts	Short/medium term	GGMC/GLSC	Exploration missions and GIS development
Trajectory: Increase of XX% in the use of alternative technologies for better mining recovery while slowing deforestation by 2030					
Encourage the use of new and/or alternative techniques/technologies to increase mining recovery	Providing of incentives for the adoption of modern and environmentally sound technology and more accurate prospecting	• Budget allocated	Short/medium term	Government (linked to LCDS/GSDS Vision 2040)	Financial resources

3 Sectoral analysis

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means
	Promotion of technology that allows greater recovery efficiency through training of miners on these technologies	• Number of Miners trained in best techniques and practices to decrease impacts on biodiversity	Short term	GGMC	Capacity building Communication
	Develop a certification for miners	• Certified miners from the GMSTCI for specific courses	Medium term	GGMC	Certification
Increase compliance to mining regulations	Increase the enforcement of existing regulations (e.g. through joint site visits by GGMC/EPA)	• Number of offences/ non-conformities recorded	Short term	EPA/GGMC	Law enforcement: site visits
	Incentivize compliance with mining regulations among small- and medium-scale miners	• Budget allocated to incentives	Medium term	GGMC	Financial resources
	Implement best practices in mining/low impact mining	• % of increased compliance among small-scale miners	Short/medium term	Guyana Women Miners' Association, Guyana Gold & Diamond Miners'	Communication Law enforcement

3 Sectoral analysis

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means
				Association, mining companies/operators	Monitoring
Trajectory: Increase of XX % in area successfully restored after mining activities by 2030					
Continue and increase the implementation of ecological restoration after mining activities	Monitor the mined-out areas restored	• % of areas restored after mining activity/ or mined-out areas restored (within the framework of mining closure and/or outside)	Short term	GGMC (link with the LCDS)	Law enforcement Monitoring
	Continue research on restoration efficiency /recovery rate of forested habitats following mining activities	• Number of corrective restoration and management actions • Described process(es) to optimize the forested habitat recovery rate in order to reach no net loss or	Short/medium term	GGMC	Research

3 Sectoral analysis

Action	Mission	Indicator	Prioritization/ Horizon	Responsible stakeholders	Means
		net gain of biodiversity			

2.4.4 Voluntary commitments for the mining sector

Ensure that at least 50% of the miners in Guyana (of all categories) are compliant with the mining regulations by 2030.

In order to attain these goals, the following means could be employed:

- *Increase the enforcement of existing regulations (e.g. through joint site visits by GGMC/EPA)*
- *Continuous training of GGMC personnel (GGMC/EPA)*
- *Capacity building of miners (of all categories) on the regulations framing mining activities, the use of new techniques and technologies, mercury-free mining techniques (small- and medium-scale miners), cyanide-free mining techniques (large- scale miners), use of retorts to reduce mercury vapour let into the atmosphere and help in recycling the mercury (small- and medium-scale miners), and reforestation (GGMC/GMSICI)*
- *Develop a certification for miners (eco-friendly labeling for gold, GGMC/EPA/ GGB/GGDMA)*
- *Incentivize compliance with mining regulations among small-scale miners through incentive distribution and eco-friendly certification (GGMC)*
- *Implement best practices in mining/low impact mining (Guyana Women Miners' Association, Guyana Gold & Diamond Miners' Association, mining companies/operators)*
- *Develop a traceable and verifiable chain of custody (GGMC/EPA).*

Decrease the deforestation rate due to gold mining in Guyana, and increase the reforestation rate through efficient rehabilitation of excavated sites and reforestation actions in other degraded areas, within the framework of environmental impacts offsetting.

In order to attain these goals, the following means could be employed:

- *Increase mining recovery in order to decrease the deforestation rate while improving productivity through the use of new and/or alternative techniques/technologies (Guyana Women Miners' Association, Guyana Gold & Diamond Miners' Association, mining companies/operators)*
- *Develop low-impact mining solutions (GGMC, Guyana Women Miners' Association, Guyana Gold & Diamond Miners' Association, mining companies/operators)*
- *Increase rehabilitation of excavated areas and reforestation activities (miners, mining companies/operators)*

Decrease the pollution due to mercury and cyanide use in mineral recovery steps by 50% every year, to reduce impacts on ecosystems, including waterways, and impacts on local populations.

In order to attain these goals, the following means could be employed:

- *Use mercury-free mining techniques (small- and medium-scale miners)*
- *Use cyanide-free mining techniques (large-scale miners)*
- *Capacity building of miners (of all categories) on regulations framing mining activities, mercury-free mining techniques (small- and medium-scale miners), cyanide-free mining techniques (large-scale miners), use of retorts to reduce mercury vapour emission let into the atmosphere and help in recycling the mercury (GGMC/GMSICI).*

4

Conclusion

4 Conclusion

The involvement of local stakeholders enabled the defining of three voluntary commitments per sector to work on during the following years. These were chosen in order to decrease pressure on biodiversity, through a transformative approach based on the capacity building of stakeholders at different steps of the value chain to better know, understand and respect regulations, and to implement good practices to decrease the respective pressures on biodiversity. However, the change of practices by farmers, millers, miners and other stakeholders will inevitably rely as well on incentives to assist in the evolution of these practices, and eventually mindsets.

The approach should follow a scale-up design, such as starting experimental projects locally in areas where the issues mentioned above are particularly important (for instance the burning of crop residues which has social impacts such as heavy pollution, etc. as well), with willing and motivated stakeholders, in order to serve as an example for the other stakeholders, and then building on the lessons learnt from these experiences to extend to larger scales. However, these commitments go hand in hand with other actions which must be dealt with intrinsically at the national scale, such as when considering taxation, importation quotas for specific products, and regulatory changes.

This study is a cornerstone, but further discussions definitely need to occur after the implementation of the first actions which are aimed at covering the gaps in baseline data. Indeed, that first step will be necessary to actually be able to set up quantified, objective and ambitious yet realistic voluntary commitments.

It is important as well to keep in mind that it is crucial to take into consideration all the direct, indirect, and induced environmental and social impacts when designing the detailed actions and associated implementation process. For example, the action of improving infrastructure to facilitate monitoring and control is a double-sided coin: on one hand it will indeed allow better control by the authorities (EPA) of miners' compliance to the regulations; however, it will at the same time exacerbate the process of habitat fragmentation and induced impact of in-migration, which will increase pressure on the ecosystems, and will especially increase deforestation.

It is very likely that the relatively low rate of deforestation in Guyana is due to the efficient monitoring and management systems of the Guyana Forestry Commission, which makes use of strategic placement of forest stations and their limited staff. Within the last 10 years, monitoring and management of the state forests have been made even more efficient with the implementation of the REDD+ monitoring, reporting and verification (MRV) of forest carbon stocks and changes. The MRV process also incorporates the extensive use of geospatial technology, which increases efficiency in monitoring and management. There is also a number of indigenous communities which also participate in forest management, that also helps the process along. The policies and regulations within the forest industry also contribute to keeping deforestation rates low, but there is room for improvement, especially since Guyana's economic circumstances are changing.

Good transport infrastructure is important as well for the development of the country, so it is crucial to find the right balance and ensure the realisation of a national Strategic Environmental Assessment (SEA), and to implement a mitigation hierarchy (avoid, minimize, restore, offset) which follows international standards for each infrastructure project.

Finally, this pioneer study focusing on the gold mining, rice and sugar cane industries can serve as an experimental study and be extended to other sectors or value chains which are developing rapidly, and represents other threats to biodiversity if not properly anticipated, framed and managed. Through the participative process, several such sectors were mentioned, such as oil and gas, and agricultural diversification.

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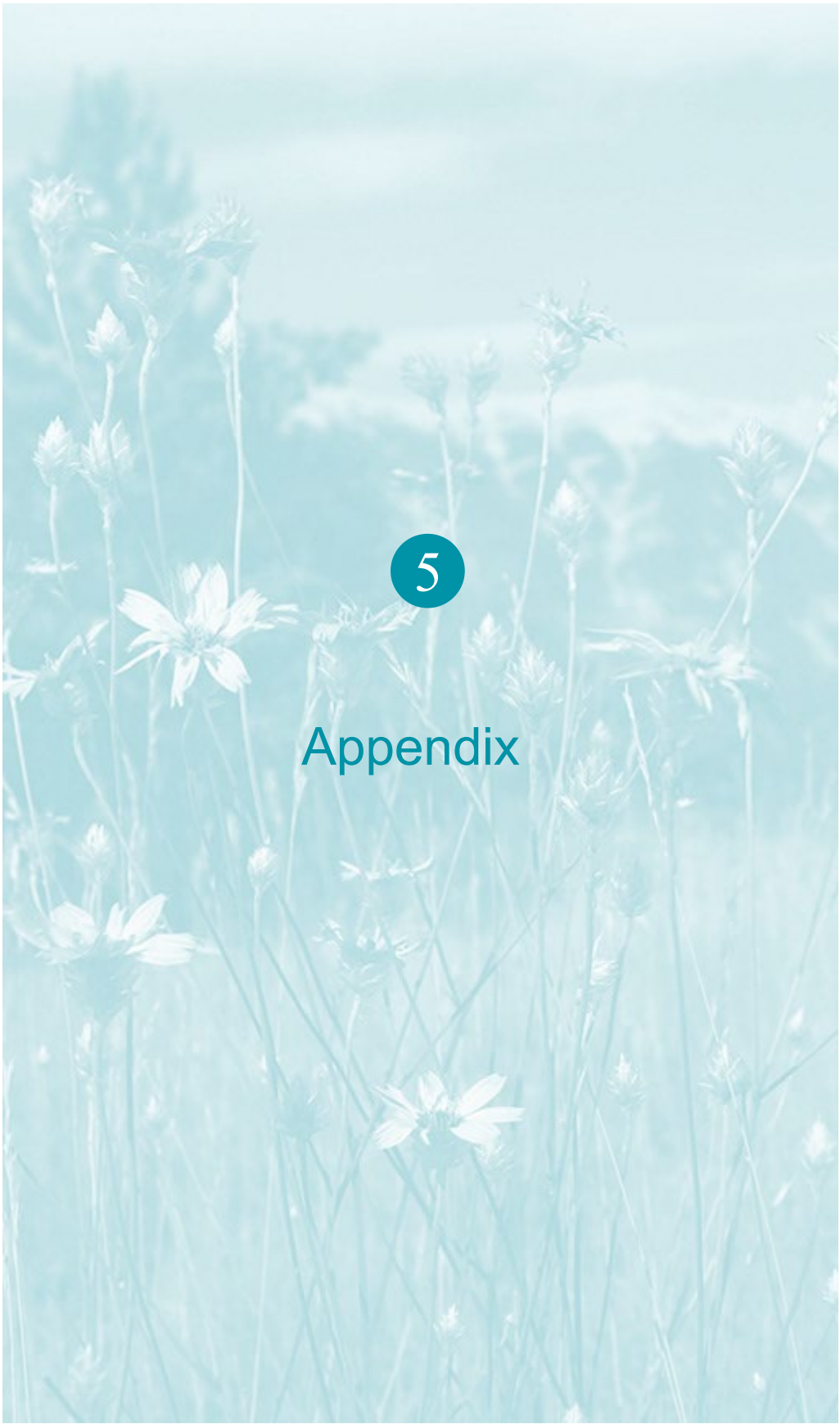

5

Appendix

5 Appendix

Appendix I - Role of the Guyana Geology and Mining Commission (GGMC)

Roles and Functions of the Guyana Geology and Mining Commission (Source: GGMC)

	The roles of GGMC
1.	To act as a development change agent in the diversification of the economic base of Guyana through its activities in the mineral sector.
2.	To create the opportunities for rapid economic development which an expanding mineral sector is ideally suited to provide.
3.	To act as a national repository for all information relating to geology and mineral resources which will facilitate an understanding of the resource base of the country.
4.	To provide to the general public the basic prospection information and advisory services, on the available economic mineral prospects.
5.	To provide advice to the government on appropriate mineral policy matters so that Guyana's mineral resources can be rationally developed and utilized.
6.	To regulate on behalf of the government all activities in the mineral sector.
7.	To act as a development change agent in the diversification of the economic base of Guyana through its activities in the mineral sector.
	The functions of GGMC
1.	Promotion of mineral development
2.	Provision of technical assistance and advice in mining, mineral processing, mineral utilisation and marketing of mineral resources
3.	Mineral exploration
4.	Research in exploration, mining, and utilisation of minerals and mineral products
5.	Enforcement of the conditions of Mining Licenses, Mining Permits, Mining Concessions, Prospecting Licenses (for Large Scale Operations), Prospecting Permits (for Medium and Small Scale operations) and Quarry Licenses
6.	Collection of Rentals, fees, charges, levies etc. payable under the Mining Act
7.	Hall Marking
	Overall objectives of GGMC
1	Increase opportunities for mineral resources development from year end 2014 levels by preventing waste, encouraging improved levels of tailings management and greater recoveries but at the same time protecting the rights of the property owners.
2	Improve safety in the mines and the processing facilities from year end 2014 levels by adhering to the requirements for the granting/renewal of permits, field inspections, accidents investigations, special investigations and enforcement.
3	Reduce the occurrences of identified pollution violation levels associated with mines and production processing facilities from year end 2014 levels by identifying and correcting existing environmental threats and by working with and using the financial and other resources of the property owners, the government and GGMC.
4	Increase the efficiency of information provision by promoting the implementation of efficient information technology programs and encourage easy access to in-house (commission) information and more efficient integration of new information into the existing database; design systems that would encourage customer-friendly retrieval of online information.
5	To develop and implement the policy for the recruitment of quality employees who can be developed, placed in positions of responsibility that are consistent with proven performance and receive competitive compensation.
	Major goals of GGMC
1.	Support the exploration, documentation and extraction of our mineral resources but at the same time protect the rights, provide equal and fair access for all entities and ensure that the charges (fees, royalties, etc.) are fair.
2.	Promote safety programs through training, monitoring and enforcement to advance safety in the operation of the various mining systems.

5 Appendix

3.	Promote environmental protection by assuring that all mineral production, storage/disposable of tailings and storage/delivery of products are conducted in such a way to minimize harmful effects on the environment and to preserve our mineral resources.
4.	Provide public access to information and services and we should strive to maximize the use of electronic programs/software by developing technological improvements, promote efficient programs that would allow us to provide more services to all stakeholders and the general public.
5.	To create an environment where we continue to recruit, develop, reward and retain our human resources for institutional continuity and growth.

5 Appendix