APPENDIX 8:
EXECUTIVE SUMMARY
Determining the Carbon Footprint of different maize farming systems within the summer rainfall crop production area in South Africa
Phase 2

APPLICATION TO THE MAIZE TRUST FOR THE FUNDING OF A CONTINUATION PROJECT

MARCH 2019

GRAIN SA
GRAAN SA

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GRAIN SA DEPARTMENT: RESEARCH AND POLICY CENTRE

INTRODUCTION

World-wide maize production occurs in an ever changing socio-economic and political environment and because of the RSA's relatively open economy, local maize production is influenced by many factors present in the international arena. The current world-wide food security situation is one of these factors and evidence of this.

Maize production in South Africa is exposed to serious threats, but also too many opportunities, creating the potential for a more prosperous South Africa. Because maize production is of economic and strategic importance it is essential that these threats and opportunities be identified and managed to optimize the potential role that the maize industry can play in making South Africa a better place for all to live in and to ensure that the RSA's status as a net exporter of maize stays intact which is an important milestone for food security.

Sustainable maize production is critical for sufficient food supply in the country and makes an important contribution to economic growth and wealth creation. It is therefore critical that the long-term sustainability of the industry is based on a competitive free market environment, functioning on sound economic principles.

Grain production can only continue sustainably in the long term if it is conducted on a profitable and competitive basis, as well as by using the natural resources in a sustainable manner. Market driven production requires the optimal utilisation of production factors such as land, capital, labour and management, in the interest of the grain industries, the economy and the conservation of the natural environment, which entails the reduction of the Carbon footprint despite the need for increasing production.

New and improved technological developments and sustainable, regenerative practices is necessary to constantly improve the efficiency of production in order to maintain the same production levels with less production inputs or to reach higher production levels with the same production input levels.

Basic and applicable production research is thus of critical importance to achieve sustainable production intensification through improved production efficiency. The development of new and improved technology and practices through the means of on-going research is one of the corner stones of sustainable production. **The introduction of Conservation Agriculture (CA) by Grain SA is seen as one of the key strategic thrusts in this regard.**

Research on improved crop production systems, development of new cultivars, **improved soil health**, optimal use of fertilisers and the safe and efficient use of agricultural chemicals, is of vital importance. Authorities have a necessary role to play in order to ensure the safe and efficient use of inputs as prescribed and controlled through applicable legislation. Sufficient price competition must be encouraged to ensure the availability of production inputs in the most economical way and to ensure quality inputs. However, state interference on the inputs side of grain production e.g. by taxing inputs such as diesel or to intervene in the inputs market cannot be economically justified and thus does not further the sustainable production of grain.

Increased efficiency of maize production has led to chronic overproduction, which confirms the local ability to produce for other markets than the local food and feed markets. To maintain production, the development of potential export markets is crucial. It is to the benefit of local consumers if local production is profitable at export parity prices.

The sophisticated production, storage and road transport systems that currently exist are a positive aspect in ensuring channels that can guarantee relatively safe food and affordable food for human animal consumption. This also adhere to international quality standards which makes it possible to produce for the export market but the systematic decline in South Africa's rail infrastructure undermines our ability to compete with other maize exporting countries.

The Department: Grain Research and Policy Centre of Grain SA continues to focus on its primary objectives and priorities for sustainable grain production in South Africa.

Grain SA has continued to provide the industry with industry-strategic research and policy information in order to enable all grain producers to produce at an optimal and profitable level.

The dissemination of industry strategic information concerning matters within the input, production and marketing fields of the grain industry has become an even higher priority for the Department: Research and Policy Development.

The exchange of strategic industry information continues through channels such as SA Graan /Grain magazine, newsletters, regional and branch meetings, as well as presentations during conferences and farmers' days.

The exchange of information via the Grain SA website has subsequently grown tremendously. However, Grain SA still faces great challenges and opportunities to serve the whole grain industry with the most accurate and up to date strategic industry information by means of the latest information technology.

THE ROLE OF GRAIN SOUTH AFRICA

Grain South Africa represents the majority of maize farmers, including a substantial portion of grain producers in the developing sector.

Grain South Africa is involved in improving and facilitating the production environment on a macro level for all maize producers in South Africa. In achieving this objective, we believe that it is also to the benefit of the maize industry as a whole.

Grain South Africa projects are structured to achieve specific goals within the broader picture and to effect project management to the full.

The projects are categorised into three main functional areas, namely the input, production and marketing environments. Even though many of the projects are to the benefit of the total industry, some of the projects may be deemed not to be to the benefit of all the sectors of the value chain. Nevertheless, we believe that these projects, if managed responsibly and transparently, will in the long term be in the interest of the total industry.

This application (Phase 2) is a proposal that will further improve our understanding and education on the complete Carbon footprint balance of the maize-based farming systems in view of continuous improvement of the sustainability of the maize industry. Grain SA has highlighted Conservation Agriculture as one of its main focus areas, which will come under the spotlight in this project, where it's C-footprint will be compared to other production systems. It is critical that C-sequestration (Phase 2) be completed and added to Phase 1 (emissions) to get the full C-balance picture.

Due to severe pressure on natural, economic, physical, human and social capital of farming communities in South Africa and in particular the maize sector, a better understanding of "sustainability" and "Carbon farming" concepts, such as C-footprint and C-sequestration, need to advance as fast as available resources will allow. In this respect, this project proposal is included in this application.

THE MAIZE TRUST

APPLICATION FOR FINANCIAL ASSISTANCE: EXECUTIVE SUMMARY

(Please note that Sections A and B of this Executive Summary have to be completed in respect of each project for which funding is requested. Only information critical to a project should be provided in these Sections and it should be kept as brief as possible. However, an applicant may submit additional information and more comprehensive details relating to a project by means of a separate and clearly marked document, the format and contents of which is within the discretion of the applicant).

A. IDENTIFICATION OF PROJECT AND APPLICANT

1. Name or Title of the Project for which Funding is Requested:

Determining the Carbon Footprint of different maize farming systems within the summer rainfall crop production area in South Africa – Phase 2

2. Name and Trading Name of the Applicant:

Name: Grain South Africa

Trading Name: Grain South Africa

B. DETAILS RELATING TO THE PROJECT APPLICATION

3. Objective of the Maize Trust Deed in terms of which the application is made:

…………………………………………………………………………………………

4. Category under which application is made (as per attached Annexure):

Crop production, Conservation Agriculture (CA)

5. Reasons why it is deemed that the Project will contribute to the above objective:

This project will contribute to the mainstreaming of sustainable use and management of natural resources (through CA), the mitigation of the negative effects of crop production on climate change, while enhancing national and household food security and income. Improved information on and increased preparedness with C-friendly maize cultivation practices, such as CA, will assist farmers to convert and align themselves to take advantage of the imminent Carbon Tax Bill to be implemented in June 2019 (Phase 1).

6. Main aim or purpose of the Project (Phase 2):

The aim of Phase 2 will be to determine the **carbon sequestration** of selected maize-based farming systems across a number of key agro-ecological regions of the summer rainfall crop production area of South Africa.

The project's short-term objectives of Phase 2 (2019-2020) are:
1. To collect or generate C-sequestration model input data (including weather variables required by the numerical C-sequestration model for a climate station in each of the key agro-ecological regions of the summer rainfall crop production area);
2. To conduct C-sequestration modelling in the summer rainfall crop production area;
3. To analyse and integrate modelling results;
4. To report and communicate C-sequestration assessment results for Phase 2.

See the project business plan (Phase 2) for more details in **Appendix A**.

7. Estimated timeframe (duration) of the Project (Phase 2):

1 year, with a continuation of three years.

8. Sector(s) in the Maize Industry that could or should benefit from the Project:

All commercial, smallholder and developing maize producers and ultimately the whole maize industry will benefit from this project through increased sustainability, higher production efficiency and increased competitiveness / profitability in the maize industry (i.e. "growing more with less").

9. Names of Other Contributors to the Project and the value/extent of contributions:

Grain SA will collaborate with the following institutions:

Blue North Sustainability (Pty) Ltd manages the Confronting Climate Change (CCC) Initiative on behalf of the South African Fruit and Wine Industry Bodies. CCC was established in 2008. The initiative focuses on the Life Cycle Assessment (LCA) of greenhouse gas emissions at farm-level and across agricultural value chains, as well as a climate change knowledge resources for the industry. The initiative currently focusses on perennial tree orchards, but CCC has already developed a carbon footprint protocol, the data collection tools, database and reporting tools for grain farming in South Africa.

Blue North Sustainability is a Stellenbosch-based sustainability practice that is focused on the development and implementation of robust and credible sustainability programs in agricultural businesses and value chains. Blue North was founded in 2011. Blue North Sustainability (Pty) Ltd will collaborate with Grain SA on this project.

TerraSim is an environmental consulting company specialising in the earth science component of sustainable land use, rehabilitation of mine- and degraded land, and remediation of contaminated land. Terrasim has a registered professional soil scientist with 24 years of experience in soil science and the environmental field. Terrasim specialises in the application of numerical modelling of the climate-plant-soil-water- and waste-soil-water continuum aspects.

10. Summary of the total estimated cost of the Project ***(Please specify the amount of the request to the Maize Trust clearly as part of the total project budget)***:

Please see the Work Plan and Budget attached in Appendix B.

Details of any capital expenditure included in the Project application:

Please see the budget attached as Appendix B.

11. Details of any overseas traveling expenses included in the Project application:

NA

12. Details of surplus Maize Trust funding available from previously funded projects:

NA

13. Details of similar Projects that were funded by other entities before:

Similar project was funded (to Grain SA team) by the Winter Cereal Trust for the winter grain production region in the Western Cape.

Appendix A – Project business plan (intrinsic value to industry) – Phase 1

Project Title

Determining the Carbon Footprint of different maize farming systems within the summer rainfall crop production area in South Africa.

Project Background

Increasingly the environmental impact of agricultural supply chains is being scrutinized by consumers, NGO's and governments. South Africa made a commitment to the international community to reduce its carbon footprint, hence the recent focus on carbon emissions, policy and the introduction of a carbon tax.

Improved cropland management has been highlighted as a very practical and viable carbon emission mitigation option and for that reason (and others) Conservation Agriculture (CA) is currently promoted by many role players in the agricultural industry, including Grain SA. However, it is important to conduct an in-country, or regional, study to assess the carbon footprint of different systems, including the assessment of soil health, which will provide essential information eventually facilitating the reduction in the carbon budget and increase in carbon sequestration rates.

It will therefore be important to demonstrate the impacts of different farming systems on the carbon footprint through accurate assessment tools and calculators of the carbon budgets. For example, through a combination of soil health assessments, carbon emission and sequestration rates / potential it will be possible to determine the impact of various management options on the net carbon budget and show how this can lead to improved farming efficiency, reduced emissions and alignment with the future carbon tax, or other incentive mechanisms. The proposed carbon tax legislation also contains mechanisms for selling agricultural carbon credits to other South African organisations to reduce their carbon tax exposure. This project will take the first steps towards understanding the potential of this farm-based carbon credit income stream.

Project Goal and Objectives

The long term goal of this project is to determine the carbon footprint of selected maize-based farming systems across key agro-ecological regions of the summer rainfall crop production area of South Africa.

The project's short-term objectives of Phase 2 (2019-2020) are:

1. To collect or generate C-sequestration model input data (including weather variables required by the numerical C-sequestration model for a climate station in each of the key agro-ecological regions of the summer rainfall crop production area);
2. To conduct C-sequestration modelling in the summer rainfall crop production area;
3. To analyse and integrate modelling results;
4. To report and communicate C-sequestration assessment results for Phase 2.

Project Approach

Phase 2 of this project aims to model the carbon sequestration of selected maize-based farming systems across eight key agro-ecological regions and for three different farming systems (conventional, conservation agriculture with high external inputs (minimum tillage) and future ideal CA with low external inputs (no tillage)) from a sample of 1 dataset per region, per farming regime. Phase 2 forms part of a longer term project where the carbon footprint methodology and results can be used within the grain industry as an adaptive management tool (Figure 1).

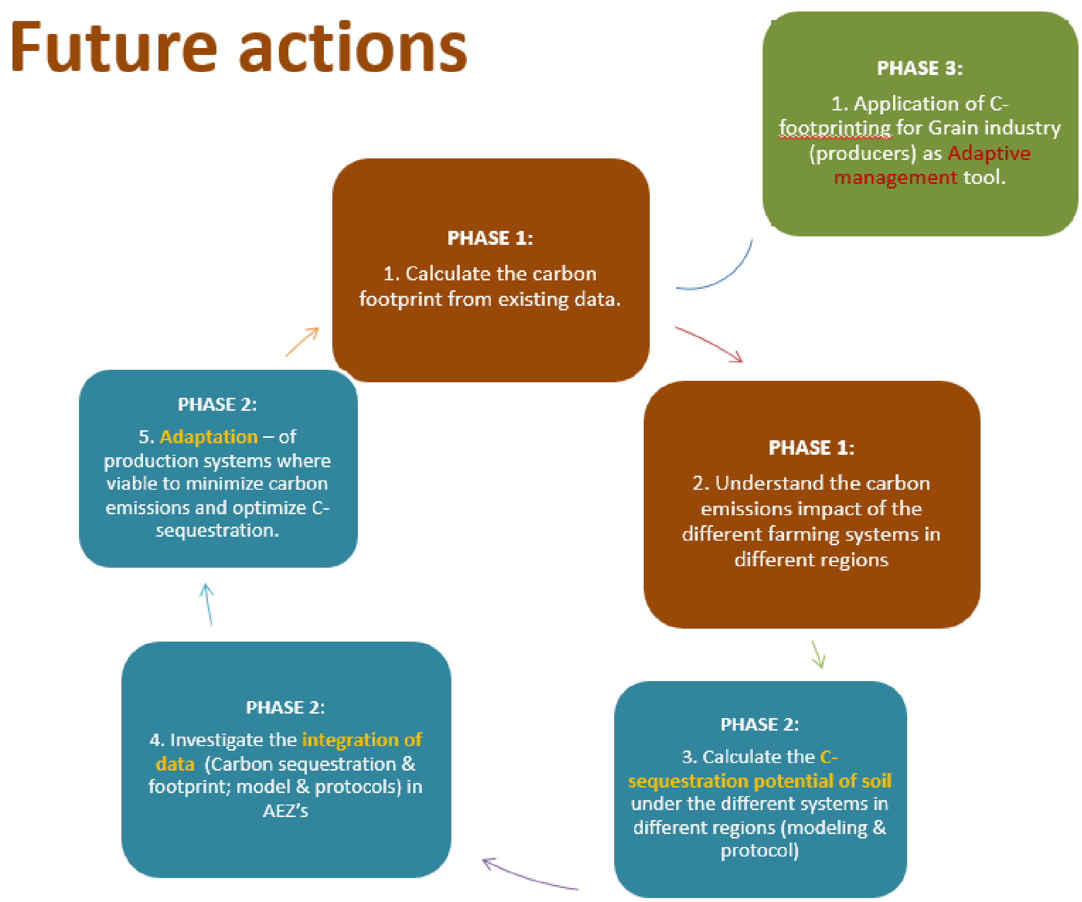

Figure 1: Carbon footprint project phases envisaged by Grain SA.

It is important to recognise that the assessment will not be representative of all farms in a specific region but rather to provide a "snapshot" view of a particular farming system in a particular region. From 9 years of experience in the agricultural carbon footprinting, CCC can confirm that farmers who measure their carbon footprint improve their farm management systems. This process often challenges current farm management systems and highlights areas where farm management systems can be improved. Combined with data on soil health and sequestration under different practices in the regions identified, the net C footprint or C budget can further stimulate thinking and awareness on more sustainable and climate-smart agricultural options. The calculation of soil carbon sequestration potential is envisaged as part of **Phase 2** of the project.

Project Scope – Carbon footprint (Phase 2)

Soil carbon sequestration tool and numerical model

The Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance for Land Use, Land Use Change and Forestry (2003) carbon sequestration tool for annual crops, specifically grains, will also be 'built' and applied in this study. The tool will take into account 2 parts, firstly the land use "Cropland remaining Cropland" or any other land uses remaining as such and secondly 'Land converted to Cropland' or any other land uses converted to other land uses during the audit period. Information is required for the period of 12 months. Each section will take into account the change in carbon stocks in living biomass, change in carbon stocks in soils and Non-CO2e GHG emissions.

The WinEPIC (Environmental Policy Integrated Climate), a numerical model that simulates the physico-chemical processes that occur in soil and water under agricultural management, will be used to predict the soil carbon sequestration potential for conventional and conservation agriculture grain farming systems in the eight regions. This model was selected for the Western Cape after a thorough evaluation process of fourteen (14) models and is viewed as the most suitable model for this project given the expected level of available data.

Data collation

Numerical soil carbon sequestration models

Information relevant to this study will be obtained by Grain SA which includes the following *minimum data* required:

- *Climate data*:
  - Minimum data required by WinEPIC, namely daily rainfall and air temperature, and long-term (≥40 years) monthly rainfall and air temperature,
  - Available daily rainfall, air temperature, solar radiation, windspeed and reference potential evaporation (Et0) to complement the minimum required weather data input for WinEPIC to improve modelling results.

- *Soils data* such as:
  - Minimum data required by WinEPIC, namely soil profile and horizon thicknesses, soil texture and rock contents,
  - Available data on organic carbon content, soil nitrogen content, particle size distribution, dry bulk density, hydraulic conductivity, occurrence and depth of impermeable layer, water holding capacity, water retention curve, and soil pH to complement the minimum required soils data input for WinEPIC to improve modelling results;

- *Plant data* such as:
  - Minimum data required, namely crop yield,
  - Available data on carbon and nitrogen contents of plant components, amount of N of litter fall, and plant tissue C:N ratio; to complement the minimum required plant data input for WinEPIC to improve modelling results;

- *Land-use and management* such as:
  - Crop rotation, planting dates, residue incorporation and tillage type, amount and timing, inorganic fertilizers type, amount and timing, and N input to the system.

The data obtained by Grain SA will be used to prepare the model input data files for the WinEPIC numerical C-sequestration model.

The IPCC carbon sequestration tool

For the current land use section, which is "Cropland remaining Cropland", information on current land use within the boundaries of the farm is required. The land uses to be provided are the following:

- Infrastructure;
- Croplands;
- Indigenous vegetation specific for South Africa (Fynbos, Nama Karoo,Grassland, Savanna, Succulent Karoo, Thicket (mainly Eastern Cape), Forest (Knysna);
- Wetlands;
- Alien vegetation encroachment and;
- Degraded land.

For each land use, information on hectares, soil type, management regime, organic matter inputs and lime application as well as the period between current and previous land use is required.

The second section encompasses the 'Land converted to "Cropland or other land uses". This section will look at the conversion from a land use to other land uses, for example:

- Conversion from cropland to infrastructure or;
- Conversion from indigenous land to cropland.

The different combinations of land use change to another will be taken into account. For each of the conversions, hectares, soil type, management regime, organic matter inputs and lime application information of previous and current land use will be required.

The results from the 2 sections will be in the form of tonnes of carbon per hectare sequestrated during the 12 month period. This value can be offset with the total carbon dioxide equivalent emissions from the farm during the same audit period.

Soil carbon sequestration modelling

The predicted C-sequestration for the study sites will be used to assess the impact of conventional and conservation agriculture systems grain farming systems on the long-term dynamics of soil organic matter under a variety of land management practices in order to determine the potential for soil carbon sequestration.

The following farming systems will be simulated:

- Conventional tillage representing different tillage practices with high external inputs in each of the regions;
- Conservation agriculture:
  - Minimum tillage representing conservation agriculture with high external inputs (current systems),

- No tillage representing conservation agriculture with low external inputs and the ‘ideal future state’ of conservation agriculture farming systems.

Numerical soil carbon sequestration model

Soil carbon sequestration potential will be predicted ***at field-scale that represents a farmers’ field based on readily available data for these regions***.

The primary aim of the carbon sequestration modelling exercise is to assess the application, potential shortcomings and ability to of numerical C-sequestration model(s) to predict long-term carbon sequestration potential for the grain farming land management practices using readily available data. The collection of non-readily data or data that is not available for the C-sequestration modelling is beyond the scope of the proposed study.

Study sites

The following eight (8) broad production regions have been identified as a framework for the assessment:

- Limpopo (Springbok flats)
- North West Province
- NW Free State
- Eastern Free State
- Northern Free State (Vrede, Frankfort, Sasolburg/Vanderbijl, Heidelberg, Koppies, Standerton, Parys)
- Eastern Highveld (Mpumalanga) & KZN
- Lower Orange river irrigation
- Smallholders (KZN)

The regions represent the range in climatic and specific land management practices, such as rotation systems, cultivation and fertilisation of grain farming systems of the summer rainfall grain production area of South Africa.

Agro-ecological zones

The soil carbon sequestration potential will be predicted with the IPCC tool and extrapolated from field-scale for a typical/likely conditions case scenario for each of the eight broad production regions. The WinEPIC modelling exercise will *not* involve the spatial upscaling from field-scale to agro-ecological zones. The WinEPIC modelling will also not involve modelling based on a GIS systems approach. The total regional assessment will be based on the total (weighted) hectares under CA and CT systems in the eight broad zones and the predicted C-sequestration results of the scenarios simulated at the field-scale.

Modelling data integration

Soil carbon sequestration modelling results and implications will be integrated with Phase 1 emission results. This implies an attempt to integrate ‘above-ground’ (results from Phase 1) and ‘below-ground’ C-sequestration (results from Phase 2) carbon budgets for the assessment of the total or net carbon footprint of grain farming systems in northern summer rainfall regions.

Communicate carbon sequestration assessment results

The carbon sequestration and budgeting results and implications will be communicated to various groups of key stakeholders through reporting and presentations.

PROJECT EXPECTED IMPACTS

This project (Phase 2) will continue the process to provide novel (new) data on and create awareness in the entire agricultural value chain (from farmers to markets) on their carbon footprint (with the emphasis on C-sequestration) and provide information on which farming systems to implement in order to improve soil health and farming efficiency and reduce the impact on climate change. In the long term this will lead to improved land management, healthier natural resources and a reduction in greenhouse gas emissions. Furthermore, if carbon tax, or any other incentive scheme is implemented in the future, this information, followed by a rigorous monitoring and implementation process, will be very useful for this sector. Determining the impact of various farming systems on carbon budgets also has long term policy implications as the information can be used to assist government in focussing their mitigation strategies for the agriculture sector.

Project Collaboration

Grain SA will collaborate with the following institutions:

Blue North Sustainability (Pty) Ltd manages the Confronting Climate Cahnge (CCC) Initiative on behalf of the South African Fruit and Wine Industry Bodies. CCC was established in 2008. The initiative focuses on the Life Cycle Assessment (LCA) of greenhouse gas emissions at farm-level and across agricultural value chains, as well as a climate change knowledge resources for the industry. The initiative currently focusses on perennial tree orchards, but CCC has already developed a carbon footprint protocol, the data collection tools, database and reporting tools for grain farming in South Africa.

The CCC initiative is project managed by Blue North Sustainability, a Stellenbosch-based sustainability practice that is focused on the development and implementation of robust and credible sustainability programs in agricultural businesses and value chains. Blue North was founded in 2011. Blue North Sustainability completed the C-sequestration assessment of the WCT funded C-footprint project in the Western Cape.

TerraSim is an environmental consulting company specialising in the earth science component of sustainable land use, rehabilitation of mine- and degraded land, and remediation of contaminated land. Terrasim has a registered professional soil scientist with 24 years of experience in soil science and the environmental field. Terrasim specialises in the application of numerical modelling of the climate-plant-soil-water- and waste-soil-water continuum aspects.

Appendix B – Work Plan and Budget for Phase 2

Objectives and Activities		Method	Duration	Month	Lead	Budget (excl VAT) (R)		
						TerraSim (TS)	Grain SA	BN
1	**To collect or generate data for soil carbon sequestration modelling for application in maize-based systems**							
1,1	Update the existing data collection tool	Desk-top	1 week	Oct-Dec'19	BN			R24 000
1,2	Collect / compile / prepare the datasets, model data files	Desk-top	4 weeks	Oct-Dec'19	GSA / TS / BN	R 45 000		R10 000
1,3	Climate data generation of ≥40 years data record for numerical C-sequestration model input	Desk-top	4 weeks	Oct-Dec'19	CCC	R 25 000		
1,4	Support & Sense check the data	Desk-top	2 weeks	Oct-Dec'19	BN			R16 000
2	**To model soil carbon sequestration for annual cropping systems in the 8 summer rainfall regions**							
2,1	Calculate / model the C-sequestation potential for each regions (x8) and system (x3) for each area (24 datasets)	Desk-top	2 weeks	Jan-Mar'20	BN / TS	R 48 000		R32 000
2,2	Calculating / model the overall C-sequestration results	Desk-top	2 weeks	Jan-Mar'20	BN			R8 000
2,3	Complete the C-sequestration report		2 weeks	Apr-Jun'20	BN			R16 000
3	**To analyse and integrate different modelling results**							
3,1	Integration of carbon footprint (emissions) and carbon sequestration data to calculate net C-footprint	Desk-top	1 week	Jul'20	BN / TS / GSA	R 5 000		R16 000
3,2	Compile reports - 6-monthly + annual	Desk-top	2 weeks	Feb+Aug'20	BN/ TS / GSA	R 17 500		R16 000
4	**To communicate carbon sequestration assessment results of phase 1 2**							
4,1	Regional Awareness sessions plus preparations (2)	Workshop	3 days	Aug-Sep'20	GSA		R 3 500	-
4,2	Project outputs (case-studies and articles)	Desk-top	3 days	Aug-Sep'20	BN	R8 000		R8 000
4,3	Close out workshop preparation	Desk-top	1 day	Aug-Sep'20	GSA/BN/TS	R2 000		R2 000
4,4	Close out workshop	Workshop	2 days	Aug-Sep'20	GSA/BN/TS	R4 000		R4 000
5	**Data, Travelling & Accommodation (only if required and billed at cost)**							
5,1	Travel, accommodatin and professional costs						R20 000	-
5,2	Data purchasing (e.g. climate, soil, etc., if not available)						R20 000	
				Sub Totals		154 500	43 500	152 000
				Total (VAT at 0%)			**R**	**350 000**

Appendix C – Literature

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