SPIER MOB GRAZING PROJECT

Verification of the carbon dioxide sequestrated and resultant greenhouse gas reductions due to regenerative farming land management activities at the Spier Mob Grazing Project.

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SUMMARY OF FINDINGS

The Green House conducted an independent verification of the carbon dioxide sequestered in soils due to the use of regenerative farming practices at the Spier Mob Grazing Project.

Reporting period: Total change in soil carbon due to the Mob Grazing Project was calculated using the baseline soil samples, collected in either September 2011 or April 2014 depending on the field, and the current samples, collected in May 2020. In determining the volume of carbon available for trading, the carbon already sold on the basis of the previous two audits was subtracted from total sequestration for the project.

Methodology: The tonnage of carbon dioxide sequestered was estimated based on changes in soil organic matter between the sampling years. The soil organic matter content was determined by taking soil samples to a depth of 30 cm, as recommended by the IPCC and GHG protocol, and laboratory testing the soil for organic matter, conducted by Brookside Laboratories in Ohio, using the Loss on Ignition (LOI) methodology. The results of the soil organic matter tests, used together with literature values for the carbon content of soil organic matter, were used to estimate the percentage change in soil carbon. The total change in sequestered carbon dioxide at the projects, was subsequently calculated using soil bulk density values (from literature), the farm field sizes and the ratio of the molar masses of carbon dioxide to carbon.

Change in carbon dioxide: Since the Mob Grazing Project began, the farm has sequestrated the equivalent of 15,886 tonnes of carbon dioxide. Based on the outcomes of the previous audits, a total of 8,784 tonnes of carbon dioxide have already been sequestered and retired from this project. Thus, in the current audit period a further 7,101 tonnes of carbon dioxide equivalent could be considered as being sequestered from this project.

Is the project real? The project is real and operational. Management and employees on the farm remained active during South Africa's Covid-19 "lock-down" in alignment with South African policy.

Is the described technology in place and functioning in accordance with its design specification? The Green House observed that regenerative farming principles, with a focus on mob-grazing, are used for the management of cattle, pigs and chickens on the farm. Livestock are maintained in high concentrations in small pastures and moved regularly to new pasture areas before overgrazing occurs. The pastures are then left for an extended period until complete recovery is achieved before grazing occurs again. This principle, combined with irrigation and the planting of nitrogen-fixing legumes and other crops, has resulted in healthy looking pastures with high plant growth in the recovered areas. The area subject to this audit also includes vineyards in which cattle are allowed to graze in the off-season and to which chicken feathers are applied as a soil conditioner.

Are the estimates of greenhouse gas emissions reduction reasonable? The estimates presented in the report are based on soil sampling and analysis consistent with internationally accepted standards (the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry and Greenhouse Gas Protocol) and are thus a reasonable representation of the carbon dioxide emissions sequestered due to the Mob Grazing Project.

Is there a discernible impact on poverty? Yes. The project employs permanent workers as part of the Mob Grazing Project with other workers employed permanently or temporarily on the farm. The Project has also trained worker in money management and recently sold 85% of the egg business to six workers. Under the supply agreement with Credible Carbon, 50% of generated carbon credit revenue is distributed directly amongst permanent Mob Grazing

Project employees. Workers indicated that this money had previously helped with their family finances and was spent on themselves and their families.

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1 INTRODUCTION

The Spier Mob Grazing Project, run by Angus McIntosh, is a 154-hectare regenerative agriculture project on the Spier Farm near Stellenbosch. Livestock management is undertaken through ultra-high stock density, more commonly known as mob grazing. This farm management approach was developed by Allan Savory during the 1980s to mimic natural cycles of migrating grazers and their interaction with grasslands (Gordon, 2011; Holmquist, 2014). The approach employs very high densities of cattle, or other grazing livestock, in small pastures for short periods. The livestock are moved numerous times a day to new grazing areas to ensure overgrazing does not occur and only the top layers of grass are consumed. Subsequently, the grassland is left for an extended period of time to ensure complete recovery and a natural seeding cycle (Chapman, 2014; Gordon, 2011; Holmquist, 2014).

The ultra-high stock densities result in large depositions of manure and urine, along with extensive trampling of the field. This trampling spreads the manure over the field, disrupts the soil surface and tramples vegetative organic matter into the soil surface. Together these factors promote increased soil carbon levels, beneficial microbial activity and grass root health (Chapman, 2014; Gordon, 2011; Holmquist, 2014; Page, 2015). Mob grazing therefore has the potential to sequester atmospheric carbon dioxide, particularly in previously degraded lands (Rush, 2008; University of Nebraska-Lincoln, 2017).

Grazing of rangelands can result in the increase or decrease of soil carbon levels, depending on the local climate, grazing history, livestock management and type of inputs provided to the fields (IFAD, 2009; IPCC, 2003). The default values presented within the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry indicate that soil carbon stocks typically remain constant or decrease within grasslands under normal grazing practices. Soil carbon levels only increase when the land is well managed and receives an external input, such as irrigation, fertiliser or seeding of the fields (IPCC, 2003). The management of fields according to the mob grazing principle is therefore expected to result in carbon sequestration that would otherwise not occur with typical livestock farming practices.

The Spier Mob Grazing Project includes the production of cattle, chicken eggs and pigs. Cattle herds are moved four times per day as per the mob grazing philosophy, while the chickens housed in their “Eggmobiles” are moved daily. The pigs are moved to a new area every third day, although their shelter is moved daily to ensure even trampling of the area. The pastures are irrigated and seeded with various perennial plants, including legumes to ensure effective nitrogen fixation, but do not receive any fertilisers or other chemicals. All meat and eggs are sold to local retailers and restaurants. In addition to the pasturelands, a number of vineyards are located on the farm. Cattle are allowed to graze in these fields in the off-season in line with the farm management approach. Furthermore, chicken feather waste is applied to the base of the vines to conserve water and increase soil nutrient levels.

This potential for carbon sequestration associated with these practices has allowed the project to be registered under the Credible Carbon voluntary-market carbon registry, which trades certified African carbon projects that make a direct impact on poverty. The Promoting Access to Carbon Equity (PACE) Centre is a non-profit organisation that assists projects with the registration and certification process.

This report documents the auditing process, conducted by The Green House, to determine the change in soil carbon, and hence the eligibility of the project for further trading of carbon credits to what has been traded already, in terms of the Credible Carbon registration requirements. These requirements include answering the following questions:

- Is the project real?

- Is the described technology in place and functioning in accordance with its design specification?
- Is the quantification of carbon in line with locally and internationally accepted norms, unbiased and verifiable?
- Is there a discernible impact on poverty?

A description of the land-use changes and current farming practices is presented in Section 2, while the soil analysis methodology is presented in Section 3. The final findings of the assessment are presented in Section 5.

2 OVERVIEW OF THE FARMING PRACTICES

The farmland occupied by the Mob Grazing Project was previously used for the cultivation of crops such as carrots, potatoes, vineyards and orchard fruits, and as dry-land pasture. Topsoil was also historically removed from some of the fields. The land was thus degraded through the use of conventional agriculture practices and poor soil management. An example of the degraded pastureland prior to the Mob Grazing Project is presented in Figure 1. Historic and current satellite images of the farm are presented in Figure 2 and Figure 3 respectively, demonstrating a shift from barren fields, particularly evident in 2007, towards more fertile fields as the Mob Grazing Project has progressed. The influence of the changes in land management and irrigation is most evident when comparing the farmed fields with those of the surrounding area. In 2007 the farmed fields are drier and more barren than the surrounding area, while currently the farmed fields are greener and support more vegetation than those fields outside the farm. The 2020 satellite images (Figure 3) show the Mob Grazing Project land to be slightly greener than the surrounding land, although the difference is less noticeable than in the 2015 or 2017 images. This is deemed to be due to the 2016-2018 drought within the region, which has limited the amount of irrigation possible, and the legacy of which is still evident in the fields.

Figure 1: Installation of irrigation in degraded pasture during 2008 (Hunter & Mills, 2013)

Figure 2: Historic satellite photos of Mob Grazing Project land in January or February A) 2007 B) 2011 C) 2015 D) 2017 (Google Earth, 2020)

Figure 3: January 2020 satellite photo of Mob Grazing Project land (Google Earth, 2020)

Currently 132 hectares of the land is irrigated and managed using regenerative farming and mob grazing techniques to produce cattle, pigs and chicken eggs, as demonstrated in Figure 4. Vineyards occupy a further 22 hectares. The

farm has converted some of the old vineyards into pasture fields and these, along with the older fields, are surrounded by "shelterbeds", as demonstrated in Figure 5. The "shelterbeds" are composed of indigenous trees and shrubs and act as a natural windbreak for the pastures.

A B

Figure 4: Mob grazing in practice – A) Recently grazed area with an area that has had time to recover in the background. B) Fully recovered area with lucerne growth. These two pictures are in the same pasture.

Figure 5: Edge of pasture showing "Shelterbed" and irrigation system

3 VERIFICATION METHODOLOGY

Verification of the Spier Mob Grazing Project sequestration activities was undertaken through a site visit, soil sampling and calculations based on the current and previous soil sampling data.

3.1 Audit timelines

This audit follows on from two previous audits conducted in June 2013 and August 2017. The 2013 audit used sampling data from September 2011 (baseline) and January 2013, while the 2017 audit used the September 2011 data (baseline for 26 of 29 fields), as well as sampling data from April 2014 (baseline for 3 of 29 fields) and March 2017. The current audit utilises baseline data from either September 2011 or April 2014 and current soil sampling data from May 2020.

3.2 Site visit and soil sampling

A verifier from The Green House conducted a site visit on 22 May 2020. This visit included witnessing the farm operations, talking to some of the workers, discussions with the farmer and soil sampling in some of the fields. The assessors were unable to be present for the sampling of all fields and the farmer completed the sampling process.

Soil sampling was conducted within each field on the farm using a 30 mm soil auger to a depth of 0.3 metres, as recommended by the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry and GHG Protocol (Echnoserve Consulting, 2014; IPCC, 2003; MacDicken, 1997). The sampling is illustrated in Figure 6. Within each field numerous randomly located samples were taken and aggregated into a composite sample. The samples were sealed in plastic bags and sent for laboratory analysis at Brookside Laboratories in Ohio, USA. Brookside Laboratories determine the soil organic matter using the Loss on Ignition methodology, which is considered one of the main analytical methods for determining soil organic matter content (FAO, 2017). The soil sampling and analysis methodology matched that used in the 2011, 2013, 2014 and 2017 analyses.

Figure 6: Soil sampling undertaken at the Mob Grazing Project

3.3 Calculation of sequestered carbon dioxide

The change in soil organic matter was calculated using the laboratory results for soil organic matter in the baseline and current soil samples. The change in soil carbon was calculated by assuming that 58 wt% (weight percentage) of soil organic matter is carbon, a value which is based on literature reported values (Chan, 2008; IPCC, 2003).

The carbon sequestered as a result of the regenerative farming practices was then calculated using the following equation:

$$Carbon\ sequested\ \left(\frac{tonnes}{ha}\right) = (2020\ soil\ carbon\ \% - previous\ soil\ carbon\ \%) \times Soil\ bulk\ density\ \times Soil\ volume$$

The average soil bulk density of 1.56 g/cm^3 that is used for the calculations was based on two previous soil studies covering three experimental sites in the region around Stellenbosch (Bekker et al., 2016; Conradie et al., 2002). The soil volume was calculated using the depth of sampling (0.3 m) multiplied by the hectare area of each field.

Finally, the sequestered carbon calculated using this equation was converted to equivalent tonnes of carbon dioxide using the relative molar masses of carbon and carbon dioxide.

4 FINDINGS

The following findings are presented based on the site visit, discussions and analysis of laboratory results.

4.1 Site visit

The site visit allowed the verifier to confirm that the farming operation existed (Figure 7) and the land was being operated according to regenerative farming and mob grazing principles, as shown in Figure 4 above. It was also clear that the farming operations result in a number of permanent and temporary jobs for people from the local communities. Due to Covid-19 regulations, discussions with farm workers could not occur, although Farmer Angus confirmed that as per the supply agreement with Credible Carbon, half of the carbon revenue paid to the project income would be distributed directly among Mob Grazing Project employees.

Figure 7: Day-to-day farm operations in May 2020

4.2 Changes in soil carbon

A summary of the soil analysis results, along with the calculated change in soil organic matter over the audit period, is shown in Table 1. As discussed previously, the time period used for calculating the change in soil carbon differs between fields. While 2011 serves as the baseline for most fields, three fields were added to the project in 2014. One of the fields has demonstrated an overall decrease in soil organic matter. This could be the result of the major drought experienced by the farm recently. Droughts have been shown to have complex effects on soil organic matter levels. On the one hand they can increase organic matter levels through an increase in dead plant material, while on the other hand can decrease soil organic matter levels by decreasing microbial activity and plant excretion into the soil (Frank et al., 2015; Geng et al., 2014; van der Molen et al., 2011).

Table 1: Results of soil analyses and changes in soil organic matter since baseline measurements

Sample number	Description	Baseline year	Starting soil organic matter (%)	Current soil organic matter (%)	Change in soil organic matter (%)
1	Chenin vineyard, rows 1 to 25	2011	1.24%	2.11%	0.87%
2	Chenin vineyard, rows 26 to end	2011	1.16%	1.57%	0.41%
4	Banded fields West	2011	0.76%	1.90%	1.14%
5	Banded fields East	2011	0.73%	2.08%	1.35%
10	Bravo 11 to 13	2011	1.29%	3.49%	2.20%
11	Bravo 1 to 5, 9, 10	2011	1.40%	2.38%	0.98%
12	Bravo 6 to 8	2011	1.10%	1.71%	0.61%
13	Bravo 14 to 20	2011	0.84%	1.31%	0.47%
15	Old Pinotage vineyard (B21-23)	2011	1.36%	1.41%	0.05%
16	De Rus, North, 1-16	2011	1.45%	2.69%	1.24%
17	Old Sauvignon blanc vineyard (O1 to 8)	2011	0.78%	2.12%	1.34%
18	De Rus, South, 17 - 30	2011	0.83%	3.14%	2.31%
19	Old carrots, B24-29	2011	0.99%	1.20%	0.21%
20	Paul Roux, West	2011	2.69%	1.23%	-1.46%
21	Paul Roux, East	2011	1.11%	2.17%	1.06%
22/1G	Orlando lucerne (O15 to 19)	2011	1.62%	3.77%	2.15%
35	River block	2014	1.92%	2.15%	0.23%
36	Slangpark (Bravo 30 to 38, Delta 31 to 33)	2014	1.61%	2.13%	0.52%
1M	Shiraz 1M (O36 to 38)	2011	0.77%	1.76%	0.99%
1N + 1P	Shiraz 1 N,O,P (O39 to 46)	2011	0.61%	1.50%	0.89%
1L	Shiraz 1L (existing Shiraz)	2011	1.02%	2.41%	1.39%
1F	Cabernet Sauvignon 1F	2011	1.55%	2.63%	1.08%
1B + 1C	Chardonnay 1B and 1C (O20 to 28)	2011	1.44%	3.87%	2.43%
1H	Cabernet Sauvignon 1H	2011	1.46%	3.05%	1.59%
1D	Chardonnay 1D (O29 to 31)	2011	1.78%	2.23%	0.45%
1E	Chardonnay 1E (O32 to 35)	2011	1.37%	2.48%	1.11%
1K	Sauvignon blanc 1K (O9 to 14)	2011	1.22%	2.45%	1.23%
1A	Lucerne 1A	2014	1.03%	1.53%	0.50%
2D + 2E	Merlot	2011	0.93%	2.39%	1.46%

Based on the values presented in Table 1, it can be calculated that a weighted average change in soil carbon and sequestered soil carbon dioxide equivalents of 0.60% and 103 tonnes CO_2e/hectare respectively has occurred since the baseline sampling. Overall, there has been a net sequestration of 15,886 tonnes of carbon dioxide equivalent since the beginning of the Spier Mob Grazing Project. A field-by-field breakdown of the carbon dioxide sequestered or released is shown in Table 2.

Table 2: Changes in carbon dioxide since baseline measurements

Sample number	Field area (ha)	Change in soil carbon (%)	Carbon dioxide equivalent sequestered (tonnes CO_2e/ha)	Carbon dioxide equivalent sequestered (tonnes CO_2e)
1	2.4	0.5%	86.4	207
2	1.4	0.2%	40.7	59
4	1.9	0.7%	113.2	217
5	4.4	0.8%	134.0	595
10	3.9	1.3%	218.4	860
11	12.0	0.6%	97.3	1,169
12	3.3	0.4%	60.6	198
13	9.4	0.3%	46.7	440
15	1.7	0.0%	5.0	9
16	17.9	0.7%	123.1	2,209
17	3.5	0.8%	133.0	472
18	14.8	1.3%	229.3	3,392
19	5.8	0.1%	20.8	121
20	6.5	-0.8%	-144.9	-942
21	5.5	0.6%	105.2	579
22/1G	2.6	1.2%	213.4	557
35	7.9	0.1%	22.8	181
36	11.6	0.3%	51.6	597
1M	1.4	0.6%	98.3	142
1N + 1P	5.1	0.5%	88.7	448
1L	2.8	0.8%	138.0	386
1F	2.4	0.6%	107.2	253
1B + 1C	4.0	1.4%	241.2	962
1H	3.1	0.9%	157.8	491
1D	1.3	0.3%	44.7	59
1E	2.6	0.6%	110.2	284
1K	3.5	0.7%	122.1	431
1A	1.2	0.3%	49.6	60
2D + 2E	10.0	0.8%	144.7	1,451
TOTAL	**154.2**			**15,886**

The previous audits estimated that the Spier Mob Grazing Project had sequestered 8,784 tonnes of carbon dioxide equivalent (7,852 tonnes and 932 tonnes in the 2013 and 2017 audits respectively), which has subsequently retired as carbon credits through the Credible carbon registry, and therefore no longer belongs to the farm. Subtracting this amount from the overall sequestration from when baselines were measured, suggests that a further 7,101 tonnes of carbon dioxide equivalent has been sequestered since the last audit.

4.3 Limitations

Soil sampling data potentially has large errors associated with the results due to the heterogeneous nature of large fields. This concern was accounted for as far as possible through taking a number of samples located randomly in each of the fields and blending to provide the sample for analysis. The soil sampling occurred at a similar time of year to the 2014 and 2017 sampling and therefore temporal flux of the soil organic matter was minimised. The 2011 sampling occurred in September and therefore a portion of any measured change in soil organic matter for the 2011 to 2020 period could be due to natural seasonal variances in soil organic matter. It may also be noted that the 2017 sampling occurred during the height of the drought, which likely decreased soil carbon levels and resulted in the relatively low carbon sequestration values recorded in the 2017 audit.

The calculations are based on literature values for the soil bulk density for this specific location and percentage of carbon within the soil organic matter due to a lack of experimentally determined values. Future studies could include tests to determine the local values of bulk density and carbon content within the organic matter.

5 SUMMARY: RESPONSE TO THE CREDIBLE CARBON REGISTRY QUESTIONS

Based on the observations presented above, the following responses to the Credible Carbon Registry questions are provided.

Is the project real? Yes. The project is real and operational.

Is the described technology in place and functioning in accordance with its design specification? Yes. The Green House observed that regenerative farming and mob grazing principles are used for the management of cattle, pigs and chickens on the farm. Livestock are grazed in high concentrations in small pastures and moved regularly to new pasture areas before overgrazing occurs. The pastures are then left for an extended period until complete recovery is achieved before grazing occurs again. This principle, combined with irrigation and the planting of nitrogen-fixing legumes and other crops, has resulted in healthy looking pastures with high plant growth in the recovered areas. The land area included in this audit also includes vineyards in which cattle are allowed to graze in the off-season and to which chicken feathers are applied.

Are the estimates of greenhouse gas emissions reduction reasonable? Yes. The estimates presented in the report are based on soil sampling and analysis consistent with internationally accepted standards (being the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry and Greenhouse Gas Protocol) and are thus a reasonable representation of the carbon dioxide emissions sequestered due to the Mob Grazing Project pasture management. The soil was analysed in an internationally recognised and independent soil laboratory.

Is there a discernible impact on poverty? Yes. The project employs permanent workers as part of the Mob Grazing Project with other workers employed permanently or temporarily on the farm. The Project has also trained worker on money management and recently sold 85% of the egg business to six workers. As before, the intention is to distribute 50% of generated carbon credit revenue to permanent Mob Grazing Project employees. Workers indicated that this money previously helped with their family finances and was spent on themselves and their families.

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