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An Analysis of Farm-based Carbon Footprint Calculators: Insights for Farmers

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Abstract: Through farming activities, a significant amount of greenhouse gases is emitted, which unfavourably contributes to climate change. In order to reduce the adverse impacts of farming activities on the environment, farmers need to get accurate insights on emissions from their activities so that they can take appropriate corrective actions to reduce their emissions. Insights on carbon emissions can be obtained by using carbon footprint calculators, which proliferated during the past few years. However, even though these tools are freely available online, limited work has been undertaken to analyse and compare their applications. Taking cognizance of this gap, this paper analyses key aspects of existing farming-based carbon calculators, notably their scope, calculation method employed, and consistency of results provided. Following application and analysis of three calculators, results showed varied categorisation of calculation parameters, granularity of inputs, lack of transparency and some inconsistent results. The limitations identified in this study provide avenues for further enhancement of these tools by the research community and regulatory bodies.

Keywords: Farming, livestock, carbon footprint calculators, carbon emissions, comparative analysis.

1. Introduction

Climate change is regarded as a major environmental and developmental challenge, adversely affecting the main potentials for sustainable development [1]. The negative impacts of climate change have largely been felt across the globe, in different ways including, shifting weather patterns, receding ice caps, crop losses, altered distribution of precipitation, increased frequency and intensities of floods and droughts, and serious ecological imbalances, which have caused substantial economic losses [2]. These effects are mainly caused by a rise in greenhouse gases (GHG). Among the sectors, agriculture has been regarded as a significant contributor of GHGs from livestock, production of crop, food processing and marketing of products, accounting for around 13.5% of the overall global anthropogenic GHG emissions [3]. Consequently, climate change disturbs the availability of food, decline the access and quality of food [4]. Therefore, policy reforms in the agricultural sector should strengthen the incentives to farmers, organize awareness-raising campaigns to help people adopt the good practices in order to achieve sustainable productivity growth and reduce carbon emissions from farming activities [5]. In order to set up those policy reforms, it is important to estimate the carbon footprint from farming activities so as to effectively determine the areas emitting more carbon footprint, thus coming up with practices towards reducing emissions. In addition, estimating carbon footprint may also help policy makers and farmers in the identification of various environmental implications of the different mitigation and management approaches [6, 7]. Since carbon footprint is a popular quantitative indicator, it simplifies communication between scientists, policy makes and farmers [1]. Such popular quantitative indicator can be determined through the use of carbon footprint calculators, which are web or mobile-based tools that enable the estimation of the carbon footprint of activities and provide advices on how emissions could be reduced. During the previous decade, there has been the proliferation of carbon calculators for various activities, including farming. However, limited work has been undertaken to analyse how such tools account for carbon emissions from farming activities. Taking cognizance of this gap, the purpose of this paper is to extend previous research on carbon footprint calculators by critically analysing how such tools account for emissions farming activities.

2. Related Works

In order to effectively manage and reduce the emissions of carbon from farming activities, it is essential to quantitatively determine the amount of carbon emitted in the atmosphere from these activities. This can be done by measuring the carbon footprint of farming activities undertaken by farmers. Carbon footprint can be measured on a weekly, monthly or yearly basis with the help of a farming carbon footprint calculator. Such calculators allow farmers to enter their respective details for a more accurate calculation that enable the latter to set up a plan for managing carbon emissions.

Within published literature, limited work has been undertaken to study and analyse farm-based carbon footprint calculators. Among the related works, a previous study presented a farm-based carbon calculator meant for the European context and is based on international standards for life cycle assessment and carbon footprinting [8, 9]. In order to evaluate the calculator, testing was done involving 54 farms based in 7 countries. Although this work is related to farm-based carbon calculator, the focus was not to compare existing carbon calculators. In line with carbon calculator comparison, previous works examined the similarities and differences among selected carbon calculators but focused only on diet [10] and personal travelling [11]. As such, given that limited published literature is available in the area of farm-based carbon footprint calculator, this study becomes important to undertake.

3. Methodology

In order to achieve the purpose of this paper and to compare existing farm-based carbon footprint calculators, an initial search was performed to identify the calculators using Google as a primary engine in order to find relevant tools. This initial search was carried out using the keywords, notably '*farm, carbon, calculators, agriculture, farming, tools'*. Out of an initial pool of 16 calculators identified, results were narrowed to select calculators that can potentially estimate carbon footprint for both crops and livestock and with no country specificity restrictions. In this process, only three calculators were found relevant, notably, Farm Carbon Cutting Toolkit (FCCT)[1], Cool Farm Tool[2] and Farming Enterprise Greenhouse Gas Emissions Calculator[3].

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[1] Farm Carbon Cutting Toolkit, available at: https://www.farmcarbontoolkit.org.uk/
[2] Cool Farm Tool, available at: https://coolfarmtool.org/
[3] Farming Enterprise Greenhouse Gas Emissions Calculator, available at: http://www.n2o.net.au/greenhouse/calculate.jsp?t=26&sc=0.4&p=1500&c=30

In order to compare the selected calculators, the framework in previous related studies [10, 11] was adapted. The reasons for adopting the framework due to their relevance in comparing carbon footprint calculators and that its adoption was found to derive insightful findings that could potentially motivate policy reforms. Based on these frameworks, different criteria are involved for comparing calculators and these are:

- *Scope* – relates to the various categories and inputs required while calculating carbon emissions.
- *Calculation Method* – involves determining the approach used by the calculators for calculating carbon emissions.
- *Consistency of results* – relates to the uniformity of results of calculations produced across calculators.

To analyse the scope, calculation method and consistency of the calculators mentioned above, the following cases were derived (based in Mauritius), for which the carbon footprint were calculated in each calculator.

- Farmer A is a small scale- farmer owing 100 perches of agricultural land. The latter has been planting potato for the past 5 years and reared 2 sheep and 4 Cattles for 6 months. To sell his produces, he travels from Vacoas to Quatre Bornes market twice a week.
- Farmer B owns 2 acres of land where half of the land is used for planting onion, cucumber, and ladyfinger for the past 4 years and the other half of land is used for rearing 4 pigs, 6 cattle, 10 goats and 3 sheep. To sells his produces, he travels from Fond Du Sac to Port Louis market 4 times a week.
- Farmer C owns 50 perches of land and has been planting brinjal for the past 2 years. To sells his produces, he travels from Quatre Bornes to Port Louis market 3 times a week.
- Farmer D is a small-scale farmer in Bamboo and has been planting carrots for the past 1 year in 30 perches of land. To sell his produces, he travels to Vacoas market every day.
- Farmer E is a small-scale farmer in Vacoas. He owns 4 acres of land where 2 acres is used to plant tomato, Carrot, Onions, and beans and 2 acres of land Is used to rear 2 cattle, 5 deer and 4 goats. To sell his produces, he travels to Port-Louis by his Van thrice a week.

For each profile defined above, data was input in the selected three farm-based calculators to compute the respective carbon footprint of the farmers. In addition, information presented in the carbon calculators were studied to further comprehend scope and calculation method.

4. Results and Discussions

Based on the methodology defined in the previous section, the findings of this study are presented and discussed in the following sections.

4.1 Scope Analysis

Table II (in appendix) shows a compilation of the key categories as well as the various factors for each category considered by the carbon calculators under investigation. It could be noticed that the three calculators had varied taxonomy or categories involved in the calculation process of the carbon footprint for farming activities. Among the calculators, Farming Carbon Cutting Toolkit implemented 10 categories, Cool Farm Tool had 8 categories and Farming Enterprise Greenhouse Gas Emissions Calculator had only 3 categories. This also highlights inconsistent categorisation of calculation parameters or inputs by such calculators, which could be due to lack of standards governing the categorisation of input parameters in carbon footprint calculators [11].

In addition to varied categorisation, differing granularities in terms of input parameters for each category were noticed. This also implied some calculators required more inputs than others. When using the carbon footprint calculators, it was noticed that not all calculators catered for soil. Soils are considered as important criteria due to their significance in the emission of an important amount of CO_2 due to respiration by micro-organisms in soils [12]. Among the calculators, only Cool Farm Tool has considered the various characteristics of soils, namely type of soils (e.g. silt, dry, moist, and sandy), soil texture, organic matter, moisture average, drainage, and pH level of soil. As far as fuel category is concerned, the Cool Farm Tool is the only calculator that allowed various inputs as energy source and energy used. Moreover, this calculator provides farmers with the facility of having different machines used during farming, thus promoting more accurate inputs from farmer. On the other hand, Farming Enterprise Greenhouse Gas Emissions Calculator is the only calculator which has taken into consideration only Petrol, Diesel and Electricity as inputs and Litres and dollar as respective inputs. The Cool Farm Tool allows farmers to input more parameters, thus denoting higher granularity in terms of inputs. Nevertheless, none of the remaining calculators permit farmers for more than one input for machines used during farming. In other words, if a farmer makes use of multiple machines during the process of farming, the latter would not able to record inputs for the calculation, thus being a limitation to the estimates, thereby adversely impacting accuracy of results produced.

For livestock, among the three calculators analysed, Farming Enterprise Greenhouse Gas Emissions Calculator catered only for three different types of livestock, which are dairy cattle, beef cattle and sheep, with the quantity of those livestock as input. Estimates from these two calculators may not be reliable since the calculators lack important parameters namely feed provided to the livestock, finished products obtained from the livestock. As such, all the three calculators have not considered all the parameters needed for an accurate estimate of carbon footprints, where the Cool Farm Tool did not account for any feed as inputs and Farm Carbon Cutting Toolkit did not consider finished products produced.

As for crop, Farming Enterprise Greenhouse Gas Emissions Calculator has catered for the least number of parameters, only typically soil. Farm Carbon Cutting Toolkit is the only calculator accounting for different types of crops, including horticultural crops, and grassland. Moreover, Farm Carbon Cutting Toolkit allows input for green manures, organic fertilisers, mineral fertilisers, plant raising and peat soils where most used variables are tonnes and hectares. However, it does not consider the net and gross yield of crops, which represent important criteria for the calculation of carbon footprints in farming. Besides most of the calculators did not cater for input of residues from the crops. Cool Farm Tool is the only calculator which considered most of the important parameters needed for a more precise estimation, but in the process did not consider the use of biomass involved in the cultivation of crops.

Furthermore, fertilizers are important to the proper growth of crops and for the supply of nutrients to crops [13]. However, they adversely contribute in the emission of greenhouse gases. Farming Enterprise Greenhouse Gas Emissions Calculator is the only calculator which has not considered any parameter for fertilizer. Since nitrogen fertilizers might be helpful in the adaption of climate change, it is important to allow calculators for data input for fertilizers to determine the footprints from those fertilizers [14]. Farm Carbon Cutting Toolkit has only catered for the quantity of fertilisers and sprays. On the other hand, Cool Farm Tool, considered different parameters such as the mode of application, the manufacturer, category of fertilizers. Those parameters indicate Cool Farm Tool has taken different aspects into consideration, thus denoting a higher granularity of inputs.

Overall, Cool Farm Tool and Farm Carbon Cutting Toolkit are the two calculators providing higher granularity of inputs since those two calculators have catered for most of the parameters needed for a comprehensive calculation of farming carbon footprints. The study carried out on the different calculators demonstrates a lack of standardised approach for categorising emission parameters and inputs.

4.2 Calculation Method

Cool Farm Tool makes use of a well-defined method for estimating footprint for different emission categories considered by the calculator. For instance, for soil, the calculator goes beyond the IPCC Tier 1 and Tier 2 techniques[4], involving indirect, and direct nitrous oxide emissions, embedded emissions form mineral fertilisers and changes in soil carbon stock [6]. Moreover, direct N_2O emissions are calculated by making use of the equation formulated in a previous study [15]. Indirect N_2O emissions are calculated through the FAO and IFA equations. The default factors from IPCC are used to estimate the amount of nitrogen lost through leaching and resulting as N_2O [16]. The standard multiplications (IPCC emission factors) are used to estimate the nitrogen lost through leaching. Besides, life-cycle assessment (LCA) principles ae used to estimate embedded emissions from mineral fertilizers, which are country-specific. Changes in soil organic carbon are modelled for a 20-year period and are affected by soil type, management (tillage) and carbon input to soil. Multipliers from a previous report [17] are applied to the impact of addition of manure, crop residue, and straw on soil stocks. For manure management, all livestock factors apply the Tier 2 approach. Nevertheless, an elementary approach is applied for other livestock categories, with the exception of cattle, enabling less user input and is generally dependent on the default values of animal performance. Concerning grazing, Cool Farm Tool computes dry matter intake based on grazing time [16]. However, the tool is allowed to estimate the feed intake based on the energy requirements calculated on the basis of milk production data and energy calculation formulae from the IPCC [18] guideline for dairy cattle.

Farm Carbon Cutting Toolkit is a carbon calculator for farmers and growers in UK and is said to use Tier 1, 2, and 3 emission approaches [19]. However, due to lack on documentation on this particular tool, the emission approach used cannot be clearly certified and details of calculations are unknown. As such, lack of transparency makes it unclear about the approach used, emission factors and formulae, among other aspects involved in the calculation process.

Similarly, Farming Enterprise Greenhouse Gas Emissions Calculator is another calculator which due to lack of documentation, the carbon footprint approach used by the application cannot be determined.

As such, among the three calculators analysed, it could be noticed that Cool Farm Tool is the calculator with a detailed explanation of the approached used by the calculator. On the other hand, lack of transparency prevails among farm-based carbon footprint calculators where the calculation method used by Farm Carbon Cutting Toolkit and Farming Enterprise Greenhouse Gas Emissions Calculator could not be determined due to lack of information published.

4.3 Consistency of Results

The annual carbon footprint for the five farmers detailed earlier were calculated via the three selected calculators, and respective values are provided in Table I, along with the mean, variance and standard deviation for each farmer. Results show that every calculator provided a different annual carbon footprint for the same farmer. Among the studied

[4] Foundation Footprint, Tiers of Emission Factors and Activity Data, available at: https://community.foundationfootprint.com/FoundationFootprintHelpCentre/Miscellaneous/IPCCTiers.aspx

calculators, it was found that Farm Carbon Cutting Toolkit and Cool Farm Tool provided relatively closer values as compared to Farming Enterprise Greenhouse Gas Emissions Calculator. The varied carbon emissions could be due to different reasons, notably, differing calculation methods, number of inputs and emission factors, among others [11]. Among the five profiles, variance was lowest for Farmer A and highest for Farmer B. It was noticed that as the number of farming activities increases, more inputs need to be made in the calculators and consequently, variance increases. This also potentially justifies the low variance for Farmer A, which has a relatively low number of inputs as compared to Farmers B and E. Overall, carbon footprint results were significantly inconsistent across studied calculators.

Profile	Annual Carbon Emissions (MtCO2e)					
	Farm Carbon Cutting Toolkit	**Cool Farm Tool**	**Farming Enterprise Greenhouse Gas Emissions Calculator**	**Mean**	**Variance**	**Std. Dev**
Farmer A	57.45	60.26	90.00	69.24	216.87	14.72
Farmer B	1000.41	1104.37	2000.00	1368.26	201348.99	448.71
Farmer C	208.86	100.75	120.00	143.20	2217.16	47.08
Farmer D	562.31	638.42	300.00	500.24	21014.15	144.96
Farmer E	1203.73	963.213	1800.00	1322.31	123733.20	351.76

Table I - Carbon Footprint of Farmers

4.4 General Discussions

Although farm-based carbon footprint calculators play an important role in providing quantitative measurements of carbon emissions from farming activities, results in the previous sections show that significant enhancements are needed to ensure that such tools provide reliable results to users. Firstly, categories used in such calculators and inputs could be better standardised and regulated to ensure correct parameters are provided to farmers in the calculation process. In addition, conversion tools could be included to enable easy change of values from one metric to another (e.g. litres of fuel to gallons).

Given that two out of the three calculators studied did not provide information about calculation method adopted, reliability of results by certain calculators become questionable. The lack of information makes it unclear about what formulae are being used, emission factors utilized, and conversion factors involved, among others. As such, farm-based carbon calculators are encouraged to provide information on their calculation methods to ensure transparency. This does not only help users and the online community understand underlying information involved in the calculation process, but to also provide feedback towards improving the tools.

Moreover, in the previous section, inconsistent results for same profiles of farmers were noted. Inconsistency in results makes the accuracy of such calculators questionable. As such, it becomes essential to implement measures towards enhancing consistency and reliability of results provided by such tools. For this, it is important to have local or international standards defined, in addition to regulatory processes to ensure that incorrect values provided by calculators are duly reported and that actions are taken to fix calculation errors.

Besides, it is important to highlight that none of the calculators studied were mobile-based applications. All of them were web-based and required the use of a browser. This could make it difficult for famers to have access to such calculators. Also, selected calculators enable farmers to have yearly carbon estimates from their farming activities. This can be a limitation to farmers who need to calculate their estimates monthly basis. Calculating carbon footprints on a monthly basis permits farmer to have a better overview on their carbon footprints temporally, thus promoting various practices to reduce those footprints during the next month, towards better management of GHG emissions.

5. Conclusions

This paper analysed key aspects of farming-based carbon calculators, notably their scope, calculation method employed, and consistency of results provided. In order to achieve the purpose of this paper, three farm-based carbon footprint calculators were utilized and critically analysed. In order to study the scope of the selected calculators, the farming categories and input parameters were investigated. Results showed that the selected calculators categorised farming activities via inconsistent ways and the granularity of the inputs varied significantly, thus showing there is limited adherence to some defined standards. Furthermore, to investigate the method of calculation employed by the selected calculators, information provided in the websites and within published documents were referred. It could be noticed that two out of the three calculators studied published limited information, thereby lack transparency on the calculation method, emission factors and formulae used, among other aspects. Finally, in order to analyse the consistency of results of such calculators, five profiles of farmers were created, and their annual carbon footprints were calculated using the respective tools. Results showed some inconsistencies in terms of computed carbon emissions that could be due to the underlying calculation method used. Overall, given the importance of carbon footprint calculators towards reducing and communicating carbon emissions from farming activities, further efforts are required from the research community and developers of such tools to further address the limitations identified in this study, in terms of scope, transparency of calculation method used and consistency of results provided by such tools. As future works, the study can be extended to further include regional farming carbon calculators, while enlarging the aspects of comparison to include communication methods and usability issues.

References

[1] D. Pandey and M. Agrawal, "Carbon Footprint Estimation in the Agricultural Sector," *Assessment of Carbon Footprint in Different Industrial Sectors,* vol. 1, pp. 20-27, 2014.

[2] N. Stern, "The Economic of cliamte change," Cambridge University Press, Cambridge, 2006.

[3] J. Dyer, X. Verge, R. Desjardins, E. Worth and B. McConkey, " The impact of increased biodiesel production on the greenhouse gas emissions from field crops in Canada," 2010.

[4] M. Brown, J. Antle, P. Baucklund, E. Carr, W. Easterling, M. Walsh, C. Ammann, W. Attavanich, C. Barrett, M. Bellemare, V. Dancheck, C. Funk, K. Grace, J. Ingram, H. Jiang, H.Maletta, T. Mata, A. Murray, M. Ngugi, D. Ojima, B. O'Neil and C. Tebaldi, "Climate Change, Global Food Security and the U.S. Food System," U.S. Department of Agriculture, 2015.

[5] Y. Gan, C. Liang, C. Hamel, H. Cutforth and H. Wang, "Strategies for reducing the carbon footprint of field crops for semiarid areas: A review," 2010.

[6] J. Hillier, C. Walter, D. Malin, T. Garcia-Suarez, L. Mila-i-Canals and P. Smith, "A farm-focusd calculator for emissions from crop and livestock production," *Environmental Modelling & Software,* vol. 26, 2011.

[7] G. Bekaroo, C. Bokhoree, P. Ramsamy and W. Moedeen, "Investigating personal carbon emissions of employees of higher education institutions: Insights from Mauritius," *Journal of Cleaner Production,* vol. 209, pp. 581-594, 2019.

[8] H. Tuomisto, C. Camillis, A. Leip, N. Pelletier, L. Nisini and P. Haastrup, "Carbon footprint calculator for European farms: preliminary results of the testing phase," in *9th International Conference LCA of Food San Francisco*, 2014.

[9] H. Tuomisto, C. De Camillis, A. Leip, L. Nisini, N. Pelletier and P. Haastrup, "Development and testing

of a European Union wide farm level carbon calculator," *Integrated environmental assessment and management,* vol. 11, no. 3, pp. 404-416, 2015.

[10] J. Padgett, A. Steinemann, J. Clarke and M. Vandenbergh, "A comparison of carbon calculators," *Environmental impact assessment review,* vol. 28, no. 2-3, pp. 106-115, 2008.

[11] G. Bekaroo, D. Roopowa, A. Zakari and D. Niemeier, "Calculating carbon emissions from personal travelling: insights from a top-down analysis of key calculators," *Environmental Science and Pollution Research,* pp. 1-20, 2020.

[12] Farm Carbon Cutting Toolkit, "Soil Carbon Emissions," 2019. [Online]. Available: https://www.farmcarbontoolkit.org.uk/toolkit/soil-carbon-emissions. [Accessed 27 May 2020].

[13] A. DeJioa, "Why do farmers use fertilizers," 18 March 2015. [Online]. Available: https://soilsmatter.wordpress.com/2015/03/18/why-do-farmers-use-fertilizers/. [Accessed 28 May 2020].

[14] B. C. Erbas and E. G. Solakoglu, "In the process of climate change, the use of fertilizers and teh effect of income on agricultural emissions," *MDPI,* 31 October 2017.

[15] A. Bouwman, L. Boumans and N. Batjes, "Modeling global annual N2O and NO emissions from fertilised fields," *Global Biogeochemical Cycles,* vol. 16, no. 4, 2002.

[16] I. Leinonen, V. Eory, M.MacLead, A.Sykes, K.Glenk and R. Rees, "Comparative analysis of farm-based carbon audits," 2019.

[17] P. Smith, D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, R. Scjoles, O. Sirotenko, M. Howden, T. McAllister, G. Pan, V. Romanenkov, U. Schneider, S. Towprayoon, M. Wattenbach and J. Smith, "Greenhouse gas mitigation in agriculture," 2008.

[18] IPCC, "IPCC guidelines for national greenhouse gas inventories," 2006.

[19] B. Willson and S. Roderick, "Delivering Solutions: Engaging Farmers adn Land Holders in the Climate Change Debate," *Handbook of Climate Change Communication,* vol. 2, 2017.

Appendix

Calculator	Categories	Farming Categories – Factors Considered							
		Input Investment	**Inventory**	**Livestock**	**Crops**	**Soils**	**Distribution**	**Waste**	**Sequestration**
Farming Carbon Cutting Toolkit	Fuels Materials Inventory Crops Inputs Livestock Waste Distribution Sequestration Processing	Fuel Type Quantity Materials Type Quantity Input Type Quantity	Inventory Type Title Quantity Year	Livestock Type Quantity Head of livestock last year Slurry % FYM % In field manure % Daily spread (fresh manure) % Dairy yield	Crop Type Quantity		Distribution Type Description Delivery distance Tonnes per journey Journeys per year	Waste Type Landfill Recycling	Sequestration type Quantity Average age
Cool Farm Tool	Crop Soils Inputs Fuel & Energy Irrigation Carbon Transport Livestock	Energy source Energy used Category Label Machine type Fuel use Number of operations Fertilizers type Manufactured in Application rate Fertilizer weight or units Application method Emissions inhibitors Events Method Water Source Pumping depth Horizontal distance Power Source		Livestock type Year Finished product amount Number of animals Length of phase Manure management	Crop name Harvest year Crop area Harvested amount(total) Farm-gate ready amount Residue amount		Mode Weight Distance		Tree Species Density last year Size Last year Size this year Trees planted/lost
Farming Enterprise Greenhouse Gas Emissions	Fuel Soils Animals	Diesel(L) Petrol(L) LPG(L)		No of Dairy Cattle No of Beef Cattle No of Sheep		Area Dryland(ha) Area Irrigated(ha) Area Pasture(ha) Fertilizer			

Calculator						applied(dryland)(kg N/ha) Fertilizer applied (irrigated)(kg N/ha)			

Table II - Calculation categories and parameters (scope analysis)