On farm level acting in order to mitigate climate change with help of a points-based system

Aurelia Nyfeler-Brunner[a], Daniel U. Baumgartner[a], Gérard Gaillard[a], Sarah Hofmann[b]

[a]*Agroscope, Department for Agroecology and Environment Research, Life Cycle Assessment Research Group, Reckenholzstrasse 191, 8046 Zürich, Switzerland,* *aurelia.nyfeler@agroscope.admin.ch, daniel.u.baumgartner@agroscope.admin.ch, gerard.gaillard@agroscope.admin,ch*

[b]*IP-SUISSE, Molkereistrasse 21, 3052 Zollikofen, Switzerland, hofmann.sarah@ipsuisse.ch*

Abstract: *Climate change mitigation regards everyone, not least agriculture considering its overall share to global warming potential. Therefore, proactive steps performed by commercial farmer organizations like the Swiss farmer association IP-SUISSE are of major importance.*

Based on positive experiences by promoting biodiversity, IP-SUISSE plans to introduce a points-based label system for climate mitigation measures. Together with Agroscope, it established a list of about 20 measures on farm-level. The principle is the following: Each measure gives right to a number of points representing each a ton of mitigated CO_2eq. IP-SUISSE label farmers have to implement a sufficient number of measures in order to reach a minimum amount of points. By doing that, the farmers are free to choose those measures which fit best on their farms. A pilot study on 30 farms is ongoing from now until 2022 for feasibility and efficiency analysis. The effect of implementing simultaneously several measures is compared to the effects of single measures. Agroscope will quantify the CO_2eq reduction of these pilot farms and estimate the whole reduction potential of IP-SUISSE label farms.

With this approach, IP-SUISSE on the one hand seeks a reduction of greenhouse gas emissions of 10% until 2022 compared to 2016 and contribute therefore to the Swiss national climate mitigation goals. On the other hand, it leads to an additional benefit of its label: its products should remain attractive for the consumer and hence for the business partners. This proactive approach might result in a large scale stimulus for the whole of Swiss agriculture and should be of interest for other countries.

Keywords: *Farm level measures, Climate change mitigation, Life Cycle Assessment, SALCA, Label*

Introduction

Climate change and its consequences regard all economic sectors. Agriculture on the one hand is directly affected by changing and hence new climate conditions, on the other hand agriculture should reduce greenhouse gas (GHG) emissions and support carbon sequestration in soils. In Switzerland, agricultural policy aims to reduce 33.3% of agricultural GHG emissions until 2050 compared to 1990 (BLW, 2011).

In this context, proactive steps from all actors along the value chain including farmers, retailers and consumers are requested. One possible way that we are presenting here is performed by the Swiss farmer association IP-SUISSE. This association holds a label aiming the sustainable production of good quality food according to high level integrated production (IP) standards. In addition, it issues guidelines regarding animal welfare, crop rotation, fertilization, plant protection, and biodiversity. With its 10.000 label members (20% of all Swiss farmers) IP-SUISSE is a powerful player in the Swiss agricultural sector. By request of its members IP-SUISSE wants to include climate mitigation measures in its guidelines.

Method

Preliminary studies

In a preliminary literature study (Mieleitner et al., 2011) we collected possible climate mitigation measures which are realizable at farm level. These actions were evaluated by experts with regard to the expected effectiveness and feasibility in the Swiss context. In the following study (Alig et al., 2015) we selected 20 measures out of the measures suggested in the above-mentioned study. We performed a life cycle assessment (LCA) for each of the 20 measures applied each in one of the four most common farm types in Switzerland, namely a) arable farming, b) milk production, c) other cattle (i.e. fattening cattle, sucking cows) and d) pig production with the help of model farms. For this purpose we used the SALCA-Method (Swiss Agricultural Life Cycle Assessment; Gaillard and Nemecek, 2009). The model farms are based on statistical values and expert knowledge to form an average farm for this farm type (Zimmermann, 2008).

Climate change mitigation measures

Based on the results of these LCAs we calculated for each climate mitigation measure the action volume necessary to reduce one ton of CO_2eq. For example to reduce one ton of CO_2eq by using green power, a farmer has to replace 7500 kWh Swiss standard electricity mix by purchasing instead the same amount of current as green power.

Table 1 shows the climate change mitigation measures IP-SUISSE farmers can choose from to reduce global warming potential (GWP) on their farms.

Table 1. GWP reduction measures of the points-based system

Production branch	Measure	Unit
Energy	(01) Purchase of green electricity	kWh
	(02) Installation of a photovoltaic plant for own use	kWh
	(03) Installation of a photovoltaic plant to supply power	kWh
	(04) Mulch- or direct seeding	ha*
	(05) ECOdrive	ha*
	(06) Adapted forest management to generate renewable energy	BCM**
	(07) Installation of solar panels	m^2
	(08) Heat recovery in heated pig housing	kWh
	(09) Heat recovery in heated poultry housing	kWh
Animal husbandry	(10) Increasing the number of lactations of dairy cows	#
	(11) Phase feeding in pig fattening	#
Plant production	(12) Covering of slurry storage	yes/no
	(13) Manure application with drag hose	m^3
	(14) Application of digestate (biogas)	t residues
	(15) Plot-specific manure accounting	ha*

*ha stands for hectare

**BCM stands for bulk cubic meter

Points-based system

Due to positive experiences IP-SUISSE had with promoting biodiversity, it intends to introduce a points-based system for climate mitigation measures. The principle of the points-based system is the following: Each measure gives right to a number of points representing

each a ton of CO_2eq mitigated. IP-SUISSE members have to implement a sufficient number of measures to a sufficient extent in order to reach a set minimum amount of points. By doing that, the farmers are free to choose those measures which fit best to their farms.

Pilot study with IP-SUISSE farmers

The current pilot study, taking place from 2016 until 2022, analyses the proposed points-based system under real conditions with respect to its feasibility and efficiency. A number of 30 voluntarily participating pilot farms were selected by IP-SUISSE based on strict selection criteria. Three farm types are considered, animal-intensive (An), mountain agriculture (Mo), and arable farming (Ar). Each type is represented by 10 pilot farms. Agroscope calculated the global warming potential (GWP) with help of the SALCA methodology for the farm year 2016. This represents the reference value for GWP for each farm without the implementation of any of the climate mitigation measures given above. In case the farmer implemented already such measures, we calculated their environmental impact and added it to the LCA results (Gross GWP, Tab. 2), in order to ensure the consistency of the foreseen comparative analysis.

In September 2017, the pilot farmers reported via questionnaire measures already applied in 2016 and indicated which ones they will implement in 2018. A second LCA calculated for the farm year 2018 will show the GWP of the farms after having implemented the chosen measures. The difference of the two calculated GWP for each farm will show the reduction of greenhouse gas emissions resulting from the implementation of the climate mitigation measures. Thanks to this procedure, we will also be able to assess the effect of simultaneously applied measures compared to the effect of a single mitigation measure.

Results

Global warming potential of pilot farms for 2016

First results show that almost all farmers already implemented climate mitigation measures in 2016 (Tab. 2). The effect of these implementations is in the range of 6 to 8% of the annual corrected GWP of the farms. Related to digestible energy (in GJ) produced on the farm, the mountain agriculture farms with mainly dairy and suckling cows show the highest value (0.9 tCO_2eq/GJ/year) followed by the animal-intensive farms (0.5 tCO_2eq/GJ/year). Due to the mostly absence of animal and therefore animal induced GHG emissions, the value for the arable farming farms is lowest (0.07 tCO_2eq/GJ/year).

The total amount of GPW of all pilot farms is 9049 tCO_2eq, thereof 44.3% (4005 tCO_2eq) derives from the animal-intensive, 39% (3534 tCO_2eq) from the mountain agriculture and 16.7% (1511 tCO_2eq) from the arable farming types.

Expected reduction of global warming potential of pilot farms for 2018

The analysis of the questionnaire shows that almost all measures proposed in the list (Tab. 1) are selected for implementation in 2018 at least once. The median of mountain agriculture and arable farming intended GWP reduction is in the same order of 28 tCO_2eq (Tab. 3). The animal-intensive farms show the largest reduction intension of 44.7 tCO_2eq.

The summarized intended GWP reductions per farming types show that, the animal-intensive reach the highest reduction of 401.9 tCO_2eq, 44% of the total amount of reduction of 908 tCO_2eq. This total amount add ups the efforts pilot farmers are willing to do in 2018. Compared to the corrected annual GWP of 2016 (9049 tCO_2eq), this sum is in the range of 10 %, which corresponds exactly to the goal of the project. However if considered that these pilot farmers belong to the most motivated group of farmers, reaching a reduction of 10% of all IP-SUISSE Farmers could be difficult.

Table 2. Results for 2016: UAA (utilized agricultural area), Digestible Energy (dE) produced on farm, GWP, Reduction GWP by implemented measures, Gross GWP

Farm types	UAA	Digestible Energy	GWP	Reduction GWP	Gross GWP	Gross GWP/dE
	[ha]	[GJ]	[tCO_2eq]	[tCO_2eq]	[tCO_2eq]	[tCO_2eq/GJ]
Median Ar	**39**	**1943**	**99**	**13**	**117**	**0.07**
Min Ar	*12*	*456*	*33*	*0*	*38*	*0.06*
Max Ar	*64*	*3216*	*331*	*24*	*352*	*0.11*
Sum Ar	386	19030	1375	137	1511	
Median Mo	**21**	**359**	**241**	**19**	**286**	**0.9**
Min Mo	*12*	*36*	*67*	*0*	*69*	*0.4*
Max Mo	*53*	*949*	*455*	*63*	*491*	*7.9*
Sum Mo	303	4248	3261	272	3534	
Median An	**21**	**899**	**353**	**22**	**372**	**0.5**
Min An	*17*	*494*	*176*	*0*	*180*	*0.1*
Max An	*38*	*3585*	*892*	*93*	*932*	*1.2*
Sum An	203	10813	3719	286	4005	
Median Total	**23**	**667**	**234**	**17**	**272**	**0.5**
Min Total	*12*	*36*	*33*	*0*	*38*	*0.1*
Max Total	*64*	*3585*	*892*	*93*	*932*	*7.9*
Sum Total	892	34091	8355	695	9049	

Ar: Arable farming, Mo: Mountain agriculture, An: Animal-intensive, Total: All pilot farms

Table 3. Intended GWP reduction by implementation of measures selected for 2018 (tCO_2eq).

Farm types	Ar	Mo	An	Total
Median	**27.3**	**28.3**	**44.7**	**27.5**
Min	*0.0*	*0.0*	*0.0*	*0.0*
Max	*68.5*	*87.7*	*93.1*	*93.1*
Sum	300.3	206.3	401.9	908.5
% of Total	33.0%	22.7%	44.2%	

Ar: Arable farming, Mo: Mountain agriculture, An: Animal-intensive, Total: All pilot farms

Discussion and conclusions

There is an evident interest of the participant farmers in the topic of climate change and mitigation measures. They appreciate on the one hand the possibility to implement the measures proposed in their daily work and on the other hand the flexibility offered by the set of about 20 measures allowing them to select according to their local conditions, farming system, soil properties, economic and personal preferences.

From a research perspective, data acquisition of 30 pilot farms is relatively time-consuming when using traditional data inquiries for performing full farm LCAs. Therefore, we look for a more efficient ways of data collection in future by implementing technical solutions based on a web-interface and several cutting points between different data collecting systems in Swiss agriculture. This should facilitate the monitoring of the pilot farm network.

The project's goal, a GWP reduction of 10% over all 10'000 IP-SUISSE label producers, seems to be feasible considering the first result of the pilot farms. Caution should be exercised due to the very small amount of farmers questioned. The entire project team looks forward to the second part of the project to gain even deeper information about the pilot farms, the implementation of the climate change mitigation measures and the introduction of the points-based system on even a broader number of Swiss farms in order to support this first analysis.

Acknowledgement

We thank the Federal Office for Agriculture FOAG of Switzerland (https://www.blw.admin.ch/blw/en/home.html) for the financial support.

References

BLW (2011) Klimastrategie Landwirtschaft. Klimaschutz und Anpassung an den Klimawandel für eine nachhaltige Schweizer Land- und Ernährungswirtschaft. *Bundesamt für Landwirtschaft*, Bern: 46.

Alig M., Prechsl U., Schwitter K., Waldvogel T., Wolff V., Wunderlich A., Zorn A. und Gaillard G. (2015) Ökologische und ökonomische Bewertung von Klimaschutzmassnahmen zur Umsetzung auf landwirtschaftlichen Betrieben in der Schweiz. *Agroscope Science* 29/2015.

Mieleitner J., Baumgartner D. U., Gaillard G. (2011) Qualitative Evaluation von Massnahmen zur Senkung der Treibhausgasemissionen von Landwirtschaftsbetrieben. Projektbericht der Phase 1. Forschungsanstalt ART.

Gaillard G. and Nemecek T. (2009) Swiss Agricultural Life Cycle Assessment (SALCA): An integrated environmental assessment concept for agriculture. In Int. Conf. *"Integrated Assessment of Agriculture and Sustainable development, Setting the Agenda for Science and Police"*, Egmond aan Zee, The Netherlands AgSAP Office, Wageningen University, 134-135.

Zimmermann A., 2008. Dokumentation zur Definition der Modellbetriebe. Interner Bericht. Forschungsanstalt Agroscope Reckenholz-Tänikon ART, Tänikon, Schweiz. 26p.