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Agricultural Greenhouse Gas Emissions: Knowledge and Positions of German Farmers

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Abstract: Climate mitigation targets must involve the agricultural sector, which contributes 10%–14% of global anthropogenic greenhouse gas (GHG) emissions. To evaluate options for implementing mitigation measures in the agricultural sector, farmers' knowledge, positions, and attitudes towards agricultural GHG emissions, their accounting, and reduction need to be understood. Using an online survey, we asked 254 German farmers about their motivation to reduce GHG emissions and their acceptance of possible regulation schemes. We examined differences between relevant farming sectors, i.e., conventional versus organic and livestock keeping versus crop-cultivating farms. Results show that German farmers are aware of climatic changes and feel a general commitment to reducing GHG emissions but lack sufficient information. We identified agricultural magazines as the most effective tool for disseminating relevant knowledge. German farmers would feel motivated to adopt climate-friendly farming styles if products were labeled accordingly and if they received subsidies and public acknowledgment for their effort. As long as there is no regulation of agricultural GHGs through taxes or subsidies, personal motivation is yet the strongest motivation for voluntary emission reduction. Our findings are timely for the further development of strategies and instruments that reduce agricultural GHG emission and account for the farmers' views. The dataset is available for further investigations.

Keywords: mitigation of climate change; stakeholder survey; attitudes; farmer knowledge

1. Introduction

Climate change is a serious threat to agriculture and to food security. The increase in mean temperature, altered precipitation patterns, and more extreme weather events jeopardize the productivity of cropping systems in many regions [1–4]. The role of agriculture in feeding a growing world population of 9–10 billion people by 2050 and eradicating poverty and hunger is at stake [5–7]. Farmers are aware of the climatic changes [8–13], and opportunities for implementing mitigation measures in the agricultural sector are being investigated [14–18].

Emissions of greenhouse gases (GHGs) is the most important driver of human-induced climate change. Agricultural activities contribute 10%–14% of global anthropogenic GHG emissions [19,20], mostly from enteric fermentation (methane), application of synthetic fertilizers (nitrous oxide), and tillage (carbon dioxide) [2]. According to modeled emission pathways [21], global reductions of agricultural methane emissions until 2030 of up to 48% relative to 2010 and of nitrous oxide emissions by up to 26% are required to limit global warming to 1.5 °C.

While agricultural emissions are recognized in many national GHG emission reports and policy proposals (e.g., The Kyoto Protocol), they are not yet implemented in international agreements such as the United Nations Framework Convention on Climate Change (UNFCCC) and are exempt from existing emissions trading schemes such as the European Union Emissions Trading System (EU ETS). The Intergovernmental Panel on Climate Change (IPCC) [21] recommends targeted non-carbon dioxide mitigation measures to reduce nitrous oxide and methane from agriculture. However, direct regulations of land-based agricultural GHG emissions encounter high monitoring and verification costs due to diffuse non-point emission sources [17,22]. Because emission levels vary considerably across space, time, and farm management, average emission coefficients do not provide good approximations [23]. So-called second-best policy measures [24,25] can reduce transaction costs but at the expense of lower efficiencies for emission reductions. A virtually unlimited number of possible second-best policy instruments makes agreements difficult, however.

The declared goal of the German government is to reduce GHG emissions by 40% of 1990 levels in 2020 [26], by 55% in 2030, by 70% in 2040, and by 80%–95% in 2050 [27]. For the agricultural sector, the objective is to reduce emissions by 31%–34% relative to emissions in 1990. Detailed plans on how to reach this goal are still lacking. In 2017, however, new fertilizer regulations were introduced, which obligate farmers to reduce nitrate, ammonia, and phosphate losses by specified fertilizer planning, calculation, and application techniques (Düngeverordnung vom 26. Mai 2017 (BGBl. I S. 1305)). While the main goal of these regulations is to avoid excess nutrient releases into the environment, especially into water bodies, they will also contribute to reducing agricultural GHG emissions. Previous studies confirmed that farmers' perceptions of such regulations significantly influenced their acceptance and effectiveness [28,29].

In this paper, we evaluate German farmers' knowledge, positions, and attitudes towards agricultural GHG emissions, their accounting, and reduction options. We identify their motivation to reduce GHG emissions, their preferred sources of information, and their acceptance of possible regulation schemes. We examine differences between farm types, i.e., conventional versus organic farms and livestock versus crop-producing farms, and we develop profiles for different farmer types. The results of this research are intended to provide valuable information to experts and policy-makers for the needed development of accounting schemes for agricultural GHG emissions as well as inform a broader audience.

2. Materials and Methods

We conducted an online survey with German farmers over a seven-week period from July 17 to August 30, 2017. We acquired participants through direct email contact, farmers associations, student representatives of different German universities offering agricultural studies, working groups of farmers, and social media (Facebook). The survey required all participating people to work part- or full-time on a farm in Germany. The topic of the survey was not disclosed in the recruitment message to reduce topic-specific sampling biases. To conduct the survey, we used the software package SoSci Survey.

The questionnaire consisted of three sections. The first section elicited sociodemographic data and agricultural business information. The second section consisted of multiple-choice statements where respondents were asked to express their opinion on climate change and its relevance to the agricultural sector and to provide information about their activities related to GHG emissions and their mitigation. The third section captured farmers' general motivation to reduce on-farm GHG emissions and their willingness to accept possible regulation options. Questions could be answered on a 5-point Likert scale.

To better understand sample composition and responses, we calculated descriptive statistics for all variables. We report these values for the entire sample and selected sub-groups of farmers. Farmers were grouped by their adherence to organic or conventional farming practices and the presence or absence of animals on the farm. Organic farming is defined according to European legislation (https://ec.europa.eu/info/food-farming-fisheries/farming/organic-farming). Conventional farming in our study includes all observed farming that does not fall under the definition of organic farming. For these sub-samples, we further summarized the descriptive statistics in profiles describing the average respondent in each of these groups.

3. Results

3.1. Characteristics of the Respondents

In total, 254 German farmers (80.3% male and 19.7% female) completed the survey. The largest proportion of participating farmers came from the federal state of Bavaria (22.4%), followed by Lower Saxony (7.5%), North Rhine-Westphalia (8.7%), Baden-Wuerttemberg (8.7%) and Hesse (6.3%). About a quarter of respondents (23.6%) did not provide information about their farm's location. Three-quarters (76.8%) of respondents worked on conventional farms, and one quarter (23.2%) worked on organic farms. In reality, organic farmers account for only 10% of all farmers in Germany. To avoid possible bias in the results, we analyzed these groups independently. The participants were between 18 and 67 years old, with an average age of 41.5 years. The average farm size was 375 ha (range: 0 to 5524 ha) of agricultural land, including arable land, grassland, pasture, horticulture, fodder crops, permanent crops, and woodland. Participating livestock farmers (81.9%) raised cattle (n = 151), hogs (n = 67), sheep (n = 30), and poultry (n = 45). The majority of participants worked full-time on a farm (83.9%); 9.4% worked part-time, and 4.3% were irregularly employed. The vast majority of participating farmers held a school diploma, 17.7% had finished secondary school after ten years of education (Realschulabschluss), 16.1% held an advanced technical school certificate (Fachabitur), and 6.7% finished secondary school (Abitur). A large proportion of respondents (42.1%) had a university degree; 4.3% had a doctorate. The most common income bracket selected by respondents was 2000–3000€ per month (24.4%). The next most selected income bracket 1500–2000 € was selected by 18.5% of respondents. Table S1 in the supplementary material presents sociodemographic data and agricultural operating information of the survey respondents in detail.

3.2. Farmers' Positions on Climate Change and Agricultural Greenhouse Gas Emissions

To determine farmers' positions towards climate change and efforts to reduce GHG emissions, we asked participants to judge nine related statements. The responses are summarized below; Figure 1 provides all values.

3.2.1. Climate Change and Agriculture

A majority of farmers agree with statements that climate change is the largest threat to agriculture (54.3%) and that its effects are already noticeable today (53.9%). Almost half of the respondents believe that the consequences of climate change are not exaggerated (48.8%) and that individual actions against climate change are useful (49.6%).

3.2.2. The Role of Agriculture in GHG Mitigation Actions

Two thirds of respondents (66.5%) feel that the public is blaming agriculture for GHG emissions. Many of the participating farmers see the potential to reduce GHG emissions from the agricultural sector (44.5%). One third (37.4%) of respondents feel that GHG emission reductions are not economically feasible; 29.5% believe that the risk of adopting climate-friendly management outweighs its farming benefits. In contrast, 17.3% of the participants also see positive income opportunities in climate-friendly management.

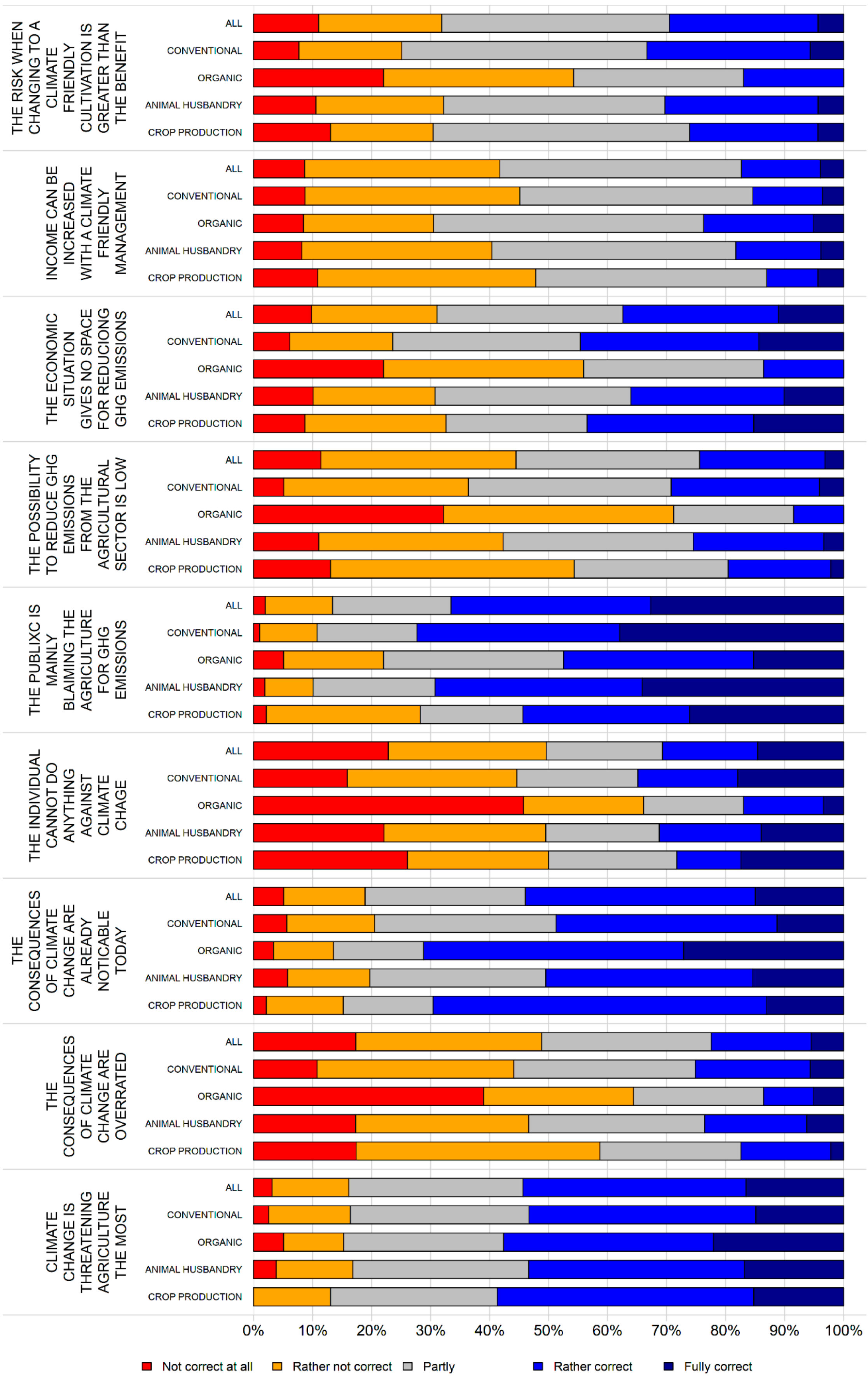

Figure 1. Farmers' positions and attitudes towards climate change and agricultural greenhouse gas (GHG) emissions.

3.3. Farmers' Knowledge Levels and Information Sources on GHG Emissions on Their Farms

3.3.1. Knowledge Level and Experience with On-Farm GHG Emissions

About half of respondents (50.4%) judged their knowledge of GHG emissions from the agricultural sector as moderate, 31.5% as rather low to very low, and 18.1% as rather high to very high. Only 7.9% of respondents have ever tried to estimate on-farm GHG emissions, mainly using Excel spreadsheets provided by the Chambers of Agriculture of the federal states or by scientific institutions.

3.3.2. Information Sources for Agricultural GHG Emissions

Almost half (46.9%) of the respondents reported that they read agricultural magazines frequently or regularly to inform themselves about GHG emission reductions; 34.3% use the internet. About half of the respondents obtained information at least sometimes from agricultural associations (51.6%) or traditional media (47.6%), i.e., radio, television, and newspapers. Respondents were split on the use of agricultural advisors; 45.3% used them at least sometimes, whereas 54.7% used this information source rarely or never. A majority of the participants rarely or never used colleagues (57.1%) or seminars and training (56.7%) as knowledge sources. The least used sources of information were working groups or regulars' tables in pubs (rarely to never: 72.8%).

3.3.3. Decision Making for Fertilization

The application of mineral fertilizers is a major source of agricultural GHG emissions [2,30]. In our survey, we asked participating farmers for details about these decisions, including whether, what, when, and how much they fertilize. Most respondents (87%) use soil analyses and personal experience (83.1%) to guide fertilization, in addition to plant analyses (48%). Agricultural advisors and application tables are relevant for 40.9% and 39% of the respondents, respectively. Only 24% of participating farmers use computer programs as a decision support tool for fertilization.

3.4. Policy Options for Reducing Agricultural GHG Emissions

The willingness of farmers to adopt GHG emission-friendly management depends on both the business environment as well as farmers' perceptions as farmers, e.g., may adopt emission-friendly farming practices for various reasons not limited to financial incentives. Furthermore, paying subsidies for emission-friendly farm management would require monitoring and verification systems, which involve sampling, preparation, calculation, and delivery of precise information on GHG-relevant agricultural activities to authorities. We summarized the surveyed attitudes, motivations, and preferred data handling below; Table 1, Figure 2, and Figure S1 provide details.

3.4.1. Attitudes towards On-Farm GHG Emission Reduction

Almost two thirds (64.2%) of the participants agreed that reducing GHG emissions is an important topic. The majority of respondents (60.2%) stated that they would reduce on-farm GHG emissions if they had more information on this topic. More than half of the farmers (55.5%) stated that lack of time prevents them from reducing GHG emissions. An overwhelming majority 79.9% of respondents would reduce on-farm GHG emissions if the associated costs were compensated. The same proportion of farmers (80.7%) would reduce emissions if they could reduce costs by changing to management that emits less GHG. A smaller proportion (65.4%) would reduce GHG emissions if such a reduction incurred a competitive advantage, while 34.6% think that the costs are higher than the benefits. The majority (64.2%) see potential to reduce GHG emissions on their farm, while 35.8% stated that they are already doing what they can (Table 1).

Table 1. German farmers' positions towards on-farm greenhouse gas emission (GHG) reduction.

Statement	All (254)	Conventional (195)	Organic (59)	Animal husbandry (208)	Crop cultivation (46)
Yes, but I need more information	153 (60.2%)	110 (56.4%)	43 (72.9)	124 (59.6%)	29 (63.0%)
No, and I do not need more information	101 (39.8%)	85 (43.6%)	16 (27.1%)	84 (40.4%)	17 (37.0%)
Yes, I would accept additional time expenditure	113 (44.5%)	76 (39.0%)	37 (62.7%)	93 (44.7%)	20 (43.5%)
No, I do not have enough time to spend on this topic	141 (55.5%)	119 (61.0%)	22 (37.3%)	115 (55.3%)	26 (56.5%)
Yes, if the additional costs are reasonably compensated	203 (79.9%)	154 (79.0%)	49 (83.1%)	169 (81.2%)	34 (73.9%)
No, because the efforts are not justified	51 (20.1%)	41 (21.0%)	10 (16.9%)	39 (18.8%)	12 (26.1%)
Yes, if I could reduce my costs because of it	205 (80.7%)	158 (81.0%)	47 (79.7%)	173 (83.2%)	32 (69.6%)
No, if this causes financial losses	49 (19.3%)	37 (19.0%)	12 (20.3%)	35 (16.8%)	14 (30.4%)
Yes, that is an important topic	163 (64.2%)	117 (60.0%)	46 (78.0%)	135 (64.9%)	28 (60.9%)
No, this is not a relevant topic for me	91 (35.8%)	78 (40.0%)	13 (22.0%)	73 (35.1%)	18 (39.1%)
Yes, if it would result in a competitive advantage (e.g., with an official label)	166 (65.4%)	124 (63.6%)	42 (71.2%)	139 (66.8%)	27 (58.7%)
No, the costs are higher than the benefits	88 (34.6%)	71 (36.4%)	17 (28.8%)	69 (33.2%)	19 (41.3%)
Yes, there is potential for reduction on my farm	163 (64.2%)	121 (62.1%)	42 (71.2%)	134 (64.4%)	29 (63.0%)
No, I am already doing what I can	91 (35.8%)	74 (37.9%)	17 (28.8%)	74 (35.6%)	17 (37.0%)

3.4.2. Motivating Factors for Reducing GHG Emissions

Farmers rated personal beliefs (75.6%) and public acknowledgment (68.9%) as very motivating for reducing GHG emissions, as well as training opportunities (43.3%) and an organized farm succession (40.2%). Examples in the vicinity (57.5%) and exchange of experiences with colleagues are somewhat to highly motivating for half of the farmers (49.6%). Almost a quarter (23.6%) of respondents would be discouraged if new technologies were required to reduce GHG emissions from agricultural activities. A competitive advantage for climate-friendly products would strongly motivate farmers to reduce emissions (75.2%). Subsidies for climate-friendly management were rated as motivating by 67.7% of the farmers. Farmers' responses to taxes on emissions do not show a clear response. Almost half (49.6%) of the respondents would feel discouraged by an upper limit for GHG emissions on the farm (Figure 2).

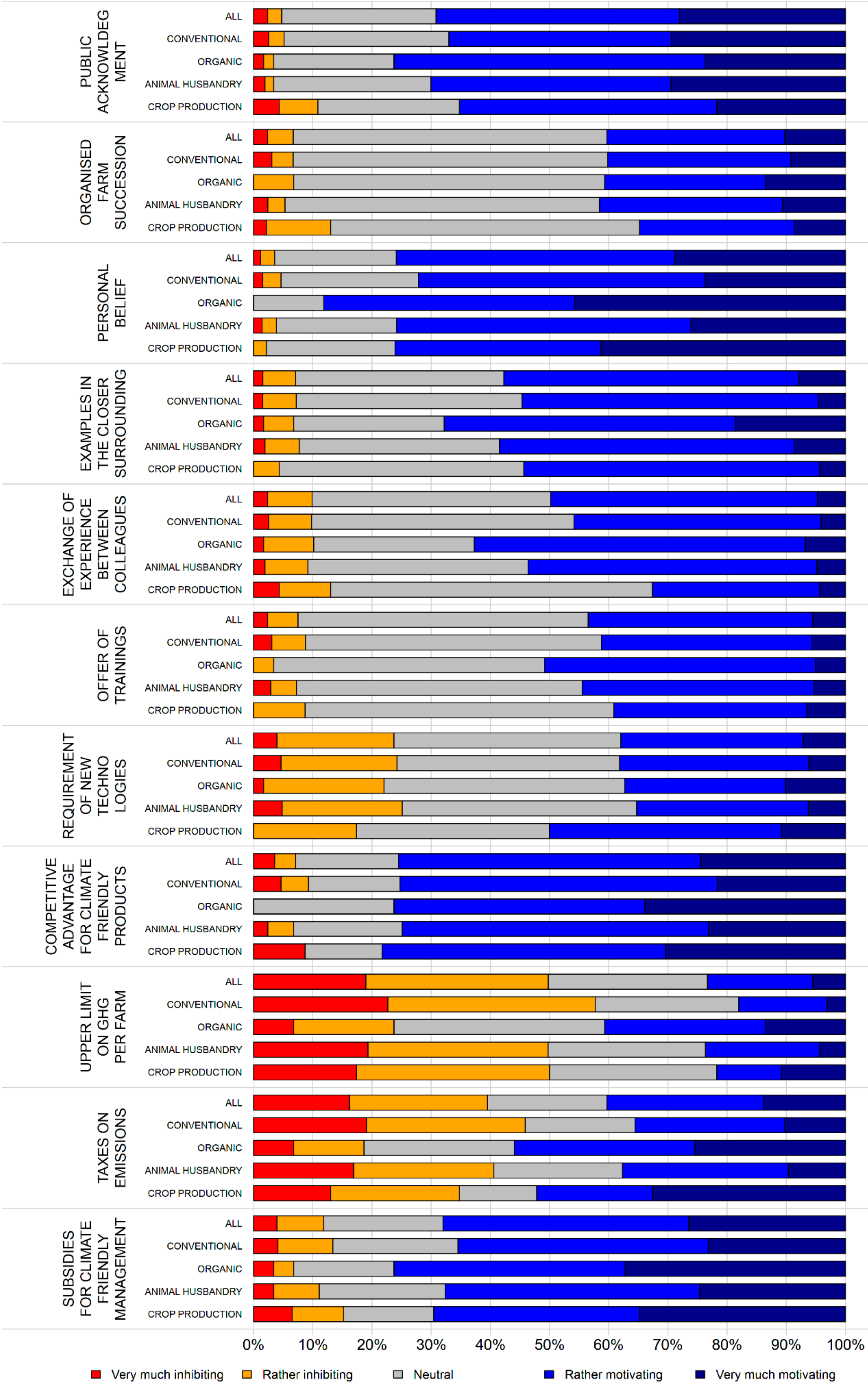

Figure 2. Motivating factors for reducing on-farm GHG emissions.

3.4.3. Data Management Preferences

Study participants judged three formats of data handling: direct delivery of management data to authorities; own calculations of GHG emissions with software, apps, or spreadsheets; and automatic collection of management data and calculation of GHG emissions with a specific IT infrastructure on agricultural machinery. Of the respondents, 46.1% would use the automatic data collection and emission calculation by on-farm IT systems ″always″ or ″often″, 44.5% would prefer to do their own calculations of emissions, and 30.3% would deliver management data to authorities for estimating GHG emissions (Figure S1).

3.5. Profiles of the Different Farmer Types

To describe the sampled farmers, we split them along two dimensions, the presence of animal husbandry in the farms' activities and whether the farmers adhere to organic farming standards. These splits were done because of the strong differences between these groups.

3.5.1. Conventional Farmers

The average conventional farmer in our study was a 41-year-old male. The average conventional farm contained a total area of 433 ha with arable land (297 ha) dominating other uses. The distribution of farm sizes was strongly leftward skewed, with 50% of farmers working on farms with less than 126 ha. In 79.5% of cases, farming included animal husbandry. The main animals held were cattle, hogs, sheep, and poultry. The number of farm animals also showed a strongly leftward skewed distribution with only a few farmers having several thousand animals.

The average conventional farmer believes that farmers are portrayed by society as the main perpetrators of GHG emission (mainly by the press and environmental organizations). This belief comes from various sources, with agricultural journals and the internet being the most important ones. The economic situation of conventional farmers is considered difficult, not allowing additional expenses or reductions in productivity, which would be necessary to reduce emissions. Consequently, when asked what would motivate him to reduce GHG emissions, subsidies or other economic advantages from GHG mitigation are rated highly, but public appreciation and pre-existing personal beliefs are rated higher still.

3.5.2. Organic Farmers

The average farmer employing organic methods (https://ec.europa.eu/info/food-farming-fisheries/farming/organic-farming) in our study is a 43-year-old male. He works on a 183 ha farm, which is significantly smaller than the average conventional farm. As with the conventional farmer, the largest proportion of land is used to grow crops (77 ha). In contrast to the conventional farmer, however, a similarly large portion of land is used as pasture (58 ha). Landownership is strongly leftward skewed, with 50% of farmers working on farms with less than 80 ha. The organic farmer is slightly more likely to keep animals on the farm than the conventional farmer (89.8%), but, as in the case of the conventional farmer, large herds are rare.

The organic farmer feels unfairly singled out by society as responsible for GHG emissions, a similar view to that held by conventional farmers. However, contrary to the conventional farmer, the average organic farmer believes in the ability of the individual and the farmer, in particular, to do something about climate change.

3.5.3. Farmers Combining Crop Cultivation and Animal Husbandry

The average farmer keeping animals in addition to cultivating crops is a 41-year-old male in our study. He keeps 1334 animals on his 358 ha farm. The distribution of both the number of animals as well as the size of the farm is leftward skewed, with the median farmer keeping only 230 animals on a 122 ha farm. The livestock of the average farmer consists of 22 horses, 46 goats, 157 sheep, 273 cows, 848 pigs, and 3865 poultry. A large fraction of farmland is used for animal keeping, 55 ha is used for fodder crops, and 54 ha used for pastures. Animal husbandry notwithstanding, the largest portion of the farm's land is used for crop cultivation (230 ha).

This type of farmer believes that society holds farmers responsible for the majority of GHG emissions. Conversely, public appreciation would strongly motivate him to reduce emissions, together with economic incentives such as subsidies or market benefits for climate-friendly products. Taxes or emission caps, however, are demotivating.

3.5.4 Farmers Cultivating crops Without Animal Husbandry

The average farmer focusing only on crop cultivation is a 42-year-old male. His farm size is 455 ha, 27.3% (98 ha) larger than that of the average mixed farm. As in the other groups, the farm size distribution is leftward skewed with the median farm taking up only 78 ha. The land is primarily used as arable land (320 ha) or for forestry (120 ha).

The crop farmer is less convinced that society primarily holds farmers responsible for GHG emissions and is less motivated by pubic appreciation, even though this is still important to him. Similarly to the animal keeping farmer, he would be motivated by subsidies or market advantages but can also be motivated by taxes.

4. Discussion

A changing climate poses a severe threat to agriculture and food production. Our results show that German farmers are aware of anthropogenic climate change and are already experiencing consequences. This finding is in agreement with previous studies conducted in Germany [8] and other regions, e.g., Wales [9], Swaziland [10], Ireland [11]; South Africa [12], and North of Europe and America [13].

While the majority of farmers perceive climate change as an important issue and see GHG reduction potential in the agricultural sector, only a few stated that they estimate GHG emissions on their farm. This suggests a lack of knowledge about adequate tools to calculate on-farm emissions at regular intervals. Information about such tools may enhance the willingness of farmers to actively reduce these emissions, to provide feedback on the success of the measures, and to broaden farmers' knowledge about agricultural GHG emission mechanisms. Available GHG tools to assess agricultural and forest practices include calculators, protocols, guidelines, and models [31,32]. Improvements of such tools may, however, be needed, as several existing GHG calculators show limited agreement on the magnitude of GHG emissions [33,34].

We investigated the decision-making for applying mineral fertilizers, a major source of agricultural GHG emissions, in depth [35]. Interestingly, more than 80% of respondents base their fertilization decision on personal experience, and less than a quarter use computer programs as support tools. The widespread adoption of computer-controlled feeding algorithms in German livestock production, however, proves that farmers are willing and able to use sophisticated computer algorithms if such algorithms lead to an increase in their economic net revenues. Adoption of sophisticated fertilization regimes, therefore, may require more reliable and user-friendly software and higher economic incentives for emission-friendly fertilizer management. In agreement with previous studies [11,12], our results suggest that most German farmers are willing to consider the adoption of climate-smart agricultural management methods provided these practices do not reduce their net farm revenues.

Our results indicate that German farmers' knowledge on agricultural emissions is moderate. Most of them do not know their on-farm GHG emission levels or means to account and monitor these emissions. Decisions on mineral fertilization are mostly made without considering the potential high nitrous oxide emissions. However, German farmers, and among them especially organic farmers, feel a general commitment to reduce their emissions and claim to be open to monitoring their GHG-related activities and to adopting climate-smart farming practices. A bottleneck thus stems the flow of information and knowledge from academia to the farmers [36,37]. In our survey, agricultural magazines are one of the most consulted information sources for German farmers and thus are an effective tool for raising awareness and conveying information about climate change, agricultural GHG emissions, and options to mitigate these emissions.

Overcoming knowledge and information gaps might encourage voluntary mitigation practices (compare [38]). However, our results indicate that farmers expect some type of acknowledgment or financial benefit for changing towards more climate-friendly farming styles. Studies confirm that improvement of certain agricultural practices could reduce both GHG emissions and increase productivity [16,39] and that economically best-performing farms emit relatively fewer greenhouse gases [40]. Technology-intensive changes such as the adoption of precision agriculture yet incur high investment cost, which could hamper their implementation [41,42]. A competitive advantage, such as an official label for agricultural products from climate-friendly management, which survey respondents across all farmer groups advocate, could offset additional costs through higher product prices.

While voluntary mitigation practices might contribute to the reduction of agricultural GHG emissions, ambitious mitigation targets require the inclusion of agricultural emissions in possible regulation schemes [21]. Options include, e.g., compensation payments for increased efforts, subsidies for climate-friendly farming styles, or taxes on emissions [43,44]. Regardless of the choice of policy option, precise information on GHG-relevant agricultural activities would be required. While 46.1% of respondents prefer on-farm information technology systems to estimate their GHG emissions, only 25% of farmers regularly use computer tools in their current business, indicating large potential for improvement. A number of companies offer whole-farm software with budgeting, fleet management, fertilizer management, and a plethora of other options, providing a convenient interface for tools estimating GHG emissions from agricultural activities [45]. These tools would have the additional advantage that single actions such as fertilizing one parcel of land on a certain day can be directly linked to changes in GHG emissions, providing valuable feedback information to farmers.

Our results indicate the German farmers prefer fewer contacts to authorities and do as many calculations on their own or with software providers. To provide a working system for subsidy payments, it is necessary to implement a standardized system of calculation as well as trustable software provided to the farmers. This can strengthen farmers' capabilities to reduce and verify GHG emission reduction. At the same time, such a provided tool or software could later be the base of emission calculations for governmental regulations [17].

We show that German farmers feel motivated to reduce their GHG emissions, but our work is subject to inevitable limitations. First, the presented results are statistically processed responses that were entered in an online survey. Participating farmers do not proportionally represent individual segments of German agriculture. Particularly, the share of organic farms, young farmers, and farmers with higher education in our survey is slightly above average. Second, all questions were formulated as closed questions to facilitate the analysis. However, closed questions may not yield true opinions and may hide confusion or misunderstandings. Third, the quality of this survey may be negatively affected by some general weaknesses inherent in surveys, particularly online surveys. These include possible dishonesty and hidden agendas of respondents, differences in understanding and interpretation, and lack of thorough responses. Lastly, we do not provide a statistical analysis of our results beyond the descriptive statistics. We tested a variety of methods but had to conclude that our sample size was too small to yield any meaningful results.

5. Conclusions

Our findings indicate a general willingness of German farmers to reduce GHG emissions but also that a lack of knowledge, time, and funds prevent most farmers from taking action. A solution to this issue could be targeted information and training campaigns in combination with appropriate policy instruments such as subsidies for climate-friendly farm management. We identified agricultural magazines as one of the currently most effective tools for disseminating new information on climate change, agricultural adaptation, and mitigation options to a broad farmer audience. German farmers would feel motivated to adopt climate-friendly farming styles if products were labeled accordingly and if they received subsidies and public acknowledgment for their effort. In the absence of regulation schemes for agricultural emission reduction through taxes or subsidies, personal motivation is yet the strongest motivation for voluntary emission reduction. Our findings are timely to inform experts and decision- and policy-makers on the upcoming development of accounting schemes for agricultural GHG emissions.

Supplementary Materials: The following are available online at www.mdpi.com/2073-445X/9/5/130/s1, Figure S1: Farmers' preferences for data collection for getting subsidies, Table S1: Sociodemographic data and agricultural operating information of survey respondents. SURVEYVARIABLES.csv and SURVEYDATA.csv: data and metadata of farmer survey.

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