



The Responsibility of Farmers, Public Authorities and Consumers for Safeguarding Bees Against Harmful Pesticides

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Abstract

The worldwide decline in bees and other pollinating insects is a threat to biodiversity and food security, and urgent action must be taken to stop and then reverse this decline. An established cause of the insect decline is the use of harmful pesticides in agriculture. This case study focuses on the use of pesticides in Norwegian apple production and considers who among farmers, consumers and public authorities is most responsible for protecting bees against harmful pesticides. The extent to which these three different groups consider themselves responsible and the degree to which they are trusted by each of the other groups are also studied. This empirical study involves both qualitative interviews with Norwegian apple farmers, consumers and public authorities and survey data from consumers and farmers. The results show that consumers consider public authorities and farmers equally responsible for protecting bees, while farmers are inclined to consider themselves more responsible. Farmers, consumers and public authorities do not consider consumers significantly responsible for protecting bees, and consumers have a high level of trust in both farmers and public authorities regarding this matter. This study also finds that a low level of consumer trust in farmers or public authorities increases consumers' propensity to purchase organic food, suggesting that those who do not trust that enough action is adopted to protect the environment take on more individual responsibility. This paper adds to the existing literature concerning the allocation of responsibility for environmental outcomes, with empirical evidence focusing specifically on pesticides and bees.

Keywords Pollinating insects · Bees · Responsibility · Pesticides · Consumers · Apple producers · Organic production · Norway

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Introduction

Several recent studies show that insects, including pollinating insects, such as bees and butterflies, are declining in diversity and biomass (Biesmeijer et al., 2006; Conrad et al., 2006; Dirzo et al., 2014; Hallmann et al., 2017). Although some recent studies (Van Klink, 2020) give a less dramatic impression of insect decline, there are good reasons to be concerned—not only because of the loss of biodiversity but also because pollinating insects are critical for the survival of a wide range of plants in nature and those used by humans for food. An estimated one-third of food production worldwide is at risk (IPBES, 2016). Therefore, urgent action must be taken to both stop the decline and restore populations of pollinating insects, including bees.

Land-use changes and pollution have been indicated as two of the more important factors (Sánchez-Bayo & Wyckhuys, 2019) driving the observed insect decline. In recent decades, agricultural intensification has had profound global effects in terms of both changing landscapes and increasing the use of pesticides, especially insecticides that have the greatest effects on bees. The prevention of further insect population decline inevitably entails keeping bee-harmful pesticide use at a suitably low level. However, for such prevention measures to be implemented effectively, someone must assume responsibility.

In this paper, the authors' main research question is as follows: what are the perceptions regarding who should assume responsibility for protecting bees and how should this responsibility be acted upon? This study contributes to the literature concerning responsibility for environmental outcomes in agriculture by considering the responsibility of the following three specific groups: (a) *farmers* who apply pesticides to their crops; (b) *consumers* who buy food products that may have been produced with pesticides that harm bees; and (c) *public authorities*, including both regulatory agencies and elected authorities. The extent to which farmers and public authorities are trusted to safeguard the wellbeing of bees is also considered. Apple production in Norway is used as the case study. The authors recognize that other groups, particularly pesticide manufacturers, may also be responsible for minimising any pesticide harm, but these groups are not a main focus in this study, as there are no pesticide manufacturers in Norway. Later in the paper, the literature on the responsibility of pesticide manufacturers will be reviewed.

Responsibility in relation to pesticide use has previously been investigated, i.e., Karlsson (2007), Drivdal and van der Sluijs (2021) and Hu (2020), and numerous studies have investigated perceptions regarding who is responsible for environmental challenges, such as climate change (see, for instance, Bickerstaff et al., 2008); Neuteleers, 2019; Schlenker et al., 1994). However, to the authors' knowledge, this study is the first to specifically examine the responsibility of consumers, farmers and public authorities in safeguarding bees against harmful pesticides.

The topics in this study include how the three identified groups (farmers, consumers and public authorities) hold each other responsible for the disappearance

of bees and the extent to which they consider themselves and their group responsible. In addition, the study questions address trust relations, which are relevant for accountability. We also estimated whether consumers' attitudes regarding responsibility and trust affect their willingness to take action to protect bees, i.e., in this case, their propensity to purchase organic food. The first part of this paper reviews the relevant literature on insect decline and responsibility. In the next part, the methodology and the results of the qualitative and quantitative studies of farmers, consumers and public authorities in Norway are detailed. Finally, the authors briefly discuss the research questions based on the findings and analyses.

Background

Over the last couple of decades, the disappearance of honeybees has been observed, especially in North America. This phenomenon has been partly ascribed to colony collapse disorder, and various causes of this disorder have been proposed, such as pesticides, pathogens, parasites and habitat degradation (Cox-Foster et al., 2007; Henry et al., 2012). Long-term studies in several countries have shown drastic changes in the community of bumblebees (Bommarco et al., 2012; Cameron et al., 2011). Furthermore, recent studies have shown that wild bees are often more important for many crops than are domesticated honeybees (Blitzer et al., 2016; Holzschuh et al., 2012).

Neonicotinoids constitute a group of systemic neurotoxic insecticides that are used against several pest insects. Over the last decade, numerous studies have revealed the sub-lethal effects of neonicotinoids on pollinating insects. These sub-lethal effects on bees include reduced immunocompetence (Brandt et al., 2016), reduced colony growth and reproduction (Rundlöf et al., 2015) and an impairment in the ability to remember the location of their hives (Henry et al., 2012). Ultimately, these harmful effects reduce the bees' ability to provide pollination services to crops, such as apples (Stanley et al., 2015).

The EU sustainable use directive (Directive 2009/128/EC) adopted by Norway in 2015 makes integrated pest management (IPM) mandatory for crops used in food production. According to the guidance of IPM, chemical insecticides should only be applied when deemed necessary according to a defined set of principles (Barzman et al., 2015), such as when farmers observe pest insects over certain damage thresholds or when decision support systems (e.g., forecast models) predict attacks of pest insects. In Norway, several specific regulations restrict the use of pesticides. For instance, there are often restrictions on the number of times that a pesticide can be applied during the season or how close to harvest pesticides can be applied. There are also restrictions that prohibit insecticides from being sprayed over flowering vegetation or at certain times of day to avoid doing so when bees are present in the areas to be treated.

Farmers in Norway are obliged to train and become certified to apply any pesticides. The Norwegian Food Safety Authorities (NFSA) oversee the training and certification of farmers who use pesticides. The NFSA are also in charge of controlling safe pesticide application. Random on-farm checks are carried out during which

the NFSA review the pesticide protocols that the farmers are using. The NFSA also carry out national surveys that check harvested apples for pesticide residues. Fruit and vegetable wholesalers also carry out pesticide residue checks in Norway.

The Question of Responsibility

Since bees and other pollinating insects are of paramount importance for both the natural world and farming, it is crucial to address the question of where responsibility lies in terms of pesticide use. In this study, we examine the following three groups that can be considered to have key responsibility for preventing the decline in bee populations caused by pesticide use in food production: *farmers*, *consumers* and *public authorities*.

According to Karlsson (2007), responsibility for an unwanted event can be ascribed to someone who is culpable of contributing to it (the Culpability Principle) and who has the capacity to do something about it (the Capacity Principle). Someone can also be considered held responsible if a clear set of prescriptions to which the actor is bound applies to the event in question (Schlenker et al., 1994). In the case of pesticides and bees, *farmers* clearly play a crucial role in preventing pesticides from causing harm to bees, as they are the ones who apply the pesticides and thus have the ultimate control over the event (Mohring et al., 2020). Farmers also have a clear set of rules and regulations regarding pesticide use that they are expected to follow. However, the responsibility of farmers extends beyond simply following regulations without question, as there are no sanctions if farmers use the maximum amount of pesticides allowed instead of only applying pesticide when it is very much necessary and when harmful insects are indeed present in their crops.

Farmers' use of pesticides should be based on knowledge and competence, and a lack of these skills can be a cause for the overuse of pesticides (Hu, 2020). Moreover, farmers may make ethical considerations that are based on, for instance, the extent to which they believe the potential damage caused by pesticide use is acceptable (Sulemana & James, 2014).

It is also possible to argue that *consumers* have responsibility for bees. Consumers buy food produced with pesticides that may have harmed insects, and if they specifically do not purchase these products, farmers will also stop using bee-harmful pesticides. However, an average consumer usually has limited detailed information regarding which pesticides are applied and their effects on health or the environment. Moreover, even those who have such knowledge are unable to determine, when buying apples, which pesticides were used and how much was applied. However, it is possible to buy organically certified apples. An organically certified farmer is required to not use any chemical synthetic pesticides, and in apple production in Norway, only specific plant protection products can be used. When consumers request and purchase organically labelled products, the market for organic products increases, and more farmers will be incentivized to stop using chemical synthetic pesticides. According to Eden (1993), whether individuals consider themselves responsible for taking care of environmental problems depends on whether they believe that they can have an impact through pro-environmental behaviour and the

extent to which they can choose this behaviour. Similarly, Bickerstaff et al. (2008) found in their study based on focus group interviews that the participants expressed a stronger sense of responsibility when the risk problems were framed in terms of choice and personal control than when the problems were framed as demanding collective or institutional responses.

For consumers to be responsible for bees and change their purchasing behaviour accordingly, they must be aware of the consequences of their purchases (Johnston & Szabo, 2011), which, in turn, depends on whether relevant information is readily available (Wells et al., 2011). However, even if such information is available, many consumers feel confused due to conflicting information regarding food safety and sustainability (Johnston & Szabo, 2011; Moisander, 2007). Furthermore, ethical aspects are only one of many reasons for making a shopping choice; other aspects, such as cost, comfort and habits, also play an important role, and consumers rarely have the time, energy or ability to make food choices based on reflective processes that aim to achieve social and environmental justice goals (Johnston & Szabo, 2011).

The very idea of “green consumption” as a solution to environmental problems has been criticized for being a part of a neoliberal political culture in which political decision-making is replaced by market rationality and stakeholder responsabilisation (Burchell, 1993; Shamir, 2008). The neoliberal responsabilisation of consumers downplays the pro-environmental roles of government and businesses and might “undermine a collective sense of civic responsibility and state regulation of ecological issues” (Johnston & Szabo, 2011). Organic certification and labelling can make it easier for consumers to choose ethically but can also represent a devolution, a transfer of regulatory control from public authorities to “the site of the cash register”. How broad public benefits can be result from these individual consumption decisions is highly questionable (Guthman 2007).

Several authors studying individuals’ responsibility for mitigating climate change claim that individuals’ duty is not to make lifestyle choices to reduce their environmental impact but, rather, to promote collective arrangements (Caney, 2014). This perspective points to *public authorities*, who, when there is an existential threat, such as climate change or the massive loss of bees, have a responsibility to protect people and the power to ensure that agents comply with their first-order responsibilities (Caney, 2014). By electing their politicians, a country’s citizens entrust the public authorities with a mandate; thus, the authorities are considered morally and legally responsible to the citizens (Pellizzoni, 2004). Responsibility is strongly linked to the notion of trust, and a perceived failure of responsibility can result in a loss of trust in organisations and institutions (Bickerstaff et al., 2008).

Finding and interpreting information about pesticides may be difficult non-specialist individual citizens and farmers. Compared with farmers and consumers, public regulatory agencies have a better grasp of the knowledge base and thus can make informed judgements when prescribing regulations, although challenges related to research gaps and diverging interpretations of scientific results still exist (Milner & Boyd, 2017; Robinson et al., 2020).

The disappearance of bees can be shown to exemplify how a neoliberal and depoliticized ‘laissez-faire’ market economy is failing to deliver an optimal outcome for society. To “moralize” markets through the responsabilisation of stakeholders is

insufficient (Shamir, 2008), and regulatory intervention by public authorities is necessary. With collective action problems, where so-called free riders have incentives to not cooperate for the benefit of all, there is a need for public institutions to enforce such cooperation (Neuteleers, 2019). In most countries, regulations governing pesticide use have been implemented to prevent unacceptably harmful pesticides from being applied to the degree that they cause fatal damage to pollinating insects. Regulation for environmental protection is in place in many different areas, and a wide range of regulatory techniques are used, such as certification schemes, education and information provision, and may include voluntary agreements and self-regulation (Lofmarck et al., 2017). Regulations are also implemented at higher levels such as the EU, and international bodies such as the FAO, WHO and WTO, who have developed standards and set maximum use and residue limits for pesticides used in food and feed.

Notably, although this study focusses on the responsibility of farmers, consumers and public authorities, other stakeholders also affect the wellbeing of bees, particularly pesticide manufacturers. Before authorisation decisions for new pesticides are made by regulators, pesticide companies have to provide scientific evidence that they do not cause unacceptable harm (Hamlyn 2019). This is done with scientific assessment studies that pesticide manufacturers have funded (Robinson et al., 2020). This position gives these manufacturers a strong responsibility in addition to the responsibility they have to provide label information regarding pesticide dosage for safe use (Hu, 2020).

Pesticide approval procedures have been criticized because of potential sources of conflicts of interest (Storck et al., 2017). In evaluations of pesticide risks, both social and ecological uncertainty and data gaps are present (Drivdal & van der Sluijs, 2021, Hamlyn 2019), and there is concern regarding the lack of transparency in pesticide regulation processes. Scientific misconduct is frequently found in pesticide risk assessments, but misconduct is generally difficult to identify, denounce or stop (Robinson et al., 2020). Furthermore, although regulations are usually formulated at the international level, both pesticide governance and vigilance widely differ at the country level (Milner & Boyd, 2017), and the power and responsibility of pesticide manufacturers are stronger in countries that are less democratic, with less developed legislative and executive institutions (Hu, 2020).

Methodology

In this study, a mixed-methods approach was used to generate both qualitative and quantitative data. The data collection and storage methods were approved by the Norwegian Centre for Research Data (NSD) and were compliant with ethical and legal privacy regulations.

The qualitative data were generated from semi-structured interviews with six apple farmers, including five men and one woman, in the three main apple-producing regions in Norway (two producers from Hardanger, Sogn and Telemark each). The selection of farmers was performed with the help of the Norwegian agricultural extension service (NLR) such that they represented different age groups, genders,

levels of experience and types of practice. Interviews were also conducted with two employees at the NFSA who had responsibilities related to pesticide regulations and use. Two focus group interviews with consumers were conducted; the participants were recruited by the market research company Norstat and represented members of the public. Each focus group included eight participants, and each interview lasted approximately two hours. In one group, the participants were aged between 18 and 35 years, and in the other group, the participants were aged between 36 and 70 years. The qualitative material was recorded, transcribed and coded with the software NVivo.

The quantitative data were gathered from a survey of Norwegian apple farmers who were recruited from fruit warehouses in Norway. Of the 460 farmers who received the questionnaire, 185 replied, but not all farmers replied to all questions. An internet-based survey of 1010 consumers was also carried-out. The consumer respondents were recruited through the market research company Norstat. For this survey, Norstat ensured that the respondents were representative of the Norwegian population in terms of location, age and gender.

The quantitative data were collated, summarized and analysed using an ordinary least square regression analysis of the data from the consumer survey using the software STATA.

Qualitative and Quantitative Results: Responsibility and Trust

The Responsibility of Farmers

When asked who they thought had the greatest responsibility for ensuring that pesticides are used safely, the farmers, employees of the NFSA and participants in the consumer focus groups quickly indicated farmers. In particular, the farmers expressed that they had a great degree of responsibility. One farmer (female) explained that farmers are responsible because they are the ones who use the pesticides and that “you choose yourself whether you want to spray or not”. Another farmer (male) claimed that “as long as pesticides are allowed, it is the farmer’s responsibility to follow the criteria and rules that are set up; so, at the end of the day, it is the one using the pesticides that has the responsibility”. Another farmer expressed the opinion that when pesticides cause problems, it is because mistakes were made by farmers and that it is not the fault of the NFSA.

This perspective is in line with what an NFSA employee described, i.e., the authorities are responsible for ensuring that pesticides are safe to use, but farmers are responsible for using them safely. Another NFSA employee (female) expressed that those applying pesticides have duties and must fulfil certain criteria and that the NFSA expect the farmers to “familiarize themselves with the various pesticides and how they should be applied in a safe manner”.

The participants in the consumer focus group discussions also considered farmers responsible for the application of pesticides. In line with the farmers interviewed, one consumer (male, 54) explained that “it does not matter what the NFSA does or what the market demand is, if the farmer misuses the pesticides,

he is the one who is going to cause damage to the environment". The consumer groups also expressed that they had confidence in farmers. One participant (female, 28) said she trusted farmers because among all different professions, farmers are the ones who "think of the generations that will come after them". Other participants believed that farmers would not use pesticides unnecessarily as this would be against their economic interest and would be throwing "money out of the window". However, some participants expressed that it was rather the regulatory system that enabled them to trust farmers. Some noted that farmer activities were controlled by the NFSA and wholesalers, preventing deviations from the regulation. Furthermore, some consumers were uncertain whether the control system really detected "rotten eggs" and what type of sanctions a farmer would face if caught misusing pesticides. Although they believed that farmers would keep their pesticide use within the rules and regulations, some consumers still thought farmers would maximise profits at the expense of the environment if they could within the regulations.

I trust that the farmer does what he should within the regulations and laws. So, if he can spray with something and it is efficient for him, I think he will do it even if it may be harmful to the environment. Male consumer (63).

One participant wondered to what extent farmers were forced to make short cuts because of time constraints; others wondered how easy it was for farmers to be well informed about all different types of pesticides and how they should be used.

All farmers interviewed expressed that they would only apply insecticides when it was strictly necessary. One of the main reasons was the fear of killing beneficial insects, which could lead to a build-up of populations of other harmful insects that cause yield damage in later years. This finding reveals an economic motivation for reduced pesticide use and one that requires knowledge regarding the effects of pesticides on insect fauna and a longer-term perspective.

When you are spraying, you think about not killing insects, sparing the bees and other beneficial insects; so, you do it late or early as a night spraying; you don't do it in the middle of the day (...). You know that the toxin doesn't separate between the different insects. It's the harmful insects that you want to do something about. Farmer (male), Hardanger.

Questions regarding trust in farmers were also raised in the consumer and farmer surveys. The question asked was "To what extent do you think the following statements are correct?", followed by three different statements. The statements and results are shown in Fig. 1.

The results show that most consumers trust that Norwegian apple farmers follow the regulations concerning pesticide use, attempt to minimize the use of chemical pesticides, and have good knowledge of pesticides. Respondents who believe that farmers attempt to minimize pesticide use are fewer than those who believe that farmers have good knowledge of pesticide use and follow the regulations, but the difference is not large. The apple farmers expressed an even greater trust in each other's competence and propensity to follow regulations and minimize pesticide use.

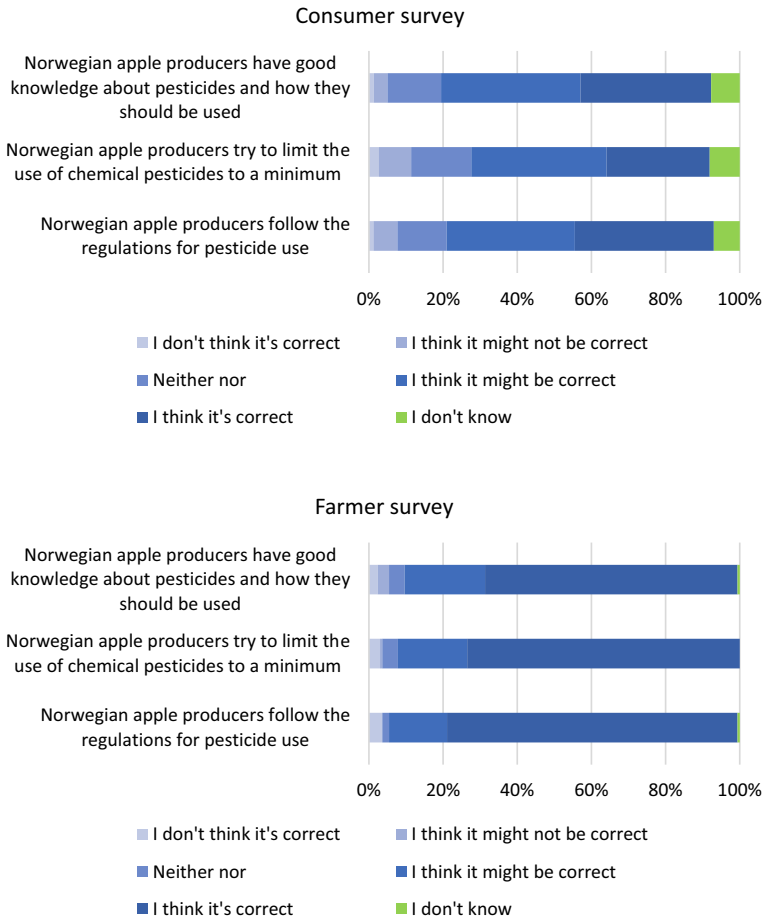


Fig. 1 Consumer (N = 1010) and farmer (N = 166) trust in Norwegian apple farmers' use of pesticides

The Responsibility of Consumers

In the interviews, there was not always a spontaneous mention of consumers' responsibility, and with the farmers and NFSA employees, it was necessary to ask specifically about consumers. However, once the topic was introduced, all groups mentioned consumers' possible influence on pesticide use through the purchase of organic food. The consumers emphasised the responsibility of consumers more than the other groups, and one participant stated the following:

I think the ultimate power is with consumers. If we change our behaviour, we will force the farmers to change their behaviour. If we only buy organic, there will only be organic. Female consumer (45).

The idea that growth in demand for organic apples can also lead to innovation in new production methods without chemical pesticides was raised. One consumer voiced that in the same way that the popularity of electric cars had accelerated the development of car batteries, people's wish to reduce pesticide use could have a similar effect on apple production.

Among both farmers and NFSA employees, there was mention of how consumers can influence pesticide use by purchasing food produced in Norway since regulations for pesticides in Norway are sometimes stricter than those in countries from which food is imported, particularly those outside the EU. Some farmers also mentioned consumers' preferences for apples with a perfect appearance. One farmer (male) said, "Of course, when they want to have this kind of A4 apple all the time, to manage that, we have to apply some pesticides". However, in this farmer's opinion, the demand for perfectness was also to some extent the responsibility of wholesalers and retailers.

The consumer focus group participants noted several shortcomings in ascribing responsibility to consumers. The lack of information regarding pesticides was often mentioned along with the fact that people in general do not know about problems with pesticides or the potential advantages of organic production.

The consumers also argued that controlling pesticide use cannot be made dependent on people's purchasing behaviour because "people always buy what is the cheapest". Furthermore, as one participant noted, consumers already have many different issues to consider when shopping, and it was considered too much to ask consumers to take responsibility for pesticide use. Some focus group participants, therefore, expressed that it is better to reduce pesticide use through the legal and political system.

People have enough with themselves and their wallet; so, maybe Big Brother Government has to force people to do what is the best for everyone (...) There is something about the big common decisions, administrations in our society, it isn't fair to put that on the shoulders of each and every one; someone up there needs to take responsibility for that. Female consumer (32).

This line of thought indicates that ordinary citizens' influence on pesticide use is based on placing pressure on public authorities, such as through the voting system. A central reason to have a democratically elected public authority is to be able to make collective decisions for the common good.

There is something about that in each country, we choose someone to represent us (...), because that the bees survive is for our own good, and I trust that those who govern do what is for our best as long as they are elected by us. (...) You hope that the government takes responsibility because they have the power to do it, to install the large measures. Female consumer (28).

Here, the participant expressed that it is the task of elected leaders to do what is good and wished for by their voters. Therefore, to some extent, the responsibility still lies with the individual but as a citizen of a community with voting power rather than as an individual consumer with buying power.

The Responsibility of Public Authorities

The responsibility of the public authorities was acknowledged by all groups interviewed in our study. In the focus group interviews, the authorities were considered uniquely placed to gain an overview of the knowledge needed to formulate adequate regulations regarding pesticide use. In addition, they have the power to place constraints on farmers and pesticide manufacturers and sanction deviations from rules and regulations.

The way I understand it, the only ones who can do something efficiently are the ones who have the overview or control over the entire business, hence the public authorities. (...) One particular farmer can spray less, but he doesn't control the other farmers. And, we can buy organic, but that's not all the others. Male consumer (63).

The NFSA employees described their responsibilities for approving only pesticides that were considered safe and for writing pesticide use instructions that farmers can easily understand, thus ensuring that they would be applied in safe amounts. These responsibilities were also noted by some farmers, who emphasised the authority's responsibility for giving them these instructions, such as instructions regarding the time periods when pesticides are safe to use.

Several participants in the consumer focus groups expressed a high degree of trust in the public authorities and expressed feelings of being "looked after" by the government, which was ensuring that all food sold in Norway was controlled and safe to eat.

I think that we live kind of in a «Nanny State». It's a bit like Big Brother is taking care, Norway is taking care: we can regulate that, you can take that power away from me, take care of that, that's fine. Female consumer (32).

Although they had the feeling that the public authorities were ensuring that everything was safe, some consumer participants also felt that this was slightly naïve and that "we as well can be surprised" or that "history shows that the authorities come running breathlessly after". With reference to a current event of contaminated drinking water in a nearby municipality, one participant (male, 57) asked, "Why should this be different?"

The survey of both consumers and farmers contained questions regarding trust and confidence in the public authorities' work in ensuring safe pesticide use. The results are shown in Fig. 2. The question asked was "To what extent do you trust that the regulations in Norway ensure that the use of pesticides safeguard...", followed by various environmental and health aspects that they could select.

The data show that the level of trust is high among both consumers and farmers but substantially higher among farmers. Consumers place slightly less trust in regulations to safeguard bees and other beneficial insects compared with consumer health, producer health, water quality and soil life.

In addition to farmers, consumers and public authorities, other stakeholders were also identified as responsible for safe pesticide use. It was noted that

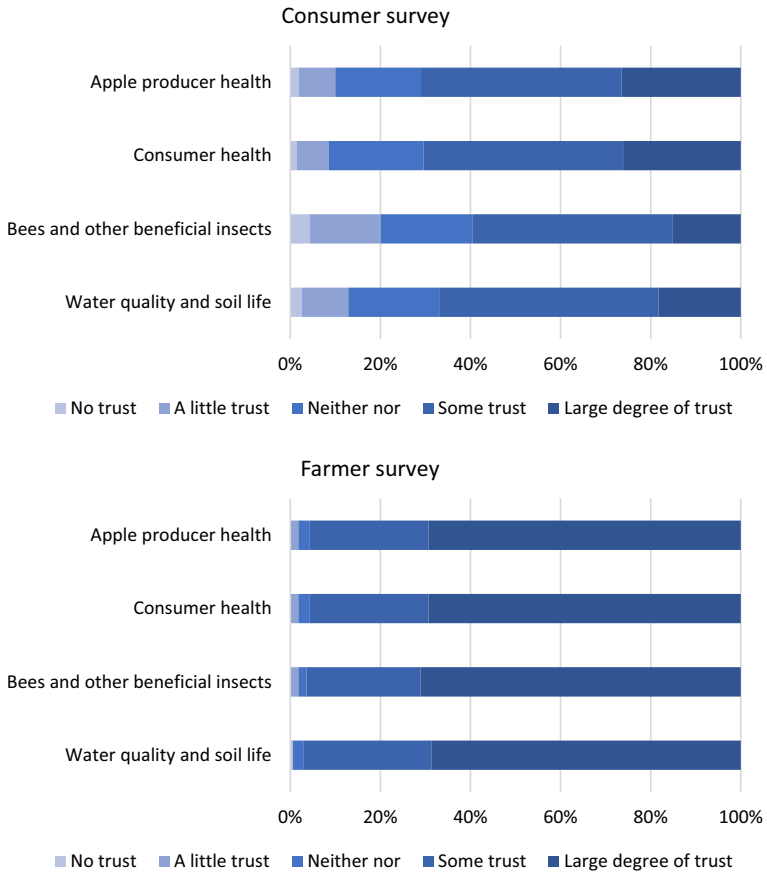


Fig. 2 Consumer (N=1010) and farmer (N=166) survey answers regarding the extent to which they trust that the regulations in Norway ensure that the use of pesticides safeguard health and environmental aspects

pesticide manufacturers, importers and wholesalers exert some control over farmers. Some consumer focus group participants noted the responsibility of researchers to discover the unintended and potentially harmful effects of pesticides. An NFSA employee remarked that the agricultural advisory extension service, which is the most important source of information for the farmers in Norway, has an important responsibility. Finally, one farmer also expressed that wholesalers had a responsibility to not price organic apples too high, making them too expensive to purchase.

Survey Results: Degree of Responsibility

In the questionnaire surveys, both farmers and consumers were asked who they believed had the most responsibility to ensure that pesticides do not harm bees. The question of responsibility was first posed as an open question. Of the 152 apple farmers who answered, only six said something other than “farmer”, “producer” or similar. Eleven answered “farmer” along with someone else, such as public authorities or pesticide producers. No respondent used the word “consumer”. This result indicates that most Norwegian apple farmers first and foremost consider themselves the main stakeholder for responsible pesticide use.

When the question was asked openly in the consumer survey, the answers were much more varied, with almost as many writing “public authorities” as “farmers” or equivalent. Only 27 of the 1010 respondents used the word “consumer”, which was mainly included along with another stakeholder.

The next survey question inquired about the degree to which public authorities, farmers and consumers were responsible for ensuring that pesticides do not harm bees. The results are shown in Fig. 3; 86% of the consumers thought public authorities were responsible to a large or a very large degree, while 88% said the same of farmers. Only 28% thought consumers had a responsibility to a large or a very large degree.

The answers of the farmers were quite different. A much larger share of the respondents (38%) did not think consumers had any responsibility, and only 3.6% thought consumers had a responsibility to a large or a very large degree. In contrast to consumers, farmers consider themselves to have a higher degree of responsibility than public authorities.

When asked to rank the responsibility of the three groups from 1 to 3 (Fig. 4), 58% of the consumers ranked public authorities as the most responsible, while 41% ranked farmers first. Only 2% ranked consumers as the most responsible. In the farmer survey, 45% ranked public authorities first, while 51% ranked farmers first, and 4% ranked consumers first.

The results show that consumers are considered as far less responsible for pesticides harming bees than public authorities and farmers. Farmers and public authorities are regarded as highly responsible by both consumers and farmers, but farmers considered themselves more responsible than public authorities. When asked to rank them, a larger share of the consumers placed public authorities before farmers, whereas in the farmer survey, more ranked farmers before public authorities.

These results indicate that it is difficult to determine who is considered to have more responsibility, i.e., public authorities or farmers. However, consumers are clearly considered the least responsible, especially by farmers. This finding indicates that there is limited support for the neoliberal standpoint that consumers should carry the responsibility for environmental outcomes through their purchases. The results also show that apple farmers in Norway have strong feelings of responsibility for ensuring that pesticide use does not harm bees.

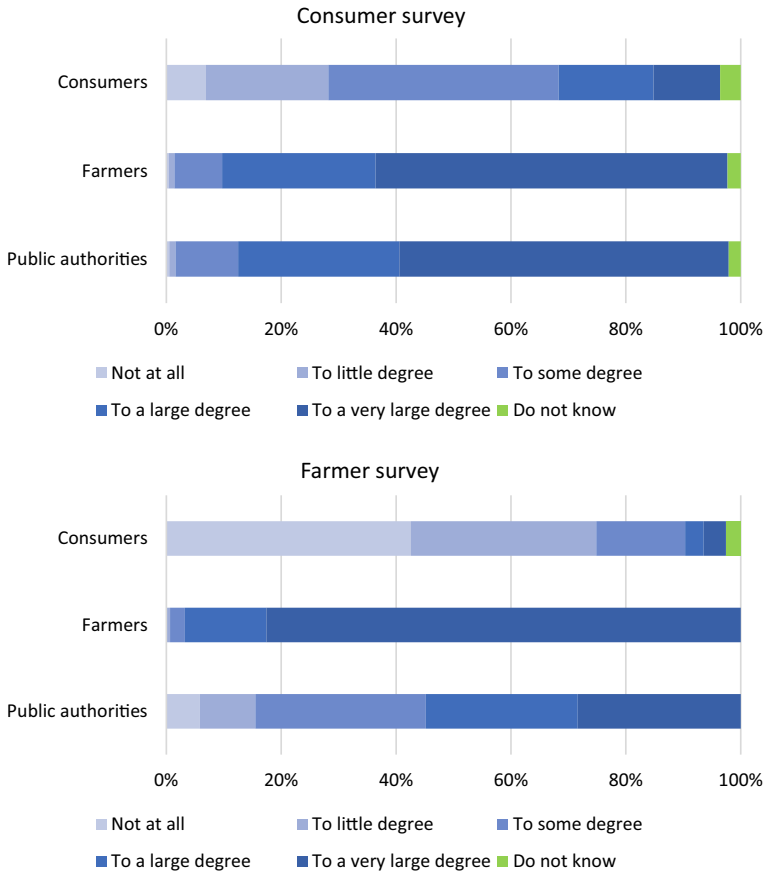


Fig. 3 Consumer (N = 1010) and farmer (N = 155) survey results regarding the extent to which they think consumers, farmers and public authorities have a responsibility to ensure that pesticides do not harm bees

Propensity of Consumers to Purchase Organic Food

The survey data were used to perform an ordinary least square (OLS) regression analysis to study the effect of attitudes regarding trust and responsibility on the propensity for consumers to purchase organic food. Purchasing organic food is a concrete action that consumers can take to reduce pesticide use, and the aim of the study was to determine whether this action may be influenced by feelings of responsibility or, more precisely, whether attitudes regarding the responsibility of public authorities, consumers and farmers and trust in farmers and public authorities influence the inclination to purchase organic food.

In the analysis, the dependent variable was frequency of purchasing organic food or food known to have been produced without the use of chemical pesticides. The independent variables are shown in the appendix Table 2, which also provides the summary statistics.

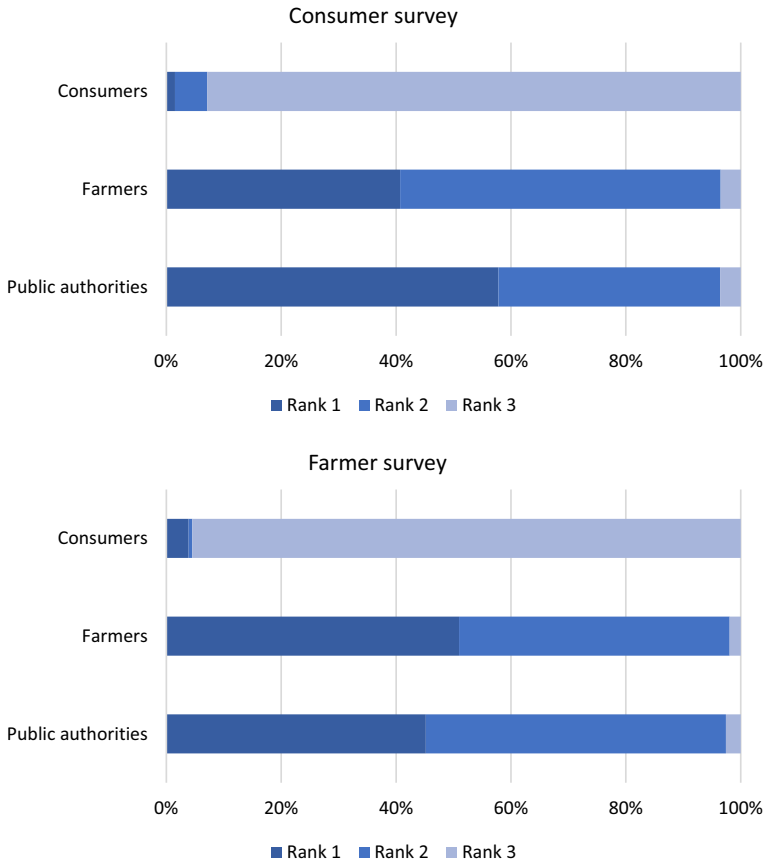


Fig. 4 Consumer (N=1010) and farmer (N=166) survey results regarding who they believed has the largest responsibility

The mean frequency of organic purchases was quite low. Only 5% of the respondents said that they purchase organic food “very often” or “always, if available”, whereas 32% answered “never” or “seldom”. Notably, taste was the most important factor when buying apples, but safety was almost equally important. Price and environmentally friendly production methods had the same average, which was significantly lower than of safety and taste. Table 1 shows the results of the OLS regression analysis.

The results show that the propensity to purchase organic food decreases with increased trust in public authorities and farmers, whereas it increases with the degree to which the respondents think that consumers are responsible for ensuring that pesticides do not harm bees. It is not affected by attitudes regarding the responsibility of farmers and public authorities. The frequency of organic purchases is also not significantly affected by the extent to which price, taste and safe food are important for a respondent when buying apples, but the more the respondents’ value that the

Table 1 OLS regression results. Frequency of purchasing organic food as dependent variable

Variable name	Coefficient	Significance level	Standard deviation
Trust in authorities	-0.11	*	0.04
Trust in farmers	-0.10	**	0.04
Attitude regarding consumer responsibility	0.10	**	0.04
Attitude regarding farmer responsibility	-0.03		0.06
Attitude regarding authorities' responsibility	0.06		0.05
Importance: price	-0.06	°	0.04
Importance: taste	-0.08		0.06
Importance: safety	0.09		0.06
Importance: environment	0.57	***	0.04
Education level	0.08	*	0.03
Age	-0.01	*	0.002
Gender	0.17	*	0.08
Income	-0.001		0.002
Rural/urban	-0.09	**	0.03
Children yes/no	0.16	°	0.09
Constant	1.80	***	0.51
R ²	0.322		
Number of observations	896		

Significance levels: '***' denotes $p < 0.001$, '**' < 0.01 , '*' < 0.05 ° < 0.1

apple was produced in an environmentally friendly way, the higher the propensity to purchase organic, and this correlation is very strong. Respondents with a higher education level, female respondents and more urbanized respondents have a higher propensity to buy organic products. The frequency of buying organic food decreases with age but is not significantly affected by income or having children. The results indicate that buying organic food, to some extent, is a choice made by those who do not trust that public authorities and farmers are taking their responsibility seriously enough regarding environmental protection and who believe that consumers have a responsibility for environmental problems, such as the disappearance of bees.

Discussion

Farmers, consumers and public authorities all have an influence on bee disappearance caused by pesticide use, and therefore, all these groups hold a responsibility in some form. The results of this study show that both consumers and farmers feel responsible, but farmers feel much more responsible than consumers. Furthermore, both consumers and farmers ascribe strong responsibility to public authorities, and it is difficult to deduce from our study which of the two, i.e., farmers or public authorities, is regarded as the most responsible for protecting bees. However, clearly, consumers are ascribed very limited responsibility.

In her study of responsibility for safe pesticide use in developing countries, Karlsson (2007) found that there are two opposing assumptions. The first assumption is that all pesticides pose a risk, and thus, the responsibility lies in public authorities and pesticide-producing companies. The second opposing view is that all pesticides are safe if they are used as prescribed, and thus, the responsibility is on farmers. One reason why our survey results do not identify one main responsible actor could be that the respondents have different perceptions regarding the risks related to pesticides and the extent to which they are safe when used as prescribed. The fact that most farmers in our survey noted their own responsibility in the first, open question indicates that they adhere to the second view, i.e., pesticides are safe when used as prescribed. However, when public authorities were mentioned specifically, many farmers seemed to be reminded that this stakeholder also has an important responsibility.

Different perceived risks regarding pesticides can partly explain the results of the OLS regression analysis, which showed that the self-reported frequency of purchasing organic food is higher among consumers with a low trust in farmers and public authorities. This result indicates that for some consumers, the risks posed by pesticides are high, and they do not trust that farmers and public authorities are doing enough to prevent damage. These consumers ascribe responsibility to themselves as individuals and take action accordingly by purchasing food free from chemical synthetic pesticides. These consumers can be considered acting according to the position described by Neuteleers (2019), i.e., when the required level of justice is not realised by means of institutions, we have a duty to fill the gap through “actions in our personal lifestyle”. Our results confirm that only a small proportion of Norwegian consumers purchase organic food on a regular basis. This finding could indicate that consumer willingness to take responsibility is low, which contrasts the neoliberal doctrine to leave the fate of bees in the hands of the market forces. The results could also be a sign that many Norwegian consumers do not assume this responsibility because their trust in institutions is high. It could be that they do not think that it is necessary to purchase organic food because the health and environmental standard of conventional food is “good enough”, which is in line with Kvakkestad et al. (2018). This finding is confirmed by the results showing that most respondents trust that Norwegian apple farmers and public authorities safeguard environmental and health outcomes.

It is beyond the scope of this study to judge whether enough is indeed being performed to prevent harm to bees from the pesticides that are being used in Norway. Several studies from other countries and at the international level find that the pesticide regulation systems are flawed and that pesticides that can cause harm to humans, animals and the environment have been authorised (Drivdal & van der Sluijs, 2021; Hu, 2020; Milner & Boyd, 2017; Robinson et al., 2020). However, there are also many examples of how public authorities, at different levels, have taken measures to safeguard bees against pesticides. Pesticides that are dangerous to bees have on several occasions been banned entirely, such as the recent bans of neonicotinoids. Furthermore, the EU Directive on IPM has made it compulsory for all farmers to think more critically about their pesticide use and prioritize preventive measures. Public authorities have the power and, therefore, a responsibility to take

such measures and softer measures, such as providing information to farmers regarding the adverse consequences of pesticide use and alternative, less harmful methods for pest control, such as biological control measures (Kvakkestad et al., 2020).

The public authorities' ability to act and influence explains why they are considered highly responsible for bees, but they share this responsibility with farmers. Farmers apply pesticides to their plants and make individual decisions regarding what, when, how and how much to apply. The control that public authorities can exert over farmers is limited, and farmers are entrusted to consider their own responsibility and act accordingly. Therefore, it is reassuring to find that the apple farmers who answered this survey almost unanimously identified themselves as the main party responsible for safe pesticide use in the first, open question. It remains to be determined whether the same attitudes are found among producers in other sectors and other countries.

In conclusion, ensuring that pesticides do not harm bees is primarily a duty shared by public authorities, who are responsible for ensuring safe pesticide regulations and information, and farmers, who are responsible for following labels and advice. Allowing consumers to carry full responsibility for bees will never be efficient, but some consumers may still take responsibility by purchasing pesticide-free food. One could also say that if other institutions are failing to fulfil their responsibility for bees, individuals have a moral obligation to do so. As citizens, according to (Rawls, 1999), consumers have a duty to obey just institutions and promote just institutions not yet established. Promoting such just institutions can be achieved through voting for responsible politicians and forming part of a public opinion that signals that protecting the bees is a priority, even if it implies extra costs for society. Purchasing organic food can signal the importance of pesticide reduction to producers and public authorities, but this should not take focus away from the importance of acting responsibly as citizens taking informed collective action through public authorities.

Appendix

See Table 2.

Table 2 Summary statistics variables used in analysis (N = 896) (“Do not know” answers are excluded)

Variable name	Question	Mean	Std. dev	Min	Max
Frequency organic purchasing	How often do you buy organic food, or food you know has been produced without use of chemical pesticides? (1: “never” - 7: “always, if available”)	3.3	1.3	1	7
Trust authorities	To what extent is the following statement correct: ‘I trust that the authorities make sure that producing the food I eat has not caused harm to the environment’? (1: “not at all correct” - 5: “completely correct”)	3.7	1.0	1	5
Trust farmers	To what extent do you think the following statement is correct: ‘Norwegian apple producers try to limit the use of chemical pesticides to a minimum’? (1: “I think it is not correct” - 5: “I think it is correct”)	3.9	1.1	1	5
Attitude consumer responsibility	To what extent do you think consumers have a responsibility to ensure that the use of pesticides do not harm bees (1: “not at all” - 5 “to a high degree”)	3.0	1.1	1	5
Attitude farmer responsibility	To what extent do you think farmers have a responsibility to ensure that the use of pesticides do not harm bees (1: “not at all” - 5 “to a high degree”)	4.5	0.7	1	5
Attitude public authorities responsibility	To what extent do you think public authorities have a responsibility to ensure that the use of pesticides do not harm bees (1: “not at all” - 5 “to a high degree”)	4.6	0.8	1	5
Importance: Price	How important is price when you are buying apples (1: “not important” - 5: “very important”)	3.4	1.0	1	5
Importance: Taste	How important is taste when you are buying apples (1: “not important” - 5: “very important”)	4.6	0.6	1	5
Importance: Safety	How important is it that the apple is safe to eat when you are buying apples (1: “not important” - 5: “very important”)	4.5	0.7	1	5
Importance: Environment	How important is the following when you are buying apples, that the apple has been produced in an environmentally way (1: “not important” - 5: “very important”)	3.5	1.0	1	5
Education level	1 is secondary school and 5 is “more than four years at university level”	3.2	1.2	1	5
Age		48	17.9	18	91
Gender	Male:0 Female:1	0.5	0.5	0	1
Income	Household income divided by number of adult household members (in 10,000 NOK)	9	12	0.3	50
Rural/urban	Where do you live? 1: Oslo (the capital and largest city in Norway)—6: “Rural are with less than 2000 inhabitants”	2.8	1.2	1	5
Children yes/no	Have children under 18 living in the household (0: no, 1: yes)	0.3	0.5	0	1

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Data Availability The data material from the consumer survey can be made available upon request. The data from the producer survey are confidential.

Declarations

Conflicts of interest The authors declare to have no conflict of interest.

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