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Farmers concerns in relation to organic livestock production

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ABSTRACT

The study describes organic producers' perceptions of organic livestock production, product commercialisation, use of contentious inputs such as allopathic antibiotics, antiparasitics and vitamins and bedding materials availability in Mediterranean (MED) and North/Western European (NWE) countries. A total of 426 MED (46.2%) and NWE (53.8%) responses were analysed revealing more difficulty finding information on alternatives to antiparasitics and antibiotics than on bedding materials. They identified 'feeding/nutrition', 'animal health' and 'welfare' as the most relevant topics in their farms. Whereas ruminants and monogastrics farmers in the NWE region also indicated 'organic regulation' as relevant, farmers rearing ruminant species in the MED region identified farm profitability and commercialisation. Farmers still mainly relied in conventional treatments but they often applied phytotherapy, although >61% of the participants did not treat their animals in the last year. If treated, most of them administered on average one course of antibiotic treatment per animal (>62%). In the MED region, the main sources of information on alternative treatments were veterinarians (>60%) and the Internet (>32%). In the NWE region, it was other farmers for producers including ruminant species (>63%) and veterinarians (>77%) for monogastric farmers. In the NWE region, direct commercialisation and through a cooperative and/or food industry were the most frequent channel used; while, in the MED region, they were the food industry and/or direct commercialisation. In conclusion, this survey provides novel cross-European insights into organic livestock producers' concerns. A particular value of the survey is that MED countries, which are often underrepresented, were well sampled.

HIGHLIGHTS

- Veterinarians were the main source of information on alternative treatments
- The internet is gaining popularity to find information on alternative treatments
- Perceptions slightly differed between North/Western and Mediterranean countries
- Organic farmers still largely rely on conventional treatments
- Phytotherapy is gaining popularity among organic farmers

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Introduction

Organic products are considered an attractive option for niche markets aimed at consumers who want safe and nutritional products, and whose production is sensitive to the environment (Rana and Paul 2017), but producers still need to be aware of agroecological

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practices, the certification process and the marketing of organic products (Jouzi et al. 2017). Mirroring the interest of consumers, the organic sector has grown considerably in recent years in Europe. Between 2007 and 2015, organic poultry production showed the greatest increase (+108% heads), followed by beef and dairy cattle (+58% heads), pigs (+46% heads), sheep (+35% heads) and goats (+15% heads) (Willer and Lernoud 2017). Moreover, organic milk production has almost doubled since 2007, from 2.7 to 4.7×10^3 tons (Willer and Lernoud 2017). However, there is less research on organic than conventional production (Jouzi et al. 2017; Manuelian et al. 2020). This seems contradictory because there are several practices perceived as contentious inputs in organic production (e.g. use of allopathic antibiotics, antiparasitics and vitamins and availably of organic feed and bedding) that farmers need to face to make organic production more 'organic' and fulfil consumers' expectations.

In the European Union, farmers willing to sell in these countries should follow the organic regulation (European Union 2018). Despite the organic production regulation in the European Union states that vitamins or provitamins used should be of natural origin, and phytotherapeutic and homoeopathic products should be used as the first option, the regulation allows allopathic treatments (conventional medication) prescribed by a veterinarian under specific situations without losing immediately their 'organic' status (European Union 2018). This suggests that organic legislation still allows practices that consumers do not necessarily associate with 'organic production'. Moreover, perception could be influenced by the geographical area. For example, German- and English-speaking countries and France have longer organic farming traditions and philosophies than Mediterranean countries (Lockeretz 2007), which could influence farmers' perceptions and worries regarding organic livestock farming.

Conducting a multi-country survey study by multi-language approach offers the possibility to cover a wide surface and participants' characteristics to achieve a better representativeness of organic farmers. Moreover, web surveys have gained popularity due to shorter delivery time, lower delivery cost, additional design options and shorter data entry time (Fan and Yan 2010). In addition, web surveys also are more flexible in terms of when the survey can be completed, may be less intimidating than interviews and help solve language limitations.

Thus, the aim of this study was to describe the views of organic livestock farmers in the Mediterranean (MED) and North/Western European (NWE) countries, by using data collected through a large on-line survey about farmers' perception of organic livestock production, product commercialisation, the use of contentious inputs in organic farming such as allopathic antibiotics, antiparasitics and vitamins and bedding materials availability.

Materials and methods

Organic livestock farmers from 13 European Union (9 EU; Austria, Denmark, France, Germany, Greece, Ireland, Italy, Poland, Spain) and near-neighbouring countries (4 non-EU; Iceland, Norway, United Kingdom, Turkey) were surveyed. Information was collected through a self-administered anonymous questionnaire with multiple-choice or multiple-check questions; open multiple-choice or multiple-check questions; semantic differential scale questions with scale from 1 (not relevant at all or very easy) to 7 (very relevant or very difficult); and open short-answer questions. The online questionnaire was designed using the 'Google Form' platform (Mountain View, CA).

The questionnaire included 36 questions divided into six sections: (i) knowledge and beliefs about organic production; (ii) medication administration; (iii) vitamins and bedding; (iv) product commercialisation; (v) general questions about the farm; and (vi) demographic questions (Supplementary Material S1).

Questionnaire development

A coordinator multi-country group of five academic experts in livestock and organic farming, social scientists and experts in designing questionnaires developed the questionnaire in English. Questions structure and wording were designed following Dillman (2007) recommendations and ordered from the most salient to the least one, with objectionable and demographic questions at the end to reduce the non-response rate. The total number of questions was minimised to avoid deterioration of data quality and were divided into sections to keep each section response time under the threshold of 30 min suggested by Dufour et al. (2010). A control question –in two different sections and with different wording– was included to ensure that only certified organic farmers participated in the study.

The resulting questionnaire was evaluated during the pilot testing by different researchers. They verified if all the necessary questions were included, if all possible answers were considered for each question, if words were understandable and if the layout was clear and easy to follow. Any adjustment needed was

discussed with the coordinator group and applied to the questionnaire.

Then, the questionnaire was translated into seven languages (French, German, Italian, Norwegian, Polish, Spanish, and Turkish), adapting Brislin's translation model (Dufour et al. 2010) considering the English version as the original document. Briefly, an expert in animal production with a high English level whose mother tongue was the final target language translated the questionnaire. Any disagreement between the English version and the translated one was discussed, solved and corrected with the responsible in the coordinator group. The English version was always considered as the original document and corrections were only made in the translated version to be sure of maintaining the same original document. In a second pilot testing phase, the links to the English, French, Italian and Spanish questionnaires were tested with a group of four farmers followed by a personal interview and minor wording adjustments were made based on their feedback.

Dissemination of the survey

The population sample was selected by a non-probability sampling technique (Baker et al. 2013) to achieve similar participation within the MED and NWE regions. The questionnaire link was distributed directly to farmers or people related to/in contact with organic livestock farmers by e-mail as this could be perceived as a more 'personal' request and increases the chance of response (Daikeler et al. 2020). Broadcasting channels (e.g. email newsletters, websites, twitter feed) from associations or research institutes were also used. Due to the difficulties recruiting participants in Denmark and Greece, the survey was conducted by telephone in these countries. The questionnaire was available for 4 months (Nov. 2018–Feb. 2019).

Statistical analysis

Prior to the analysis, questionnaires in disagreement with the control question or duplicate participation were discarded (73 out of 499). Questionnaires were classified by the region (MED: Greece, Italy, Spain, Turkey; NWE: Austria, Denmark, France, Germany, Iceland, Ireland, Norway, Poland, United Kingdom) and by the species in the farm (only ruminants: cows, sheep and goats; only monogastrics: laying hens, poultry-meat, pigs, equine, rabbits, fishes and bees; mixed: both ruminants and monogastrics).

Results for continuous variables are presented as mean ± standard error, semantic differential scale as median with interquartile range (IQR) and other discrete variables as relative frequency with 95% confidence interval (95%CI) for proportions expressed as percentage. The analysis was performed with SAS v9.4 (SAS Inst. Inc., Cary, NC, USA) and Microsoft Excel 2016 (Microsoft Office Professional Plus, Microsoft Corporation, Albuquerque, NM, USA).

Results

Participants' characteristics

From a total of 499 response, 426 questionnaires were retained for the analysis. France (31.7%) and Spain (27.2%) were the countries with the largest contribution to the sample, followed by Austria (11.0%) and Greece (9.9%; Supplementary Figure S1). Overall, participants were equally distributed between the MED (46.2%) and NWE (53.8%) regions.

Participants' characteristics are displayed in Supplementary Table S1. In both regions, men between 31 and 60 years old mainly filled out the questionnaire. Participants identified themselves as consumers of organic products and indicated ethical considerations as the main reason for becoming organic farmers. Despite most participants coursed higher education studies, in MED countries a slightly greater participation of farmers with a high school diploma participated when considering the different higher education study levels listed. While questionnaires were mainly completed by the owner/co-owner in the MED region, both farm owner/co-owner or manager/herdsman participated in the NWE region equally. Moreover, a greater proportion of NWE than MED participants were affiliated with an organic producers' association.

Concerning the type of production (Supplementary Table S2), in both regions, most farmers reared only one species, but in the NWE region more producers had multispecies farms, which increased the proportion of what we classified as 'mixed farms'. In both regions, participation of ruminant farms was more frequent, and beef, dairy cattle and sheep production were the most frequent activities.

In general, in both regions, farms employed a median of 2 persons (IQR: 1 to 3 persons; $n = 424$ farms), with IQR slightly wider in monogastric farms in the MED (1 to 5 persons; $n = 30$ farms) than NWE region (1 to 3.5 persons; $n = 30$ farms) and wider than in ruminant (1 to 3 persons; $n = 238$ farms) and mixed farms (2 to 3 persons; $n = 117$ farms).

Farms in the NWE than the MED region had a longer organic tradition, in particular when referring to farms raising ruminant species. In the NWE region, half of the ruminant farms had been certified as organic in the last 8.5 years (IQR: 2 to 18 years; $n = 116$ farms); monogastric farms, in the last 7.5 years (IQR: 3 to 14 years; $n = 28$ farms); and mixed farms, in the last 14 years (IQR: 4 to 20 years; $n = 78$ farms). In the MED region, half of the ruminant farms had been certified as organic in the last 4 years (IQR: 1 to 13 years; $n = 123$ farms); monogastric farms, in the last 7 years (IQR: 3 to 10 years; $n = 31$ farms); and mixed farms, in the last 10 years (IQR: 5 to 16 years; $n = 39$ farms).

Knowledge and beliefs about organic production matters

In the MED region, ruminants farmers believed that it was more difficult to find comprehensive information regarding alternatives to 'allopathic antibiotics' and 'allopathic antiparasitics'; monogastrics and mixed farmers also added 'synthetic vitamins' to the most difficult topics (Figure 1). In the NWE region, ruminant farmers also identify those three arguments as more difficult to find comprehensive information on alternatives (Figure 1). On the other hand, monogastrics and mixed farmers only indicated 'allopathic antibiotics' and 'allopathic antiparasitics', respectively, as the most difficult topic (Figure 1). Finding information about 'rules and regulations on organic production' and 'bedding alternatives' seemed easier compared to the other topics in both regions (Figure 1).

Moreover, the most relevant issues identified by the farmers in both regions and for all productions were 'feeding and nutrition', 'animal health' and 'animal welfare' (Figure 2). In the MED region, ruminants farmers also identified 'diseases (incidence, treatment, prevention)', 'farm profitability', 'commercialisation of the organic products' and 'labour' as relevant as the issues previously mentioned (Figure 2). Similarly, mixed farmers also mentioned 'diseases (incidence, treatment, prevention)', 'farm profitability', 'commercialisation of the organic products' and 'farm dimension and land availability' as the most relevant issues (Figure 2). In addition, monogastrics farmers only identified as less relevant 'farm profitability' (Figure 2). In the NWE region, ruminants and monogastrics farmers also indicated 'regulation' as relevant as 'feeding and nutrition', 'animal health' and 'animal welfare' (Figure 2).

In the MED region, ruminants and mixed farmers identified 'welfare', 'animal health', 'land availability' and 'access to the organic market' as the most important barriers to becoming an organic producer (Figure 3). Monogastrics farmers also included 'production cost' (Figure 3). In the NWE region, ruminants and mixed farmers' most important barriers were 'legislation restrictions' and 'production cost'; and for monogastric farmers 'infectious diseases, vitamin deficiencies and parasite control effectivity' (Figure 3). In general, lower punctuation was assigned to those barriers in the MED than in the NWE region.

Frequent health issues declared by the farmers and preference of treatments

Despite most farmers indicated not administering antibiotic treatments during 2018 (MED, 62.2%–64.5%; NWE, 61.3%–77.8%), the proportion was usually lower

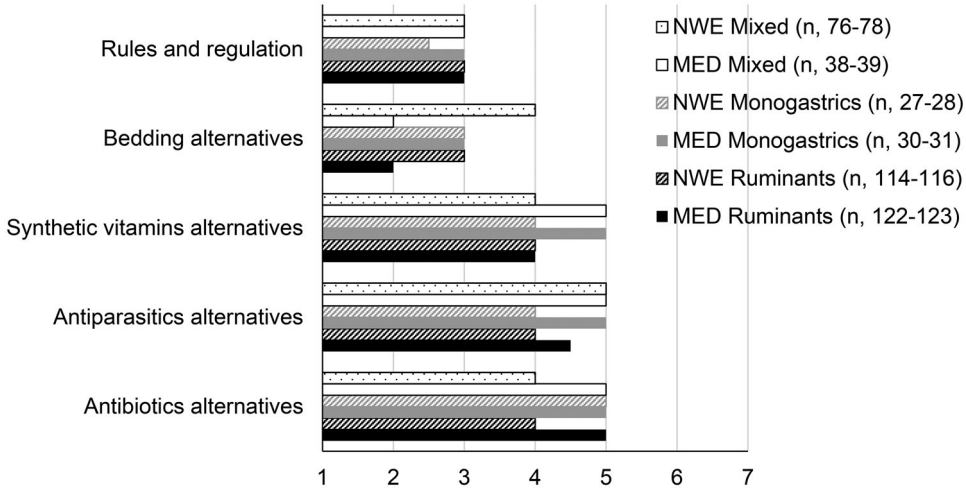

Figure 1. Difficulty (median) declared by the farmers to find comprehensive information on animal organic production regarding different topics (1 = very easy; 7 = very difficult). MED, Mediterranean; NWE, North/Western Europe; mixed, ruminants and monogastrics.

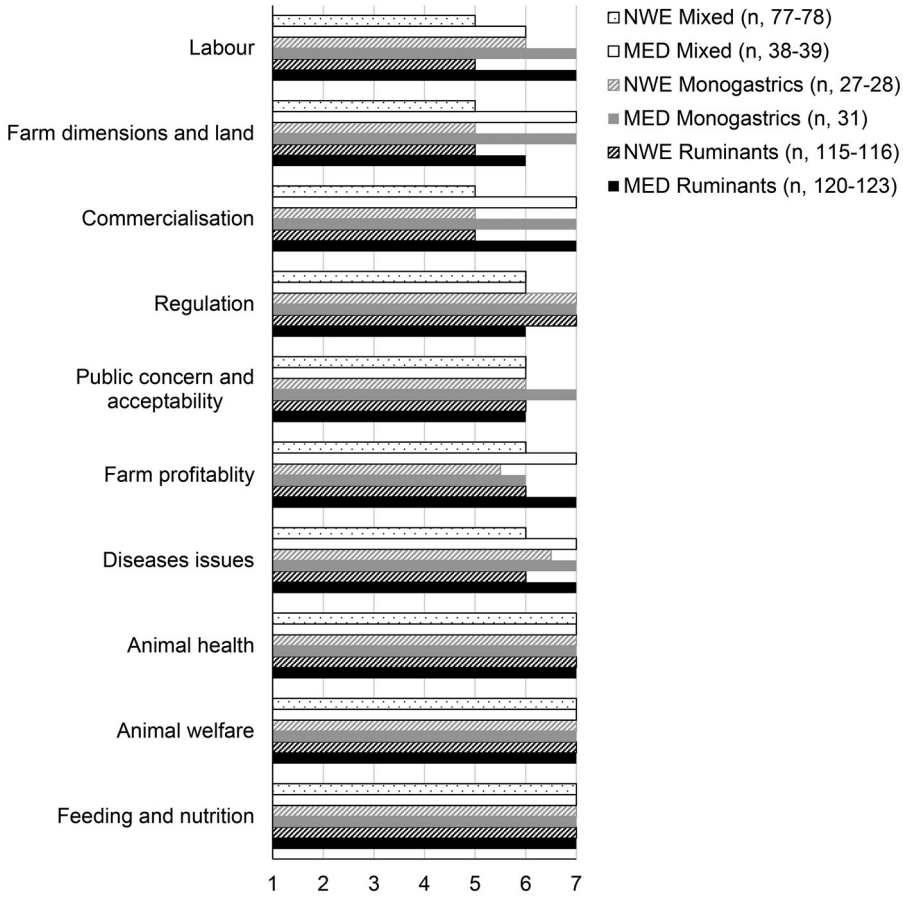

Figure 2. Importance (median) indicated by farmers to several issues as organic livestock producers (1 = not relevant at all; 7 = very relevant). MED, Mediterranean; NWE, North/Western Europe; Mixed, ruminants and monogastrics.

in the MED than the NWE region (Supplementary Table S3) as a greater proportion of farmers treated more than 80% of their animals with antibiotics in the MED (11.5%–19.4%) than NWE region (4.5%–10.4%; Supplementary Table S3). In both regions and all species categories, most of them (MED, 62.5%–93.3%; NWE, 70.0%–76.5%) administered on average one course of antibiotic treatment per animal (Supplementary Table S3).

As displayed in Table 1, the three most frequent diseases in the MED region for ruminants were 'mastitis' (50.0%), 'pre-stomacal/gastrointestinal diseases and diarrhoea' (34.2%) and 'internal parasites' (30.0%). For monogastric and mixed farms, they were 'pre-stomacal/gastrointestinal diseases and diarrhoea' (44.8% and 35.3%, respectively), 'internal parasites' (44.8% and 38.2%, respectively) and 'skin problems/external parasites' (37.9% and 35.3%, respectively). In the NWE region, the three most frequent diseases for ruminants were 'internal parasites' (50.9%), 'lameness' (42.7%) and 'mastitis' (40.0%). For monogastrics, they were 'internal parasites' (60.9%), 'pre-stomacal/gastrointestinal diseases and diarrhoea' (34.8%), 'skin problems/external parasites' (26.1%) and 'respiratory diseases' (26.1%). For mixed farmers, they were 'internal parasites' (58.7%), 'mastitis' (33.3%) and 'lameness' (33.3%). Additionally, 'abnormal behaviour' was also frequently selected (21.7%) by monogastric farmers in the NWE region.

Due to the interaction observed between health issues and species category, and the low number of responses for each health issue within the region, the information regarding the preference of treatments is not presented by species category and region. Although conventional treatments were still used (≥50%) for almost all health issues, farmers recorded the use of alternative treatments (i.e. plant products, homeopathy and/or probiotics) in all pathology groups (Figure 4). Exclusive use of alternative treatments was above 50% when referring to 'pre-stomacal/gastrointestinal diseases and diarrhoea' (66.8%; 95%CI, 60.4%–73.3%), 'abnormal behaviour' (62.5%; 95%CI, 42.1%–82.9%), 'skin problems/external parasites' (59.5%; 95%CI, 52.1%–66.9%), 'neonatal/development abnormalities' (57.7%; 95%CI, 37.7%–77.7%) and 'footpad lesions' (57.4%; 95%CI, 44.2%–70.6%).

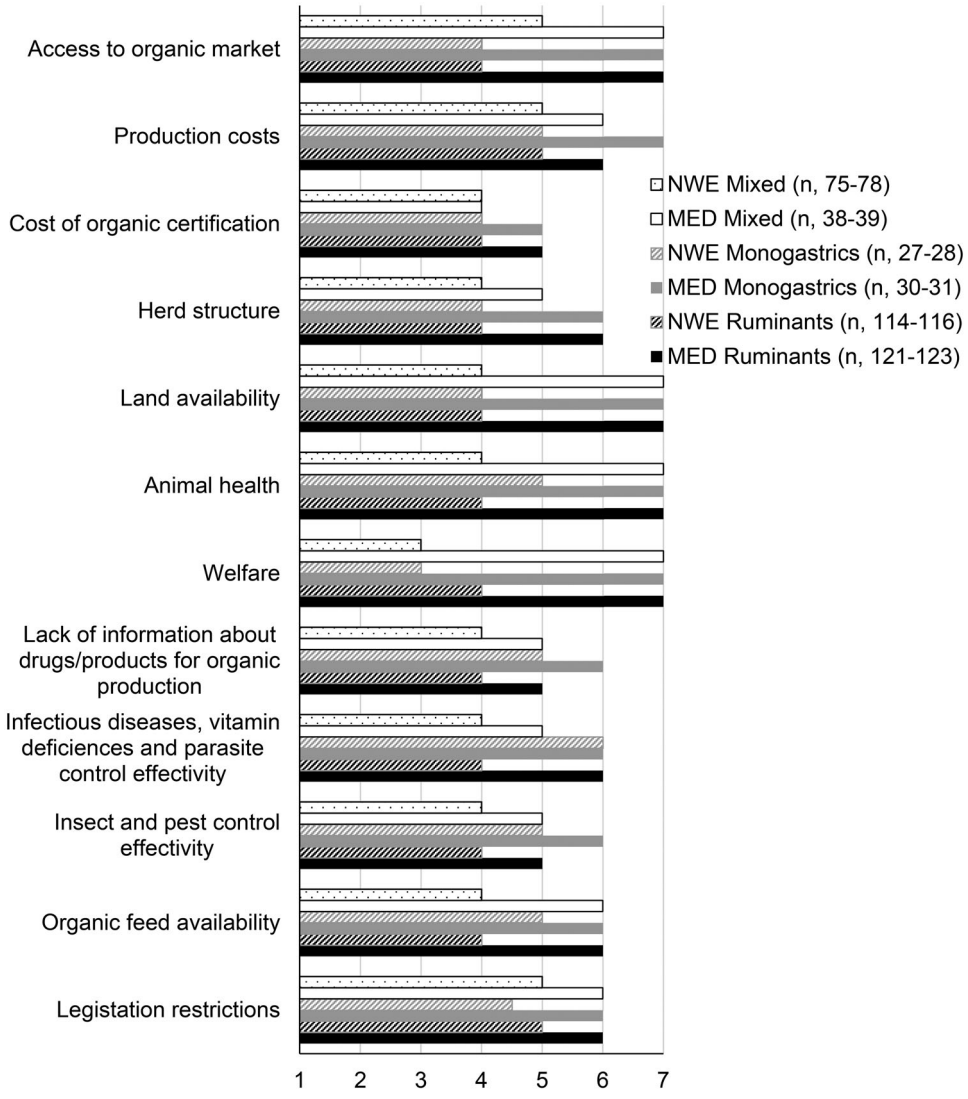

Figure 3. Importance (median) of several issues when becoming organic producers based on the farmers' perception (1 = not relevant at all; 7 = very relevant). MED, Mediterranean; NWE, North/Western Europe; Mixed, ruminants and monogastrics.

Amongst all proposed alternative treatments (plant products, homeopathic products and/or probiotics), plant products were chosen more frequently, exclusively or along with other alternative or conventional treatments (Figure 5) and, particularly, when treating 'skin problems/external parasites' (87.5%; 95%CI, 81.4%–93.6%) and 'internal parasites' (82.4%; 95%CI, 75.9%–88.8%). Homeopathy was selected exclusively or along with other alternative or conventional treatments by about 50% of the farmers treating 'metabolic disease' (60.0%; 95%CI, 49.1%–70.9%), 'lameness' (48.1%; 95%CI, 37.0%–59.3%), 'mastitis' (48.1%; 95%CI, 37.0%–59.3%) and 'reproductive diseases/infertility' (48.1%; 95%CI, 37.0%–59.3%). Probiotics were rarely selected exclusively or along with other alternative or conventional treatments and only in cases of 'pre-stomacal/gastrointestinal diseases and diarrhoea' (27.0%; 95%CI, 17.1%–37.0%).

In all species categories, NWE producers usually obtained information about the use of natural products and plant extracts through different sources of information (83.3%–87.7%), whereas MED producers relied either on one (32.3–45.0) or several (55.0%–64.5%) sources (Supplementary Table S3). In the MED region, the most important source for all farmers was 'veterinarians' (60.5%–70.0%) followed by 'the internet' (32.5%–53.3%; Table 1). In the NWE region, the most important source for ruminants and mixed farmers was 'other farmers' (63.2% and 66.7%, respectively) and for monogastrics farmers were 'veterinarians' (77.8%; Table 1). Moreover, for ruminants and mixed farmers, 'cooperative/association of farmers' seemed more relevant in the NWE (28.1% and 30.7%, respectively) than in the MED region (11.7% and 2.6%, respectively; Table 1).

Table 1. Frequent health issues and sources of information about the use of natural products and plant extracts by productive category and region (MED, Mediterranean; NWE, North/Western Europe) expressed as relative frequency (95% confidence interval).

Trait	Ruminants	Monogastrics	Mixed[a]
Frequent health issues[b]	MED ($n = 120$)	MED ($n = 29$)	MED ($n = 34$)
	NWE ($n = 1110$)	NWE ($n = 23$)	NWE ($n = 75$)
Internal parasites	30.0 (21.8–38.2)	44.8 (25.9–63.7)	38.2 (22.0–54.5)
	50.9 (41.6–60.2)	60.9 (39.8–82.0)	58.7 (47.6–69.8)
Mastitis	50.0 (41.1–58.9)	6.9 (0–16.5)	32.4 (16.7–48.0)
	40.0 (30.9–49.1)	4.3 (0–13.2)	33.3 (22.7–43.9)
Lameness	28.3 (20.3–36.4)	3.4 (0–10.4)	32.4 (16.7–48.0)
	42.7 (33.5–51.9)	17.4 (1.0–33.8)	33.3 (22.7–43.9)
Pre-stomacal/gastrointestinal diseases/diarrhoea	34.2 (25.7–42.6)	44.8 (25.9–63.7)	35.3 (19.3–51.3)
	24.5 (16.5–32.5)	34.8 (14.2–55.4)	20.0 (11.0–29.0)
Respiratory diseases	30.8 (22.6–39.1)	24.1 (7.9–40.4)	23.5 (9.3–37.7)
	23.6 (15.7–31.5)	26.1 (7.1–45.1)	25.3 (15.5–35.1)
Skin problems/external parasites	19.2 (12.2–26.2)	37.9 (19.5–56.4)	35.3 (19.3–51.3)
	20.0 (12.6–27.4)	26.1 (7.1–45.1)	28.0 (17.9–38.1)
Reproductive diseases/infertility	26.7 (18.8–34.5)	3.4 (0–10.4)	8.8 (0–18.3)
	30.9 (22.3–39.5)	17.4 (1.0–33.8)	24.0 (14.4–33.6)
Footpad lesions	14.2 (8.0–20.4)	13.8 (0.7–26.9)	8.8 (0–18.3)
	4.5 (0.7–8.4)	8.7 (0–20.9)	1.3 (0–3.9)
Metabolic diseases	6.7 (2.2–11.1)	–	–
	11.8 (5.8–17.8)	–	9.3 (2.8–15.9)
Abnormal behaviour	0.8 (0–2.5)	3.4 (0–10.4)	2.9 (0–8.6)
	0.9 (0–2.7)	21.7 (3.9–39.6)	4.0 (0–8.4)
Others	5.0 (1.1–8.9)	10.3 (0–21.9)	14.7 (2.9–26.5)
	2.7 (0–5.8)	–	–
Sources of information sources about the use of natural products and plant extracts used[a]	MED ($n = 120$)	MED ($n = 30$)	MED ($n = 38$)
	NWE ($n = 114$)	NWE ($n = 27$)	NWE ($n = 75$)
Veterinarian	64.2 (55.6–72.7)	70.0 (53.7–86.3)	60.5 (45.1–76.0)
	38.6 (29.7–47.5)	77.8 (61.3–94.2)	45.3 (56.1–77.3)
Other farmers	25.0 (17.3–32.7)	30.0 (13.7–46.3)	23.7 (10.2–37.1)
	63.2 (54.3–5.6)	33.3 (14.7–52.0)	66.7 (56.1–77.3)
Internet	32.5 (24.2–40.8)	53.3 (35.6–71.1)	39.5 (24.0–54.9)
	31.6 (23.1–40.1)	59.3 (39.8–78.7)	48.0 (36.8–59.2)
Magazines/journals	13.3 (7.3–19.4)	16.7 (3.4–29.9)	23.7 (10.2–37.1)
	36.8 (28.0–45.7)	18.5 (3.1–33.9)	46.7 (35.4–57.9)
School/courses	18.3 (11.4–25.2)	26.7 (10.9–42.4)	26.3 (12.4–40.2)
	21.9 (14.4–29.5)	29.6 (11.6–47.7)	28.0 (17.9–38.1)
Specialised meetings	16.7 (10.0–23.3)	20.0 (5.8–34.2)	15.8 (4.3–27.3)
	23.7 (15.9–31.4)	22.2 (5.8–38.7)	32.0 (21.5–42.5)
Independent consultant	15.0 (8.6–21.4)	16.7 (3.4–29.9)	13.2 (2.5–23.9)
	26.3 (18.3–34.4)	18.5 (3.1–33.9)	25.3 (15.5–35.1)
Cooperative/association of farmers	11.7 (6.0–17.4)	10.0 (0–20.7)	2.6 (0–7.7)
	28.1 (19.9–36.3)	11.0 (0–23.5)	30.7 (20.3–41.0)
Feed industry	9.2 (4.0–14.3)	10.0 (0–20.7)	2.6 (0–7.7)
	3.5 (0.1–6.9)	11.0 (0–23.5)	6.7 (1.1–12.3)

[a]Mixed, ruminants and monogastrics.
[b]Question with multi-check response.

Preference of vitamins use and voluntary vaccination

In the MED region, most farmers do not include vitamin additives in the animals' feed (67.5%–89.7%; Table 2). However, in the NWE region, the proportion of farmers that knowingly used vitamin additives (42.3%–50.0%) was similar to those that declared not using them (50.0%–57.7%; Table 2). Considering the farmers that added vitamins (MED, 55; NWE, 151), in both regions most of them used natural vitamins (MED, 53.7%; NWE, 55.4%; Supplementary Table S2).

In the MED region, ruminants and monogastrics farmers either used or did not voluntary vaccination whereas in mixed farms fewer farmers applied voluntary vaccination (23.1%) than those who did not use it (Table 2). On the other hand, in the NWE region, only monogastric farms either used or not voluntary vaccination whereas in ruminants (23.3%) and mixed (17.9%) farms, fewer farmers applied voluntary vaccination (Table 2).

Housing and bedding materials preference

In the MED region, most ruminant (59.0%), monogastric (60.0%) and mixed (46.2%) farmers kept their animals in 'free-stalls with an external paddock or in free-range with movable sheds' (Table 2). Moreover, a same proportion of mixed farmers also kept their animals on 'pasture' (46.2%; Table 2). In the NWE region, most ruminants (27.6%) and monogastric (48.1%) farmers kept their animals either in 'free-stalls with an external paddock or in free range with movable sheds' (Table 2). Ruminants

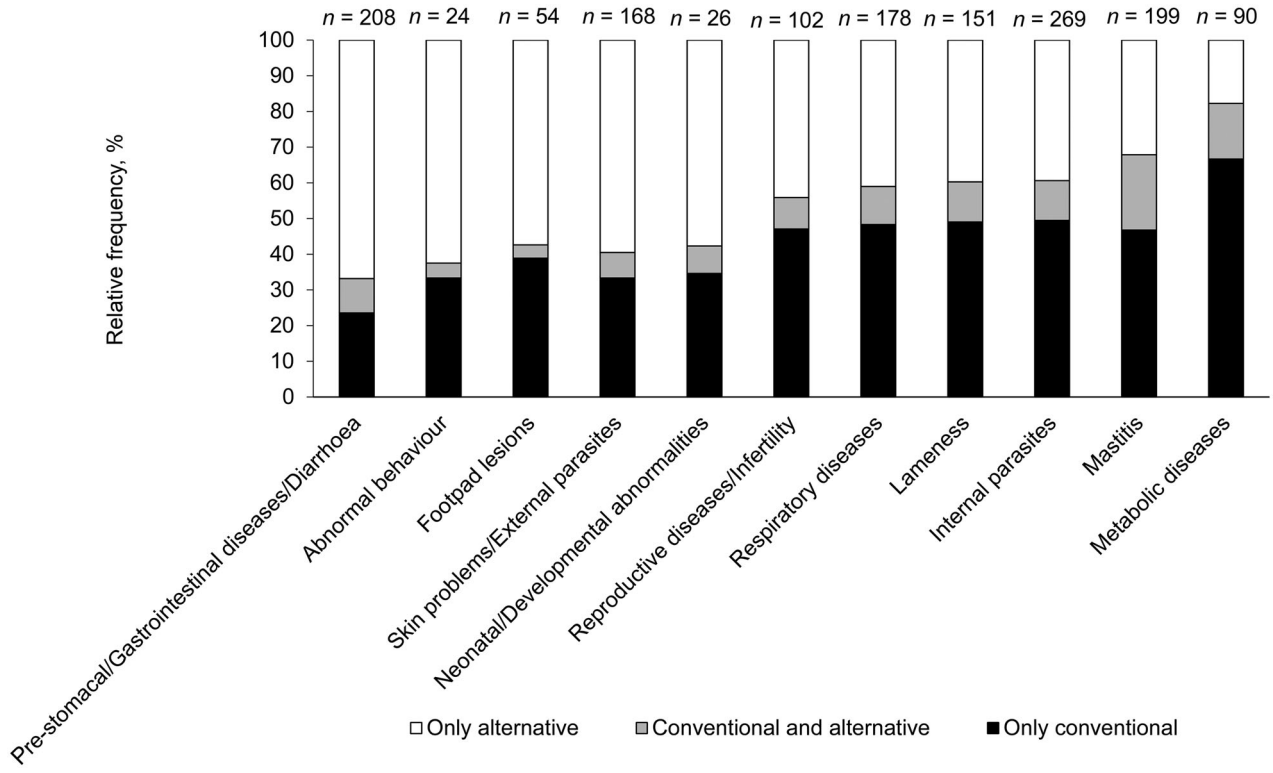

Figure 4. Treatments selected by livestock producers based on the health issue. Black, only conventional treatments; Grey, conventional and alternative treatments; white, only alternative treatments.

farmers also kept their animals in 'free-stall with stalls or cubicles with loose housing' in a high proportion (25.9%; Table 2). On the other hand, most mixed farmers kept their animals either on 'pasture' (32.1%) or in 'free-stalls with an external paddock or in free range with movable sheds' (29.5%; Table 2).

From the different bedding materials proposed in Table 2, straw was the most frequently used one, regardless of the region and species category. However, a lower proportion was observed in the MED (48.4%–83.7%) than the NWE (78.6%–93.1%) region. In ruminants and mixed farms, sawdust and synthetic mattresses were used more often in the NWE (Ruminants, 11.2% and 14.7%, respectively; Mixed, 16.7% and 7.7%, respectively) than the MED region (Ruminants, 3.3% and 7.3%, respectively; Mixed, 2.6% and none, respectively). Moreover, wood shavings were used more often in the NWE (14.1%) than the MED region (2.6%).

Commercialisation and added value of organic products

In both regions, most monogastric and mixed farmers sell all their production as organic (Table 3). However, ruminant farmers had greater difficulty selling their production as organic because a greater proportion stated that they sold as organic less than 50% of the production (Table 3). A small proportion of participants manufacture their own products, but this proportion was slightly higher on ruminant and mixed farms in the NWE than MED region (Table 3). In the MED region, most farmers raising ruminant species sold their products only through one commercial channel, whereas monogastric farms either used one or more channels (Table 3). In the NWE region, all farmers' categories used up to 3 different channels (Table 3).

Looking into the specific commercialisation channels that farmers selected, preferences showed some differences between regions, with sales 'to a cooperative' as more relevant in the NWE than the MED region (Table 3). Moreover, in the MED region, 'internet sales' represented a relatively important share, particularly for mixed farms (Table 3). In the MED region, most ruminant farmers sold 'to the food industry', 'directly on their own farms' and/or 'in local markets'. Most monogastrics farmers sold 'in local markets', 'directly on their own farms' and/or 'to the food industry'. Most mixed farms sold 'directly on their own farms', 'to the food industry', 'in local markets' and/or 'internet sales'. In the NWE region, most ruminant farmers sold 'to a cooperative', 'directly on their own farms' and 'to the food industry'. Most monogastrics farmers sold 'directly on their own farms', 'in local

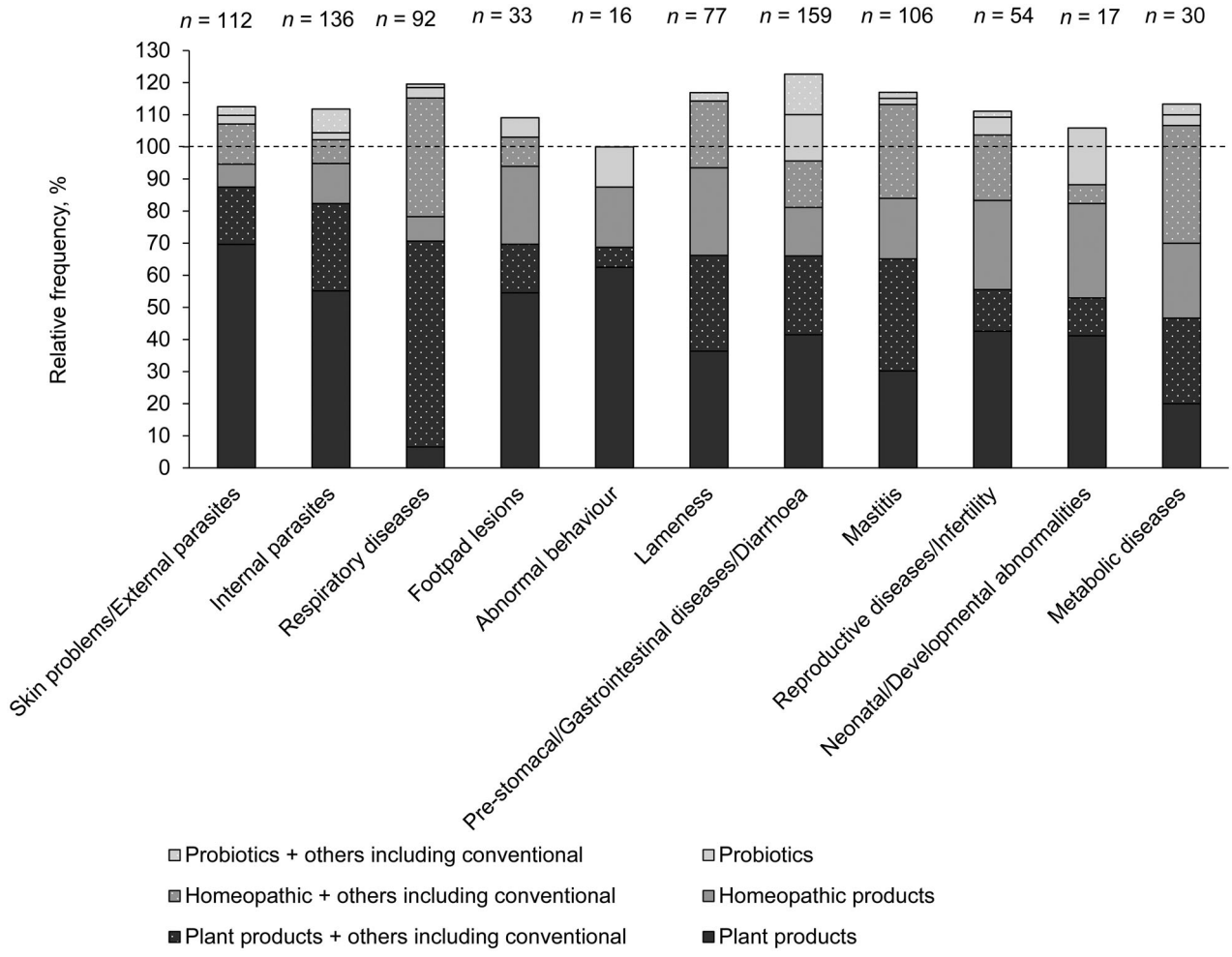

Figure 5. Alternative treatments are preferred for several health issues. Dark grey, using plant products treatments; Grey, using homeopathic treatments; light grey, using probiotics treatments; solid colours, exclusive selection of an alternative treatment. Data above 100% are due to using a multi-check question.

markets', 'to the food industry' and/or 'to a cooperative'. Most mixed farms sold 'directly on their own farms', 'to a cooperative' and/or 'in local markets'.

Discussion

Limitations of the study

Despite it is not possible to generalise from the results due to the intrinsic limitations of the study design, the total number of responses (nearly 500) is remarkable as well as the high participation of MED organic farmers. It is worth noting that less than 3.8% of animals for each species in Europe are raised organically (Willer et al. 2020), and we are not aware of a similar survey among organic livestock farmers in Europe.

Other limitations worth to mention is that we conducted a web survey not allowing us to calculate the response rate because we did not know how many farmers had access to the questionnaire. In addition, internet access could be a barrier in our study, however, during 2018 internet access in Northern Europe, Western Europe and Southern Europe was 95%, 94% and 88%, respectively (Kemp 2019). Moreover, rural areas can lag behind in digital access and new information and communication technology (ICT), and there are digital disparities even within a developed economy (Basu and Chakraborty 2011). Nevertheless, organic livestock farms tend to be managed by younger farmers with a higher level of education than conventional ones (Rigby et al. 2001; Kings and Ilbery 2010; European Commission 2016). Although we did not survey conventional farms, our participants' profile in terms of age and education level, in particular in the NWE region, were in agreement with the current situation on organic farms (Padel 2001; European Commission 2016; Blanco-Penedo et al. 2019). These factors combined with rural isolation and the need for connectivity to share and acquire information (Burbi and Rose 2016) could

Table 2. Use of vitamin additives, voluntary vaccination and type of barn by productive category and region (MED, Mediterranean; NWE, North/Western Europe) expressed as relative frequency (95% confidence interval).

Trait	Ruminants	Monogastrics	Mixed[a]
Use of vitamin additives	MED ($n = 123$)	MED ($n = 31$)	MED ($n = 39$)
	NWE ($n = 116$)	NWE ($n = 28$)	NWE ($n = 78$)
Yes	32.5 (24.3–40.8)	32.3 (15.9–48.6)	10.3 (0.8–19.7)
	45.7 (36.7–54.7)	50.0 (30.6–69.4)	42.3 (31.4–53.2)
No	67.5 (59.2–75.7)	67.7 (51.4–84.1)	89.7 (80.3–99.2)
	54.3 (45.3–63.3)	50.0 (30.6–69.4)	57.7 (46.8–68.6)
Voluntary vaccination	MED ($n = 123$)	MED ($n = 31$)	MED ($n = 39$)
	NWE ($n = 116$)	NWE ($n = 28$)	NWE ($n = 78$)
Yes	53.7 (44.9–62.4)	48.4 (30.9–65.9)	23.1 (9.9–36.2)
	23.3 (15.6–30.9)	46.4 (27.1–65.8)	17.9 (9.5–26.4)
No	46.3 (37.6–55.1)	51.6 (34.1–69.1)	76.9 (63.8–90.1)
	76.7 (69.1–84.4)	53.6 (34.2–72.9)	82.1 (73.6–90.5)
Type of barn[b]	MED ($n = 122$)	MED ($n = 30$)	MED ($n = 39$)
	NWE ($n = 116$)	NWE ($n = 27$)	NWE ($n = 78$)
Mixed (free-stall with external paddock/free range in movable sheds)	59.0 (50.3–67.7)	60.0 (42.6–77.4)	46.2 (30.6–61.7)
	27.6 (19.5–35.7)	48.1 (28.4–67.9)	29.5 (19.4–39.6)
Pasture	20.5 (13.4–27.6)	13.3 (1.2–25.4)	46.2 (30.6–61.7)
	19.0 (11.9–26.1)	25.9 (8.6–43.3)	32.1 (21.7–42.4)
Free-stall with stalls/Cubicles with loose housing	9.0 (4.0–14.1)	3.3 (0–9.7)	2.6 (0–7.5)
	25.9 (17.9–33.8)	11.1 (0–23.5)	26.9 (17.1–36.7)
Free-stall with bedding/Loose housing in straw	7.4 (2.8–12.0)	10.0 (0–20.7)	5.1 (0–12.0)
	20.7 (13.4–28.0)	11.1 (0–23.5)	14.1 (6.4–21.8)
Animal tethered (not free to move)	6.6 (2.2–10.9)	–	10.3 (0.8–19.7)
	6.9 (2.3–11.5)	–	2.6 (0–6.1)
Other	0.8 (0–2.4)	13.3 (1.2–25.4)	2.6 (0–7.5)
	2.6 (0–5.5)	3.7 (0–11.2)	1.3 (0–3.8)
Bedding materials[c]	MED ($n = 123$)	MED ($n = 31$)	MED ($n = 39$)
	NWE ($n = 116$)	NWE ($n = 28$)	NWE ($n = 78$)
Straw	83.7 (77.3–90.2)	48.4 (30.9–65.9)	69.2 (54.8–83.6)
	93.1 (88.5–97.7)	78.6 (62.7–94.5)	92.3 (86.4–98.2)
Waste hay	12.2 (6.4–17.9)	6.5 (0–15.1)	10.3 (0.8–19.7)
	19.0 (11.9–26.1)	7.1 (0–17.1)	24.4 (14.9–33.8)
No bedding/compacted soil	6.5 (2.2–10.8)	12.9 (1.2–24.6)	23.1 (9.9–36.2)
	0.9 (0–2.5)	3.6 (0–10.8)	–
Sand	2.4 (0–5.2)	–	–
	1.7 (0–4.1)	–	1.3 (0-3.8)
Sawdust	3.3 (0.1–6.4)	3.2 (0–9.4)	2.6 (0–7.5)
	11.2 (5.5–16.9)	3.6 (0–10.8)	16.7 (8.4–24.9)
Mattress for animals	7.3 (2.7–11.9)	–	–
	14.7 (8.3–21.1)	–	7.7 (1.8–13.6)
Wood shavings	3.3 (0.1–6.4)	6.5 (0–15.1)	2.6 (0–7.5)
	4.3 (0.6–8.0)	3.6 (0–10.8)	14.1 (6.4–21.8)
Coconut fibre	0.8 (0–2.4)	–	–
	–	–	–
Other	3.3 (0.1–6.4)	6.5 (0–15.1)	12.8 (2.4–23.3)
	6.0 (1.7–10.3)	7.1 (0–17.1)	5.1 (0.3–10.0)

[a]Mixed, ruminants and monogastrics.
[b]Question with multi-check response.
[c]Yes-No question for each type of bedding material.

suggest a greater use of ICT and internet access, increasing the chances to participate in an online survey.

Therefore, despite the limitations of this survey study, we are confident that the results we are presenting could help fill the gap of information regarding the perception of organic farmers in organic livestock production.

Participants' characteristics

Participants' profiles in terms of gender matched the characteristics of the agricultural sector: the lower participation of women mirrored the gender gap typical of the agricultural sector in the European Union (European Comission 2016; Blanco-Penedo et al. 2019). Participants' distribution by age group was in agreement with the current situation on organic farms (Padel 2001; European Comission 2016; Blanco-Penedo et al. 2019), as was their higher education level (Padel 2001; Kings and Ilbery 2010). Most participants indicated ethical considerations as the main reason for becoming organic farmers, which is in agreement with the reported ideology behind this type of production (Lockeretz 2007).

The existing longer organic farming tradition and philosophy in German- and English-speaking countries and France (Lockeretz 2007) could support the greater

Table 3. Commercialisation of the production/products by productive category and region (MED, Mediterranean; NWE, North/Western Europe) expressed as relative frequency (95% confidence interval).

Trait	Ruminants	Monogastrics	Mixed[a]
Sell as organic	MED ($n = 122$)	MED ($n = 31$)	MED ($n = 39$)
	NWE ($n = 115$)	NWE ($n = 27$)	NWE ($n = 78$)
≤50% of the production	28.7 (20.7–36.7)	9.7 (0–20.0)	12.8 (2.4–23.3)
	30.4 (22.1–36.7)	11.1 (0–23.5)	15.4 (7.4–23.4)
51–70% of the production	6.6 (2.2–10.9)	6.5 (0–15.1)	5.1 (0–12.0)
	7.0 (2.3–11.6)	–	1.3 (0–3.8)
71–99% of the production	17.2 (10.5–23.9)	9.7 (0–20.0)	10.3 (0.8–19.7)
	17.4 (10.5–24.3)	7.4 (0–17.8)	16.7 (8.4–24.9)
100% of the production	47.5 (38.7–56.4)	74.2 (58.9–89.5)	71.8 (57.7–85.8)
	45.2 (36.2–54.3)	81.5 (66.1–96.9)	66.7 (56.3–77.1)
Manufacture their own products	MED ($n = 118$)	MED ($n = 31$)	MED ($n = 39$)
	NWE ($n = 115$)	NWE ($n = 27$)	NWE ($n = 78$)
Yes	18.6 (11.7–25.6)	19.4 (5.5–33.2)	23.1 (9.9–36.2)
	24.3 (16.5–32.2)	18.5 (3.1–33.9)	37.2 (26.5–47.9)
No	81.4 (74.4–88.3)	80.6 (66.8–94.5)	76.9 (63.8–90.1)
	75.7 (67.8–83.5)	81.5 (66.1–96.9)	62.8 (52.1–73.5)
n of commercial channels	MED ($n = 114$)	MED ($n = 29$)	MED ($n = 39$)
	NWE ($n = 115$)	NWE ($n = 26$)	NWE ($n = 77$)
1	68.4 (59.9–76.9)	48.3 (29.3–67.3)	53.8 (38.3–69.4)
	51.3 (42.2–60.4)	42.3 (22.3–62.3)	32.5 (22.1–42.9)
2	18.4 (11.3–25.5)	20.7 (5.3–36.1)	20.5 (7.9–33.1)
	34.8 (26.1–43.4)	38.5 (18.8–58.1)	32.8 (26.1–43.4)
3	10.5 (4.9–16.1)	27.6 (10.6–44.6)	23.1 (9.9–36.2)
	12.2 (6.2–18.1)	19.2 (3.3–35.2)	22.1 (12.9–31.3)
4	2.6 (0–5.6)	3.4 (0–10.4)	2.6 (0–7.5)
	1.7 (0–4.1)	–	1.3 (0–3.8)
Commercial channels[b]	MED ($n = 114$)	MED ($n = 29$)	MED ($n = 39$)
	NWE ($n = 115$)	NWE ($n = 26$)	NWE ($n = 77$)
Directly in the farm	33.3 (24.7–41.9)	44.8 (25.9–63.7)	69.2 (54.8–83.6)
	45.2 (36.2–54.3)	61.5 (41.9–81.2)	67.5 (57.1–77.9)
To the food industry	53.5 (44.4–62.6)	34.5 (16.4–52.6)	33.3 (18.6–48.1)
	31.3 (22.9–39.7)	26.9 (9.0–44.8)	23.4 (14.0–32.8)
To a cooperative	15.8 (9.1–22.4)	13.8 (0.7–26.9)	10.3 (0.8–19.7)
	51.3 (42.2–60.4)	26.9 (9.0–44.8)	46.8 (35.7–57.8)
In local markets	22.8 (15.1–30.5)	65.5 (47.4–83.6)	25.6 (12.0–39.3)
	22.6 (15.0–30.2)	42.3 (22.3–62.3)	32.5 (22.1–42.9)
Internet (web market)	11.4 (5.6–17.2)	17.2 (2.9–31.6)	25.6 (12.0–39.3)
	7.0 (2.3–11.6)	7.7 (0–18.5)	9.1 (2.7–15.5)
To other farmers	6.1 (1.8–10.5)	–	–
	0.9 (0–2.6)	11.5 (0–24.4)	3.9 (0–8.2)
Others	4.4 (0.6–8.1)	10.3 (0–21.2)	10.3 (0.8–19.7)
	6.1 (1.7–10.4)	–	9.1 (2.7–15.5)

[a]Mixed, ruminants and monogastrics.
[b]Question with multi-check response.

proportion of NWE than MED participants affiliated to an organic producers' association we observed. As well as the greater participation of younger farms in the MED than the NWE region and the greater participation of multispecies farms in the NWE than the MED region. Moreover, a huge growth of organic product sales (+175.8% from 2008 to 2018) and organic producers (+85.5% from 2008 to 2018) has been registered in the last decade (FiBL 2020).

In both regions, the amount of labour observed in our study is in agreement with a study of European organic dairy cattle farms that showed a median of 2–3 full-time workers (Blanco-Penedo et al. 2019). In addition, the wider range we recorded in monogastrics than in ruminant farms is in line with the results obtained in several European countries in a recent bibliographic review (Orsini et al. 2018).

Farmers' position on bedding alternatives in organic production

Most farmers declared using straw as bedding material, in agreement with other studies on dairy cattle carried out at the European level (Blanco-Penedo et al. 2019). Although the origin of the straw was not specified in the survey, the availability of organic straw for bedding/litter is quite limited. For example, in Spain only 3.4% of cultivated surface for cereal-grain production was managed organically in 2018 (MAPA 2020). That means that the lack of organic straw forces organic farmers to use conventional straw as bedding material—which is allowed in organic production—which carries the residues of pesticide treatments during its production. Therefore, there is little incentive to look for alternatives. That could explain why farmers

perceive that they can easily find information on alternatives for bedding materials in organic production. However, as the availability of organic straw is limited, farmers need information about alternatives to straw (e.g. untreated wood shavings leaf litter, bracken) in organic production and awareness on that topic has to be raised. Moreover, more research to develop and test potential bedding material for organic production and dissemination of the findings are needed.

Farmers' position on alternatives for synthetic vitamins and allopathic treatments

The lower number of farmers that included vitamin additives in the MED region could be partially explained by the farmers perception of difficulty in finding alternatives to 'synthetic vitamins' in organic production. This is supported by the fact that in the NWE region, more farmers incorporate vitamin supplements and they find it less difficult to identify alternatives to 'synthetic vitamins' than on 'allopathic antibiotics' or 'allopathic antiparasitics'. Nevertheless, animal concentrate feed usually incorporates a synthetic vitamin pre-mix to ensure that the animals' needs are met since there is a high variability and instability of the natural forms in food. Thus, some farmers' lack of awareness of the detailed composition of the concentrate fed could influence the results even if, by law, feed ingredients must be clearly labelled. To better understand farm vitamin use further questions should be asked.

Results indicated that farmers in both regions and in all productions are worried the most about 'feeding and nutrition', 'animal health' and 'welfare'. This could explain their belief that it is more difficult to find comprehensive information regarding alternatives to 'allopathic antibiotics' and 'allopathic antiparasitics' than to alternative 'bedding materials', as these matters worried them the most. Moreover, the higher score assigned in the MED than the NWE region to 'animal health' and 'welfare' could partially be due to the lower tradition of organic production in the MED than the NWE region (Lockeretz 2007).

In both regions, mastitis was identified as one of the most problematic issues on ruminant farms since it is a pathology perceived as one of the main problems in dairy farms (Hovi et al. 2003), both organic and conventional (Sutherland et al. 2013). The relevance of mastitis was also reported by organic dairy producers in Ohio (USA) who reared Holsteins, Jerseys and crossbreeds (Brock et al. 2021).

In both regions, a high proportion of ruminant and monogastric producers indicated internal parasites as a major health problem, in agreement with reviews by Sutherland et al. (2013) and Escobar (2016). Parasite infestation is more frequent in poultry and pigs under organic production because animals have regular outdoor access compared to intensively conventionally managed animals (Kijlstra and Eijck 2006). Parasites may be one cause of 'pre-gastric or gastrointestinal/-diarrhoea' problems, a common health issue selected by farmers.

In the NWE region, behavioural problems in animals were quite frequent in monogastric farms and rarely indicated in ruminant farms. In pigs, Alban et al. (2015) reported that, based on post-mortem inspection, behavioural problems such as skin lesions and tail biting seem to be more frequent in organic than in conventional production probably because tail docking is not allowed in the former. In poultry, feather pecking continues to be a problem in organic production since beak trimming is prohibited, and infestation by mites (*Dermanyssus gallinae*), coccidia (Eimeria spp.) and gastrointestinal nematodes are frequent (Zeltner and Maurer 2009).

In agreement with a survey conducted in 2019 in Ohio (USA; Brock et al. 2021), farmers indicated a very low use of conventional treatments, especially those in the NWE region. The USA farmers stated that they relied more on other methods of improving the cow's immune system than the use of vaccines. However, Brock et al. (2021) reported greater voluntary vaccination among organic dairy producers than in the present survey. The organic regulation in the USA (NOP-standard, National Organic Program) is more restrictive than the EU (European Union 2018) regarding the use of conventional treatments, as NOP states that animals in organic production cannot receive allopathic treatments if milk and meat is marketed as organic without the animal permanently losing its organic status (Brock et al. 2021). Moreover, further reductions in antibiotic use are discussed in Europe and some organic standards such as the NOP have a zero antibiotic use standard.

Although few producers indicated having treated some of the health problems listed, there is still a greater use of allopathic than alternative treatments. Nevertheless, only phytotherapy, homeopathy or/and probiotics were listed as possible alternative treatments, and other disease-prevention strategies were not evaluated. The use of phytotherapy seems to be rising, particularly when treating health issues such as 'pre-gastric/gastrointestinal diseases and diarrhoea',

'skin problems' and 'footpad lesions' (>50% in the survey). Although mastitis was one of the most prevalent pathologies, the exclusive use of alternative treatments reported by the participants is slightly above 30%. Peer-review publications of ethnoveterinary studies (involving the use of medicinal plants and management) as alternatives to antibiotics and antiparasitics in Europe are scarce and mainly conducted in Italy, Spain and Turkey (Mayer et al. 2014). However, the last report of the EMA-ESVAC showed that veterinary antimicrobial sales for food-producing species in 2018 were high in Spain and Italy (>200 mg/PCU) compared to France and Austria (<50 mg/PCU) (EMA-ESVAC, 2020). In fact, Spain and Italy were the 2nd and 3rd highest countries for antimicrobial sales for food-producing species in 2018 (EMA-ESVAC, 2020), which could explain the greater proportion of animals treated with antibiotics we observed in the MED than NWE region.

Farmers' position on commercialisation and added value of organic products

In the MED region, aspects related to 'farm profitability', 'commercialisation of the organic products', 'labour' and 'farm dimension and land availability' had higher score than in the NWE. This could be explained by the greater relevance of the economic aspects we observed in the former than in the later when deciding to become an organic producer.

Moreover, 'internet sales' seemed to be more relevant in the MED than NWE region. Short food supply chains (direct sales, local markets and the internet) are those in which there is no, or only one, intermediary between producer and consumer and are typical of the organic markets in MED countries (López García et al. 2015). On the other hand, sales to the agrifood industry are more often found in NWE countries (López García et al. 2015). The relative importance of sales through the internet observed in our survey could be influenced by the method used for compiling and disseminating the survey. Nevertheless, the online sales position in our results could suggest that organic farms seek to expand their market without losing contact with the consumer, as well as adding value to their products through direct marketing (Orsini et al. 2018). Likewise, the use of the internet by farmers in the MED region stands out as one of the main sources of information on the use of natural products or plant extracts. The use of the internet could be over-represented by having conducted the survey online, but it could also be a characteristic of the organic livestock sector due to the profile of the producers being younger and having a higher level of education (Padel 2001; Kings and Ilbery 2010).

Conclusions

This study suggested that organic farmers in the MED and NWE region face more difficulty in finding information on alternatives to antiparasitics and antibiotics than on bedding materials, however, they mainly used straw. Although veterinarians were the main source of information on alternative treatments, in the MED region they also relied on the internet while in the NWE region they asked other farmers. In both regions, farmers identified 'feeding/nutrition', 'animal health' and 'welfare' as the most relevant issues in their farms. However, in the NWE region, ruminants and monogastrics farmers also indicated regulation related to organic production as a relevant issue, whereas, in the MED region, farmers rearing ruminant species were also quite worried about farm profitability and product commercialisation. Farmers still mainly relied on conventional treatments, and among the alternatives, they applied more frequently phytotherapy. However, most farmers declared not to use antibiotics in the last year, and if used, only applied one course of antibiotic treatment per animal, which is in agreement with the EU organic regulation. In relation to product commercialisation, in the NWE region, direct commercialisation and through a cooperative and/or food industry were the most frequent channels used. While, in the MED region, the food industry and/or direct commercialisation including internet sales were the most frequent ones. Therefore, this survey has provided novel cross-European insights into the concerns and use of contentious inputs in organic livestock farming in the MED and NWE regions. Moreover, the survey has filled an important knowledge gap on the MED organic livestock systems which is often undersampled or ignored.

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Ethics statement

Procedures adopted in this study do not fall into the scope of an animal ethics evaluation. Data was processed in accordance with the General Data Protection Regulation 2016/679 (GDPR) and the Data Protection Act 2018. The study has been reviewed and approved by the Research Commission of DAFNAE at UNIPD stating that the questions do not conflict with the Declaration of Helsinki.

Disclosure statement

The authors declare that there is no conflict of interest associated with the article. The authors alone are responsible for the content and writing of this article.

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Data availability statement

No data were deposited in an official repository. The data presented in this study are available free of charge for any user upon reasonable request from the corresponding author.

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