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1 **Status report on education in economics of animal health: results from a European survey**

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40

41 **Abstract**

42 Education on the use of economics applied to animal health (EAH) has been offered since the 1980s.
43 However, it has never been institutionalized within the educational courses for veterinarians and there
44 is no systematic information on current teaching and education activities delivered in Europe.
45 Nevertheless the need for economic skills in animal health has never been greater. Economics can add
46 value to disease impact assessments; the understanding of people's incentives to participate in animal
47 health measures; and refining resource allocation of public animal health budgets. The use of economics
48 should improve animal health decision-making. An online questionnaire survey was conducted in
49 European countries to assess current and future needs and expectations of people using EAH. The main
50 conclusion from the survey is that education in economics appears to be inconsistently offered in Europe,
51 and information about the availability of training opportunities in this field is scarce. There is a lack of
52 harmonization of EAH education and significant gaps exist in the veterinary curricula of many countries.
53 Respondents expressed concerns regarding the limited education on decision making and assessing
54 impacts of animal diseases or using economics for general management depending whether respondents
55 belonged to an educational institution, a public or a private body. Both public and private organizations
56 indicated an increasing importance to the use of EAH in the future. This would motivate the
57 development of teaching methods and materials which aim at developing the understanding of animal
58 health problems for the benefit of students and professional veterinarians.

59

60 **Key words**

61 Economics applied to animal health, training, Europe, veterinary curricula, teaching methods and
62 materials

63

64 **Introduction**

65 Economics applied to animal health (EAH) is a relatively young field in relation to other fields of
66 study^{1,2}. It is concerned with “making rational choices and decisions in the allocation of scarce resources
67 for the achievement of competing goals”, thereby providing the greatest benefit to society^{3,4}. Factors
68 such as globalisation, climate change, and changing food production have contributed to several animal
69 health crises in Europe in the past decade. These crises had dramatic adverse effects on the livestock
70 sector and public health and resulted in significant disruptions to markets and the wider economy.
71 Consequently, there is a need for more effective and efficient animal disease control to avoid negative
72 economic, social and political consequences. To achieve this, knowledge and skills from different
73 disciplines are needed, including economic skills in animal health. Indeed, there is an increasing demand

74 for disease impact assessments and improvements in the allocation of resources for disease surveillance
75 and control for which economics can add value. Discussions are intensified on who should carry the
76 costs of animal health (and disease) and cost-sharing frameworks, which require economic expertise,
77 are being developed to redistribute the financial burden of disease^{5,6}. Moreover, emergence and re-
78 emergence of animal diseases is strongly related to people's behavior and an understanding of incentives
79 through the use of economics allows more refined approaches to disease management. In general, the
80 best use of economics should improve animal health decision making whatever the level of focus
81 considered (individual animal, herd or population).

82 While teaching and training on the use of EAH has been offered since the 1980s, it has never been
83 institutionalized within the educational courses for veterinarians⁷. An inventory of the current EAH
84 teaching and education activities delivered throughout Europe is lacking. There is also a need for
85 mapping the needs of people using economics in animal health now and in the future. Such information
86 could inform the standard setting process for veterinary curricula and the development of future
87 educational materials.

88 These aspects motivated the creation of the NEAT project, "Networking to enhance the use of
89 Economics in Animal Health, Research and Policy Making in Europe and beyond"⁸. NEAT aims at
90 developing and strengthening educational materials and delivery methods to animal health
91 professionals, i.e. veterinarians and related professionals in research, education, private business and
92 service delivery whose activities focus on promoting animal and public health and animal welfare (e.g.
93 animal health economists, technical advisors, epidemiologists). It is a cadre of animal health economists
94 or professionals with a particular interest in the field; all 60 partners (mainly from European countries)
95 of the project have strong links through training, research and consultancies to the animal health services
96 and livestock sectors of member states. The goal of this study was to provide an overview of the status
97 quo of teaching and training activities and techniques in EAH in Europe and to investigate the needs
98 and expectations of end users. Focusing on economics applied to animal health, economics applied to
99 business as a mean to make veterinarians better operators of their practice was not explicitly considered
100 here.

101

102 **Methods**

103 Three questionnaires for different target groups were developed using Webropol 2.0 (Webropol oy,
104 Helsinki, Finland) and distributed online. The first target group included curriculum setting bodies as
105 well as educational institutions such as veterinary or agricultural schools and universities. The second
106 target group were non-educational private organizations including veterinary organizations, industry
107 bodies (farm and food organizations), producers, service providers, consulting agencies and supply
108 chain associations. The third target group were public bodies encompassing government and other public
109 agencies, research institutes, international organizations and non-governmental organizations. All
110 questionnaires were available exclusively in English. They were piloted among 12 contacts from Italy,

111 Germany, France and Finland recruited by NEAT partners. Questionnaires were sent in May 2013 to
112 646 contact persons, 233 of which were working for educational institutions, 280 for private
113 organizations and 133 for public bodies, and originating from 30 different countries. To compile these
114 contact lists, all NEAT partners were asked to provide contact details of all veterinary and agricultural
115 schools in their country as well as contact details of private and public institutions for which EAH was
116 perceived to be of relevance (see description of target groups above). All data were compiled in a
117 spreadsheet file in the common document management system of the project. For each country, a local
118 NEAT referent contact was identified and asked to distribute the questionnaire in the respective country.
119 When no relevant referent could be identified, the lead institution of NEAT screened the public pages
120 of the institutions listed to identify general contact details. All three surveys were also made publicly
121 available on the project website (www.neat-network.eu), and were announced through the NEAT
122 newsletter and through the Epivet mailing list. The respondents answering through this channel were
123 asked to categorize themselves in the group they believed to belong to. A reminder was sent to the 646
124 targeted respondents three weeks after the beginning of the survey, two weeks before its closure.
125 Questionnaires (Appendix 1) were structured in 3 sections addressing (i) the respondent as an individual
126 (demographic data, training and current and/or past experience of economics) but also linked to the
127 organization he/she was representing (geographical location, area of professional activity, relevance of
128 economics in the activity) (ii) the characteristics of current teaching and education provided with in
129 depth questions targeted at educational institutions enquiring about minimum qualification required to
130 participate, topics, teaching methods, resource allocated and enrollment fees and (iii) perceptions about
131 the current and future needs of EAH education across different time horizons and reasons for possible
132 changes regarding the needs. This third section is detailed in Table 1. The questionnaires for the three
133 target groups contained the same general sections and topics but questions were formulated so as to be
134 relevant to the different target groups. The questionnaires included open and closed questions. The
135 closed questions were either check-lists, multiple choice (including where appropriate a category
136 'Other') or under a rating format with Likert or numerical scales.
137 Data were treated confidentially and only the core study group had access to individual responses that
138 were anonymized for analysis. Data were retrieved and statistics obtained using Modalisa version 7.0
139 (Kynos, Paris, France). Descriptive analysis were performed in three steps, considering first the total
140 number of answers received, second the different target groups and third the respondent country when
141 possible. Ethical approval (URN 2013 0080H) was received from the Ethics and Welfare Committee of
142 the Royal Veterinary College (London, UK).

143

144 **Results**

145 *Sample description and respondents profiles*

146 A total of 236 persons responded (among which 32 answered through the public website), thus resulting
147 in a response rate of 37%. Seventy eight answers (of the 236), were given by educational institutions

148 which included schools, faculties or departments of veterinary medicine, agriculture, food science and
149 biomedical science but there were no replies from curriculum setters. Eighty one answers were retrieved
150 from private organizations and 77 from public bodies. Response rates for the three groups were 33%,
151 30% and 58% respectively. The matching between people identified by NEAT partners as belonging to
152 an educational institution or a public body and self-declaring themselves in the questionnaire to work
153 for these types of organizations was good but there was some mismatch for private bodies (Table 2 1).
154 Respondents originated from 25 different countries (Table 3). The number of contact persons among
155 responding countries ranged from 1 to 168 persons in Italy with a mean of 25 and a median of 14.
156 Response rate per country was very variable and ranged from 10 to 100%. The number of persons
157 answering per institution was also variable depending on the country. Educational institutions covered
158 more countries (n=18, this equals 64% of countries covered by contacts provided for this target group)
159 than private and public bodies (respectively n=14 and n=20, that is 67% and 87%). Information from
160 Belgium, France, Hungary, Italy, Slovenia, Spain, Switzerland and United-Kingdom were received for
161 all three target groups. The majority of respondents were between 30 to 49 years old (54%, n=230), with
162 similar distributions of people in their 30ies, 40ies and 50ies in educational institutions and public bodies
163 (around 40% in their 30ies and 30% in their 40ies). There were more people of the age of 50 or more
164 among those representing private bodies (42%, n=34). Respondents had a high degree of qualification,
165 mostly in the areas of veterinary medicine (65%). A large part of the respondents (73%) had previous
166 experience, contact or training in economics and generally agreed about its usefulness (over 70% of
167 persons responded the training had helped them either to understand how economy works or to solve
168 practical economic problems). However, less than half of all respondents judged the coverage of issues
169 in the EAH training they had received as adequate (36%, n=145) and that extra educational material had
170 been easy to find (48%, n=140) (Figure 1). Economics was considered as a relevant activity for about
171 half of the respondents which dedicate up to one fourth of their professional time to some topics in this
172 domain. Fifty six percent of respondents were mainly engaged in administration, management or
173 research activities.

174

175 *Current situation of the training and teaching in EAH*

176 Over two thirds of respondents (73%, n=170) said their organization did not offer teaching or training
177 in EAH. It was the case for 41% of the educational institutions surveyed (n=43). Educational institutions
178 that offer EAH training provide generic EAH training and specialized training in a “bachelor course”
179 (26%, n=9), “master course” (34% n=11) and as “post-graduate training” (29%, n=10) that overlaps
180 with the previous category (multiple answers were possible). Other organizations only provide courses
181 of higher specialization: post graduate training (27%, n=8) and/or internal training/seminars (21%, n=6)
182 (multiple answers possible). A majority of respondents (74%, n=175) reported having poor information
183 about the training opportunities available in their country or elsewhere.

184 Current undergraduate or postgraduate teaching programs in educational institutions are mainly based
185 on general economics concepts and delivered as lectures combined with exercises (each method being
186 cited as compulsory by 67% and 56% of respondents, respectively). E-learning is not commonly used
187 (27% never use it, n=62). The topics covered by the current programs in educational institutions were
188 diverse as shown in Table 3 but over 90% of them included an introduction to economics with basic
189 concepts (proportion calculated on the basis of a total of 29 curricula, some respondents giving
190 information for more than one curriculum). More than a third of respondents reported to use practical
191 examples on how to apply economics in animal health issues (31%, n=9). “Students” and “veterinarians
192 in profession” are the most important categories of targeted audience of current EAH training (24
193 curricula out of 32 (75%) and 11 curricula out of 32 (34.4%), respectively) but they can be diverse as
194 all proposed answers were cited for more than 10% of curricula except farmers (e.g. advisors, industry
195 representatives, government representatives).

196 The courses are typically (median response) attended by 85 students (SD= 75, range: 10-250), require
197 30 hours of study (SD= 131, range: 0-700) and are taught by one or two staff (61%, n=26) with a
198 background in animal science and an economics specialization. In most cases, a poor degree of
199 innovation year by year was reported (70% of respondents, n=29 reported training does not change from
200 year to year). Only 41% of the teaching delivered by educational institutions was reported as not
201 involving any collaboration. When teaching was done in collaboration, national collaboration seemed
202 to be more practiced than international (80% vs 14%, n=29 vs 5 respectively).

203

204 *Current needs*

205 Regarding the current need for more expertise and training in the institutions, respondents among all
206 groups identified the economic impacts of animal diseases and the support to public or sector level
207 decision making as topics requiring further developments in the current courses delivered or further
208 expertise. The area of cost-effectiveness and/or cost-benefit analysis was also frequently pointed out by
209 educational and private organizations. The rest of the topics identified differ according to the groups:
210 private bodies showed an interest towards a wider range of topics, while educational institutions and
211 public bodies selected most frequently “estimating the financial and economic impacts of animal
212 diseases” most frequently (Table 5).

213 In terms of format, a majority of respondents from educational institutions would like the classroom
214 format to continue (57%, n=42), while also identifying a need for an increased use of e-learning and
215 field training (62% and 64%, n=45 and 46 respectively). About 37% (n=56) of respondents from private
216 and public bodies answered their organization could possibly devote one week per year to the training
217 of their staff in EAH and 33% (n=50) said that they would prefer 1 or 2 days per year of EAH training.

218

219 *Need for training in the future and drivers of change*

220 Different topics were listed at the micro economic level on one hand, and at the meso and macro-
221 economic level on the other hand (Table 6). The majority of respondents believed the needs were going
222 to remain stable or increase whatever the topic cited and whatever the timespan considered (short,
223 medium or long term) (at least over 70% of the respondents per topic and time span). In particular, all
224 groups identified the economic/financial impact of animal disease at microeconomic level as a topic
225 with a need for further expertise in the future, i.e. more than 90% of respondents believed that the need
226 will increase over time. Similar proportions of respondents from educational institutions and private
227 organizations also identified firm equilibrium (calculating production costs and revenues), consumer
228 behavior and cost effectiveness/cost benefit analysis as topics that will gain importance. Public bodies
229 seemed to attribute increasing relevance to farm and agro-food system related topics on the contrary to
230 educational institutions.

231 Regarding factors possibly determining the change of needs in EAH, the most important across all
232 groups were concerns about human health (rated as very important by 54% of the 236 respondents)
233 followed by national or international food laws, regulations and policies (49% of the 236 respondents).
234 Findings were similar for all three groups. However, many respondents from veterinary organizations
235 and industries (54%, n=44) considered structural changes (e.g. in herd/flock size, farm size, food
236 industry concentration, international trade patterns) as very important in determining the changes in
237 EAH needs.

238

239 **Discussion**

240 This is the first survey ever conducted to obtain an overview of the extent, content and format of EAH
241 education currently delivered in Europe and to assess current and future needs and expectations of
242 people using EAH. The survey revealed a large variability of EAH teaching and training offered by the
243 different educational institutions surveyed not only depending upon the country considered. There was
244 no harmonization between the different curricula and limited exchanges to run or promote them.
245 Whatever the type of organization considered, there was a clear demand for further education
246 opportunities in topics such as the economic impacts of animal diseases and the support to public or
247 sector level decision making. The majority of respondents believed the needs were going to increase
248 whatever the topic cited and whatever the timespan considered.

249 The survey had a wide geographical coverage that was extended beyond the initial European target
250 (unpublished results) as answering the questionnaire was made possible on a voluntary basis through
251 the website of the network. The number of contacts per country was very variable depending on the
252 inputs of the corresponding NEAT partners and was not homogenized before the survey as results per
253 country could potentially be useful locally. Consequently, the largest number of respondents originated
254 from Italy which was also the country which had provided the greatest number of contacts and this
255 should be kept in mind when interpreting the results. However, response rates per countries were
256 variable ranging from 0% to 100%. The variability in the number of contacts available and the response

257 rate may be due to various factors. First, the effort NEAT partners put into compilation of the list may
258 have differed across countries due to other demands on their time and/or interest. Second, the
259 dissemination of the survey at country level also showed some variation. Although there were regular
260 telephone conference meetings and email correspondence with clear guidelines for the overall
261 management of the survey, the local referent identified for each country was relatively autonomous for
262 administration of the survey and thus had some freedom in choosing how to approach and motivate
263 personal contacts. Overall it potentially enabled to collect more information than what we could have
264 expected from countries where English is not commonly practiced. On the downside, this approach
265 increased the variability in the sample. The number of respondents might have been greater in some
266 parts of Europe if we had made questionnaires available in other languages. However, this was not
267 possible given the time frame and budget of the project. In some cases there were multiple respondents
268 per institution. This should not distort the results, as these are likely respondents from different faculties
269 or departments within for example a university structure with differing focus (e.g. animal health and
270 food science departments within a university). This is particularly true in Italy where large universities
271 prevail with a multiplicity of departments that can have some degree of overlapping in terms of areas of
272 activities but the questions in the first part of the questionnaires were not designed to capture these
273 details. Because data were not received from all agricultural or veterinary organizations within European
274 countries and information about the training opportunities in respondents' respective countries was often
275 poor, the number of available courses related to animal health economics was probably underestimated.
276 The findings indicate that training in economics applied to animal health is inconsistently offered, in
277 particular in veterinary education, and information about the existence of training opportunities in this
278 field is scarce. There is a potential but significant gap between training in economics of animal health
279 delivered in the veterinary curricula and end-users needs. Reducing the lack of knowledge about training
280 across Europe and increasing the attractiveness and opportunities of training in EAH for instance
281 through increased use of e-learning and collaboration between educational organizations would help the
282 educational organizations both to further develop training in EAH and to meet the strategic goals of the
283 Bologna process of the European Union as student mobility for example⁹. It should also tackle the lack
284 of harmonization among the EAH education delivered following the same philosophy of these series of
285 agreements between different European countries designed more broadly to ensure comparability in the
286 standards and quality of higher education qualifications¹⁰.

287 It appears that people trained in economics attribute a relevant role to this discipline in their professional
288 activity in a wide range of cases; but that the coverage of issues in the teaching has been critical for
289 some of them. The current training identified by the respondents was mainly focusing on introductory
290 economic topics and farm-level issues. The results suggest that a greater utilization of fundamental
291 microeconomic principles, sector- and national-level economic approaches and analytical skills in the
292 teaching of EAH might also be warranted.

293 The working organization of the respondent seems to affect the respondent's expectation about the
294 problems that economic discipline can solve as reflected by their current needs for expertise. Thus,
295 people working for educational and public institutions were more concerned with decisions and impacts
296 of animal health (intervention decisions, economic impacts) while those of veterinary organizations and
297 industry bodies were more focused on using economics for general management. Regarding teaching
298 methods, the results suggest that there is scope to increase the use of e-learning and distance-training in
299 this field as in other fields of veterinary education¹¹. Public and private bodies appeared to be the most
300 likely to invest in targeted teaching or short-term training (e.g. one up to a few days seminars or courses).
301 This may reflect the need for problem-solving skills and multidisciplinary thinking but also the need for
302 a wide range of specialized skills, depending on the individual needs, as has been found in some other
303 areas of veterinary medicine¹². The identification of the future needs was less distinct and only marginal
304 differences between groups were observed. Shorter questionnaires may have enabled to increase the
305 number of answers related to this last section of the respective questionnaires and helped draw stronger
306 conclusions. However, it appears public organizations anticipate an increasing need for training in
307 microeconomic and agri-food related topics in the future. Both public and private organizations
308 indicated an increasing importance to the use of economics in animal health in the future.

309 The survey results show that there is scope to enhance the use of EAH in animal health education.
310 However, in practical terms, the inclusion of EAH will need to be balanced against the many other topics
311 that form part of balanced curricula. While small changes may be possible within current settings, larger
312 changes would require dialogue with standard setting bodies and agreements on accreditation and
313 licensing. Bearing this in mind, NEAT participants are defining common short, mid and long term action
314 lines to identify training models, teaching methods and materials aimed at developing the understanding
315 of animal health problems to the benefit of students and professional veterinarians ([www.neat-](http://www.neat-network.eu)
316 [network.eu](http://www.neat-network.eu)). First steps of possible actions have been listed as: (i) promote the institutionalization of
317 EAH in the veterinary curricula by lobbying curriculum setting bodies; (ii) produce a book for
318 undergraduates with basic concepts and cases that would combine theory and application of existing and
319 various economic tools through different Excel based exercises so that it allows users to learn and apply
320 what is presented; (iii) adopt a practical approach of EAH teaching/training developments at
321 undergraduate and postgraduate level through the use of case studies. These steps are expected to
322 enhance EAH teaching and training in NEAT partner institutions, promote harmonization and
323 innovation, and contribute to the education of animal health professionals with relevant skills to tackle
324 modern challenges.

325

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332

333 **References**

334 1 Howe KS, Christiansen KH. *The state of animal health economics: a review*. Proceedings of the
335 Society for Veterinary Epidemiology and Preventive Medicine, 68-80, 2004.

336 2 Rushton, J., Viscarra, R.E., Otte, J., McLeod, A. & Taylor, N. *Animal Health Economics. Where have
337 we come from and where do we go next?* Perspectives in Agriculture, Veterinary Science, Nutrition and
338 Natural Resources, CABI. 2007 1 No. 031

339 3 Morris RS. *The application of economics in animal health programs: a practical guide*.
340 Rev.sci.tech.Off.int.Epiz. 18(2), 305-314, 1999.

341 4 Rushton J. *The Economics of Animal Health and Production*. IN: Cabi Publishing, Wallington, UK,
342 2009, 364 pages.

343 5 Rich KM., Perry BD. *The Economic and Poverty Impacts of Animal Diseases in Developing
344 Countries: New Roles, New Demands for Economics and Epidemiology*. Prev. Vet. Med. 101 (3-4):
345 133–47, 2011.

346 6 Schwabenbauer K. *The role of economics for animal health policy makers*. Eurochoices, 11(2): 18-
347 21, 2012.

348 7 Howe KS. *The economics of veterinary services: a perspective*. Br. Vet. J. 144, 4, 343-350, 1988.

349 8 Anonymous. *Animal health economics network formed*. Vet. Rec. doi: 10.1136/vr.d167, 2011.

350 9 Potomkova J, Mihal V, Cihalik C. *Web-based instruction and its impact on the learning activity of
351 medical students: a review*. Biomed. Pap. Med. Fac. Univ. Palacky Olomouc Czech Repub., 150(2),
352 357-361, 2006.

353 10 European higher education area 2010 The Bologna Process. <http://www.ehea.info/>. Accessed
354 08/18/14.

355 11 Artemiou E, Adams CL, Toews L, Violato C, Coe JB. *Informing web-based communication curricula
356 in veterinary education: a systematic review of web-based methods used for teaching and assessing
357 clinical communication in medical education*. JVME. 41(1), 44-54, 2014.

358 11 Alonso S, Dürr S, Fahrion A, Harisberger M, Papadopoulou C, Zimmerli U. *European veterinary
359 public health specialization: post-graduate training and expectations of potential employers*. JVME.
360 40, 76-83, 2013.

361

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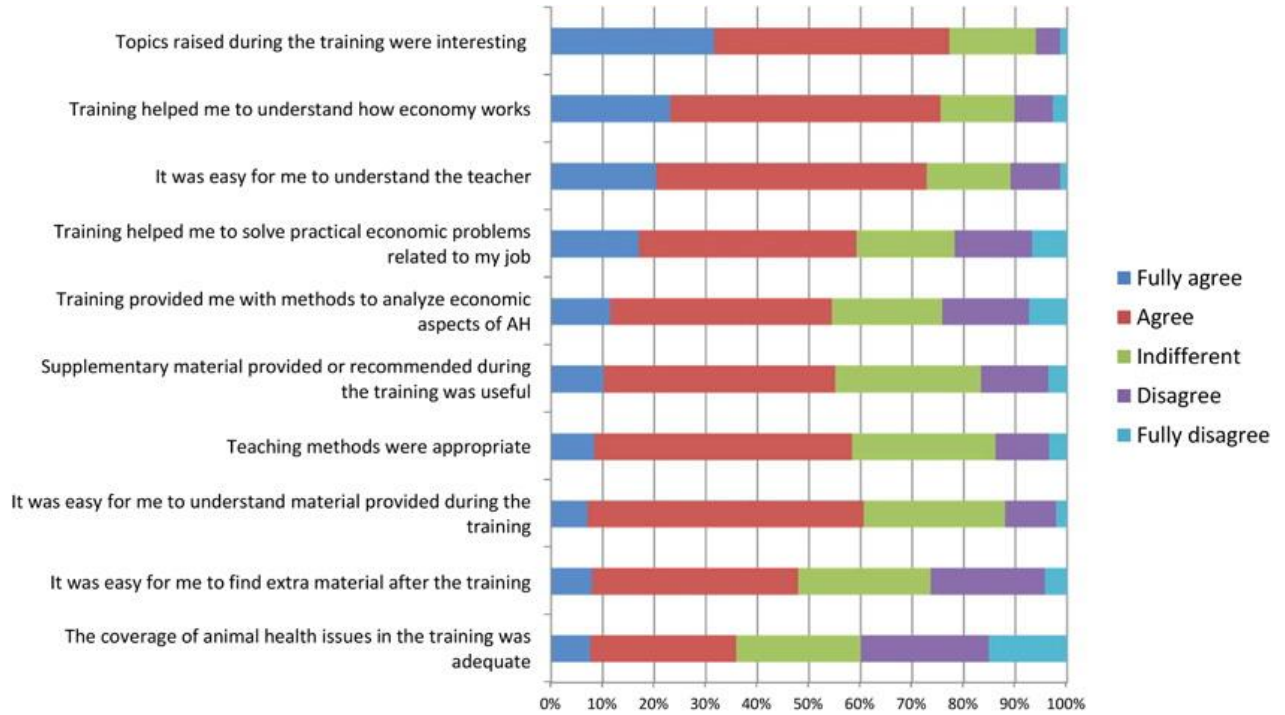
363 **Figure captions**

364

365 Figure 1: Opinions of respondents to the statements regarding training in EAH that they have received

366 (minimum N=138 respondents)

367



368

369 Table 1: Questionnaire structure in section 3 related to the current and future needs of training along
 370 with the drivers of change

	Questionnaire educational institutions	Questionnaire private organizations	Questionnaire public bodies
Need of training today	<i>Current use and need of EAH</i>		
	3.1. What kind of problems do you expect to solve by applying economics? 3.2. How much of typical student's time in your current economics of animal health training program is related to the following topics?	2.1 Does any aspect of your organization involve the following economic dimensions, and how important are they?	2.1 For what kind of problems does your organization apply economics?
	3.3. Think about the attention that is currently given to different topics. Which topics would you like currently a) to be reduced or have significantly less emphasis, b) to keep a similar amount of attention, c) to get more emphasis?	2.2 For which topics and how much does your organization currently need more expertise? 2.3 In which topics and how much would personnel in your organization benefit from further training?	2.2 For which topics does your organization currently need more expertise? 2.3 Who currently provides your organization with this expertise? 2.4. Are your organization's needs in terms of expertise currently fulfilled 2.5. For people from your organization providing the expertise, would they benefit from training in the following topics?
	<i>Training methods and potential resource allocation</i>		
	3.4 How much of the current training methods do you use are under the following formats? 3.5 Which format would you like to be a) reduced, b) used as much as currently or c) used more?	2.4 By which methods would your organization like its personnel to receive further training? 2.5 How much time would your organization possibly devote to economics of animal health training	2.6. If people from your organization provide the needed expertise and that they need specific training, which format would be the most suitable for this training 2.7. How much time would your organization possibly devote to economics of animal health training (please tick the chosen answer)?
Need of training in the future	3.6 If you think that the needs of veterinary experts are going to change in the future for some topics, please tick the topics concerned, give the time span over which you believe they will become of concern, and indicate whether the needs are anticipated to decrease (-), be the same (0) or increase (+)?	2.6 If you think that the needs of your organization regarding economics of animal health will change, with respect to the time span over which you expect changes to come about, please tick a) the topics concerned, and b) whether you expect their importance to increase (+), decrease (-), or remain about the same (0).	2.8 If you think that the needs of your organization regarding economics of animal health will change, with respect to the time span over which you expect changes to come about, please tick a) the topics concerned, and b) whether you expect their importance to increase (+), decrease (-), or remain about the same (0).
Drivers of change	3.7 What factors will determine the change, and how important are they?	2.7 What factors do you consider will determine the changes you have indicated above, and how important are they?	2.9 What factors do you consider will determine the changes you have indicated above, and how important are they?

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373 Table 2: Number of questionnaires sent per type of organization surveyed reflecting the investigators'
 374 classification compared to auto-classification of main activity by respondents per target group
 375 (educational institutions, private organizations, public bodies).

Auto-classification by respondents	Educational institutions (first target group)	Private organizations (second target group)	Public organizations (third target group)	Total
Educational institution	73	7	12	92
Research institute	6	6	14	26
Government		2	36	38
Service provider, consulting agency	4	7	5	16
Producer of physical products		6		6
Veterinary organization	1	19	24	44
Farming organization or industry organization	1	43	6	50
Supply chain association		7		7
Other	1	1	4	6
Total	86	98	101	285

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 377 Table 3: Number of contacts per country covered by the survey and number of answers received.

Country	Number of contacts	Number of answers	Number of responding bodies**
Italy	168	54	35
France	95	26	23
Slovak Republic	3	20	8
UK	24	16	15
Hungary	15	11	8
Germany	102	10	10
Belgium, Croatia*, Finland, Greece, Ireland, Portugal, Romania, Spain, Switzerland, Turkey	≤25	≤7	2-7
Bosnia and Herzegovina, Sweden	≤10	<5	2-4
Albania, Austria, Bulgaria, Denmark, Estonia, Lithuania, Netherlands	≤3	≤4	1-4
Latvia, Norway, Poland, Serbia	<5	0	0

378 *exception with 45 number of contacts
 379 **not all respondents mentioned the organization/body they were working for
 380

381 Table 4: Topics currently covered in 29 of economics applied to animal health curricula according to
 382 the sample of educational institutions which responded to the survey (respondents could give
 383 information for multiple curricula).
 384

	Number of answers	Frequency (%)
Introduction to economics, basic concepts	27	93.1
Accounting, finance	8	27.6
Firm-level economics, production and costs functions, profit maximization, supply decisions	21	72.4
Demand theory, consumption, consumer preferences	16	55.2
Sector-level economics, simultaneous analysis of demand and supply in one sector, analysis which focuses on agriculture	16	55.2
Economics at the level of national economy, analysis covering other sectors in addition to agriculture	6	20.7
Economics of public policies and public interventions, decision-making of public bodies	3	10.3
International trade	1	3.4
Practical examples on how to apply economics in animal health issues	9	31.0
Analytical derivation of economic results	2	6.9
Total / curricula	29	

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Table 5: Percentage of respondents being of the opinion that more expertise is currently needed in their organization for a topic of EAH

Topics	Proportions of respondents believing their organization needs more expertise in the topic (%) *		
	Educational institutions	Private organizations	Public bodies
Calculating production costs and revenues	26.9	69.2	46.8
Estimating the (economic/financial) impacts of animal disease	59	77.2	71.4
Pricing of products and inputs, including data relating to food, feed, veterinary services etc.	37.2	62.0	40.3
Market or sector analysis	30.8	67.6	33.8
Market price analysis (e.g. trends, price building)	29.5	65.8	24.7
Supply chain analysis and/or management	24.4	64.5	35.4
Consumer behavior analysis	35.9	64.5	44.2
Cost-effectiveness and/or cost-benefit analysis	43.6	76.0	52.0
Problem analysis to influence public policy decisions	43.6	60.8	58.5
Project and /or program evaluation in the public sphere	38.5	55.9	48.1

391 *For educational institutions are reported the % of respondents that want the topic to get more emphasis ("add"). For the two other
 392 categories are reported the % of respondents believing the need of expertise in the topic is "medium" and "a lot"
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395 Table 6: Proposed EAH topics regarding which the needs of the institutions surveyed might change in
 396 the future.
 397

Topics at the level of farm, firm or individual person / Directly related to your organization
Production costs (including all inputs, outputs), profit maximization
Economic impacts of animal disease
Accountancy, finance
Pricing, marketing related to food, feed and veterinary services
Investment analysis
Topics at the level of sector, market or national economy / Concerning the wider market or economy
Economic impact of animal disease
Market or sector analysis
Market price analysis (price trends, price formation)
Supply chain analysis, supply chain management
Consumer behavior, demand analysis theory, consumption
Cost-effectiveness analysis, cost benefit analysis
Support to public or sector-level decision making
Project or program evaluation, policy analysis, policy impacts

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