Of Experts, Politicians and Beasts: Setting Priorities in Farm Animal Conservation Choices

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Abstract
We consider the choice of farm animal breeds for conservation programmes. Based on an analysis of past decisions in EU member countries to enter breeds into the conservation programmes of rural development plans and based on the results of an expert survey among breed societies and scientists, we find an inconsistency in the valuation of breed characteristics. Policy makers seem to be less concerned about considering true extinction risk and diversity and more about cultural values and about means to benefit a larger number of farmers for raising rare breeds.

Keywords: Animal genetic resources, conservation, expert survey, farm animal breeds, revealed policy preferences.

JEL-Codes: Q18, Q28

1 Introduction

Relative to its size, Europe owns a large proportion of worldwide farm animal genetic resources (AnGR) and biodiversity: More than a quarter of the worldwide recorded cattle, sheep, pig and horse breeds are found in Europe (FAO, 2003). This diversity of animal breeds has played an important role in the history of the European economy. However, during the second half of the 20th century, the populations of some breeds have diminished below a critical size and some breeds have even become extinct. The underlying causes for this development can be found in the industrialization of animal agriculture and in the rising ubiquity of few high yielding and productive breeds.

The importance of conserving farm AnGR has increasingly been acknowledged over the past 20 years. In 1992, the United Nation's Conference on Environment and Development explicitly mentioned their importance in its agenda 21 and Convention on Biologic Diversity (United Nations, 1992). To face the problem of extinction and eroding farm animal biodiversity, a number of efforts have been undertaken by different institutions, among others the European Union.

Despite the increasing interest in and importance attributed to farm AnGR, research has provided little guidance as to how conservation programmes should select valuable breeds. Weitzman (1992, 1993, 1998) has recognized that the issue of biodiversity conservation is an inherently economic question and provides a framework for decision analysis. In this framework the objective is to distribute a limited budget among conservation efforts such as to maximise the expected welfare from diversity and other conserved characteristics. While his framework is of high generality and applicable to many diversity conservation questions, he was primarily interested in the conservation of species diversity (for an example see Weitzman, 1993, or Metrick and Weitzman, 1996, 1998). However farm AnGR conservation is not a question of species conservation. Here the breed level is of primary importance.

The Weitzman model has been applied to the question of breed selection into conservation programmes by Cañon et al. (2001), García et al. (2002), Laval et al. (2000), Marti and Simianer (2002), Simianer (2002), Simianer et al. (2003) and Thaon d'Arnoldi et al. (1998). This transposition of Weitzman's original framework is challenged by two major objections. A first criticism against the transposition of Weitzman's diversity concept to breed conservation is the reduction of the diversity notion to a single dimension (Bruford, 2004). Livestock diversity regarding breeds cannot be characterized by between-breed diversity only, i.e., their genetic distinctiveness, but within-breed diversity, i.e. the genetic variation within a breed, is of primary importance. Some would even argue that this dimension is more important as it influences the viability of a breed regarding future breeding success and, e.g., its resistance to altered environmental conditions. In fact, within-breed diversity accounts for 50 to 70% of total genetic variance (Hammond and Leitch, 1996). The issue is further complicated by the fact that not only one level of diversity, i.e. which breed, is of importance but also a second level, i.e. how many breeds of each species are to be protected.

Second, basically none of the applications has recognized the necessity to include other dimensions of welfare stemming from the conservation of breeds but their contribution to diversity. Only Simianer (2002) attempts to overcome this very restrictive nature of the objective function by extending it to the objective of preserving specific traits. This is a major drawback, since society is not blindly conserving diversity for its own sake. Much is known about the different livestock breeds, their specific merits in various or highly specialized production systems, their genetic and phenotypic characteristics, so that utility should be extended to take these contributions into account.

In addition, society poses many demands on agriculture. It is not only to serve the demand for food, but to provide for a variety of high-quality products and regional specialties, in addition to cultural and landscape amenities. Taking into account all these different aspects in designing efficient biodiversity conservation programmes is a major challenge for the future.

The description of many of the evoked aspects is a task for geneticists and husbandry experts. However, the importance attributed to each individual attribute and the weighing of the attributes in conservation-programme decision making has to be decided by society and is a task of genuine interest to economists.

This paper analyses the question of how society does or, possibly should, weigh breed characteristics by taking two distinct approaches. First, past decision making of breed conservation is analysed to inquire into the priorities that EU member countries express when selecting breeds for their currently ongoing conservation efforts within rural development plans (RDPs) that are regulated under EC 445/2002. Under the hypothesis that the adopted programmes reveal policy-makers', and hence society's, preferences for the conservation of different breeds, we analyse a large data base linking the decision to establish a breed conservation programme to various attributes of farm animal breeds.

While this evaluation allows assessing policy makers' preferences that may reflect various influences by breeders, scientists and society as a whole, we compare these results with those from an expert survey on the conservation of farm AnGR that was primarily addressed to scientists and animal breeding societies.

The following section gives an introduction to farm animal conservation programmes co-funded by the European Union within the instrument of RDPs. Then we present in section 3 the data base and the methods used in its analysis. Section 4 discusses the results. We turn next to a discussion of these results in light of data from an expert survey in section 5 and conclude in section 6.

2 In-Situ Conservation of AnGR in the European Union

During the late 1980's, the European Common Agricultural Policy (CAP) came under increasing pressure to provide production curbing policies and to undertake measures for enhancing the environmental benefits of agriculture. In response, the MacSharry reform of 1992 has introduced agri-environmental measures under regulation EC 2078/92. While the results of these measures were criticized for being too modest from an environmental point of view, this reform presented a significant change in the CAP. For the first time it introduced new instruments to the CAP that previously almost exclusively relied on price support and market control mechanisms. It basically founded the second pillar of the CAP (Baldock and Bennett, 2001). Later on, Agenda 2000 regrouped many existing and new measures concerning rural development, including the agri-environmental measures, into regulation EC 1257/1999.

Already under regulation 2078/92, European farmers received incentives to raise local, endangered breeds, an objective explicitly stated in Article 2 of the regulation. In several EU-15 countries, a total of 253 breeds benefited of a support estimated at more than 100 ECU by large animal unit (Simon, 1999).

The evaluation of the actions undertaken during the first years of the programme suggested that traditional breeds generate benefits in addition to their contribution to farm animal biodiversity. These are (1) endowment with resistance characteristics, adaptability and robustness; (2) landscape amenities; (3) adaptation to extensive production systems; (4) potential development of quality products (Yarwood and Evans, 2003). In addition to these benefits, the evaluation report underlined that the support of these breeds could induce farmers to remain in marginal rural areas.

We provide a brief overview of the current state of in-situ conservation of animal genetic resources in the EU according to the application of regulations 1257/99, and regarding regulations 1750/99 and 445/2002 concerning its implementation. Two databases have been used for this initial descriptive analysis. The first database is constructed from the FAO DAD-IS database (2004) and provides a description of the breeds present in different countries of the EU. The second concerns the breeds that do actually receive support by the EU. It was constructed by Signorello and Pappalardo (2003) who examined 69 RDPs adopted in the 15 EU member states before the enlargement of 2004 with respect to breed conservation.

Table 1 summarizes the results of this analysis. The FAO database counts 1555 breeds of the six mammalian animal species ass, cattle, equine, goat, pig, and sheep. Of these 1555 breeds, 317 (20%) are considered extinct. Among the remaining breeds, 107 are considered of unknown endangerment status, 529 in normal situation and 602 (48%) at risk. These are further classified as critical[1] (161), in danger[2] (280), critically-maintained[3] (37) and in danger-maintained (124).

Table 1. Current state and in situ conservation of AnGR in EU-15 countries

Country	Total	Extinct		At Risk		Eligible**		RDP	
		Total	%	Total	%*	Total	%*	Total	%***
Austria	54	24	44.44	20	66.67	30	100.00	29	96.67
Belgium	49	5	10.20	17	38.64	18	40.90	13	72.22
Denmark	66	4	6.06	30	48.39	45	72.58	-	-
Finland	22	-	-	13	59.09	15	68.18	6	40.00
France	282	100	35.46	82	45.05	109	59.89	54	49.54
Germany	225	-	-	152	67.56	164	72.88	46	28.05
Greece	28	1	3.57	11	40.74	31	114.81	20	64.52
Ireland	45	5	11.11	20	50.00	24	60.00	3	12.50
Italy	227	72	31.71	77	49.68	111	71.61	77	69.37
Luxembourg	9	-	-	4	44.44	9	100.00	1	11.11
Netherlands	29	1	3.44	10	35.71	18	64.28	-	-
Portugal	31	3	9.67	3	10.71	15	53.57	4	6.67
Spain	140	25	17.85	63	54.78	53	46.08	45	84.91
Sweden	70	5	7.14	32	49.23	38	58.46	12	31.58
UK	278	72	25.89	68	33.01	117	56.79	-	-
EU	1555	317	20.38	602	48.63	797	64.37	310	38.90

*: The percentage is calculated in relation to the number of remaining breeds.
**: Counts the number of breeds whose population is smaller than those specified in regulation EC 445/2002.
***: The percentages are calculated in relation to the number of eligible breeds.
Source: FAO (DAD-IS, 2004) and Signorello and Pappalardo, 2003.

When considering the distribution of endangered breeds across countries, Germany occupies the first rank in absolute numbers with 152 breeds at risk, followed by France (82) and Italy (77). Looking at the percentage of breeds at risk the order is Germany (67.56%), Austria (66.67%), Finland (59.09%) and Spain (54.78 %). In the other countries less than 50% of the existing breeds are at risk. Generally speaking, the countries that are better endowed with genetic resources have a higher percentage of breeds at risk. At the breed level, the correlation between these two numbers is 0.93. Germany, the UK, France, Italy and Spain contribute to 71% of breed diversity and host 73% of the breeds at risk.

[1] This group consists of breeds with the following characteristics: The number of reproducing females is smaller than 100 or the number of reproductive males is less or equal 5; the total population size is slightly above 100 and declining and less than 80% of females are bred pure.
[2] This group of breeds has the following characteristics: The number of reproductive females is between 100 and 1000 and the number of reproductive males is less than 20 but above 5; the total population size is slightly larger than 100 and growing or slightly about 1000 and declining; less than 80% of females are bred pure.
[3] Breeds are classified as critically-maintained or endangered-maintained if the definitions above apply and a conservation programme is in place or the breeds are maintained by commercial companies or research institutes.

Comparing the two data bases (FAO and RDPs) shows that the number of breeds covered in RDPs is with 310 at about 52% of breeds that the database of the FAO considers as at risk. In EC regulation 445/2002 the threshold for risk of extinction is set according to the number of breeding females: less than 7 500 for cattle, 10 000 for sheep and goat, 5 000 for horse and ass and 15 000 for pig. If one considers the breeds with population sizes below this threshold, 797 breeds (64%) could be considered eligible under current EU regulation. However, only 39% of the eligible breeds are actually introduced and receive conservation subsidies co-founded by the EU.

A further analysis of the database reveals that the number of breeds covered in RDPs varies considerably across countries and across species. Looking at coverage rates by country, the EU is led by Austria (96.67%), Spain (84.91%), Belgium (72.22%) and Italy (69.37%). Greece, France and Finland occupy a medium position with coverage rates of 64.52%, 49.59% and 40.00%, respectively. The other countries, Sweden, Germany, Portugal, Ireland and Luxembourg have coverage rates below average. Three countries, Denmark, the Netherlands and the UK, did not integrate measures of breed conservation in their RDPs. Taking a perspective of absolute numbers, it is Italy followed by France, Germany and Spain who have introduced the greatest number of breeds into their RDPs.

A precursory look at these trends leads one to the hypothesis that the countries with the greatest number of extinct breeds are the most active in breed conservation: For example, Austria has lost 44% of its original endowment of breeds and introduced 29 of the remaining 30 eligible breeds in RDPs. For France and Italy we observe similar trends. On the other hand, in Germany no breed seems to have been extinct and it only introduced 28% of eligible breeds in its RDP, a share that is significantly below the EU average of 39%.

If one looks at the distribution by species, sheep occupy the first rank. Overall 100 sheep breeds are covered in RDPs. They are followed by cattle breeds (93), horse breeds (60), goat breeds (29), pig breeds (17) and ass breeds (11). However, in relative terms, the ranking changes being led by asses (92%), cattle (47%), sheep (43%), goat (43%), horse (29%) and pig (21%).

3 Data and Methods

3.1 Econometric Model of Determinants of In-Situ Conservation Choice

Looking at the descriptive analysis of the databases, one is led to the hypothesis that the decision to enlist an eligible breed varies considerably by country and by species. We want to further scrutinize this hypothesis, at the same time accounting for other effects that may lead politicians and other decision makers in their conservation choices. We follow Metrick and Weitzman (1996, 1998) who used a similar approach analysing US decision making regarding the Endangered Species Act. Their model is based on the revealed preference approach of government decision making (Rausser and Freebairn, 1974; McFadden, 1975, 1976; Cropper et al., 1992). From a formal analysis of the diversity conservation question based on Weitzman's (1998) diversity concept they derive four factors that should determine the decision to preserve a species (or subspecies or population). These are: utility of the species, distinctiveness of a species, survivability following a conservation plan and cost of enhancing survivability.

Following these considerations, we denote the attractiveness of a breed *j* to be considered for an in-situ conservation programme as Y_j^* and let it be a function of the various attributes of breed *j* described by vector X_j. Then we let

$$Y_j^* = f\left(X_j, \alpha, \varepsilon_j\right) \tag{1}$$

where α is a vector of parameters to be estimated and ε_j is an error term.

We cannot observe a breed's specific attractiveness for conservation, but we can observe, ex-post, if a breed is covered in a RDP or not. Let Y_j be the observed conservation decision where $Y_j = 1$, if the breed exceeds a certain threshold attractiveness, say $Y_j^* > C$, and zero otherwise. Assuming $f(\cdot)$ to be a linear function, we obtain the probability (Pr) that a breed is covered by a RDP as

$$\Pr(Y_j = 1) = \Pr(X_j\alpha + \varepsilon_j > C) = 1 - \Pr(\varepsilon_j \leq C - X_j\alpha) \tag{2.1}$$

$$\Pr(Y_j = 0) = \Pr(X_j\alpha + \varepsilon_j \leq C) = \Pr(\varepsilon_j \leq C - X_j\alpha) \tag{2.2}$$

We specify the probability distribution of the error term as normal and obtain a probit model. The model is estimated using maximum likelihood procedures.

3.2 Data

We use data by the European Association of Animal Production (EAAP, 2004) to estimate this model. The EAAP provides a large amount of information about the characteristics of individual breeds that in this depth is not available in the FAO database. From this database we collected data on six species in twelve EU-15 countries that cover breed conservation in their RDPs. Applying the population size threshold of the regulation EC445/2002, we construct a sample of 548 eligible breeds of which 265 are covered in RDPs. At the cost of some breeds that are not covered in the EAAP database, we gain more information about breed characteristics. Still, our database contains 87.4% of all breeds and 85.5% of all eligible breeds. We do not find any indication that limiting the sample led to any bias.

Table 2 presents a summary of the data by country. The dependent variable is if an eligible breed is chosen for a conservation programme or not.

Table 2. Sample distribution of breeds by country according to EAAP database

	Total according to FAO database		**Sample formed from EAAP database**			
			Eligible		**RDP**	
Country	**Eligible**	**RDP**	**Number**	**%***	**Number**	**%***
Austria	30	29	21	70.00	20	68.96
Belgium	18	13	18	100.00	12	92.30
Finland	15	6	15	100.00	5	83.33
France	109	54	104	95.41	48	88.88
Germany	164	46	163	99.39	46	100.00
Greece	31	20	17	54.83	14	70.00
Ireland	24	3	22	91.66	3	100.00
Italy	111	77	103	92.79	73	94.80
Luxembourg	9	1	4	44.44	1	100.00
Portugal	15	4	10	66.67	2	50.00
Spain	63	45	37	58.73	30	66.66
Sweden	38	12	34	89.47	11	91.66
EU	627	310	548	87.40	265	85.48

*: The percentage is calculated in relation to the data from the FAO-database presented in table 1.

As explanatory variables we identify four categories of breed attributes that may help to explain why a breed enters into a RDP or not (table 3). The first category of variables includes information about population dynamics of the breed: its population size in natural logarithm; if the recent trend in its population size is increasing or declining (base line is a stable population size); and if the number of herds (breeding farms) is smaller than 10. We consider these as indicators of the endangerment status of a breed. This endangerment status increases the fewer animals there are and the fewer herds are breeding.

Table 3. Explanatory variables of in-situ conservation decision

Variables	Description	Expected Sign	Mean	SD
Population characteristics				
Ln-Pop	Continuous variable taking the natural logarithm of the population size of the breed	-	5.530	1.714
T-Growing	Binary variable with value 1 if the breed is growing in its population size and 0 if not	-	0.390	0.488
T-Decreasing	Binary variable with value 1 if the breed is declining in its population size and 0 if not	+	0.321	0.467
No. of Herds	Binary variable with value 1 if the has a number of breeding herds greater than 10 and 0 if not	+	0.583	0.493
Value characteristics				
Herdbook	Binary variable with value 1 if the breed has a herdbook and 0 if not;	+	0.877	0.327
Spec. Char.	Binary variable with value 1 if the breed carries a specific characteristic and 0 if not	+	0.458	0.498
Uniqueness characteristics				
Autochthonous	Binary variable with value 1 if the breed is autochthonous and 0 if not;	+	0.419	0.493
Geo – Countries	Binary variable with value 1 if the breed is present in only one country and 0 if not	+	0.677	0.468
Geo – Regions	Binary variable with value 1 if the breed is present in all regions of a country and zero if not	+	0.642	0.479
Conservation characteristics				
In-situ	Binary variable with value 1 if the breed has already benefited of an in-situ conservation programme before the RDP and 0 if not	+	0.268	0.443
Ex-situ	Binary variable with value 1 if the breed is included in an ex-situ conservation programme (semen and /or embryo) and 0 if not	-	0.198	0.399
Control variables				
Dummy w.r.t. species	Indicator variable for one of the six species (base line for pig)	+/-	-	-
Dummy w.r.t. country	Indicator variables for 11 of the 12 countries (base line for Sweden)	+/-	-	-

We include a second set of variables that refers to the value characteristics of the breeds: if it has a herdbook and if the breed carries some specific characteristics (rusticity, resistance, adaptability, specific products etc.). We chose the first variable following the logic of EU regulation. The EU requires breeds to be autochthonous and to carry a herdbook or to be managed by some breeding association. In addition, a breed that has a registered herdbook could be argued to be of higher cultural value. The variable indicating the presence of specific characteristics is considered to confer information on the use-value of a breed. Together, these two variables measure the utility component of Weitzman's (1998) model.

The third set of variables refers to the uniqueness of a breed, i.e., if it is autochthonous (as required by EU regulation) and its geographic repartition within a given country and across countries. These variables measure the specificity and rareness of a breed in a local, national and international context.

The last set of variables refers to the question if the breed has benefited before of an *in-situ* or *ex-situ* conservation programme. Two methods of AnGR conservation are used in the EU: *in-situ* and *ex-situ*. The *in-situ* conservation consists in conservation of animals in their respective production system. This type of conservation does not only allow conserving the targeted genes but also the whole genome as a complex of genes co-adapted to the biological community in the original eco- and production system.

As far as *ex-situ* conservation is concerned, there exist two methods. The first consists in conserving breeds *in-vivo* outside their traditional production environment, for example in natural parks or in zoos. The second concerns cryoconservation of semen or/and embryos. While the technique of *in-vitro* conservation has made a lot of progress, in particular for species of agricultural interest (cattle, goat, pork and horses), the cryoconservation of ovocytes is not yet sufficiently efficient to be utilised in conservation programmes. Cryoconservation of males and females separately could, though, have important advantages, because it offers the possibility of genetic combination of female and male lines and thus it diminishes the risk of genetic diversity loss in small populations.

The choice between these two techniques depends on the objectives and costs of conservation (Gandini and Oldenbroek, 1999). In general, *in-situ* conservation is considered to be the better solution because it maintains the evolutionary and adaption capacity of the population. Nonetheless, cryoconservation also presents many advantages of reducing the risks associated to the manifestation of animal disease outbreaks and could be used complementary to the in-situ conservation approach to control the process of genetic erosion. Gandini and Oldenbroeck (1999) suggest that the issue of conservation must be argued rationally on an integrated approach that takes into account both techniques.

At present cryoconservation is generally accepted and allowed in EU countries. We use a dummy variable to describe the breeds that are covered by cryoconservation programmes. In addition, we use a dummy variable indicating if a breed was covered by other in-situ conservation programmes before the introduction of RDPs. Finally the fourth category of variables is comprised of dummies that control for species and countries. The variables, along with their expected impact and summary statistics, are listed in table 3.

4 Results

The results of the probit estimation are shown in table 4 that gives the parameter estimates along with their t-values in the 2nd and 3rd column and the marginal effects in the 4th and 5th column. The log-likelihood test shows that the model is highly significant and 83% of the predictions are correct.

Table 4. The determinants of in-situ conservation of AnGR in EU countries – Probit model results

Explanatory Variables	Probit		Marginal Effects	
	Parameter	t-statistic	Value	t-statistic
Constant	-3.024***	-5.182	-1.201***	-5.213
Population characteristics				
Ln-Pop	0.092*	1.789	0.036*	1.790
T-Growing	0.221	1.193	0.088	1.196
T-Declining	-0.089	-0.450	-0.035	-0.451
No. of herds	-0.582***	-3.241	-0.229***	-3.328
Value characteristics				
Herdbook	0.012	0.051	0.004	0.051
Specific characteristics	0.350**	2.234	0.138**	2.254
Uniqueness characteristics				
Autochthonous	0.772***	4.773	0.300***	5.01
Geo – countries	0.574***	3.130	0.222***	3.292
Geo – region	0.824***	4.199	0.313***	4.582
Conservation characteristics				
Ex-situ	0.224	0.852	0.089	0.854
In-situ	0.494**	2.234	0.195**	2.287
Dummy w.r.t. species (base species: pig)				
Ass	1.717***	2.602	0.491***	6.306
Cattle	0.754***	2.578	0.292***	2.766
Goat	0.474	1.463	0.186	1.521
Horse	0.758***	2.692	0.294***	2.853
Sheep	0.962***	3.493	0.366***	3.894
Dummy w.r.t. countries (base country: Sweden)				
Austria	2.736***	3.943	0.572***	17.501
Belgium	0.951***	2.101	0.345**	2.645
Finland	-0.111	-0.205	-0.044	-0.207
France	-0.192	-0.549	-0.075	-0.555
Germany	0.477	1.317	0.188	1.343
Greece	0.160	0.323	0.063	0.324
Ireland	-0.400	-0.787	-0.152	-0.839
Italy	0.600*	1.674	0.234*	1.756
Luxembourg	0.799	0.999	0.297	1.189
Portugal	-1.403***	-2.623	-0.402***	-5.160
Spain	1.132***	2.576	0.399***	3.487
Number of observations	548.000			
Log-likelihood	-208.564			
χ^2	341.969***			
Correct predictions (%)	83.029			

***: parameter significant at 1%.
**: parameter significant at 5 %.
*: parameter significant at 10%

4.1 Population characteristics

The first set of variables characterises the extinction risk of the breed. It is described by the population size, the recent trend in population size and the number of breeding herds. Contrary to our expectations, breeds with a larger population size are more likely to be included in a conservation programme. The variable is significant at the 10% level. Increasing or declining trends of population size are found to be not significant. Finally the variable referring the number of breeding herds actually raising that breed is found to be highly significant. However its sign is again against our expectation and negative. The more breeding herds there are, the more likely it is that a breed is considered in a conservation programme of a RDP. This contradicts our expectations, as breeds with a small number of breeding herds are at a higher risk of homozygosis and lower within-breed variation. On the other hand, a larger number of herds will benefit a larger number of farmers, so that it could be possible that politicians are rather seeking a means of income distribution or are obeying to greater pressure from a greater number of farmers.

4.2 Value characteristics

The second set of variables refers to the value characteristics of the breeds. The EU regulation requires breeds to be managed by a herdbook or by some breeding association. At the same time this variable may confer information about the cultural value of a breed. The results of the probit estimation confirm our hypothesis that this characteristic increases the probability for a breed being included in a conservation programme. The result that a herdbook does not enter significantly in the estimation suggests that the alternative eligibility criterion of being managed by a breeding organization is considered sufficient by member states for a breed to qualify for a conservation programme.

The second variable in this category refers to the specific value characteristics that distinguish one breed from others. The characteristics considered when constructing our database are numerous and varied. They concern aspects of reproduction, production (quantity and quality) and adaptability to specific environments. The variable takes the value 1 if the breed has a (or several) specific characteristics and zero if not. We find a positive coefficient to this variable that is significant at the 5% level. The marginal impact on the probability of being included in a RDP is relatively large (0.138), showing that these breeds have high chances of being included in conservation efforts co-funded by the EU.

While the specific characteristics refer to the value of preserving a breed on the one hand, they may also indicate the cost dimension of conservation programmes on the other hand, as breeds with specific characteristics of private value to breeders may require less public support for successful conservation.

4.3 Uniqueness characteristics

The parameter to the variable autochthonous turns out to be highly significant. Being specific to the region where it is raised, the breed has a high chance to be selected into a conservation programme. The marginal value of this variable shows that being autochthonous raises the probability of a breed to be in a conservation programme by 30%.

The geographic dimension of breeds has been approached using two variables. The first informs about the geographic distribution within a country and the second refers to the geographic distribution across countries. Both variables are highly significant and the signs of their parameters confirm our expectations. If a breed cannot be found in any other country, then it is more likely to be included in a RDP. The dummy variable increases the probability of being included by 22%. At the same time, the fact that a breed is associated to one and only one region of a given country makes it more unique, possibly in a cultural sense, and raises its probability of being included in a conservation programme by 31 %.

4.4 Conservation characteristics

The parameter to the variable regarding *ex-situ* conservation has not been significant. For our sample, 30% of the breeds are covered by cryoconservation programmes and RDPs. We do not find a systematic difference suggesting that both types of conservation are used in a complementary or substitution relation between these conservation efforts.

The next variable concerns the question if a breed has been covered by *in-situ* conservation programmes before regulation 455/2001 has been applied. This variable has a highly significant positive effect. Overall 113 out of 265 breeds have been covered before and now been integrated in RDPs. This effect may be explained by member countries now using the possibility of co-financing their original efforts in terms of breed conservation. It also suggests that member countries recognize the importance of posing economic incentives to farmers if they want to develop successful conservation strategies. Indeed, through the recent reforms the CAP orientates itself to posing incentives for environmentally benign agriculture, e.g., by decoupling subsidies and by introducing eco-conditionality. Reducing the competitive advantage of intensive production systems that have greatly benefited from the old CAP, this tendency encourages interest in traditional livestock breeds (Yarwood and Evans, 1999).

Finally, we find a large number of country and species dummies significant. This concurs with our descriptive analysis in section 2. After controlling for the other variables, breeds of the species ass, cattle, horse and sheep are significantly more likely to be covered in RDPs than pig and goat. In addition, more covered breeds are found in Austria, Belgium, Italy and Spain, whereas fewer are expected in Portugal when compared to the base country Sweden.

The results of the probit analysis lead to the conclusion that the consideration of breeds in RDPs is not driven by considerations of extinction risks. This confirms conclusions by Signorello and Pappalardo (2003) who found that a large number of breeds at risk of extinction according to the FAO have not been integrated into RDPs.

The characteristics that mostly determine the chances that a breed is considered in a RDP are being autochthonous and carrying specific value-traits. This picture can be brought in context to the remarks raised by Simon (1999). Analysing the programmes put in place according to the first regulation 2078/92, he came to the conclusion that the conservation objectives are guided by a logic of future potential and by cultural reasoning. These objectives are quite different from those brought forward for biodiversity conservation for developing countries by the FAO.

5 Expert Survey

The purpose of this section is to compare the results of the empirical analysis of how decisions regarding AnGR conservation are actually taken to the view of experts in the field. To do so we conducted a survey among experts. The experts to whom the survey was addressed were identified through various databases. Among them are the national coordinators of the EAAP and of the FAO charged to follow the management of AnGR. In addition we identified breeding associations in various EU-countries and scientists and administrators being concerned with the conservation of AnGR in one or another way. The database has been constructed to be representative of different countries, professions, and disciplines. In total, the survey instrument was sent to almost 300 experts in summer 2004. Since not everybody identified could be contacted, only 275 experts received the questionnaire. Another six questionnaires had to be ignored, as there were too many data missing. In total we received 137 usable responses, an effective response rate of 51%.

The sample consists to 33.6% of geneticists, 44.5% animal scientists, 8% veterinarians, 16% agronomists, 14.5% socio-economists. Most work in research (24.8%) or higher education (24.8%), 3.6% in veterinary medicine, 5.8% in administration, 38% in breeding societies and 7.3% in other organisations (e.g., NGOs, consultants). They have experience with conservation programmes (48.9%), animal breeding programmes (42.3%), and administrative issues (29.9%). Almost half of them (44.5%) have a doctoral degree and 36% a university diploma.

A share of 60.6% of our expert sample considers the issue of AnGR erosion as very important and another 35.8 % as important. They find that putting in place conservation programmes for AnGR is important and should be done for the reasons listed in table 5.

Table 5: Principle reasons for conservation of AnGR

Reason	Frequency	%
Potential use (Option value)	94	68.89
Cultural and historical function	68	49.63
Environmental and landscape function	48	35.56
Genetic adaptability	29	21.48
Typical products	24	17.78
Scientific function	24	17.78
Maintenance of diversified production systems	20	14.81
Specific genetic character	17	12.59
Disease resistance	13	9.63
Economic function	11	8.15
Food function	7	5.19
Aesthetic function	4	2.96

When being faced with the statement that the EU requires breeds to be (1) autochthonous, (2) at risk of extinction, (3) play a role in environmental conservation and (4) have to be managed by a breeding society or herdbook, a share of 12.4% of the queried experts found these criteria very sufficient and another 52.6% found them sufficient. Regarding each individual criterion, most agreed to the idea of extinction risk but fewer (less than 50%) agreed to the role of breeding societies or the criteria of contributing to environmental conservation. However, almost 65% agreed to the statement that the criterion of being an autochthonous breed is an important selection criterion.

Table 6. Other eligibility criteria suggested by experts

Criteria	Frequency	%
Genetic distinctiveness	73	53.28
Cultural Role	46	33.58
Typical Products	35	25.55
Genetic within breed variety	25	18.25
Geographic distribution	25	18.25
Phenotypic distinctiveness	16	11.68
Age and number of breeders	16	11.68
Percentage of females purely bred	14	10.22
Genetic value characteristics	13	9.49
Average herd age	13	9.49
Tendency of population size	11	8.03
Disease resistance	5	3.65
Other reasons	22	16.06

We asked which other criteria they would find important for breed conservation programmes. The additional criteria are listed in table 6. Most suggest considering indicators of diversity such as genetic distinctiveness, phenotypic distinctiveness and genetic within-breed diversity. Of importance are also the cultural role and the typicity of products of the breeds. These are already acknowledged in current conservation programmes as our analysis has shown. Other parameters relate to the management of extinction risks such as the age and number of breeders, the percentage of females purely bred and the tendency in population size.

6 Conclusions

This paper provides an analysis of decision making regarding breed conservation in the EU. We find that current decision making in EU member countries shows a preference for selecting autochthonous breeds that are unique on a regional or EU-basis. According to our results, it seems that among the breeds that fulfil the eligibility criteria in terms of population size, the conservation programmes put in place operate independently of extinction risk. Indeed, it is more likely to find a breed with a large population size and many breeding herds in a programme than one with few animals in a small number of herds.

These results are similar to those found in Metrick and Weitzman (1996, 1998). Analysing data regarding listing and spending decision within the US Endangered Species Act, their econometric analysis revealed that charistmatic megafauna effects do seem to matter a lot; and so there is strong evidence that people weigh utility aspects of species heavily. Second, survivability and cost seem to play the expected role in spending decisions. However, they find as we do, that lower endangerment increases the amount of money spent on a listed species. These results were later on confirmed by Dawson and Shogren (2001) using panel data regarding spending decisions on endangered species during the 1993-96 period. However, they argue (p. 527) "that these time-invariant factors could be more fundamental components such as the underlying ecosystem that provides critical habitat, the historical commercial/game use of the species with its related size, a well-developed knowledge base created over the years given the relatively low costs of researching the vertebrates, or any combination of these of other factors that do not change within this time horizon."

According to our results the characteristics that mostly determine the chances for a breed to be considered in a RDP are being autochthonous and carrying specific value traits. This picture can be brought in context to the remarks raised in Simon (1999). Analysing the programmes put in place according to the first agri-environmental regulation EC 2078/92, Simon concluded that the conservation objectives are guided by a rationale of future potential and cultural reasoning. These objectives are quite different from those modelled in applications of Weitzman's approach to breed conservation that in general focus on the maximization of diversity and ignore the direct utility aspect of a breed.

The revealed policy preferences contrast starkly with the results of the expert survey. The queried experts put much more emphasis on genetic distinctiveness and within-breed diversity. However, both policy makers and experts agree in their assessment that the specificity of a breed and its future potential should be taken into account when making conservation choices. The results suggest that increasing the efficiency of breed conservation in the European Union requires the consideration of diversity dimensions together with other value traits of farm animal breeds.

These results lead to one important question. Should one expect politicians and experts to agree? In their 1998 paper, Metrick and Weitzman (p. 21) start their opening paragraph:

> Decisions about endangered species reflect the values, perceptions, uncertainties, and contradictions of the society that makes them. The defining limitation of the economics of biodiversity preservation is the lack of a common denominator or natural anchor. As a society , we have not even come close to defining what is the objective. What is biodiversity? In what units is it to be measured? […] Until we as a society […] decide what is our objective, all the scientific data imaginable will not help economists to guide policy.

Viscusi and Hamilton (1999) argue that individuals tend to misassess risks and since politicians are human they are likely to make their regulatory decisions based on biased risk assessments. And replicating findings by Cropper et al. (1992) they find that regulatory decision making regarding superfund sites favour high risks and highly publicised risks. As this may be the case in the area of health regulation, this may also be the case in other regulatory areas. In the end, one may question if it is to be expected that Becker's (1983) model of competitive pressure groups applies in that competition among pressure groups leads to efficient policy making (cf. Ando, 2003).

The contribution of this paper is to confront the revealed policy preferences in the area of breed conservation with priorities that would be set by experts. Who is right in answering the normative question of what should be done in farm AnGR conservation remains an issue open to debate in science and society.

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