Millaista maatalouden geenivarojen säilyttämispolitiikkaa kansalaiset tukevat?
Citizens' preferences for policies to conserve agricultural genetic resources

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TIIVISTELMÄ

Maatalouden geenivaroilla tarkoitetaan viljelykasvien ja kotieläinten perinnöllistä monimuotoisuutta, eri lajeja ja niiden sisäistä muuntelua. Geenivarojen riittävä monimuotoisuus on tärkeää erityisesti jalostukselle ja sen myötä tulevaisuuden elintarviketurvalle. Vuosituhansien kuluessa Suomen oloihin sopeutuneet alkuperäiskasvilajikkeet ja -eläinrodut ovat kuitenkin harvinaistuneet maatalouden tuotanto-olosuhteissa tapahtuneiden muutosten takia. Viljelijöiden ja päätöksentekijöiden lisäksi myös kansalaisten mielipiteillä on roolinsa geenivarojen säilyttämispolitiikkaa suunniteltaessa. Kansalaisten kiinnostus geenivarojen säilyttämistä kohtaan kertoo säilyttämisen koetuista hyödyistä.

Tutkimuksen tavoitteena oli tuottaa tietoa kansalaisten geenivaroihin liittyvistä arvoista sekä heidän halukkuudestaan tukea geenivarojen säilyttämistä. Erityisesti paneuduttiin siihen, kuinka kansalaiset arvottavat geenivarojen säilyttämispolitiikan erilaisia ominaisuuksia, esimerkiksi arvotetaanko eläin- ja kasvigeenivarojen säilyttämistä yhtä suurella painolla ja toisaalta suosivatko kansalaiset tiloilla vai geenipankeissa tapahtuvaa säilyttämistä.

Tutkimuksessa käytettiin valintakoemenetelmää. Tutkimusaineisto kerättiin Internet-kyselyllä kesällä 2011. Kyselyssä esitettiin vastaajille suomalaisten alkuperäisrotujen ja -lajikkeiden säilytysohjelmien valintatilanteita, joista he valitsivat itselleen mieluisan geenivarojen säilyttämispolitiikan ottaen huomioon säilyttämisen kustannukset. Kansalaisten valintoja mallinnettiin multinomiaalisella logistisella regressiolla (conditional logit). Lisäksi tarkasteltiin vastaajien heterogeenisuutta latent class –valintamallilla. Vastaajista erottui viisi eri ryhmää, jotka arvottivat geenivarapolitiikan ominaisuuksia eri tavoin.

Tulokset osoittivat vastaajien valintojen loogisuuden, sillä ohjelman kannatus laski kotitaloudelle veroina koituvien vuotuisten kustannusten myötä. Erityisen tärkeänä vastaajat pitivät karjarotujen säilyttämistä tiloilla. Vastaajien preferenssit eivät kuitenkaan olleet yhtenäiset, vaan ne poikkesivat vastaajaryhmissä. Ryhmät nimettiin seuraavasti: 1) Säilyttäjät, 2) Kustannusherkät eläinten säilyttäjät, 3) Nykytilan kannattajat ja 4) Kustannustietoiset ja 5) Harkitsemattomat. Kussakin näissä ryhmässä säilyttämispolitiikan ominaisuuksia painotettiin eri tavoin. Esimerkiksi ”Säilyttäjät”, joita oli 27 % vastaajista, painottivat kasvigeenivarojen säilyttämistä sekä tiloilla että geenipankissa muita ryhmiä enemmän. Saadut ryhmät tunnistettiin sosio-ekonomisten ja asennemuuttujien avulla. Ryhmäjaon lisäksi mallien perusteella voidaan arvioida geenivarojen säilyttämispolitiikkojen kansalaisille tuottamaa rahamääräistä hyötyä ja verrata hyötyjä säilyttämisen kustannuksiin.

Asiasanat: maatiaislajikkeet, maatiaisrodut, valintakoe, kansalaisten heterogeenisyys

Introduction

The intensification of agriculture has led to remarkable changes in the utilization of agricultural genetic resources and many previously common breeds and varieties have become rare or even endangered (FAO 2007, 2010, Drucker, Gomez & Anderson 2001). In Finland, Eastern and Northern Finncattle, the Kainuu Grey Sheep and the Åland Sheep are endangered according to the FAO classification (FAO 2003) and, for example, majority of the old Finnish crop varieties and Finnish landrace pig are already extinct.

Making informed decisions on the appropriate focus and extent of conservation of agricultural genetic resources requires information on both the costs and benefits of conservation. Economic analyses involving the valuation of conservation benefits can guide resource allocation of various types of genetic resources and conservation methods (Artuso 1998). The value of genetic resources is not typically revealed by markets, as they are not directly traded in the markets or the prices of agricultural products do not completely indicate their value (Oldfield 1989, Brown 1990, Drucker et al. 2001). Although the importance of economic analyses has been recognized, the literature on the monetary value of genetic resources in agriculture is relatively limited (see e.g. Evenson et al. 1998 and Rege and Gibson 2003, Ahtiainen & Pouta 2011).

Currently the conservation policy of farm agricultural genetic resources in Finland is based on international agreements such as the Convention on Biological Diversity (1992) and the Global Plan of Action for Animal Genetic resources (FAO 2007). National genetic resource programs were initiated for plants in 2003 and for farm animals in 2005 to strengthen the conservation of genetic resources in Finland. Although there has been some progress in the implementation of the programs, they have also suffered from shortage of funds and lack of political interest in conservation.

To re-evaluate the conservation policy, there is a need to use valuation methods capable of estimating also the non-use value components of genetic resources, i.e. stated preference methods. The choice experiment (CE) method has been found suitable to valuing genetic resources due to its flexibility and ability to value the traits of breeds or varieties and their attributes. Choice experiment makes it possible to value benefits of both plant genetic resources (PGR) and animal genetic resources (AnGR). The terms refer to all cultivated plant species and varieties, as well as all animal species and breeds that are of interest in terms of food and agricultural production. The CE method can also be used to evaluate the means of conservation in situ (live animals and plants) and ex situ (as seeds, cryopreserved embryos and other genetic material). Previous choice experiments have focused on valuing breeds or varieties and their attributes, especially on attributes that are related to the use of the breed or variety in agriculture (Birol et al. 2006, Ouma et al. 2007).

In this study we present the results of a choice experiment valuing the benefits of a genetic resource conservation program in Finland. We test the effect of in situ and ex situ conservation on citizen choices between programs. We also analyse whether the plant varieties and animal breeds are perceived equally valuable by citizen. As the conservation of agricultural genetic resources (AgGR) cannot be expected to be equally valuable to all citizens, we analyse the existence of citizen segments that value differently the conservation of genetic resources.

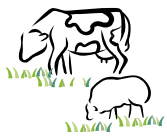
We can assume that AgGR is a rather unknown good for some of the respondents of the valuation survey. However, in valuation surveys respondents are assumed to make “informed” choices when responding to value elicitation questions (e.g. Blomquist &Whitehead 1998). Therefore, we offered an opportunity for respondents to obtain further information on AgGR. In our case, the internet-based survey allowed us also to measure how much time respondents took in reading the information and responding to questions. Furthermore, we also measured response certainty and tested the effects of uncertainty and information as reasons for heterogeneity.

Material and Methods

Data

The survey data was collected using a probability-based internet panel during the summer 2011. The Internet panel of a private survey company, Taloustutkimus, comprised 30 000 respondents who had volunteered to participate in the panel (Taloustutkimus 2013). First, the survey was tested with the pilot study of 138 respondents. Second, the final data set consisted of 1860 **r**esponses with a response rate of 30%. Based on the socio-demographic variables, the data represented the population rather well.

Table 1. Attributes of conservation programs

Conservation measures		Description	Current state
Native food plant varieties in gene banks		Native food plants are stored in the gene bank, either as seeds or plant parts.	Gene bank contains seeds from about 300 landrace varieties. Plants that are added vegetatively (e.g, berry and apple varieties) are missing.
Farms growing native food plants		Farmers and hobby gardeners cultivate native food plants on farms or in gardens.	7 farms grow seeds of native food plants with agri-environmental support. Other activities than growing seeds is not supported.
Native ornamental plant varieties mapped and in gene banks		Scientists identify and register native ornamental plants. Varieties are preserved in the gene bank, either as seeds or plant parts.	Only a small part of the native ornamental plants are known. The official gene bank storage is not provided.
Native breeds in gene banks		Landrace breeds are kept in the gene bank as gametes and embryos.	Gene bank contains Western, Eastern and Northern Finncattle as well as Finn-, Åland and the Kainuu sheep. Native chicken, goat and horse are missing from gene bank.
Native breeds on farms		Native breeds are kept on farms in their natural environment. The breed is considered to be endangered if the number of females is less than 1000.	The farms secure goat, horse, chicken, Finnish sheep and Western Finncattle. Eastern and Northern Finncattle as well as Åland and Kainuu sheep are endangered.

Survey questions

After introducing the topic, the respondents were offered two links to obtain further information of PGR and AnGR. The time used for staying on these information pages was recorded. After several questions about perceptions of genetic resources, the survey proceeded to the choice experiment. The choice experiment was framed by telling respondents that conservation of native plant varieties and animal breeds is not yet comprehensive in Finland. The survey presented a program that would conserve majority of the varieties and breeds on farms and in gene banks. The operation of gene banks would be extended to missing plants and varieties. The conservation on farms would be enhanced by developing the support for farmers from conservation activities. Furthermore, those who are using native varieties in gardens were told to be supported monetarily and by providing information.

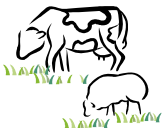
The respondents were explained that the conservation program would be financed with an increased income tax between years 2012 and 2021. Depending on the extent of the program the

expenses for taxpayers would vary, but all taxpayers would participate in financing the program. The attributes of the programs were explained to respondents with a table (Table 1).

Next, the respondents were presented conservation programs that were compared to the current situation, which was the status quo alternative in the choice experiment. Each program was described with five attributes and their levels and the cost attribute (tax) (Table 2). Each respondent faced six different choice sets.

We employed Bayesian D-efficient design using Ngene-program (v. 1.0.2), to allocate the attribute levels to the choice situations in the choice experiment survey. Efficient designs aim to generate parameter estimates with as low as possible standard errors, and thus produce the maximum information from each choice situation (see e.g. Rose and Bliemer 2009). We generated 180 choice tasks, blocking them into 30 subsets, which resulted in six choice situations presented for each respondent. The final design had a D-error of 0.002.

Table 2. Example of a choice set.

		Current state	Conservation program A	Conservation program B
Native food plant varieties in gene banks		approximately 300	400	400
Farms growing native food plants		7 farms	2000 farms	1000 farms
Native ornamental plant varieties mapped and in gene banks		some	majority	about half
Native breeds in gene banks		3 cattle breeds 3 sheep breeds	3 cattle breeds 3 sheep breeds chicken goat horse	3 cattle breeds 3 sheep breeds goat
Native breeds on farms		goat, horse, chicken, Finnsheep, Western Finncattle	horse, 3 cattle breeds 3 sheep breeds	goat, horse, chicken, 3 cattle breeds 3 sheep breeds
Cost for taxpayers €/year during 2012-2021	€	0 € / year	80 € / year	200 €/year
I support the alternative		( )	( )	( )

Statistical models

The random utility based choices have originally been econometrically modeled with a conditional logit model (also called multinomial logit model) (McFadden 1974). Also in this study, the conditional logit model is used as a baseline to obtain a general impression of the importance of attributes to respondents. The conditional logit, however, assumes a similar preference structure for all citizens, which implies that all respondents have similar tastes for the attributes. In this study, we are particularly interested in defining heterogeneous citizen segments having a similar preference structure within the segment. One approach that allows this heterogeneity is the latent class model (Boxall & Adamowicz, 2002), which has been frequently

used in modeling choice experiments of environmental conservation programs (e.g. Grammatikopoulou et al. 2012, Garrod et al. 2012).

Heterogeneity is statistically included in the latent class model by simultaneously dividing individuals into behavioral groups or latent segments and estimating a choice model in these classes. In each latent class, preferences are assumed to be homogeneous, but preferences and hence utility functions are assumed to vary between the segments.

The estimation is carried out by assuming first one class, then two classes, three classes and so on. In each step the explanatory power of the model is assessed to decide on the optimal number of classes. For this purpose we used BIC and AIC information criteria, which are log-likelihood scores with correction factors for the number of observations and the number of parameters. The latent class model also provides information necessary to calculate the willingness to pay for a good with various attribute combinations for citizen segments.

In order to profile the heterogeneous citizen segments, the resulting class membership of individuals was regressed using a logistic regression model for each class. The independent variables for class memberships were respondents' socioeconomic characteristics, perceived values and responsibilities, use of provided information, response uncertainty and how long it took to respond to the survey.

Results

Table 3 presents the conditional logit model results for the choice of conservation program. As expected the cost of the program for tax payers affected negatively the probability of choosing the conservation program. Regarding the attributes, the number of conserved food plants in the gene bank was not statistically significant. All other attributes had significant coefficients. The higher number of farms growing native plant varieties increased the choice probability. The higher the amount of ornamental plants to be mapped and conserved in gene bank, the more probable it was that the respondent chose the program. Conserving currently missing native breeds of Finnish goat, horse and chicken in the gene bank all affected positively on the support of the program. The effect was highest for horse, then chicken and lowest for goat. The guaranteed existence of cattle breeds on farms had positive and significant effect on choice. As expected the effect was higher if the number of cattle breeds was three instead of two. This was also the case with sheep breeds. There, however, the two conserved breeds did not have positive effect on choice compared with the status quo of one conserved breed. The alternative specific constants (ASC) were somewhat unexpected. When compared to ASC 1 the higher coefficients for ASC 2 and 3 indicated that there was tendency for the respondents to choose the conservation program that could not be explained with the attributes. The difference between ASC 2 and 3 indicated, however, that the conservation program that was presented first got more support. This was surprising as the order of presenting the programs was random in the survey.

The homogeneity of the preferences was tested in estimation of latent class models. Based on AIC and BIC information criteria, the estimation process showed that model of five citizen clusters was optimal. Table 4 presents the model with cluster names based on the preferences they indicated in the latent class model as well as the logit model for the membership of each cluster (Table 5).

The latent class model showed that although there were attributes that did not differ significantly between clusters, such as conserving goat and chicken breeds in gene banks and cattle breeds on farms, most of the attribute preferences varied significantly between clusters. The first class named as "conservationists" covered 28 % of the respondents. They did not take the personal cost of the conservation program into account in their decision process as the coefficient of the bid variable was not significant. Instead, all the conservation attributes had significant and positive signs. Contradictory to other clusters, for conservationists also all plant related attributes were significant. Table 5 shows that on attitude level this cluster perceived higher use and existence values from genetic resource conservation than other respondents. They also perceived higher than average uncertainty of their responses in choice experiment. This uncertainty may have lead to ignoring the cost variable.

Table 3. Model results from conditional logit (CL) model

Attributes	Coefficient	Std.error	Wald p-value
ASC 1	-0.2970	0.0676	0.000
ASC 2	0.3092	0.0357	
ASC 3	-0.0122	0.0362	
Bid	-0.0045	0.0002	0.000
Plants in bank	-0.0005	0.0232	0.980
Plants on farms	0.0318	0.0038	0.000
Ornamental plants in bank SQ	-0.0478	0.0235	0.016
Ornamental plants in bank L2	-0.0096	0.0205	
Ornamental plants in bank L3	0.0574	0.0203	
Goat SQ	-0.0357	0.0137	0.009
Goat in bank	0.0357	0.0137	
Horse SQ	-0.0703	0.0138	0.000
Horse in bank	0.0703	0.0138	
Chicken SQ	-0.0503	0.0144	0.000
Chicken in bank	0.0503	0.0144	
1 cattle breeds on farms (SQ)	-0.1136	0.0227	0.000
2 cattle breeds on farms	0.0288	0.0203	
3 cattle breeds on farms	0.0848	0.0198	
Sheep breeds on farms (SQ)	0.0233	0.0224	0.014
2 sheep breeds on farms	-0.0568	0.0198	
3 sheep breeds on farms	0.0335	0.0205	
No. of respondents	1608		
No. of replications	9484		
Log Likelihood	-9830.90		
Correct predictions	47 %		
ρ^2 (overall)	0.004		

Note: z-test : *** 1% significance level, ** 5% significance level, * 10% significance level

The second cluster that covered one fourth of the respondents was named as “bid sensitive animal conservers”. For them the alternative specific constants for the program alternatives were both high. The coefficient of the bid was significant and second highest of all clusters. The emphasis of their preferences was in conservation of animal breeds. The conservation of plant varieties in gene banks was even negatively valued. These respondents perceived more often than average that citizens and consumers should be responsible for the conservation of genetic resources. They also had positive agri-environmental attitudes. The respondents in this cluster had also used more than average time to familiarize with the information available in the survey of plant genetic resources.

A confusing aspect in third cluster was the big difference between the alternative specific constants for the two conservation programs. This group, with 17% of respondents, had considerably higher tendency to choose the conservation program A than B although there was no reason for that in the experimental design. The bid variable followed expectations, but for the other attributes only class independent variables were significant. The logistic regression revealed that members of this cluster were older and had lower income. They were relatively certain of their preferences even though they did use less the information and responded in average faster than other respondents. As there were unexplained tendencies in their responses they were named as “randomists”.

The fourth class with 16% of respondents preferred clearly the status quo option, as the alternative specific constants for the program options were negative. The coefficient of the bid variable was not significant. Some of the attributes even affected negatively on their choice. These “status quo preferers” were consistent with their attitudes and choices. The relative importance of

AgGR was low as well as the perceived existence and use values. Citizen and consumers were more seldom seen as those responsible for conservation, instead, it was perceived as farmers' responsibility.

Table 4. Latent class models for conservation program choice.

	Class 1	Class 2	Class 3	Class 4	Class 5	Overal	
Pseudo R^2	0.12	0.30	0.02	0.01	0.46	0.56	
Class Size	0.28	0.25	0.17	0.17	0.13		
Class names	Conserva-tionists	Bid sensitive animal conservers	Randomists	Status quo preferers	Bid sensitives	Wald p-value	Wald (=) p-value
ATTRIBUTES	Coefficients and significance levels						
ASC 1	-1.108***	-3.117***	-0.964***	1.768***	-0.662***	0.000	0.000
ASC 2	0.385***	1.594***	1.780***	-0.423**	0.538***		
ASC 3	0.723***	1.523***	-0.816***	-1.345***	0.124		
Bid	0.000	-0.018***	-0.002*	-0.001	-0.039***	0.000	0.000
Plants in bank	0.141***	-0.144**	-0.050	-0.370**	0.177*	0.007	0.000
Plants on farms	0.108***	0.001	0.028	0.003	0.017	0.000	0.000
Ornamental plants in bank SQ	-0.420***	0.030	0.135	-0.029	-0.285**	0.000	0.000
Ornamental plants in bank L2	0.133***	-0.002	0.009	-0.060	0.129		
Ornamental plants in bank L3	0.287***	-0.028	-0.144	0.088	0.156		
Goat SQ	-0.052***	-0.052***	-0.052***	-0.052***	-0.052***	0.004	C.i.
Goat in bank	0.052***	0.052***	0.052***	0.052***	0.052***		
Horse SQ	-0.139***	-0.120***	-0.078	0.435***	-0.220***	0.000	0.001
Horse in bank	0.139***	0.120***	0.078	-0.435***	0.220***		
Chicken SQ	-0.070***	-0.070***	-0.070***	-0.070***	-0.070***	0.000	C.i
Chicken in bank	0.070***	0.070***	0.070***	0.070***	0.070***		
1 cattle breeds on farms (SQ)	-0.145***	-0.145***	-0.145***	-0.145***	-0.145***	0.000	C.i.
2 cattle breeds on farms	0.049**	0.049**	0.049**	0.049**	0.049**		
3 cattle breeds on farms	0.095***	0.095***	0.095***	0.0954***	0.095***		
1 Sheep breeds on farms (SQ)	-0.206***	0.077	-0.036	0.599***	-0.216*	0.000	0.002
2 Sheep breeds on farms	0.053*	-0.073	-0.146	-0.286	0.062		
3 Sheep breeds on farms	0.153***	-0.004	0.182	-0.313	0.154		

Note: Significant at a *** 99% level, ** 95% level and *90% level, based on z-statistics. C.i. indicates that the parameter was class independent

The fifth class of respondents (13%) named as "bid sensitives" had the highest coefficient for the cost variable of all groups. Still the alternative specific constants expressed that they were interested of conservation programs. Almost all conservation attributes had significant coefficients. Among them particularly the ex situ conservation of Finnhorse effected their choices positively. The logit model for this group showed that although they used more than average time for responding, they felt uncertainty of their choices.

Discussion and conclusions

These preliminary results of a choice experiment concerning AgGR policy show citizens' interest in the conservation of native breeds and varieties. Additionally, there was considerable variation in the preferences among citizen groups. From the five identified respondent groups, two groups covering over half of the respondents could be described with high interest in the conservation of native breeds and varieties. One group clearly preferred current state of conservation instead of a more intensive conservation. One group was favorable to conservation if the expenses were on low level. One cluster of respondent was wavering in their preferences. This kind of response behavior was identifiable with the variables of information use, response speed and uncertainty measures.

The study will continue by defining the willingness to pay estimates for various types of conservation programs.

Table 5 Logistic regression models profiling consumer classes.

Characteristics	Mean	St. dev.	Class 1	Class 2	Class 3	Class 4	Class 5
			coefficients and significance levels				
Constant			-2.76***	-43.31***	48.77***	39.90**	-29.46**
Female[1]	0.49	0.5	-0.46***				
Year of birth[2]	1960	15		0.02***	-0.02***	-0.02**	0.02*
High income[1]	0.45	0.49			-0.39**		
High education[1]	0.29	0.46				-0.72***	
East Finnish[1]	0.11	0.32			0.40*		
Childhood in city[1]	0.41	0.49				-0.68**	
Uncertainty[2]	6,85	2.23	0.12***		-0.09**		-0.08**
Agri-environmental attitude[2]	3.26	0.44	0.37*	0.43**			
Relative importance of ag-gen[2]	0.94	0.16		-1.482***	1.412**	-1.82**	
Existence values[2]	0.00	1.00	0.32***			-0.50***	
Use values[2]	0.00	1.00	0.38***			-0.39***	
Citizen responsibility[2]	0.00	1.00		0.29***	0.21**	-1.06***	-0.43***
Consumer responsibility[2]	0.00	1.00		0.17**		-0.31**	-0.38***
Farmer responsibility[2]	0.00	1.00	-0.16**			0.27**	
Familiarity of products[2]	2.03	0.42					-0.48**
Info use (animals) > 0.5 min [1]	0.33	0.47				-0.39*	
Info use (plants) > 0.5 min [1]	0.35	0.48		0.54***	-0.47***		
Hasty response[1]	0.05	0.22			0.70*		-1.08**
N			1088	1201	1098	1077	1199
Nagelkerke R^2			0.103	0.083	0.071	0.397	0.104
Chi square			81.99	71.44	46.48	252.37	68.25
p-value			0.000	0.000	0.000	0.000	0.000
Correctly classified (cut 0.5)			69.6	71.6	83.9	90.4	86.8

Note: Significant at a *** 99% level, ** 95% level, *90% level. [1] Dummy variable. [2] Numeric variable. [3] Categorical variable.

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