Agri-Environmental Policies in a Transition Economy: Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms

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Summary

Agricultural biodiversity is a crucial environmental resource. Much of the agricultural biodiversity remaining today is found on the semi-subsistence farms of poorer countries and on the small-scale farms and home gardens of more industrialised nations. The traditional Hungarian home gardens, which serve as small farms, are an example. Historically, these home gardens have served important functions related to food security, diet quality, and local culture. Some policies related to European Union accession threaten the survival of traditional home gardens in Hungary's transitional economy. This paper applies the choice experiment method to estimate the value farmers themselves attach to the agricultural biodiversity still found in these micro-agroecosystems. One of several related studies, its aim is to enhance policy understanding of the role of Hungarian small farms and home gardens in the National Agri-Environmental Programme. The analysis is based on primary data collected in three environmentally sensitive areas of Hungary where pilot agri-environmental programmes have been initiated. Findings demonstrate the variation in values farmers assign to home gardens across regions and households, with implications for the design of efficient public conservation programmes.

Keywords: Agricultural biodiversity, Conservation, Choice experiment method, Hungary, Home garden

JEL Classification: Q12, Q18, Q26

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1. Introduction

Agricultural biodiversity is one of the most important of environmental riches because it ensures the food or livelihood security of billions of people today as well as the resources for future agricultural innovations (FAO 1999). In recognition of its importance, international agreements such as the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture encourage the design of policies that convey economic incentives for farmers to conserve agricultural biodiversity (CBD 2002).

Much of the agricultural biodiversity remaining today is found on the semi-subsistence farms of poorer countries and on the small-scale farms and home gardens of more industrialised nations, many of which are found in more economically marginalised areas (Brookfield 2001; Brookfield et al. 2002; IPGRI 2003). The traditional home gardens of Hungary, which are in fact small farms in description, are an example. On these privately-owned homestead fields, the use of labour-intensive, traditional production techniques has persisted throughout the period of collectivised state farming and the subsequent transition to market-oriented, large-scale farming. Many are rich in agricultural biodiversity in terms of crop and livestock species, varieties and breeds, as well as in the soil micro-organisms that result from decades of production without chemicals. Home gardens also play a significant cultural role in Hungarian society, having provided farm produce that contributes colour, flavour, and nutrients to the diets of both rural and urban people in time periods and locations when markets or state institutions did not.

Hungary is preparing to join the European Union (EU). The national agricultural and environmental policies and programmes being developed to comply with the *acquis* appear to neglect Hungarian home gardens. Home gardens may cease to exist if agri-environmental measures do not recognise the public and private economic value generated by their multiple functions, much of which is absent or understated in markets.

To evaluate policy options, more information is needed about the benefits and costs of supporting Hungarian home gardens. Favourable benefit-cost ratios are more likely to occur in locations where both the public and private values of the resources to be conserved are high. Public benefits are high in locations of relatively abundant agricultural biodiversity; private benefits are high among the farmers who value it most. Where private benefits are high, the public costs of conservation programs will also be "least"- though costs will vary depending on the support mechanism (Krutilla 1967; Brown 1991).

In the study reported here, the choice experiment method is used to estimate the private economic value rural households assign to agricultural biodiversity in their home gardens and to characterise those locations and households that value it most. The analysis presented here is part of a research project whose purpose is to generate information that is useful for the design of policies and programmes for agricultural biodiversity conservation on home gardens in Hungary[1]. The policy context is presented in the next section. Section 3 summarises the choice experiment approach, followed by a description of methods used to collect data. The final section draws the conclusions and states the policy implications.

2. Policy context

Hungarian agriculture today has a dual structure consisting of large-scale, mechanised farms alongside semi-subsistence, small-scale farms operated with traditional farming practices. Dualism has persisted in some form throughout Hungarian history, and most recently during the socialist period of collectivised agriculture from 1955 to 1989 (Kovách 1999; Meurs 2001). Even today semi-subsistence agricultural production is an important component of economic activity in Hungary[2].

Home gardens played an important role in food security during the socialist period when families were permitted to cultivate privately the small plots located adjacent to dwellings. Even now village level markets remain thin in many areas of rural

[1] The research project is led by the Institute for Agrobotany, Tápiószele, in partnership with the Institute of Environmental Management, Szent István University, Gödöllo, and the International Plant Genetic Resources Institute (IPGRI), Rome, Italy.

[2] Of the about 10 million people now populating Hungary, it has been estimated that nearly 2 million Hungarians produce agricultural goods for their own consumption and as a source of additional income (Már 2002) on an estimated 800 000 home gardens of up to 1 ha (Simon 2001). The 1996 Microcensus implemented by the Hungarian Central Statistical Office (HCSO) reported that 33 % of people aged 14 and over were engaged in auxiliary agricultural work, although few relied on agriculture as a main occupation.

Hungary as a result of a combination of high transaction costs and historical discouragement of food and labour market formation. Consequently, rural households continue to rely on their home gardens for at least some of the foods they consume and to enhance the quality of their diet. Though there is wide variation among them, production in home gardens was and still is accomplished with family labour, traditional farming practices, ancestral crop varieties and livestock races, and limited use of purchased inputs. Hungarian home gardens not only serve as 'small repositories of agricultural biodiversity' (Már 2002), but also contribute to conservation of Hungarian cultural heritage. In addition, home gardens play a part in protection of rural settlements and lifestyles by enabling people to remain in the countryside.

This stylised depiction of Hungarian home gardens is consistent with the notion of multifunctional agriculture, which views agriculture as providing a bundle of public goods in addition to private goods (food and fibre). Public goods supplied by agriculture include rural settlement and economic activity, food security, safety and quality, biodiversity, cultural heritage, amenity and recreational values (Romstad et al. 2000; Lankoski 2000). The concept of multifunctional agriculture is embraced by the EU's reformed Common Agricultural Policy (CAP) and is stated in the 2078/92 agri-environmental regulation of the EU. Each EU member country, including those preparing to become full members in 2004, is expected to encourage production of agricultural public goods through the development of a National Agri-Environmental Programme (NAEP).

Hungary's NAEP (Juhász 2000) was accepted by the Ministry of Agriculture and Regional Development in 2000 and launched experimentally in 2002. NAEP proposes that the intensity of agricultural production in a region should depend on its natural and human resource endowments. Several areas of Hungary with low agricultural productivity and high environmental value have been designated as environmentally sensitive areas (ESAs). NAEP seeks to protect these areas as habitats for endangered plant and animal species. Direct payments, training programmes and technical assistance are provided to the farmers who are willing to participate in agri-environmental schemes that promote the use of specified farming methods.

Hungarian NAEP recognises that extensive agricultural methods are most suitable for conserving biodiversity of endangered wildlife and providing other agricultural public goods, but the role of home gardens in the programme has not yet been elucidated. Proposed EU agricultural policies designed for accession states also fail to recognise the possibility of provision of public goods through home garden production. Special Accession Programme for Agriculture and Rural Development (SAPARD), prepared for accession countries, considers the dual structure of agriculture that exists in several of these countries as inefficient. SAPARD proposes either a) subsidies for transformation of semi-subsistence small farms to commercial farms, or b) direct payments to land-holdings larger than 0.3 ha on the condition that the land is managed in a way compatible with protection of the environment, as suggested by the NAEP of the member country (Commission of the European Communities 2002).

If the Hungarian NAEP does not include home garden production as a means of supporting multifunctional agriculture, the survival of home gardens is threatened by the structure of incentives. Though the benefits of home gardens accrue first to the farmers that cultivate them, they are national, intergenerational and potentially global in nature. Excluding home gardens from any agri-environmental programme that supports multifunctional agriculture could in fact result in diversion of incentives, which would lead to loss of agricultural biodiversity, as well as economic inefficiencies. The next section presents the analytical approach employed in this paper.

3. The choice experiment approach

Since most of the outputs, functions and services that home gardens generate are not traded in the markets, non-market valuation methods must be used to determine the value of their benefits. These benefits primarily accrue to farmers in non-market use values, or utility. The preferences of farmers, who are both producers and consumers of home garden outputs, determine the implicit values they attach to home gardens and their attributes (Scarpa et al. 2003).

Of the range of environmental valuation approaches, the choice experiment method is most appropriate for valuing home gardens with their multiple benefits and functions. This is because this method enables estimation not only of the value of the environmental asset as a whole, but also of the implicit value of its attributes (Hanley et al. 1998; Bateman et al. 2003). This approach is a relatively new addition to the portfolio of stated preference methods, with a theoretical grounding in the Lancaster's model of consumer choice (Lancaster 1966), and an econometric basis in models of random utility (Luce 1958; McFadden 1974).

Lancaster proposed that consumers derive satisfaction not from goods themselves but from the attributes they provide. For illustration of the basic model behind this choice experiment, consider a farmer's choice for a home garden, and assume that utility depends on choices made from a set C, i.e. a choice set, which includes all the possible home garden options. The farmer is assumed to have a utility function of the form

$$U_{ij} = V(Z_{ij}, S_i) + e_i \qquad (1)$$

where for any farmer *i*, a given level of utility will be associated with any alternative home garden j. Utility derived from any of the home garden alternatives depends on the attributes (Z) of the home garden and the socio-economic characteristics (S) of the farmer.

The random utility approach is the theoretical basis for integrating behaviour with economic valuation in the choice experiment. In this approach, the utility of a choice is comprised of a deterministic component (the first term on the right hand side of Equation

(1)) and an error component, e_i, which is independent of the deterministic part and follows a predetermined distribution. This error component implies that predictions cannot be made with certainty. Choices made between alternatives will be a function of the probability that the utility associated with a particular option (j) is higher than that for other alternatives. Assuming that the relationship between utility and characteristics is linear in the parameters and variables function, and that the error terms are extreme value (Gumbel),[3] identically and independently distributed, the probability of any particular alternative *j* being chosen can be expressed in terms of logistic distribution. Equation (1) can be estimated with a conditional logit model or a multinomial logit model (McFadden 1974). Generally preferred for its easy computational use, the multinomial logit model results in a conditional indirect utility function

$$V_{ij} = m(b + b_1 Z_1 + b_2 Z_2 + ... + b_n Z_n + b_a S_1 + b_b S_2 + ... + b_m S_j) \, . \qquad (2)$$

The alternative specific constant (ASC) term, b, is unique for each of the alternatives that are considered in the choice sets. The vectors of coefficients b_1 to b_n and b_a to b_m are attached to the vector of attributes of the home garden (Z) and to the vector of interaction terms between the home garden attributes and socio-economic characteristics of the farmer, respectively. Socio-economic characteristics enter the utility function as interaction terms with the choice attributes since they are constant across choice occasions for any given farmer.

The choice experiment method is consistent with utility maximisation and demand theory (Bateman et al. 2003). When parameter estimates are obtained, welfare measures can be estimated from the multinomial logit model using the following formula:

$$CS = \frac{\ln \sum_k \exp(V_{k1}) - \ln \sum_k \exp(V_{k0})}{a} \qquad (3)$$

[3] The Gumbel distribution is similar to the normal distribution in shape but the mathematics associated with it is better behaved. The Gumbel distribution is given by $P(e_{ij}=<t)=F(t)=\exp(-\exp(-t))$

CS is the compensating surplus welfare measure, a is the marginal utility of income (generally represented by the coefficient of the monetary opportunity cost attribute in the choice experiment) and V_{i0} and V_{i1} represent indirect utility functions before and after the change under consideration. For the linear utility index the marginal value of change in a single attribute can be represented as a ratio of coefficients, reducing equation (3) to

$$W = -1\left(\frac{b_{attribute}}{b_{monetary\,variable}}\right) \tag{4}$$

This part-worth (or implicit price) formula represents the marginal rate of substitution between income and the attribute in question, or the willingness to pay (or willingness to accept compensation) for a change in any of the attributes.

4. Data collection

4.1. Selection of study sites

The three ESAs (covering 22 settlements) that were selected are Dévaványa, Orség-Vendvidék and Szatmár-Bereg (Figure1). These ESAs were selected not only because high levels of agricultural biodiversity (in terms of crop genetic diversity rich crop landraces) have been discovered therein, but also because they represent contrasts in market infrastructure and agro-ecological features that are associated with farming system and intensity of land use.

[FIGURE 1]

Dévaványa is closest to the economic centre of the country, on the Hungarian Great Plain. The landscape is a flat mosaic of cultivated lands and grasslands. Soil and climatic conditions are well suited to intensive agricultural production. It is the most urbanised ESA among the three, with the highest population density and well-developed road and market infrastructure. Migration from this ESA is not a major problem, although the number of inhabitants is stagnating (Gyovai 2002). The unemployment rate is slightly higher than the Hungarian average at 12.4% (National Labour Centre 2000). NAEP aims to conserve the rich wildlife of this ESA (Juhász 2000).

Located in the southwest, Orség-Vend has a heterogeneous agricultural landscape with knolls, valleys, forests, grasslands and arable lands. Its poor soil conditions render intensive agricultural production methods impossible. Settlements are very small in area, as well as population, and most are far from towns (Gyovai 2002). The population is declining and ageing, though the unemployment rate of 4.8% is one of the lowest in the country (National Labour Centre 2000). NAEP encourages extensive production methods to conserve the picturesque landscape, natural and semi-natural habitats in this ESA, which also serve as a tourist attraction (Juhász 2000).

Szatmár-Bereg is situated in the northeast, far from the economic centre of the country. Its landscape consists of moors, grasslands, forests, and arable lands. Settlements are also small and the population is declining and ageing, due to lack of public investment (Gyovai 2002). Roads are of poor quality and the regional unemployment rate is 19% (National Labour Centre 2000). NAEP seeks to promote nature conservation in Szatmár-Bereg by establishing a national park (Juhász 2000).

Settlement areas, population, and market infrastructure differ for Dévaványa relative to the other two ESAs, but not between the other two. Dévaványa also has more primary and secondary schools than the other two sites, and is the only ESA with food markets. The number of enterprises and shops reflects the extent of urbanisation and settlement sizes (Table I).

[TABLE I]

4.2. Sample survey of farm households

Household lists were compiled for each ESA and a screening questionnaire was sent to identify those with home gardens. The response rate was augmented through key informants and household visits. A total of 322 respondents were interviewed in August 2002.

The average family size is three persons and children are few in all ESAs. Households in Orség-Vend have significantly higher levels of income than those in

Dévaványa and Szatmár-Bereg, but the difference between Dévaványa and Szatmár-Bereg is insignificant. The numbers of family members employed off-farm are similar across ESAs. On average, households in Dévaványa and Orség-Vend spend approximately the same percentage of their income on food and but this percentage is statistically higher than in Szatmár-Bereg. Home garden decision-makers are elderly, and neither their average age nor years of experience differs statistically among the three regions. A large proportion of them is retired, though the percentage is statistically lower in Dévaványa. Szatmár-Bereg has a higher percentage of people with less than eight years of education than do the other ESAs. The likelihood that a farm household cultivates a field in addition to a home garden is greater in Orség-Vend than in either of the other ESAs, though the areas of land owned and cultivated are less. The farm households in Dévaványa, the most favoured ESA in terms of agro-ecological conditions and market and other infrastructure, cultivate the smallest home gardens and the largest fields among the three ESAs (Table II).

[TABLE II]

4.3. Choice sets

A choice experiment is a highly 'structured method of data generation' (Hanley et al. 1998), relying on carefully designed tasks or "experiments" to reveal the factors that influence choice. Experimental design theory is used to construct profiles of the home garden in terms of its attributes and levels of these attributes. Profiles are assembled in choice sets, which are presented to the farmers, who are asked to state their preferences.

Identification of the home garden attributes and the levels they take was accomplished with the aid of NAEP experts and agricultural scientists, drawing on the results of informal and focus group interviews with farmers in each ESA. Each attribute represents a different aspect of agricultural biodiversity. The total number of crops grown in a garden of fixed size is an indicator of crop species richness, or inter-specific crop diversity. Mixed crop and livestock production represents agro-diversity, or diversity in the agricultural management system relative to specialised crop production. Organic production is indicated by whether or not crops are grown with industrially produced and marketed chemicals. Presence of a landrace in the garden expresses crop genetic diversity, or intra-specific crop diversity. The expected percentage of the annual household food consumption the home garden will supply is a proxy for the monetary attribute necessary for estimating welfare changes (Table III).

[TABLE III]

A large number of unique home garden descriptions can be constructed from this number of attributes and levels[4]. An orthogonalisation procedure was used to recover only the main effects, consisting of 32 pair wise comparisons of home garden profiles. These were randomly blocked to 6 different versions, two with 6 choice sets and the remaining four with 5 choice sets. In face-to-face interviews, each farmer was presented with 5 or 6 choice sets. Each set contained two home gardens and an option to select neither garden. The farmers who took part in the choice experiment were by and large those responsible for making decisions in the home garden. Enumerators explained the context in which choices were to be made (a 500 m^2 garden); that attributes of home gardens had been selected as a result of prior research and were combined artificially; and defined each attribute to ensure uniformity. Overall, a total of 1487 choices were elicited from 277 farmers.

5. Results

Using the complete data set from all three ESAs, multinomial logit models with logarithmic and linear specifications were compared. The highest value of the log-likelihood function was found for the specification with the crop species diversity variable in logarithmic form, indicating that the marginal willingness to accept compensation for this attribute is diminishing. For the population represented by the sample, indirect utility from home garden attributes takes the form

$$V_{ij} = b + b_1 \ln(Z_{diversity}) + b_2(Z_{agro-diversity}) + b_3(Z_{organic}) + b_4(Z_{landrace}) + b_5(Z_{selfsufficiency}) \qquad (5)$$

[4] The number of home gardens that can be generated from 5 attributes, 2 with 4 levels and the remaining 3 with 2 levels is $4^2*2^3=128$.

where b refers to the alternative specific constant and b_{1-5} refers to the vector of coefficients associated with the vector of attributes describing home garden characteristics.

5.1. Targeting ESAs

As hypothesised in the survey design and supported by the descriptive statistics, households in the three ESAs are likely to value home garden attributes differently. The null hypothesis that the separate effects of ESA are equal to zero was rejected with a Swait-Louviere log-likelihood ratio test at the 0.5% significance level, based on regressions with the pooled and separate ESA samples (Table IV). This result suggests that underlying parameters are distinctive for each ESA.

[TABLE IV]

In Dévaványa ESA, where food markets as well as road infrastructure are fully developed, farmers' demand for either crop species diversity or landraces is insignificant. There is a significant and relatively large demand for organic production. The demand for agro-diversity is also large and significant owing to some complementarity between field crop production and animal husbandry in the home garden. In the isolated ESA of Orség-Vend, where food markets are absent in the settlements, distance to the nearest towns is great and road infrastructure is poor, the demand for crop species diversity and landraces are each significant and nearly as large as the demand for agro-diversity. No demand for organic production is evident, reflecting poor soil quality in this ESA. In the isolated ESA of Szatmár-Bereg, where market infrastructure is poor, home gardeners demand crop species diversity and landraces. Farmers in Szatmár-Bereg also place great importance on agro-diversity, perhaps in part because the high unemployment rates in this ESA render labour intensive animal husbandry practices less costly in terms of the opportunity cost of time.

The monetary attribute in this choice experiment is a benefit rather than a cost since the property rights to gardens, their produce and functions reside with those who were surveyed (Freeman 2002). Secondary data on the annual expenditure of average Hungarian household on food consumption (HCSO 2002) were combined with the regression coefficients to compute equation (4), interpreted here as the willingness to accept (WTA) compensation for a possible loss (Table V)[5].

[TABLE V]

Farmers in Orség-Vend and Szatmár-Bereg attach the highest values to inter- and intra-species crop diversity as well as substantial values to agro-diversity. Results suggest that public investments to conserve crop diversity in home gardens would cost least in these regions compared to Dévaványa.

5.2. Targeting households

The demand for home gardens and their attributes depends on the characteristics of the farm households who manage them. In random utility models the effects of socio-economic characteristics cannot be examined in isolation but as interaction terms with the attributes. Multicollinearity problem result from including all the interactions between the many socio-economic characteristics measured in our survey and the five home garden attributes (Breffle and Morey 2000). To address this limitation, independent variables were eliminated based on Variance Inflation Factors (VIF). Five independent variables remained: 1) the number of household members with off-farm employment; 2) the experience of the home garden decision maker(s); 3) the percentage of household income spent on food; 4) the number of household members that participate in home garden cultivation; and 5), whether or not the household also cultivates a field.

Equation (5) was then extended to include the 25 interactions between the 5 home garden attributes and the 5 household and decision-maker characteristics:

$$V_{ij} = b + b_1 \ln(Z_{diversity}) + b_2(Z_{agro-diversity}) + b_3(Z_{organic}) + b_4(Z_{landrace}) + b_5(Z_{selfsufficiency}) + d_1(Z_{diversity} \times S_{offfarm}) + d_2(Z_{agro-diversity} \times S_{offfarm}) + ... + d_{25}(Z_{selfsufficiency} \times S_{cultivatefield}) \qquad (5')$$

Interactions that are significant at 10% significance level and less are reported for each ESA in Tables VI through VIII.

[5] WTA is the relevant measure of economic value when those with property rights face the prospect of

[TABLE VI]

[TABLE VII]

[TABLE VIII]

In Dévaványa ESA, the demand for crop species diversity decreases with the number of household members employed off-farm. Households cultivating fields in addition to home gardens also prefer lower levels of crop species diversity in the garden. These findings are consistent with the hypothesis that in this region, field crop production and off-farm activities yield higher returns compared to cultivating home gardens rich in crop species diversity. Households spending a greater share of their income on food (i.e. poorer households) prefer more diverse home gardens in Dévaványa. Demand for landraces in the home garden also increases with food expenditure. The interaction between the demand for organically produced home gardens and the number of family members who are employed off-farm is also positive. Organic production can be a costly activity since chemical inputs that are certified as organic cost more than regular fertilisers. At the same time, organic methods might not produce all that is needed for the household's food consumption. Households with off-farm incomes may have more means to purchase organic fertilisers and to supplement their consumption with items purchased at the local markets found in Dévaványa.

In Orség-Vend ESA, the demand for crop species diversity increases with the number of household members employed off-farm, though the demand for landraces is negatively associated with the same characteristic. The more experienced the primary decision-maker, the lower the demand for an organically produced home garden. Demand for organic production method rises with the food expenditure of the household, perhaps because less wealthy households lack the funds to acquire complementary inputs that are required for non-organic production. Demand for the level of self-sufficiency provided by the garden increases with the share of the food in household expenditures, indicating that poorer households rely more on home garden production for food.

And finally, in Szatmár-Bereg ESA, households cultivating a field demand agro-diversity in the home garden. Demand for agro-diversity decreases with the number of household members that is employed off farm since animal husbandry is a labour-

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losing well being based on those rights.

intensive activity with high opportunity costs. Preferences for home gardens without landraces may reflect government subsidies for the seeds of modern crop varieties in Szatmár-Bereg. Demand for the level of self-sufficiency expected from the home garden decreases with the experience of the primary decision-maker. The more experienced decision-makers are generally those who are older, who may choose to retire from home garden production if given the choice. The greater the number of participants in home garden production, the lower the level of self-sufficiency they demand that it provide. Household income and the number of members employed off-farm increase with the number of home garden participants (who are usually adults), and households with higher incomes rely less on the home garden output for their livelihoods.

The conditional demand functions reported in Tables VI-VIII can be used to calculate the value assigned by the farm household to home garden attribute (Scarpa et al. 2003), by modifying Equation (4):

$$W = -1\left(\frac{\hat{b}_{attribute} + d_{atribute} \times S_1 ... + d_{attribute} \times S_5}{\hat{b}_{monetaryatribute} + d_{monetaryatribute} \times S_1 + ... + d_{monetaryatribute} \times S_5} \right) \qquad (4')$$

Variables S_{1-5} are the socio-economic factors under consideration. The compensation payments that households are willing to accept for giving up outputs and functions of their home gardens are shown in Table IX, according to three socio-economic "profiles."

[TABLE IX]

Profile 1 represents a household of average size, with a relatively high income, two household members working off-farm, and three members participating in home garden production. This household does not engage in field cultivation and spends 30% of its income on food. The primary decision-maker in the garden has 20 years of experience. Profile 2 pertains to a small household of two elderly members and no employment outside of the farm and no other farm fields. This household spends 50% of its income on food. Both of its members work in the garden, and primary decision-maker has 50 years of experience. Profile 3 describes a relatively large household whose livelihood is agriculturally-based since its members cultivate at least one field along with the home garden. Five of its members work in the garden, one of its members works off farm and the household spends 40% of its income on food. The experience of the primary decision-maker in the home garden is 30 years.

WTA value estimates for the three household profiles in the three ESAs disclose four main results. First, crop species diversity has no use value in Dévaványa, though it is valued highly by all types of households in the other two ESAs where there are no village food markets and hence high transactions to market participation. Second, the agro-diversity attribute is valued most highly in Dévaványa as a result of complementarity between animal husbandry and intensive feed production in fields. Though this traditional Hungarian method of integrated livestock and crop production is especially important for older households, it is also observed among Szatmári households that are younger and farm-based.

Third, the demand for organically produced home gardens show the properties of an Environmental Kuznetz curve (EKC). That is, those home gardeners who are the poorest and oldest prefer these techniques as do younger home gardeners, but not those who are middle-aged and middle-income. Older gardeners may not have the means to purchase chemical inputs yet have long experience with labour-intensive, input-extensive production methods. Younger home gardeners that have off-farm occupations and more education also prefer organic production methods, possibly with organically certified inputs, compared to no inputs at all. Middle-aged, middle-income households may prefer non-organic methods because of the high opportunity costs of their time, their ability and a habit of using chemical inputs (formed during the chemical input-intensive period of collectivised agriculture).

Finally, in all three regions, the elderly household with longest years of experience in gardening values landraces the most. This demonstrates unequivocally that Hungarian cultural heritage and crop genetic diversity embedded in landraces are now being conserved by the remaining home gardeners who are elderly.

6. Conclusions and Policy Implications

The purpose of this study was to estimate the (use) values associated with traditional Hungarian home gardens and their multiple attributes. Data were collected in personal interviews with a random sample of households in three purposively selected, environmentally sensitive areas (ESAs) of Hungary that are included in the National Agri-Environment Programme (NAEP). The choice experiment method was applied to investigate farmers' valuation for home gardens and their attributes conditional on the characteristics of the ESAs and socio-economic characteristics of the households. Statistical analysis enabled hypothesis tests about the possible effects of economic change on the value of these attributes to farmers, and profiling of the ESAs and households that value the home gardens the most.

In general, findings support the a priori assumption that home gardens and their multiple attributes contribute positively and significantly to the utility of farmers in ESAs of Hungary. To the extent that they are representative of other ESAs in the country, they confirm the view that home gardens continue to be a vital national institution. Our estimates represent lower bounds since only the private use values of home gardens were estimated[6]. The results confirm that the relative importance rural people ascribe to home gardens and their attributes depends on the socio-economic characteristics of the farm households, as well as on the household's location, representing a combination of factors related to market infrastructure, farming system, soils and landscape, and cultural references.

Such profiling of the ESAs and farmers with the highest demand for agricultural biodiversity may help in targeting conservation programmes. Public investments to support conservation will be relatively less where the private value gained from conservation is high. Our analysis has shown that in the two isolated regions, where food markets are lacking, soils are poorer and landscapes are heterogeneous, home gardens that are rich in intra- and inter-species crop diversity are likely to be highly valued.

[6] If the public (regional, national or global) use and non-use values that these home gardens generate were also taken into account, these value estimates are expected to be higher. Considering traditional home gardens as a whole for example, it can be expected that the Hungarian or EU public would attach non-use values to them for conservation of Hungarian and/or EU cultural heritage. Another example of public value is embedded in landraces, as Smale, Bellon and Aguirre Gomez (2001) note ' In addition to the private value they [landraces] generate for the farmers who grow them, landraces have social value because plant breeders use them as sources of novel alleles (gene types) or gene combinations to improve the crops that produce the food, feed and fibre on which societies depend.'

Landraces are attached the highest value by elderly, experienced home gardeners, who are typically retired. Organic production is valued most highly by younger, more educated, households with higher income, followed by those that are older with lower income. And finally, home gardeners, who also engaged in field cultivation, appear to attach high values to agro-diversity, defined as integrated livestock and crop production.

The overriding policy concern in Hungary is whether or not public decision-makers are prepared to recognise the contribution of Hungarian home gardens to multifunctional agriculture. There is insufficient assurance that Hungarian society can rely indefinitely on its rural households to conserve these 'small repositories of agricultural biodiversity' and cultural heritage. Hungary is a transitional economy that will soon become a member of the European Union. When that happens, isolated regions are likely to be drawn into markets and the opportunity costs of the labour now used in home garden production is likely to rise. If home gardens are valuable to Hungarian society, a decision must now be made to develop a policy framework to ensure their continuity. The most proximate means to do so is the NAEP, which is structured around farmer contract payments. Other mechanisms for conveying economic incentives to smallholder farmers, such as niche markets, or farmer-owned brands conferred through denomination of geographic origin, producer co-operatives or trademarks, might also be assessed.

Figures and Tables

Figure 1. Location of the study sites

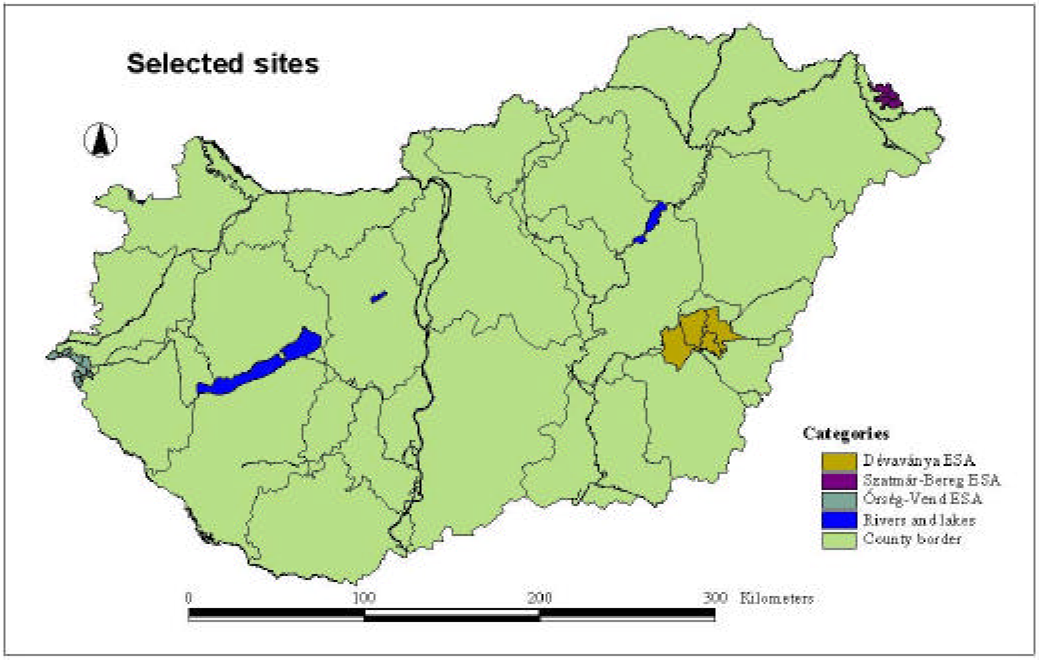

Table I. Population and market infrastructure characteristics for selected ESAs

Variable	Dévaványa	Orség-Vend	Szatmár-Bereg
		ESA mean (st. dev.)	
Area (ha)	21464.6	1636.2	2407
	(6439.1)	(900.9)	(755.9)
Population	9928.6	373.4	659.0
	(3672)	(365.9)	(152.7)
Population per ha	0.44	0.202	0.28
	(0.04)	(0.102)	(0.06)
Number of primary schools	2.4	0.36	0.83
	(1.14)	(0.51)	(0.41)
Number of secondary schools	1	0	0
	(0.71)	(0)	(0)
Number of food markets	1	0	0
	(0)	(0)	(0)
Distance to nearest settlement	0	19.8	18.35
with food market (km)	(0)	(6.8)	(3.23)
Number of enterprises	491.2	21.5	22.83
	(306.4)	(27.8)	(9.93)
Number of shops	140.8	4.18	9.67
	(71.0)	(5.19)	(3.5)
Regional rate of unemployment	12.4	4.8	19.0

Source: TSTAR Database, Hungarian Central Statistical Office, 2001 (Census) and Hungarian National Labour Office (2000).

Table II. Household and home garden decision-maker characteristics by ESA

Variable	Definition	Dévaványa	Orség-Vend	Szatmár-Bereg
		Mean (st. dev.)		
Family size*	Number of family members	2.75 (1.19)	3.12 (1.63)	2.79 (1.42)
Home garden participants*	Number of family members that work in home garden	1.95 (0.99)	2.54 (1.33)	2.38 (1.28)
Children*	Number of family members =< 17 years	0.29 (0.69)	0.51 (0.83)	0.43 (0.78)
Off farm employment	Number of family members employed off farm	0.94 (1.07)	0.94 (1.1)	0.8 (1.01)
Income*	Average monthly income from off-farm employment, pensions, rents, gifts or other benefits	75806.76 (26862.84)	92646.73 (43647.04)	71685.59 (40740.68)
Food expenditure*	Stated % of income spent on food consumption	39.75 (15.45)	39.7 (16.7)	32.81 (11.84)
Home garden area*	in m^2	539.88 (678.5)	1613.80 (2861.17)	2649.23 (3041.85)
Land owned*	in m^2	46475.63 (208398.84)	17921.29 (31780.07)	31840.43 (50487.88)
Land cultivated*	in m^2	36468.54 (205514.18)	14450.81 (34819.33)	29965.85 (75712.22)
Age	Average age of home garden decision-makers	58.0 (12.99)	57.69 (12.43)	56.56 (15.02)
Experience	Average years farming experience of home garden decision-makers	42.32 (17.52)	40.43 (17.15)	38.37 (19.61)
		Percent		
Household cultivates a field*	Household cultivates a field along with the home garden	23.21	65.14	41.82
Retired*	Retired decision-makers	62.5	75.5	76.36
Education*	Decision-makers with less than 8 years of education	12.5	4.5	21.3

Source: Household sample survey, Hungarian on-farm conservation project, 2002. Subsample sizes are 110 in Orség-Vend, 110 in Szatmár-Bereg and 112 in Dévaványa. (*) T-tests and Pearson Chi square tests show significant differences among at least one pair of ESAs at 5% significance level.

Table III. Home garden attributes and attribute levels used in the choice experiment

Home garden attribute	Definition	Attribute levels
Crop Species Diversity	The total number of crops that are grown in the garden.	6, 13, 20, 25
Agro-diversity	Mixed crop and livestock production, representing diversity in agricultural management system.	Mixed crop and livestock production vs. Specialised crop production
Organic Production	Whether or not industrially produced and marketed chemical inputs are applied in farm production.	Organic production vs. Non-organic production
Landrace	Whether or not the home garden contains a crop variety that has been passed down from the previous generation and/or has not been purchased from a commercial seed supplier.	Home garden contains a landrace vs. Home garden does not contain a landrace
Self-sufficiency	The percentage of annual household food consumption that it is expected the home garden will supply.	15%, 45%, 60%, 75%

Table IV. Demand for home garden attributes in each ESA

Attribute	Dévaványa			Orség-Vend			Szatmár-Bereg		
	Coeff.	s.e.	t-stat	Coeff.	s.e.	t-stat	Coeff.	s.e.	t-stat
Constant	0.050	0.399	0.126	-1.475	0.450	-3.281	-0.685	-1.544	0.123
Crop Species Diversity	-0.031	0.123	-0.248	0.284	0.135	2.106	0.295	0.130	2.277
Agro-diversity	0.504	0.070	7.245	0.256	0.077	3.327	0.414	0.073	5.647
Organic Production	0.293	0.072	4.070	0.116	0.077	1.507	0.158	0.073	2.162
Landrace	0.085	0.065	1.310	0.241	0.071	3.393	0.174	0.067	2.615
Self-sufficiency	0.014	0.003	4.401	0.029	0.004	7.714	0.024	0.035	6.825
Sample size	533			455			499		
r^2	0.10915			0.12533			0.18471		
Log likelihood	-521.6492			-430.4925			-446.9454		

Table V. WTA estimates for each home garden attribute per ESA (in € per household per annum, in 2002 prices)

Attribute	Dévaványa	Orség-Vend	Szatmár-Bereg
Crop Species Diversity	--	-111	-141
Agro-diversity	-404	-100	-198
Organic Production	-235	--	-76
Landrace	--	-95	-83

(--) Demand for the attribute is not statistically significant at 5% level.

Table VI. Effects of household and decision-maker characteristics on demand for home garden attributes in Dévaványa*

Variable	Coefficient	s.e.
Constant	0.91953	0.5220
Crop Species Diversity	-0.6235	0.2657
Agro-diversity	0.5120	0.0724
Organic Production	0.1394	0.0986
Landraces	-0.1819	0.1766
Self sufficiency	$0.9x10^{-6}$	$0.2x10^{-5}$
Crop species diversity * no of household members employed off farm	-0.0153	0.0070
Crop species diversity * household cultivates a field	-0.0317	0.0130
Crop species diversity * food expenditure of the household	0.0018	0.0004
Organic production * no of household members employed off farm	0.1821	0.0711
Landraces * food expenditure of the household	0.0070	0.0041
Self sufficiency * food expenditure of the household	$0.8\ x10^{-7}$	$0.5\ x10^{-7}$
Sample size	533	
r^2	0.151	
Log likelihood	-486.6	

* Interactions with significance levels 10% and less are reported

Table VII. Effects of household and decision-maker characteristics on demand for home garden attributes in Orség-Vend*

Variable	Coefficient	s.e.
Constant	-1.8277	0.5109
Crop Species Diversity	0.2739	0.1719
Agro-diversity	0.2636	0.0826
Organic Production	0.3026	0.2492
Landraces	0.4097	0.1070
Self sufficiency	0.7×10^{-5}	0.2×10^{-5}
Crop species diversity * no of household members employed off farm	0.0115	0.0062
Organic Production * food expenditure of the household	0.011	0.0052
Organic Production * experience	-0.149	0.0046
Landrace * no of household members employed off farm	-0.1351	0.0670
Self sufficiency * food expenditure of the household	0.8×10^{-7}	0.5×10^{-7}
Sample size	455	
r^2	0.147	
Log likelihood	-380.36	

* Interactions with significance levels 10% and less are reported

Table VIII. Effects of household and decision-maker characteristics on demand for home garden attributes in Szatmár-Bereg*

Variable	Coefficient	s.e.
Constant	-0.6705	0.4810
Crop Species Diversity	0.2747	0.1410
Agro-diversity	0.4102	0.1247
Organic Production	0.0859	0.0788
Landrace	0.2633	0.0957
Self sufficiency	0.2×10^{-4}	0.3×10^{-5}
Agro-diversity * no of household members employed off farm	-0.0137	0.0788
Agro-diversity * household cultivates a field	0.2353	0.1574
Landrace * household cultivates a field	-0.2470	0.1428
Self sufficiency * experience	-0.9×10^{-7}	0.5×10^{-7}
Self sufficiency * number of home garden participants	-0.2×10^{-5}	0.7×10^{-6}
Sample size	499	
r^2	0.192	
Log likelihood	-385.45	

*Interactions with significance levels 10% and less are reported

Table IX. WTA compensation values by household profiles by ESA (in € per household per annum, in 2002 prices)

Region and Attribute	Profile 1	Profile 2	Profile 3
Dévaványa			
Crop Species Diversity	+405	+408	+429
Agro-diversity	-346	-391	-367
Organic Production	-338	-107	-230
Landrace	-19	-128	-71
Orség-Vend			
Crop Species Diversity	-116	-92	-103
Agro-diversity	-103	-88	-95
Organic Production	-133	-39	-109
Landrace	-55	-137	-99
Szatmár-Bereg			
Crop Species Diversity	-134	-136	-286
Agro-diversity	-64	-201	-530
Organic Production	-42	-43	-89
Landrace	-127	-138	-17

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(lix) This paper was presented at the ENGIME Workshop on “Mapping Diversity”, Leuven, May 16-17, 2002
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(lxi) This paper was presented at the Eighth Meeting of the Coalition Theory Network organised by the GREQAM, Aix-en-Provence, France, January 24-25, 2003
(lxii) This paper was presented at the ENGIME Workshop on “Communication across Cultures in Multicultural Cities”, The Hague, November 7-8, 2002
(lxiii) This paper was presented at the ENGIME Workshop on “Social dynamics and conflicts in multicultural cities”, Milan, March 20-21, 2003
(lxiv) This paper was presented at the International Conference on “Theoretical Topics in Ecological Economics”, organised by the Abdus Salam International Centre for Theoretical Physics - ICTP, the Beijer International Institute of Ecological Economics, and Fondazione Eni Enrico Mattei – FEEM Trieste, February 10-21, 2003
(lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003
(lxvi) This paper has been presented at the 4th BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL) , Venice, August 28-29, 2003
(lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003
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