# The proximity of a field plot and land-use choice: implications for land consolidation

**Grammatikopoulou Ioanna, Myyrä Sami, Pouta Eija**

**MTT Agrifood Research Finland**
**Email: ioanna.grammatikopoulou@mtt.fi**


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**Abstract**

*Traditional methods in agricultural economics and agricultural engineering have yielded mixed results when specifying the costs of an unfavourable parcel structure. Concepts related to travel costs and the production function are frequently applied when the costs of farming distant parcels are examined. However, farmers' perspective regarding preferences for land use is ignored or partly overlapped by predictions made by researchers. Based on applied econometric models fitted to stated preference data, we revealed that the proximity of a field plot is a relevant factor affecting land-use decisions. One-fourth of landowners would change the use of a field plot if the condition of distance was changed. Landowners would continue farming a field plot if its distance from the farm compound was reduced, being willing to accept on average €79 less in net income per ha per year. The effect of a greater proximity of field plots to the farm compound following land consolidation was heterogeneous, particularly depending on the farm size and its location.*

**Keywords**: land use options, distance factor, land consolidation, choice experiment, multinomial logit model, random parameters model.

## 1. Introduction

Land fragmentation, the splitting of a single farm into numerous individual parcels of land, is a worldwide phenomenon that is often related to the natural development of ownership through inheritance. Land consolidation addresses land fragmentation by comprehensively reallocating rural land consisting of fragmented agricultural holdings. The aims of this procedure vary from country to country, but the general objective is to improve the division of land through land exchange to form plots that better fit their use and thus increase agricultural productivity.

In the consolidation of agricultural land, the goal is for plots to be larger and closer to the farm compound. Although the strong general hypothesis is that the larger the plot size, the more efficient production will be, research results have been mixed. Decreasing agricultural productivity has been associated with the increasing distance (Bently, 1987; Najafi, 2000; Lerman, 2002; Vitikainen, 2004; Niroula and Thapa, 2007; Zhang and Wang, 2009; Falco et al.,2010). An unfavourable field plot structure also reduces investments in land improvements (Mwakubo et al., 2005).On the other hand Wu et al. demonstrated that the size of individual plots was not a significant factor for the productivity of grain production in China. Myyrä and Pietola (2002) found no connection between the average distance to field plots and farm profitability in Finland. Niroula and Thapa (2007) reported an association between smaller plots and higher yields. These conflicting results might reflect the complexity of the issue. The datasets used in previous studies have often been focused on the agricultural perspective. Land-use options other than farming and the role of inactive landowners in agriculture are often ignored. To avoid these shortfalls, we focus on the effect of the distance of field plots from the farm compound on land-use decisions, including not only farming but also other land-use options, with data representing all agricultural landowners in Finland.

Agricultural land accounts for a small proportion of the total land area in Finland, and the field plots are separated by forests and watersheds. However, it is not only the natural surroundings that make the field plot structure fragmented and unfavourable for farming. The ongoing structural adjustment, where 3% of farms are ceasing production annually, has not helped to improve the field plot structure. This is because landowners who give up farming are typically unwilling to sell their agricultural land (Myyrä and Pouta, 2010). Neither it is typical that the nearest neighbour leases land to an active farmer. At the same time stagnation in ownership development and the pressure to intensify farming has gradually shifted land cultivation from landowners to tenants. During 1974–2009, the proportion of land cultivated by tenants under lease contracts increased from 4.8% to 34.8%, a trend that is expected to continue. Nevertheless, based on earlier studies, land consolidation might be successful in improving the economic efficiency of Finnish farms by increasing the average field plot size (Vitikainen, 2004).

While land consolidation increases field plot sizes, it also affects the distance between the farm compound and the field plots. The economic effects of these adjustments are typically calculated by travel cost methods (Klemola et al., 2002). However when the distance to a field plot is greater, the landowner may consider other options for land use than farming. This is currently evident in Finnish arable farming. Because of changes in land use, the travel costs to the most distant field plots decreased to a new level, in some cases to zero.

The main purpose of this article is to examine how the distance of field plots from the farm compound affect land-use decisions. The alternative forms of land use considered here are farming, managing without farming, selling, leasing out, setting aside or afforestation. However, as land-use decisions are also connected to the profits generated by the land use, a secondary aim is to estimate the willingness of farmers to accept a lower income when the distance to a field plot is reduced. Based on this, we can determine the value of the proximity of field plots as perceived by the landowner and provide information on the relative value of farming for the landowner compared to the option to lease out.

## 2. Data

*Mail survey*

The sample of landowners, including active farmers and passive landowners, was selected from the register of the Finnish Tax Administration. To define the criteria for sampling, the field area and regional distribution of ownership in the population were analysed. This information was used to form sampling clusters to gain a representative sample of both active and passive landowners and various farm sizes from all regions of Finland. A survey was mailed to the sample of 6,080 landowners[1] to acquire data on their land-use decisions and background variables. The survey questionnaire had been developed following focus group discussions and a pilot survey. The mail survey yielded a total of 2,684 observations corresponding to 44% of the original sample. In addition to the mail survey data, information on the respondents was available from the register of

[1] From the initial sample of 6,080 owners of farmland selected from the register, 318 (5.2%) did not live at the registered address or they reported not owning agricultural land.

agricultural taxation and income taxation. This made it possible to compare the respondents to the general farming population. The respondents represented the population of farmland owners in Finland quite well, as the differences between the data and the population were all under five percentage units with respect to the demographic profile, farm size and geographical distribution.

The mail survey included a choice experiment question concerning land-use choices in relation to the distance of a field plot from the farm compound and the net income produced by the land-use alternative. In the first choice set, distance was defined to the landowners as 'near' while in the second choice set was defined as 'far'. To concentrate on the effect of distance, we controlled the size of the plot by fixing it to 2 ha, which is close to the average size of Finnish field plots (2.39 ha). After careful description of the land-use alternatives, the landowner had the possibility to choose one form of land use when the net income varied from low to high. The applied bid levels were pre-tested in a focus group. Variation in the bid levels according to the land-use alternatives was necessary to obtain variation in the probability of selection for each land-use choice. However, the bid levels were realistic and consistent with the actual net incomes gained.

**3. Statistical methods**

The present analysis of observed land-use decisions is based on the *random utility* framework developed by McFadden (1974). The model suggests that a decision maker *n* faces a set of mutually exclusive alternatives, $j = 1,2,\ldots. J$. The level of utility $U_{nj}$ that is obtained from each alternative cannot be directly observed, but it can be decomposed into the deterministic part $V_{nj}$ and the unobserved part $\varepsilon_{nj} \ \forall \ j$ that is considered random:

$$U_{nj} = V_{nj} + \varepsilon_{nj} = \beta_j x_n' + \varepsilon_{nj}$$

where $\beta_j$ corresponds to the associate parameters for each alternative, $x_n$ is a vector of explanatory factors for each decision maker *n* and $\varepsilon_{nj}$ is the error term. Given the model specification, explanatory factors correspond to the socio-demographic characteristics of the sample. Furthermore, in our case analysis they also correspond to the distance factor, which should not be regarded as an attribute of choice (since its value does not vary among alternatives), but rather as a condition factor. *First,* to examine the effect of the distance factor as well as that of socio-economic characteristics on the respondents' decision making, we employed a multinomial logit model (MNL) model. The parameters of the MNL model are difficult to interpret, both in terms of magnitude as well as of sign (Green, 2008). Marginal effects, on the other hand, provide a more direct interpretation. The marginal effect of an explanatory factor $x_i$ on the choice probability for alternative *j* would be: $\frac{\vartheta P_{ij}}{\vartheta x_i} = P_{ij}(\beta_{ij} - \overline{\beta}_i)$ and thus it is not only dependent on the parameter $\beta_{ij}$ but also on the average of all other parameter alternatives.

As the MNL approach does not incorporate the alternative specific attribute of net income, *secondly* a conditional logit (CL) model was employed to estimate the effect of net income and the associated welfare benefits. Individual-specific characteristics are excluded and the set of explanatory variables is shifted from landowner to land-use

characteristics. The CL model also provides the information necessary to calculate the welfare change related to a hypothetical scenario. For the linear utility index, the marginal welfare measure estimate (willingness to pay or willingness to accept) for attribute *i* is provided by the ratio of the coefficient for attribute $\beta_i$ to the negative of the coefficient for the net income attribute $\beta_p$, *ceteris paribus*: $MWTP\ or\ MWTA = -(\beta_i / \beta_p)$ (Louviere et al., 2000).

A major limitation of the aforementioned MNL and CL models is that the models can represent systematic taste variation but not random taste variation (Train, 2009). To reveal any heterogeneity in preferences among respondents, we *thirdly* applied a random parameters model (RPL). RPL is a highly flexible model that can approximate any random utility model (McFadden & Train, 2000), and also obviates the limitations of MNL and CL models.Individual characteristics may be introduced by interacting socioeconomic variables with alternative-specific attributes.

The parameters of all the models were estimated using the Limdep 3.0 Nlogit software package. The data were weighted according to the field area owned. Owners with less than one hectare were excluded from the analysis. In RPL, the probabilities were estimated by simulating the log-likelihood with 100 Halton draws.[2]

## 4. Results

*Observed land-use decisions*

Descriptive analysis revealed that land-use decisions were significantly associated with the distance of the field plot from the farm compound. Farming was the most favoured alternative for plots close to the compound, but leasing was favoured for the most distant plots. Approximately one-fourth of respondents changed their choice of land use when the distance to the plot was altered. The effect of distance as an interaction factor with net income might also have a determinant role. The mean net income differed in a statistically significant way between 'near' and 'far' fields for the land-use alternatives 'farm', 'lease out' and 'afforest', being lower when distance to the plot was indicated as near. The opposite results were recorded for the options 'manage without farming' and 'sell'.

*Multinomial logit*

The distance factor as well as owner and farm characteristics formed the independent variables of the MNL model. The model performed extremely well in predicting the most important land-use alternatives such as farming and leasing out. The MNL model was moderate in fitting the data, correctly classifying 54% of the cases with the overall fit measured by the psreudo-$R^2$ considered satisfying (0.21). Table 1 presents the estimates of the marginal effects for each factor and alternative.

Distance was found to be a strong factor, significantly predicting the choice probability of the land-use alternatives. Holding all other variables constant, when the field plot was

[2] Bhat (2001) reports that when using Halton intelligent draws, results may be comparable to models estimated using random draws with only one-tenth of the total number of draws.

stated to be near rather than far in relation to the farm compound, the landowner was 12.1% more likely to prefer farming the plot, but 6.4% and 3.8% less likely to prefer selling the land and afforesting it, respectively. Proximity also positively affected the choice of the alternative 'manage without farming', but negatively the 'lease out' and 'set aside' alternatives, although not statistically significantly. The results of the model were consistent with the data.

In addition to the distance factor, the demographic and behavioral characteristics of the landowners also had determinant role in decision making. The model revealed that with a one-year increase in the age of the landowner, he or she was 0.7% less likely to continue farming but 0.4% more likely to lease out the land, which was expected given the labor requirements of farming. A higher level of education increased the probability of continuing to farm by 1.8%. Landowners who stated engagement in agriculture as their main occupation revealed an 11.8% and 3.8% lower probability than employees engaged in other occupations of leasing out their land and afforestation, respectively. Pensioners were 7.7% more likely to prefer leasing out than employees. As expected, the current income source formed a significant factor determining future land use. When the farm income was mainly derived from leasing out the land, the probability of leasing out in the future increased by 29.9% while the respective probability of choosing to continue farming the land decreased by 15.6%. On the other hand, when sales from agricultural activity were the main income source, the landowner was 13.2% more likely to remain in farming, while the opposite trend was observed for the 'lease out' option.

The location of the farm in eastern as opposed to southern Finland reduced the probability of selling by 5% but increased by 2.1% the probability of afforesting the land. The same tendency regarding afforestation was demonstrated by landowners who owned farms in the north, whereas these landowners revealed a 5% lower probability of continuing to farm. Landowners in the western part of Finland were 6.4% less likely to manage the land without farming compared to those in the south, but were more likely to continue farming or sell the land. The scale of land ownership was also found to be a significant predictor of the land-use decision. The probability of remaining in farming increased considerably with a greater field area. The opposite was observed for the 'manage without farming' and 'afforest' options. If the field area increased to 15 ha and above, the landowner was 4.5% more likely to sell but 18.8% less likely to lease out the land.

The model also revealed that expectations for the returns on non-agricultural investments significantly affected landowners' choices. If the investment returns doubled, the landowner would be 0.68% more likely to continue farming and 0.57% less likely to sell the land. Past land-use decisions also seemed to determine the present choices. Respondents who had previously sold land were more likely to lease out, while respondents who had leased out land in the past were more likely to sell or afforest. Landowners' objectives (reported in detail in Pouta et al., *in press*) were related to the probability of selecting a particular land-use alternative. Multiobjective owners demonstrated a higher probability of continuing to farm than agricultural earners. It was noteworthy that the probability of choosing the option 'farm' was 44% lower for those

belonging to the group of indifferent owners and 12% lower for the passionless amenity owners. The management of a field plot without farming was most likely to be preferred by family-oriented owners. Indifferent owners had a higher probability of selling their land than other owner groups.

**Table 1. Estimated marginal effects of the MNL model.**

| | Farm | Manage without farming | Sell | Lease out | Set aside | Afforest |
|---|---|---|---|---|---|---|
| Constant | *0.127 | **0.184 | **-0.146 | -0.077 | **-0.027 | **-0.062 |
| Age | ***-0.007 | -0.001 | **0.002 | ***0.004 | **0.000 | **0.001 |
| Education | *0.018 | -0.017 | -0.013 | *0.019 | -0.001 | -0.006 |
| Employment | | | | | | |
| Employee[R] | | | | | | |
| Farmer | ***0.106 | **0.061 | -0.003 | ***-0.118 | -0.008 | **-0.038 |
| Entrepreneur | -0.015 | 0.034 | -0.007 | 0.001 | -0.007 | -0.006 |
| Pensioner | -0.050 | -0.018 | -0.006 | **0.077 | -0.004 | 0.002 |
| Other | 0.073 | 0.022 | 0.023 | *-0.087 | -0.004 | -0.027 |
| Agricultural income | | | | | | |
| None[R] | | | | | | |
| Only rent | ***-0.156 | ***-0.164 | ***0.066 | ***0.299 | **-0.018 | **-0.026 |
| From sales | ***0.132 | *0.051 | 0.019 | ***-0.145 | **-0.021 | ***-0.037 |
| Only subsidies | 0.046 | -0.005 | 0.005 | -0.040 | *-0.015 | 0.009 |
| Location of farm | | | | | | |
| South[R] | | | | | | |
| East | 0.026 | -0.001 | **-0.056 | 0.004 | *0.005 | **0.021 |
| West | *0.038 | **-0.064 | *0.032 | 0.011 | -0.003 | -0.013 |
| North | *-0.046 | -0.017 | -0.001 | 0.031 | 0.004 | ***0.027 |
| Field area | | | | | | |
| 1–3 ha[R] | | | | | | |
| 3–7 ha | ***0.169 | ***-0.103 | -0.004 | -0.038 | 0.001 | ***-0.025 |
| 7–15 ha | ***0.180 | **-0.080 | -0.027 | -0.035 | -0.002 | ***-0.036 |
| over 15 ha | ***0.265 | **-0.068 | *0.045 | ***-0.188 | 0.004 | ***-0.059 |
| Return from other investments (%) | ***0.000068 | -0.000019 | ***-0.000057 | -0.000002 | 0.000001 | 0.000008 |
| Sold farmland_past (No=1, Yes=2) | ***-0.012 | 0.000 | -0.002 | **0.012 | 0.000 | 0.002 |
| Rented farmland_past (No=1, Yes=2) | 0.002 | -0.007 | **0.009 | *-0.008 | 0.001 | ***0.004 |
| **Proximity (far=0, near=1)** | *****0.121** | **0.016** | *****-0.064** | **-0.031** | **-0.004** | *****-0.038** |
| Clusters | | | | | | |
| agricultural earners[R] | | | | | | |
| multiobjective owners | ***0.058 | -0.001 | **-0.057 | 0.029 | **-0.022 | -0.007 |
| family oriented owners | -0.029 | ***0.084 | ***-0.095 | 0.043 | -0.004 | 0.001 |
| passionless amenity owners | ***-0.123 | 0.017 | 0.014 | **0.075 | 0.003 | 0.014 |
| indifferent owners | ***-0.448 | -0.039 | ***0.184 | **0.233 | **0.017 | ***0.053 |
| **Probabilities at the mean vector** | 0.227 | 0.252 | 0.134 | 0.328 | 0.010 | 0.049 |
| Sample | 3320.000 | | | | | |
| Correctly classified | 53.68% | | | | | |
| Unrestricted Log-likelihood | -4048.365 | | | | | |

| | |
|---|---|
| Restricted Log-likelihood | -5149.349 |
| Chi-squared | 2201.968 |
| Pseudo- $R^2$ | 0.21 |

R: Reference variable
* At the 10% significance level. ** At the 5% significance level. *** At the 1% significance level.

*Conditional logit and random parameters results*

A CL model (Table 2) was estimated using the net income reported in the survey as an attribute for each alternative. Alternative specific constants (ASCs) for each choice were included so as to capture the systematic but unobserved information on the respondents' preferences for land-use alternatives. The ASCs take a value between 0 and 1 implying the relative choice probability. The 'lease out' option, the most frequently selected land-use option, was defined as the reference level, and ASCs were interpreted as the deviation from that choice. The model was estimated separately for the two distance cases ('far' and 'near' field plots). Table 2 also reports the estimation results of an RPL model that accounts for heterogeneity. The location of the farm and the scale of the field area were introduced as covariates interacting with the random parameters aiming to capture the sources of heterogeneity. We assumed that all ASC parameters are random and normally distributed, while preferences for the net income attribute remain homogeneous.

**Table 2. CL and RPL parameter estimates**.

| | **Far** | | | **Near** | | |
|---|---|---|---|---|---|---|
| ***Attributes*** | **CL Coeff. (s.e.)** | **RPL Coeff. (s.e.)** | **Coeff.std (s.e.)** | **CL Coeff. (s.e.)** | **RPL Coeff. (s.e.)** | **Coeff.std (s.e.)** |
| ASC_Lease out[R] | | | | | | |
| ASC_Farm | ***-0.609 (0.061) | ***-2.607 (0.455) | 0.138 (2.898) | ***-0.285 (0.054) | ***-2.422 (0.684) | 0.704 (1.110) |
| ASC_Manage without farming | ***-0.808 (0.064) | **-1.214 (0.488) | 0.549 (1.437) | ***-0.797 (0.064) | ***-1.015 (0.169) | 0.035 (2.264) |
| ASC_Sell | ***-1.711 (0.118) | -6.826 (4.202) | 5.415 (3.718) | ***-2.132 (0.135) | ***-2.664 (0.597) | 0.210 (3.201) |
| ASC_Set aside | ***-1.912 (0.124) | *-2.532 (1.528) | 0.946 (1.991) | ***-2.137 (0.133) | -31.531 (62.396) | 18.649 (36.079) |
| ASC_Afforest | ***-0.840 (0.076) | **-1.153 (0.572) | 0.385 (2.052) | ***-1.376 (0.089) | -84.540 (143.367) | 62.982 (105.750) |
| Net income | ***0.003 (0.000) | ***0.004 (0.001) | - | ***0.002 (0.000) | ***0.004 (0.001) | - |
| ***Location interactions[1]*** | | | | | | |
| ASC_Farm*SOUTH[R] | | | | | | |
| ASC_Farm*EAST | - | 0.013 (0.170) | - | | 0.273 (0.177) | - |
| ASC_Farm*WEST | - | ***-0.129 (0.183) | - | | 0.079 (0.188) | - |
| ASC_Farm*NORTH | - | ***-0.287 (0.218) | - | | -0.156 (0.197) | - |
| ***Field area interactions*** | | | | | | |
| ASC_Farm*1–3 ha[R] | | | | | | |
| ASC_Farm*3–7 ha | - | ***1.136 (0.317) | - | | ***1.038 (0.316) | - |
| ASC_Farm*7–15 ha | - | ***1.746 (0.330) | - | | ***1.602 (0.404) | - |
| ASC_Farm*over 15 ha | - | ***3.529 (0.459) | - | | ***3.815 (0.806) | - |
| Sample size | 2304 | 2076 | | 2307 | 2071 | |
| Log likelihood | -3720.012 | -3016.108 | | -3519.782 | -2746.336 | |

| | | | | |
|---|---|---|---|---|
| $\rho^2$ | 0.09841 | 0.1891 | 0.14805 | 0.2598 |

[1:] *Presentation is limited to the results of interaction factors with the 'farm' option.
[R]: Baseline option
* At the 10% significance level. ** At the 5% significance level. *** At the 1% significance level.

The negative sign of ASCs of the CL model indicated that respondents received less utility from all other land-use options than leasing out.For the options 'farm' and 'manage without farming', the utility decline was less severe. These shifts in utility imply that particularly for those fields close to the farm compound, owners preferred land uses that retained the plot in agriculture and in ownership. The land-use decision was also positively affected by net income, as expected.

Allowing for heterogeneity improved the fit of the model, as pseudo-$R^2$ values were higher for the RPL than for the CL model. The likelihood ratio test rejected the null hypothesis that the estimated model was no better than the base model ($-2LL > x^2_{35,0.005}$ that is 621.07 and 534.48 respectively). In the RPL model, all respondents received less utility from other land uses compared to the 'lease out' option. Likewise in the CL model results, the 'farm' option indicated a smaller decline in the utility level with proximity. Parameter estimates for the 'sell', 'set aside' and 'afforest' options were not statistically significant.

For the 'farm' option in particular, the examination of the spreads of each parameter around their respective means revealed that preference heterogeneity mainly originated from the size of the farm. Heterogeneity in the mean parameter estimate for the 'ASC_Farm*over 15 ha' suggested that across the sampled population, large-scale landowners tended to have positive individual specific given the proximity of the plot to the farm compound. The mean parameter for the 'ASC_Farm*West' became positive with proximity, implying that owners of land in western Finland increased their utility when continuing to farm compared to the utility received by respondents owning farms in the south. This indicates that land consolidation would be more beneficial in western than in southern Finland. However, parameter estimates for heterogeneity in the mean of all location interaction factors were found to be nonsignificant in the model for land-use decisions concerning plots near the farm compound.

*Welfare estimates*

The welfare estimates of land-use choices addressed to landowners were represented by the marginal WTA welfare measure for choosing an alternative with reference to the 'lease out' option. The Delta method was applied to estimate the standard errors of marginal WTA estimates. Table 3 presents the results of the welfare estimates for choosing to continue farming.[3] Respondents were willing to accept a lower net income from farming a plot if it was located close to the farm compound. To calculate the real value of proximity, we used the discount factor of 5% and 20 years (12.48). This type of discount factor is typically used in land consolidation when the stream of future benefits

[3] According to the CL model, WTA for all other options, given the proximity of a field plot to the farm compound, should decline, implying that respondents would rather lease out their land than sell, set aside or afforest.

is calculated relative to the present value (Hiironen et al., 2010). The average value per respondent was found to reach €1298.7 and €987.1 per plot hectare according to the CL and RPL model, respectively.

**Table 3: Marginal WTA (MWTA) for 'farm' land-use option and MWTA reduction considering the proximity of field plot to the farm compound (€/ha).**

| | CL | | RPL | |
|---|---|---|---|---|
| | **Far** | **Near** | **Far** | **Near** |
| **Mean** | 219.49 | 115.43 | 237.864[1] | 158.770[1] |
| **95% C.I.** | 155.63-283.35 | 66.72-164.14 | 222.894-252.835 | 145.003-172.537 |
| **Reduction in MWTA (discounted by 5% for 20 years)** | | 1298.669 (1109.597-1487.741) | | 987.093 (972.079-1002.119) |

[1] Calculations are based on unconditional (randomly simulated) mean parameter estimates derived from the RPL model and weighted for each category that heterogeneity accounts for.

## 5. Conclusions

Our results clearly indicate that land-use decisions are dynamic and take place according to owner characteristics, the net income produced as well as field plot structure. The use of agricultural land differs significantly according to the distance between farm compound and the field plot. The results also demonstrated that one-fourth landowners would change their land use in response to a change in the distance condition. This supports the view that land consolidation affects land-use choices.

Dynamic land-use decisions and the costs from fragmented field plots are bound together. The costs have typically been measured with the travel cost method, where the land-use alternatives are set by the researcher. In this study we relaxed this assumption. Stated land-use choices were used instead of our predictions. To do this, we used a new approach by applying the concept of marginal willingness to accept a lower net income. This approach particularly focused on land-use changes and thus provided new information on the possible effects of consolidation. However, the approach also has limitations. In our study, we left the perception of distance to the landowner, as the 'far' and 'near' plots were farm-specific. Nevertheless, a strength of our analysis is that all agricultural landowners were included, not only those who are active farmers.

In our study we did not introduce the land consolidation policy to the respondents, but we examined its effects with the assumption that a decrease in the distance from the farm compound to farm plots would be a result of consolidation. On average, landowners were willing to farm their fields given the proximity of the plot to the farm compound with a reduction in net income of €79 per ha per year. If land consolidation provided similar field plots close to the compound, it would produce a welfare gain of €987 after discounting by 5% over a 20-year period. This takes into account the possibility for the landowner to change the land-use allocation, and he/she does not have to continue with the initial land use. The results revealed that the welfare gains also varied within land uses dependent on the proximity of the field plot. For example, landowners were reluctant to sell field plots close to their farm compound.

Our results did not reveal any significant differences in values of land consolidation according to the location of the farm. However, the results were clear with respect to the farm size. The distance effect could be easily interpreted so that large-scale land owners (> 15 ha) would gain more benefits from a coherent holding resulting from land consolidation than small-scale landowners. The results also highlighted the previously observed problem concerning the willingness of small-scale landowners to participate in land consolidation (Dijk, 2006).

According to our study, owners who hold farms in the eastern and northern parts of Finland showed a greater tendency to afforest their land, which might considerably affect the landscape of these areas. The eastern part of Finland has already experienced an increase in the area of forest and a decrease in the field area, resulting in severe pressure for landscape diversity (Hietala-Koivu, 2002). Public preferences for valuable landscape areas in northeastern Finland reported by Karjalainen and Komulainen (1998) indicated the importance of agriculture in maintaining high scenic values and also pointed out the declining role of afforestation. Land consolidation may provide a solution to prevent land uses that would reduce public appreciation of the landscape.

Land leasing is already an important land-use alternative in Finland, accounting for 33% of the agricultural land area. It appears that land leasing in Finland will increase to the levels observed in France (75%) and Germany (60%). Our results provide a clear justification to emphasize the participation of all landowners in land consolidation, not only active farmers. As the 'lease out' option provides the highest utility to landowners, it can be assumed that leasing will continue to increase in the future. This will raise further challenges and open research questions, because leased plots are difficult to allocate in land consolidation. Should leased plots be situated close to landowner or the lease holder? In the future, non-farming landowners may support land consolidation if the position of their plots in leasing markets improves with consolidation.

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