

Approach and methodologies for evaluation of Land Consolidation policies: an example from Galicia, N.W. Spain*

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Land consolidation in Galicia

Land consolidation has become a policy for dealing with property structure through the enactment of successive laws in 1952, 1955, 1962 and finally in 1973, all of them with agricultural objectives.

In April of 1981, Galicia became an State (Autonomía) and L.C. became its jurisdiction. The regional government of Galicia has also passed an Act in 1985 (Xunta de Galicia, 1985) to reflect the regional characteristics, including spatial organization in parishes, and aligning plans with parish limits. No other relevant contributions or modifications to the national law of 1973 were introduced by this Act.

In 2001, the amendment of Galician Land Consolidation Act was voted on, being the first tentative to integrated=comprehensive approach. Moreover, evaluation of the results of LC has been made a legal requirement with it. The aims of Land Consolidation in this new Galician LC Act (2001):

“to promote the constitution of farms of suitable structure and dimension, trying to extend their medium size; to maintain and increasing land productivity, planning farms and farmland use and respecting the environment; all of that dealing with the objective of “fixing” the population of rural areas, making profitable the productive activity”.

Land consolidation is the most widely used tool in rural development in the last fifty years, but the intense fragmentation that has been already described triggers the fact that LC is still practised in pursuit of the objective of increasing agricultural productivity.

The first problem that has to be overcome when describing land development in Galicia is the lack of systematic information, mainly historical registers. Even so, we could say that land consolidation actions in Galicia, that started in 1952, currently cover more than 1130 zones, with an annual investment of € 30 million (this amount should be only considered as a reference). This dynamism in the consolidation process is mainly due to the problem posed by land fragmentation and smallholdings. At present, land consolidation in Galicia affects 1/5 of its total area and more than 200,000 landowners.

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Evaluation of land consolidation

This study represents the continuation of the work initiated by Crecente et al. (2002). In the last project, an evaluation project was carried out by the LandLab of the University of Santiago de Compostela during 2000-01 that covered the period 1950-2000.

In evaluating efficacy, we have not considered the broader objectives now attributed to LC in some countries (environmental management, non-agricultural rural land use planning, etc. For most of these issues there are no records that go back to 1950).

We have not analysed the factors involved in rural development in general, or evaluated the current role of LC in rural development in Galicia.

Rather, the aim was to determine: (1) whether Galician LC policy has actually resulted in land consolidation; and (2) whether it has been successful in achieving the ends for which it was originally adopted: improvement of the efficiency of farming and forestry, and stabilization of rural population. As a secondary issue, we have studied changes in land use, an issue of environmental relevance related with efficiency and demography. The question of whether land consolidation has in fact been achieved includes two different aspects: the degree of consolidation achieved in particular areas by completed LC processes carried out in those areas; and the frequency with which LC processes in particular areas have been abandoned.

To study the mentioned issues we used formal statistical analyses in the framework of the EU evaluation guidelines ([European Commission, 2000](#)). This work illustrates how the EU guidelines can be applied to the evaluation of policies in the long term. More specifically, we sought answers to the following five questions:

- Q1. Has LC influenced property structure in rural areas?
- Q2. Has LC influenced land usage?
- Q3. Has LC intensified agricultural and forestry production?
- Q4. Has LC tended to reduce emigration from rural areas?
- Q5. Does the paralysis of LCPs depend on local socioeconomic factors, and if so, on which?

Material and Methods

Our first concern was to limit our analysis to communities that remained rural in nature throughout the study period. To this end, on the basis of informed judgement, we tentatively defined rural municipalities as municipalities with population densities of less than 100 inh/km². We then validated this definition by inspecting correlations between each of the 250 variables mentioned and municipal population density in 1991 (the year of the last census published before this study was initiated), and by discriminant factor analysis. Finally, from the 191 municipalities identified as rural, we excluded 11 coastal municipalities. The expression “rural municipalities” hereinafter refers to the remaining 180 municipalities.

Criteria, indicators and statistical analyses

Q1: Has LC influenced property structure in rural areas?

For a positive answer to this question, we adopted three criteria concerning active farms or forestry businesses (C1.1), plot size and ownership irrespective of productive activity (C1.2), and property regimes (C1.3). Table 1 shows these criteria and their corresponding indicator variables.

Values of indicators I1.1-I1.9 were obtained by using official censuses of agricultural activity carried out in 1962, 1972, 1982 and 1989 (INE, 1963, 1973, 1984, 1993).

Analyses of variance were performed to determine whether the changes observed in each intercensal period (1962-1972, etc.) depended on how much of the area of the municipality had been subjected to LC processes that had been completed in that period or in preceding periods.

For this purpose, municipalities were classified as class 0 (no consolidation), class 1 (<10% of the total area consolidated), and class 2 (>10% of the total area consolidated). Analyses were only performed at municipality level because data for several of the indicators I1.1-I1.9 were only available at this level.

Table 1
Criteria and indicators for Q1

Q1. Has land consolidation influenced property structure in rural areas?	
Criteria	Indicators
C1.1. Changes in the structure of active holdings in rural municipalities depend on consolidation activity	I1.1. Changes in the number of active holdings I1.2. Changes in the average area of active holdings I1.3. Changes in the number of plots per active holding
C1.2. Changes in holding size and/or structure in rural municipalities depend on consolidation activity	I1.3. Changes in the number of plots per municipality I1.4. Changes in the number of plots per proprietor I1.5. Changes in mean plot size I1.6. Changes in mean holding size
C1.3. Changes in the property regime structure of rural municipalities depend on consolidation activity	I1.7. Changes in the percentage of agroproductive area worked by freeholders I1.8. Changes in the percentage of agroproductive area worked by métayers I1.9. Changes in the percentage of agroproductive area worked by leaseholders

Q2: Has LC influenced land usage?

Table 2 shows the criterion and indicators used to answer this question. Values of indicators I2.1-I2.4 were obtained by using second and third series 1:50,000 forestry maps constructed in 1986 and 1998, respectively (MMA, 1988, 2001). These maps had been previously compared to the results of aerial photoanalysis for 10 different municipalities, which confirmed that the quality and precision of these maps were adequate for our purposes.

To make information retrieval easier, these maps were integrated with parish and municipal maps and databases into a geographical information system (GIS). Analyses of variance were performed to determine whether the changes observed depended on how much of the area of the parish had been subjected to LC processes completed in that

period or in preceding periods. For this purpose, parishes were classified as class 0 (no consolidation), class 1 (<50% of the total area consolidated), and class 2 (>50% of the total area consolidated).

Table 2
Criterion and indicator for Q2

Q2. Has land consolidation influenced land usage?	
Criterion	Indicators
C2.1. Changes in land usage in rural parishes depend on consolidation activity	I2.1. Changes in the area of land devoted to farming I2.2. Changes in the area of land devoted to forestry I2.3. Changes in the area of land devoted to protective woodland I2.4. Changes in the area of unproductive, non-protective hill land

Q3: Has LC intensified agricultural and forestry production?

The criteria for this question concerned the area of land devoted to or suitable for agriculture or forestry (C3.1), other agricultural production factors (C3.2), and other agricultural activity data (C3.3). The criteria and their indicators are detailed in Table 3. Values of indicators I3.1-I3.16 were obtained by using the second and third series 1:50,000 forestry maps (MMA 1988, 2001) that we had incorporated into our GIS (I3.1-I3.5), the official censuses of agricultural activity taken between 1962 and 1989 (INE 1964, 1991) or the commercial yearbook of La Caixa for the year 2000 (La Caixa, 2001) (I3.6-I3.15), and the official land register for 1997 (I3.16).

Analyses of variance were performed to determine whether the changes observed in various relevant periods depended on how much of the area of the parish had been subjected to LC processes completed in that period or in preceding periods. For this purpose, parishes were classified in the same way as for Q2.

Table 3
Criteria and indicators for Q3

Q3. Has land consolidation intensified agricultural and forestry production?	
Criteria	Indicators
C3.1. Increase in land area devoted to or apt for agriculture or forestry depends on consolidation activity	I3.1. Changes in area devoted to agriculture I3.2. Changes in area devoted to forestry I3.3. Changes in area with forestry potential (scrubland) I3.4. Changes in area devoted to agriculture or forestry (= I3.1 + I3.2) I3.5. Changes in area devoted to agriculture or forestry or with forestry potential (= I3.1 + I3.2 + I3.3)
C3.2. Increases in other agricultural production factors depend on consolidation activity	I3.6. Changes in the number of cows per farm I3.7. Changes in the number of dairy cows per farm I3.8. Changes in the number of tractors I3.9. Changes in the number of agricultural machines other than tractors I3.10. Changes in the percentage of the proprietor's time devoted to working the holding I3.11. Changes in the number of man years (228 days' work by 1 man) that are devoted per year to agriculture or forestry
C3.3. Changes in other agricultural activity indices depend on consolidation activity	I3.12. Changes in the number of active holdings I3.13. Changes in the percentage of the occupied population engaged in agriculture I3.14. Changes in the number of farming cooperatives, agricultural associations, etc. I3.15. Changes in unemployment I3.16. Changes in the average registered value of land in the municipality

Q4: Has LC tended to reduce loss of population in rural areas?

Before answering this question, we checked whether there were actual differences in population loss between rural and non-rural or coastal municipalities. Then, we investigated the five criteria listed in Table 4 and their indicators.

The values of the demographic variables I4.1-I4.5 were obtained by using the population censuses taken in the years 1960, 1970, 1981, 1991 and 1999. For C4.1-C4.4, analyses of variance were performed to determine whether the changes observed in each intercensal period depended on whether parishes had been subjected to LC processes completed in that period or in preceding periods (C4.1, C4.2), or on how much of the area of the parish had been subjected to such processes (C4.3, C4.4).

For the purposes of C4.5, the non-immediacy of the effects of LC was considered by weighting consolidated land area by a factor of $(n-1)/10$ during the n th year following termination of the LC process ($1 \leq n \leq 10$). Then, population changes were compared among the same three classes of municipalities or parishes described for Q1 and Q2, respectively. These classes were now defined on the basis of the weighted consolidated area S' , i.e. class 0 comprised those for which $S' = 0$, and classes 1 and 2 comprised those for which S_0 was respectively $<10\%$ and $>10\%$ of the area of the municipality, and $<50\%$ and $>50\%$ of the area of the parish. We have considered that the full effects of LC on population emerge over a period that is much shorter than the 30 years considered by other authors (Van Huylenbroeck and Martens 1992; Coelho 1992; Van Huylenbroeck et al., 1996).

Table 4
Criteria and indicators for Q4

Q4. Has land consolidation tended to reduce emigration from rural areas?	
Criteria	Indicators
C4.1. Parish population trends depend on consolidation activity	I4.1. Changes in parish populations
C4.2. Municipal population trends depend on consolidation activity	I4.2. Changes in municipal populations
C4.3. Parish population trends depend on the percentage of land area that has undergone consolidation	I4.3. Changes in parish populations
C4.4. Population trends in an area comprising the parish and neighbouring parishes ^a depend on the percentage of land area that has undergone consolidation in the "central" parish	I4.4. Population changes in the areas in question
C4.5. Population trends depend on the percentage of land area that has undergone consolidation when the non- immediacy of the effects of consolidation is taken into account	I4.5. Changes in parish populations

Q5: Does the paralysis of LCPs depend on local socioeconomic factors, and if so, on which?

Before answering this question, we conducted 100 analyses of variance to determine whether the paralysis status classes defined in the previous section differed significantly from any of the 100 socioeconomic variables in the municipal database. Discriminant factor analysis was then performed by using 15 of these socioeconomic municipal variables to determine whether any subset of these 15 variables were jointly capable of distinguishing among the three paralysis classes. The 15 variables were chosen intuitively for the purpose in hand and showed no significant mutual pairwise correlations when all 180 rural municipalities were considered. The selected variables

follow (asterisks indicate values assigned or published by La Caixa for the year 2000): average registered value of land (per hectare); number of agricultural machine units; percentage of the population with schooling; number of commercial premises; municipal economic rating*; municipal tourism rating*; ratio of number of telephones to number of landowners; number of bank offices; market share*; number of farming or agribusiness cooperatives*; industrial activity*; percentage of working population working in agriculture (data from IGE-Instituto Gallego de Estadística); increase in number of dairy cows between 1989 and 1999; percentage of total municipal area suitable for farming or forestry; and percentage of working-age population that is unemployed (data from IGE).

In relation to Q5, each municipality in which LCPs had been initiated was assigned to one of three paralysis status classes (labelled -1, 0 and 1) according to the area covered by paralysed projects: less than 15%, between 15% and 50%, or greater than 50% of the total area affected by LCPs in that municipality.

Statistical significance. All the statistical tests used a significance level $\alpha=0.05$.

Table 5
Criterion and indicator for Q5

Q5. Does the paralysis of land consolidation projects depend on local socioeconomic factors, and if so, on which?

Criterion	Indicator
C5.1. The paralysis of consolidation activity is affected by the socioeconomic characteristics of the municipality	I5.1. The paralysis status of the municipality

Results and discussion

The evaluation method used in this work conforms to the standard EU model comprising questions, criteria and indicators, and assesses social, agroindustrial and environmental aspects of LCPs by examining their effects on population trends, farm structure and qualitative and quantitative land use. In addition, it considers the applicability of the current LC policy by investigating the factors associated with the paralysis of LCPs. This method applies multivariate statistical analyses to data compiled into databases that are integrated in a GIS for the study area.

Answers to questions Q1- Q5

Due to lack of space, we present and discuss results for only a selection of the criteria and indicators listed in Tables 1-5.

Q1: Has LC influenced property structure in rural areas?

Table 6 shows that LC has indeed favoured reductions in both the number of plots of land per municipality and the number of plots per active holding (I1.3). At the same time, LC has favoured an increase in the number of active holdings per municipality (I1.1), at least for class 2 municipalities. Lower reductions were observed in the other classes, which contributes to preservation of the agricultural activity in rural areas and, therefore, to stabilization of population in these areas.

Table 6

Dependence of changes in selected land fragmentation indices^a on prior land consolidation activity in rural municipalities (only indices and periods showing significant variation are shown)

Period ^b	Class ^c	No. of municips.	$\Delta P(62-72)$	$\Delta PpAH(62-72)$	$\Delta AH(72-82)$	$\Delta P(72-82)$	$\Delta PpAH(72-82)$	$\Delta P(82-89)$
Pre-1970	0	143	-5,861	-3.00	ns8	-4,612		
	1	28	-10,075	-6.32	ns	-10,532*		
	2	9	-15,952	-11.25	ns	-8,031*		
Pre-1970	0	131	—	—	-68.92*9	-4,540*	-3.78*	
	1	30	—	—	-93.13*	-5,999*	-3.96*	
	2	19	—	—	87.00	-13,833	-8.73	
Pre-1970	0	117	—	—	—	-4,180	ns	-47.44*
	1	37	—	—	—	-6,403	ns	-59.63*
	2	26	—	—	—	-11,978	ns	-105.17

^a $\Delta V(y1-y2)$ = change in variable *V* between the years *y1* and *y2*, where *V* stands for *P* (the number of plots per municipality), *PpAH* (number of plots per active holding), or *AH* (number of active holdings per municipality).

^bPeriod in which consolidation was terminated.

^cAs defined in before. Symbols: "ns" indicates that there are no significant between-class differences for the variable and consolidation period in question, * that the difference between the two starred values for the variable and consolidation period in question is not significant.

Q2: Has LC influenced land usage?

Table 7 shows that LC has lessened the conversion of agricultural land to forestry that is associated with the generalized decline in rural population in Galicia. In addition, we must consider the effects of preserving the agricultural landscape as the original cultural landscape of this region.

Table 7

Dependence of changes in land uses^a between 1986 and 1998 on land consolidation activity in rural parishes prior to 1981

Class ^b	No. of parishes	Land use			
		Farming	Forestry	Woodland ^c	Hill ^d
0	2,255	-10.68	12.15	ns	ns
1	96	-5.46*	4.63*	ns	ns
2	183	-5.72*	7.74*	ns	ns

^aChanges in the percentage of land devoted to the uses in question (I2.1-I2.4).

^bAs defined before.

^cProtective woodland not primarily devoted to timber production.

^dUnproductive, non-protective hill land. Symbols (ns, *) as for Table 6.

Q3: Has LC intensified agricultural and forestry production?

In keeping with the answer to Q2, the analyses performed to answer Q3 show that, regardless of LC activity, there has been an overall increase in land devoted to forestry (I3.2) or of potential value for forestry (I3.3), at the expense of agriculture. Supplementary analyses show that this trend has involved, in particular, the installation of forestry species that are fast-growing and/or require only minimal maintenance, such as *Eucalyptus globulus*. However, this trend was almost twice as marked where no LC had been carried out than where LC schemes had been implemented (Table 8).

Table 8
Dependence of changes in selected forestry-related indices^a between 1986 and 1998 on land consolidation activity in rural parishes prior to 1981

Class ^b	No. of parishes	Land use	
		Fast-growing species	Land with forestry potential
0	2,255	14.60	8.74
1	96	8.61*	3.78*
2	183	8.92*	4.35*

^aIncreases in the percentage of land devoted to the indicated uses.

^bAs defined before.

Q4: Has LC tended to reduce loss of population in rural areas?

The preliminary analysis showed that, since 1960, the 180 inland municipalities with less than 100 inhabitants per km² in 1991 have suffered significantly greater population losses than other municipalities. However, the results listed in Table 9 for I4.1 show that these losses have been less severe where LC has been carried out than where no LC process has been completed. In fact, some parishes in which LC has been performed have gained population. The fact that LC had greater impact in the decade 1960-1970 than in subsequent periods can be attributed to the general loss of agricultural population that has occurred since 1970. In keeping with these findings, Table 10 shows the same trends at the municipal level (I4.2).

Finally, when consolidated land area is weighted in order to consider the non-immediacy of the effects of LC (C4.5), the same conclusions are obtained: the greater the area of consolidated land, the less the decline in population.

Table 9
Population changes over various periods in rural parishes in which land consolidation (LC) had (1) or had not (0) been completed during some earlier period (averages per parish)

Period in which LC terminated	LC status	No. of parishes	Period for which population changes are reckoned			
			1960–1970	1970–1981	1981–1991	1991–1996
1960–1970	0	2,381	–9.065	ns	ns	—
	1	109	–3.717	ns	ns	—
1960–1970	0	2,384	—	—	ns	–1.293
	1	106	—	—	ns	0.028
1960–1970	0	2,111	—	—	ns	–1.417
	1	379	—	—	ns	–0.230
1960–1970	0	2,025	—	—	—	–1.399
	1	465	—	—	—	–0.528

Table 10
Population changes over various periods in rural municipalities in which land consolidation (LC) had (1) or had not (0) been completed during some earlier period (averages per municipality)

Period in which LC terminated	LC status	No. of municipalities	Period for which population changes are reckoned	
			1991–1996	1991–1998
Pre-1991	0	91	–1.861	–2.768
	1	89	–0.39	–1.151
Pre-1996	0	71	ns	–2.723
	1	109	ns	–1.477

Table 11 shows the results obtained at parish level (14.5). When the main aim of the rural development policies implemented by the regional government is to combat rural depopulation, these results must be taken into consideration.

Table 11
Average change in population between 1991 and 1999 in rural parishes in which 0% (LC = 0), < 50% (LC = 1) or > 50% (LC = 2) of the land had been consolidated prior to 1996, when consolidated land area is weighted to take into account the time elapsed since consolidation (54)

LC status	No. of parishes	Population change
0	2,008	–2.40*
1	282	–2.13*
2	197	–1.53

Q5: Does the paralysis of LCPs depend on local socioeconomic factors, and if so, on which?

For none of the 100 socioeconomic variables considered in the preliminary analysis were there significant differences among municipalities of the three paralysis status classes defined before. However, discriminant factor analysis by using the 15 starting variables specified in Q5 afforded an expression that correctly classified 65% of municipalities on the basis of the registered value of land, their tourism rating, the number of bank offices, the percentage of the working population working in agriculture, and the increase in the number of dairy cows between 1989 and 1999. The coefficients of these variables in the discriminant expression are, respectively, 0.71, -0.40, -0.41, 0.60 and -0.46. Strikingly, the larger the percentage of the working population working in agriculture, the more likely are LC processes to be paralysed. This may be attributed to the fact that it is harder to design LCPs that satisfy all owners in areas where a relatively large number of owners work a small amount of good-quality agricultural land.

Conclusions

The results of this study show that the LC schemes put into effect in Galicia over the past half-century have improved agricultural land structure by reducing the number of plots per holding. In addition, these schemes have reduced the generalized decline in the number of active holdings and in the area of land devoted to agriculture; and have likewise reduced the decline in the population of rural areas. These effects were more important in the decade 1960-1970. From mid-1980s onwards, the effects have not been so clear due to accession to the EU and to the socioeconomic changes undergone in rural areas. These findings confirm that LC has been an important instrument of rural development. Notwithstanding, improvements in the process of selection of particular areas for LC would be highly desirable in order to avoid wasting public resources on projects that are eventually paralysed.

Because of the increasing availability of relevant data in electronic formats, the method used to evaluate the success of LC in this study can in principle be easily extended, if necessary, by incorporating data for further indicator variables into its databases. The method used assesses social, economic, environmental and administrative factors within the general EU guidelines for project evaluation and with the aid of GIS-assisted analyses. This assessment constitutes an approach that should be generalizable to the evaluation of other rural development initiatives that involve land reorganization.

References

- Coelho, J. P., 1992. *Análise de Projectos de Emparcelamento Rural. O caso de Valença do Miño*. Ph.D. Thesis. Universidade Técnica de Lisboa.
- Crecente Maseda, R., Alvarez, C. and Fra, U. (2002). Economic, social and environmental impact of land consolidation in Galicia. *Land Use Policy* 19, 135-147.
- European Commission, 2000. *Common Evaluation Questions with Criteria and Indicators*, Document VI/12004/00 Final, Bruxelles.
- La Caixa, 2001. *Anuario Comercial de España del año 2000*.
- MMA, 1988. *Mapa Forestal de España. Escala 1:50,000*. Ministerio de Medio Ambiente, Madrid.
- MMA, 2001. *Mapa Forestal de España. Escala 1:50,000*. Ministerio de Medio Ambiente, Madrid.
- Miranda, D., 2002. *Caracterización y Evaluación de la Concentración Parcelaria en Galicia. Propuesta de un procedimiento integrado de Ordenación Rural basado en métodos avanzados de SIG, Fotogrametría Digital y Análisis Multivariante*. Ph.D. Thesis. University of Santiago de Compostela. Santiago de Compostela, Publications and Scientific Exchange Service.
- Miranda, D., Crecente, R. and Alvarez, M.F. (2006) Land consolidation in inland rural Galicia, NW Spain, since 1950: An example of the formulation and use of questions, criteria and indicators for evaluation of rural development policies . *Land Use Policy* 23, 511-520.
- Van Huylenbroeck, G., Martens, L., 1992. The average value ranking multi-criteria method for project evaluation in regional planning. *European Review of Agricultural Economics* 19, 237-252.
- Van Huylenbroeck, G., Coelho, J., Pinto, P.A., 1996. Evaluation of land consolidation projects (LLCs): a multidisciplinary approach. *Journal of Rural Studies* 12 (3), 297-310.
- Xunta de Galicia, 2001. *Lei 12/2001 de Concentración Parcelaria en Galicia*.

