

## **Renewing the evaluation of land consolidation effects**

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**Key words:** land consolidation, cost-benefit analysis

### **SUMMARY**

Land consolidation projects (LCP) in Finland can receive public financing to cover the expenses if a project is found to be cost-effective. The amount of public financing depends on the impacts of the land consolidation and the purposes that the LCP is carried out for. In order to start such a project, it is necessary to prove that the benefits of the project will be higher than the costs. After the project, the final expenses that are not covered by the public funding are divided among the land owners based on the benefits they have gained from the project. In order to choose the best projects to finance (from society's point of view) and to carry out (from the landowners' point of view), it is essential to have reliable methods to analyse the effects of LCP. The methods must also be used in the same way in all projects.

The need to renew the cost-benefit analysis in Finland became apparent after it was discovered that different methods are used and the results vary significantly depending on the method used. This observation brought up the need to renew the process of evaluating land consolidation effects. This renewal work was based on a large study of the methods available for evaluating LCP. The study focused on the evaluation methods used not only in Finland but also in Sweden, Netherland, Germany and Switzerland. The study of foreign methods was based on a questionnaire sent to experts in the land consolidation field.

The methods used in other countries provided new prospects for developing the benefit valuation of LCPs in Finland. The cost-benefit analyses used in Germany were found to be particularly thorough. In Finland, the effects of a land consolidation project were based on the impacts on the agricultural sector but Germany also took many other points of view into consideration as well, such as ecological, regional economical and social impacts, all of which were logically sorted out for the evaluation process. In Finland, a decision was made to divide the effects into five categories that analyse the effects from the agricultural, transportation, ecological and regional economical and social point of view. The valuation of different categories will initially be based on the market price method, secondly on the cost method (e.g. damage cost avoided) and finally on pure consideration of values.

After the study, a valuation application was developed to help with the valuation process, especially when valuating agricultural and transportation effects. A thorough set of instructions was also drawn up to help analyzing other impacts.

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## 1. BACKGROUND

Finland is the most sparsely populated country in the EU, and its climate and northern location present special challenges for the profitability and competitiveness of agriculture. At the same time, a fragmented property structure resulting from, for example, society-driven land consolidation and settlement activities has a detrimental effect on Finnish agricultural productivity. Despite the fact that the number of farms has dropped from 96,000 to 67,000 during Finland's EU membership, there has been no significant change in the way parcels of arable land are structured. The structural development of farm economy has led to a larger average farm size, but the benefits of larger size have remained unexploited because the parcels of arable land are small and scattered. (MMM 2007; Myyrä 2002; Maisi 2007; Ylikangas 2004)

### 1.1 Strategic guidelines concerning land consolidation

The objectives set for Finnish national regional policy are development of national and international competitiveness, a viable and balanced regional structure and responding to the special challenges of the regions. The goal is a balanced regional structure that keeps all provinces viable. The national development targets for regions call for strengthening the operational requirements for primary production in rural areas and ensuring that the viability and profitability of rural areas develops in a manner that retains the competitiveness of the sector in different regions. The European Commission has also emphasised the importance of forming contiguous and sufficiently large agricultural production units as the prerequisite for a profitable farm economy. (SM 2003; VN 2007; MMM 2007)

In December 2007, the Ministry of Agriculture and Forestry published a land reallocation strategy for 2008-2013, according to which public financing should be allocated so that the measures implemented produce the best possible impact. According to the strategy, the focus in 2008-2013 should be on combining different points of view in land consolidation, in which case views related to the environment, landscape and traffic safety etc. can be more extensively taken into consideration. Land reallocation should broadly support social goals, such as rural viability and environmental protection so that the activities would help to achieve the best possible overall impact. In order to appropriately focus public financing, it must be possible to calculate the benefits of land reallocation in a sufficiently accurate manner, and the calculations also have to be comparable between different sites. The only way to ensure that public financing is prioritised to the correct and most socially appropriate sites is by means of uniform accounting tools that are sufficiently detailed and used throughout the country. (MMM 2007)

## **1.2 The impacts of land consolidation**

The starting point for land consolidation activities is the existence of economic grounds for the arrangements. The property division in the land reallotment area should improve enough to justify the selected implementation method in terms of its economic impacts. The benefit resulting from land consolidation should in all cases be greater than the costs and drawbacks. (preconditions for LCP see Real Estate Formation Act 67 §)

Land consolidation has agricultural effects because the size, accessibility and shape of the parcel of arable land often changes in conjunction with the project. The quality and amount of cultivated land also changes in many cases. Furthermore, the number of parcels of arable land decreases and other production opportunities can increase. Land consolidation also has ecological effects on the climate, water system and the biodiversity and landscape of nature. Land consolidation measures aimed at minimising movement affect the travel times and traffic safety of road travellers. Land consolidation may cause a variety of social and often indirect regional economic impacts. The drainage measures carried out in conjunction with land consolidation can affect the environment and farming itself. It should be possible to include of the above-mentioned effects in the process when the benefits and drawbacks of land consolidation are compared, in other words, when the implementation decision is being prepared. (Hiironen et al. 2009)

## **1.3 Purpose of the study**

The purpose of the study is to compare the usability and reliability of different methods used in benefit and cost accounting in land consolidation projects when applying for project financing. The study is intended to determine the effects of land reallotment and formulate a calculation method that can be used to help assess the feasibility of agricultural reallotment within the National Land Survey of Finland.

## **2. EVALUATION OF EFFECTS IN DIFFERENT COUNTRIES**

The following chapter presents how the valuation of land consolidation effects is performed in different European countries. The study of foreign methods was based on a questionnaire sent to experts in the land consolidation field.

### **2.1 Evaluation of land consolidation effects in Finland**

Evaluation of the feasibility of land consolidation should first and foremost be performed in the needs analysis phase, commensurately and using uniform methods, in order to prioritise the projects so that public financing is objectively and analytically allocated to the "best" sites. It should also be possible to assess the feasibility of field reallotment in conjunction with apportionment of expenses, because the costs of the project that are not paid from state

funds are divided among the landowners. Thus, the evaluation should take into account the social benefit (when making the implementation decision) and the impact on landowners. A cost-benefit analysis should be performed in Finland before and during the project.

In Finland's present land consolidation practice, the effects of agricultural reallocation are evaluated using three methods, the results of which differ significantly from each other. Evaluation of effects other than those that are agricultural has mainly been ignored in Finland's present land consolidation practice. More detailed examination has shown that none of the methods for valuing agricultural benefits currently utilised are fit for use as such. (Hiironen et al. 2009)

The best starting point was found to be a valuation method based on cost accounting, in which the matching principle is used to determine the logical link between income and costs. A method based on cost accounting was found to be transparent, because every change in income can be traced to its cause. Furthermore, the method already includes a sensitivity analysis that makes it easy to examine the reliability of calculations as a function of different variables or the raw data provided. The drawback of a benefit valuation method based on cost estimation is its heavy basic structure, in other words, the extensive calculations required for accurate cost accounting. As a result, a spreadsheet application was developed for Finland in conjunction with this study. It automatically calculates the various impacts as a function of raw data. The application utilises geographic information obtained from the JAKO data system concerning the prevailing property structure before and after land consolidation. (Hiironen et al. 2009)

The biggest problem when assessing agricultural effects using the present valuation methods has been the fact that the effects have been evaluated on the basis of average data. Thus, the assessment has focused on how much the parcel size, distance to the homestead, etc. has changed on average. Depending on the method of calculation, this has led to inaccuracies of 100-300%, because the average data does not describe actual change. The numbers must always be calculated on a parcel-specific basis, and other so-called social impacts included as part of the cost-benefit analysis. (Hiironen et al. 2009)

## **2.2 Evaluation of land consolidation effects in Sweden**

Land reallocation activities in Sweden focus on forest reallocation and there is very little agricultural reallocation. The main purpose of land reallocation proceedings is to improve forest productivity. Above all, the proceedings clarify the property structure. Furthermore, the proceedings clarify joint ownerships of forests, which in many cases can be very fragmented. A cost-benefit analysis is a prerequisite for forest reallocation in Sweden. In order to implement a project the cost-benefit analysis must prove that it will be profitable.

In Sweden, the cost-benefit analysis is performed before implementation of land reallocation, in which case its purpose is to provide information for decision-making concerning whether land allocation should even be initiated. The cost-benefit analysis is further specified as the

land reallocation plans become more detailed, which means that the content and accuracy of the analysis vary depending on the readiness of the plans. The first plans are made on a very rough level, primarily to identify the potential of the arrangement. However, it is worth noting that, prior to implementation, the plans are accurate enough to value the benefits on a property-specific basis. This makes it possible to identify the relative share of costs and estimate the absolute costs even before the project is implemented. Although a cost-benefit analysis is not performed at the end of the project, it can be assumed that realisation of cost estimates and their relationship to the targets set is monitored in some other instance after land reallocation.

In Sweden, the cost-benefit analysis only includes those benefits with a clear monetary value, but it appears that project implementation can also be justified by its other impacts, such as clarification of the property structure. However, the above-mentioned effects that are difficult to measure in terms of money are not taken into account in the so-called theoretical end result of the cost-benefit analysis, which apparently has significant importance when making the implementation decision for the project. Thus, benefit valuation focuses strongly on the so-called direct benefits of forest reallocation, such as quantifying reduced harvesting costs. Benefits taken into consideration in cost-benefit analyses are the size, shape, location and number of the parcels of forest land. The analyses also take the effect of improved road networks into account. In addition to direct benefits, the analyses can also address the importance of dismantling joint ownerships.

Benefit valuation is performed from the landowners' perspective. There is no actual barrier to taking social benefits into consideration, but apparently they are assumed to primarily result from the multiplier and ripple effects of benefits generated for landowners.

Land reallocation can be implemented if the direct forestry benefits to the landowners exceed the costs to them resulting from the project.

### **2.3 Evaluation of land consolidation effects in Switzerland**

Switzerland is a federal republic comprising 26 cantons. Each canton has its own legislation extending all the way to the Constitution, which means that the benefit valuation practice described below is quite generalised. As in Germany, land consolidation in Switzerland is a diverse proceeding that serves the needs of different stakeholders. The aims of land consolidation include improving the productivity of the farm economy and ensuring that environmental protection targets and corporate economic land needs are met while clarifying the cadastral register and preparing for natural disasters. A cost-benefit analysis is a prerequisite for implementing land consolidation when needed, in other words, a cost-benefit analysis is mandatory in extensive land consolidations that concern different stakeholders but not in smaller reallocations of agricultural or building land that only serve the interests of certain parties.

The cost-benefit analysis is usually carried out during the preparation phase of land consolidation and again after the consolidation is completed. The analysis is used primarily to determine the profitability of land consolidation and as the basis for making the implementation decision as well as for apportioning the costs of land consolidation. The analysis differs depending on the phase in which it is performed. A kind of proposal for measures is drawn up before performing land consolidation, and this illustrates the impacts of the project, such as increased parcel size and the amount of land reserved for levees. Then the effects presented in the proposal for measures for the project are compared to the project costs and a decision made concerning whether the costs are acceptable in relation to the targets set. The cost-benefit analysis performed after completion of land consolidation primarily measures the benefit to landowners and farmers, and is used as the basis for apportioning costs.

In Switzerland, the monetary value of benefits is only calculated for private parties, such as landowners and farmers. In contrast, the monetary value for public effects is not generally calculated. Private effects are considered to be changes in: the area and shape of the parcel; the location and number of parcels; and improved road, drainage and sprinkling networks. Public effects are considered to be changes in: amounts of emissions (to soil, air and water system); biodiversity and landscape; public land acquisition; social capital (reduction in conflicts concerning public land acquisition); and flood protection. In terms of public effects, monetary value is only calculated for flood protection, which is estimated based on the cost of damage resulting from floods.

In Switzerland, the benefits are evaluated for both the private and the public sector. For the most part, the benefits to both parties carry equal weight in decision-making, although it is natural to emphasize the private benefits in smaller projects. However, the guiding principle is that benefits to both the private and public sectors should exist before a project is implemented.

## **2.4 Evaluation of land consolidation effects in Netherland**

In addition to land reallocation, land consolidation can include the planning and implementation of road and water construction projects and establishment of recreational areas and nature and landscape protection sites. The prerequisite for implementing land consolidation is that the proceedings are approved as a development project in the national rural development plan that is updated annually.

Land consolidations can only be “processed” in a more detailed manner in the regional development plan, where the feasibility of each project is determined using a cost-benefit analysis. The cost-benefit analysis is carried out again after completion of the project, apparently for apportionment of costs.

In the Netherlands, most cost-benefit analyses take into consideration changes in: the area and shape of the parcel; and the location and number of parcels. Changes in the following areas

are also taken into account as required: road and sprinkling networks; biodiversity and landscape; and flood protection. It appears that changes are identified by means of a list rather than by assigning values in euros.

In the Netherlands, benefit valuation is carried out from the point of view of society and the farmer. The benefits to both parties are taken into consideration equally when making the project implementation decision so that the benefits can be appropriately emphasised in accordance with the purpose of the land consolidation. Although the outcome of the cost-benefit analysis might be negative in terms of implementing land consolidation, the project may still be carried out for reasons of policy.

## **2.5 Evaluation of land consolidation effects in Germany**

Germany is a republic comprising 16 states that exercise extensive independent decision-making power. Because state laws are subordinate to the national laws and there is no national legislation governing benefit valuations for land consolidation, the cost-benefit analyses performed in conjunction with land consolidation vary in different parts of the country. Land consolidation is aimed at increasing the profitability of rural livelihoods and ensuring the supply of building land by arranging to separate agricultural and forestry land from urban settlement and activities. The purpose of land consolidation can be considered to be clarification of the regional structure, which includes combining areas dominated by agriculture and separating areas required for residential and business needs. German land consolidation mainly involves arranging building land, land rearrangement projects and agricultural reallocations and are, in terms of benefit valuation, more diverse than the “Finnish” agricultural reallocations that were examined in this study. Land consolidation in Germany requires the performance of a cost-benefit analysis, at least in some states. In order to implement a project, the need for land consolidation must be demonstrated by means of a cost-benefit analysis or other important factors.

The German states have different practices for calculating the benefits of land consolidation. For example, Bavaria does not utilise a cost-benefit analysis yet, although the matter is under study and implementation is being considered. In contrast, Rheinland-Pfalz, Nordrhein-Westfalen and Lower Saxony all use a cost-benefit analysis.

The cost-benefit analysis is usually performed during the preparation phase of land consolidation and again immediately after the consolidation is completed. The analysis is apparently used primarily to determine the profitability of land consolidation and as the basis for making the implementation decision as well as for apportioning the costs of land consolidation. The analysis appears to differ depending on the phase in which it is carried out, because the cost-benefit analysis performed right after the completion of land consolidation is more extensive and includes the opinions of the parties involved regarding the success of the project. However, rather than affecting the amount of expenses paid by each party, the experiences of the parties involved are primarily used to monitor activities and develop the process itself.

The benefits and costs taken into consideration in a German cost-benefit analysis are divided into the following sub-categories: agricultural; agricultural structural and social; ecological; and regional economic impacts.

In addition, each sub-category is divided into primary and side effects. Primary effects are a direct consequence of the targets of land consolidation, while side effects are not a direct consequence of land consolidation but a result from it. Direct farm economy effects refer to the immediate effects of agricultural reallocation on the farm. Thus, changes in size, shape and location of parcels of arable land are taken into consideration when evaluating the effects. All farm economic effects are so-called primary effects because they are the target of land consolidation. Direct agricultural structural and social effects refer to the reduced need for work in conjunction with land consolidation, which is manifested as increased leisure time. This increase in leisure time provides the opportunity for raising income level by increasing the size of the farm or doing other types of work. Indirect agricultural structural and social effects refer to, for example, the need for more labour due to an increase in arable land, which subsequently reduces unemployment costs. Ecological effects are related to the environment and nature. The primary ecological effects of land consolidation are considered to be changes in the landscape and biodiversity. Ecological side effects of land consolidation are considered to be reduced emissions resulting from a decreased need for transport. Primary regional economic effects include benefits resulting from clarification of the property structure and cadastral register. Regional economic side effects include reduced road maintenance costs and improved conditions for tourism.

In Germany the benefits are evaluated from the perspective of the farmer, the landowner leasing the land and the society, naturally depending upon the purpose and extent of land consolidation. In general, land consolidation can only be carried out if the cost-benefit analysis that reflects the overall impacts has a positive outcome. In practice, this only occurs if there is broad approval for implementation of land consolidation from the landowners and farmers.

### **3. CONCLUSIONS**

This chapter presents a summary about evaluation of land consolidation effects in Europe and gives a recommendation for evaluation of land consolidation effects in Finland.

#### **3.1 Evaluation of land consolidation effects in Europe**

A summary of the questionnaire study and examination of foreign benefit valuation methods indicates that the principles and starting points for accounting are quite similar in different parts of Europe. To begin with, the principle is to focus society resources appropriately and productively, which should be demonstrated using a cost-benefit analysis. Secondly, costs that are paid by parties other than the society should be fairly allocated depending on how much



each party has benefited from the consolidation. The cost-benefit analysis is often divided into two parts according to its purpose, reflecting social profitability and the benefits to the parties involved. Social profitability is examined to justify the implementation decision for land consolidation, and benefits to the participants are determined in order to distribute the costs of land consolidation.

Thus, the principles are in order but implementation is not, because the effects are often so unclear and difficult to measure that valuation is impossible in practice. Thus, nearly every foreign expert had his/her own opinion regarding how the effects of land consolidation should be evaluated. It appears clear that Finland is not the only country where benefit calculations for land consolidations require standardisation and the development of reliable valuation methods. The best starting points for further development of Finnish valuation practice may have been provided by the cost-benefit analysis used in Rheinland-Pfalz, which organised the different components of social effects resulting from land consolidation in a thorough manner.

### **3.2 Recommendation for evaluation of land consolidation effects in Finland**

This section presents the effects of land consolidation and their evaluation, which are recommended for use in cost-benefit analyses for land consolidation. The effects have been divided into the following main categories: agricultural effects; transportation effects; the effects of drainage and similar measures; ecological effects; and social and regional economic effects.

This structure for classifying the effects is recommended for use as such in needs analyses for land consolidation (financing applications). A spreadsheet application is utilised when valuating the effects, and it calculates the current value of the effects as a function of raw data. A capitalisation period of 20 and 30 years and a 5% interest rate is used when calculating current values. Some of the ecological effects and the social and regional economic effects have been identified and included in the cost-benefit analysis on a case-by-case basis, but not using the value given in euros.

#### **3.2.1 Agricultural effects and their valuation**

The effects of agricultural reallocation have a direct impact on farm profitability, in other words, they are directly visible when practicing agriculture as changes in expenses or income. Farm expenses are influenced by changing the area, shape and accessibility of parcels of arable land, which, for example, cause changes in the working time available for cultivation. Farm income can be influenced by changing the quality or amount of arable land, which, for example, causes changes in crop size.

All of the effects listed below are included in the spreadsheet application. The spreadsheet application provides a result for the overall benefit of agricultural effects of land consolidation and apportioned benefits according to the following distribution: reduction of cultivation expenses due to increased parcel size (€); reduction of transport costs due to the decreased

number of parcels, decreased distance to the homestead and improved road class (€); reduction in marginal damage and overlapping application due to the decreased number of margins in parcels (€); change in costs of manure spreading due to changes in parcel size (€); reduced cultivation costs due to improved parcel shape (€); and change in income due to change in production sector (€).

Accounting in the spreadsheet application is performed by production sector, with a certain typical cultivation cycle assumed for each sector.

### 3.2.2 Transportation effects and their valuation

The possibilities for land consolidation to affect transportation costs are based on a reduced need for transport and the separation of long-haul and local transport. Gathering a farm's fields on the same side of the road/railroad and closer to homesteads improves traffic safety for road users and traffic flow. The opportunities to affect railroad transportation costs focus on level crossings, which slow railroad traffic and pose a safety risk for rail and road traffic. Reducing the number of level crossings improves the flow of railroad traffic and the safety of the road crossing the railroad. These impacts mostly involve travel time and accident costs. This valuation is included in the spreadsheet application.

### 3.2.3 The effects of drainage work and other measures and their valuation

Land consolidation involves installing underground drainage in fields and piping, straightening and cleaning main ditches.

The benefits of underground drainage come in the form of a reduced need for drainage between fields. In a way, this actually creates new farmland. The removal of open ditches and simultaneous reduction in the area of marginal damage around ditches increases the effective field area, which can then be used for producing crops. An increased crop resulting from better drainage on the parcel provides further benefits. Underground drainage also generates income due to a reduction in costs. The most significant savings are gained from reduced labour input as there is no need to drive around open ditches. Material consumption is reduced when double amounts of seed and fertiliser are not longer spread along the sides of open ditches.

Cleaning main ditches is primarily necessary for cultivation reasons; excess water has to be removed from the fields. In addition, cleaning enhances other drainage work in the field area. Basic drainage in the area has to be properly arranged in order to ensure the functionality of underground drainage. Cleaning also makes the exchange of fields possible, because in land consolidation no one wants to accept a field with poor drainage.

Piping of main ditches enables land reallocation because the size of parcels of arable land often increases when pipes are installed in the main ditches between the parcels. Thus, piping makes it possible to form larger parcels. In such cases, the reduction in turning and

overlapping transports saves time, fuel, fertilisers and pesticides as well as decreasing compaction damage. At the same time, the cultivation area increases and detrimental marginal effects are reduced (in other words, crop size increases). However, the agricultural effects of piping (the benefits of larger parcels, such as lower cultivation expenses, increased crop size, etc.) have already been assessed in section 4.1 in conjunction with agricultural effects, and thus they will not be re-evaluated here.

Estimation of the value in euros of piping and similar effects has been included in the spreadsheet application.

#### 3.2.4 Ecological effects

Land consolidation causes ecological effects on the: the water system; the climate; and the landscape and biodiversity of nature.

The effects of land consolidation on the water system are caused by the drainage work carried out in the projects. Cleaning of main ditches increases surface and channel erosion, which causes soil run-off into the rivers and lakes and slight deterioration of the shore. Organic planning of cleaning (or piping of main ditches) can reduce the negative effects that cleaning has on the water system. In terms of the water system, piping of the main ditches is a better alternative than an open channel, because the pipes reduce the phosphorous load caused by agriculture. Underground drainage also reduces surface runoff from fields and, in comparison to open ditches, increases flow rates during times of low water, which in turn reduces the amount of phosphorous washed into the water system. It should also be noted that the water management in the field and land structure are the foundation for successful cultivation, which directly affects nutrient runoff because phosphorous and nitrogen runoff decrease as growth increases. Valuation of water system effects has not been included in the spreadsheet application, which means that the importance of the effect as part of other effects must be evaluated at the discretion of those performing the assessment.

The possibilities for land consolidation to reduce climate emissions is primarily based on gathering parcels close to homesteads and decreasing so-called criss-cross driving. Criss-cross driving refers to one farmer travelling many kilometres to cultivate parcels of arable land while other farmers also travel to cultivate land that is located close to another farmer's land or otherwise unnecessarily far away. In addition to criss-cross driving, emissions can be affected by collecting parcels into units that are larger and better shaped, thus reducing the amount of time and fuel needed for cultivation. Estimation of the value in euros of climate effects is included in the spreadsheet application.

Land consolidation affects the landscape and biodiversity in the area. However, these effects are so case-specific that it is considered too complicated to estimate their value in euros. A well-maintained production landscape is an important part of the image of each farm and the entire rural area. Landscape management can have a decisive impact on the image people have of rural areas. For example, grazing animals and well-maintained production buildings

contribute to a positive image of the rural area and agriculture. A prerequisite for preserving the rural cultural landscape is a viable rural area that can maintain the values associated with a cultural landscape, and economically profitable land consolidation can be expected to have a positive impact on this matter. Valuation of landscape and biodiversity effects has not been included in the spreadsheet application, which means that the importance of the effect as part of other effects must be evaluated at the discretion of those performing the assessment.

### 3.2.5 Social and regional economic effects

Land consolidation has social and regional economic effects that are often indirect by nature, in other words, land consolidation can cause these effects although it does not directly aim for them. The effects are so case-specific that it is considered too complicated to estimate their value in euros. Social and regional economic effects are divided into four main categories, each of which should be evaluated at the discretion of those performing the assessment: services, employment and business activity; population structure, housing and movement; recreation, health and safety; equality, sense of community, etc. An important factor when assessing social effects is the ability to identify the effect in each specific case. The person performing the evaluation needs to actively interact with the people, because the effects can vary a lot depending on the case.

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## **BIOGRAPHICAL NOTES**

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