IMPACTS OF CAP DESIGNS ON RURAL TERRITORIES AND THEIR VIABILITY: SIMULATION EXPERIMENTS ON A SMALL GERMAN REGION AND DISTRIBUTIVE EFFECTS[1]

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Abstract

We investigate in this paper the participation of farms in the agri-environmental measure "extensive grassland" and the consequences on land use in the case study area Ostprignitz-Ruppin in the federal state of Brandenburg in Germany. We first vary the level of agri-environmental payments (AEP) per hectare in the framework of Agenda 2000. Then we investigate the impacts of the actual decoupling policy which includes the possibility of keeping the land in good agricultural and environmental conditions. For this purpose we use the agent-based model AgriPoliS whose dynamic nature offers an original way to understand farmers' individual decisions to participate or not in this agri-environmental measure. The simulations show that AEP can avoid land abandonment to some extent. However regional decoupled payments put the relevance of this measure into question, as farmers reduced their participation after the reform of the policy.

Keywords: CAP, agri-environmental payments, decoupling, multifunctionality.

Introduction

Agricultural activities have a major role in rural areas. Farms produce agricultural goods, shape landscapes, provide jobs and have impacts on the quality of environment. Direct payments, as distributed in the framework of the Agenda 2000 of the Common Agricultural Policy (CAP), were a necessary support to the income of a majority of European farmers. Now decoupled from production, these payments are supplemented by a rural development policy, aimed at supporting multifunctional aspects of agriculture. Multifunctionality expresses a shift in the composition of demand that the agricultural sector is facing. Rather than purely providing food commodities at competitive prices, society now expects agriculture to fulfill other functions.

Agri-environmental payments are a direct example of this shift in the societal demand. "*Agri-environment measures are designed to encourage farmers to protect and enhance the environment on their farmland. It provides for payments to farmers in return for a service – that of carrying out agri-environmental commitments that involve more than the application of usual good farming practice*" (European Commission, 2005). These payment scheme combinations are a strong driver for structural changes. What are the dynamics of these changes and which consequences do they have at the landscape level? How do they affect this sector at the individual farm level and which groups are more favoured than others?

We will investigate these questions with the case study area Ostprignitz-Ruppin (OPR), located in the federal state of Brandenburg, 100 km in the North-West of Berlin in Germany. OPR is characterised by a constant decline of farming activities, representing a risk for future rural viability, rural employment, and

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occupation of land. This could also endanger the maintenance of wetlands which is of particular importance for the quality of environment and waters in the region, as well as a cultural good of historical value.

That is why the federal state of Brandenburg introduced an Agri-Environmental Measure (AEM) "conversion of land into extensive grassland" in the framework of the Agenda 2000 of CAP. This measure aims not only at maintaining marginal land in a minimal good condition, meaning the farmer subscribing to this measure has to mow the grass twice a year, but also at providing pasture land for ruminants. Its implementation on an area of at least 30% of the UAA of the farm delivers the farmer an Agri-Environmental Payment (AEP) of 130 €/ha of land used as extensive grassland.

In this paper, we use the agent-based simulation model AgriPoliS to investigate farms' decisions to convert land into AEP eligible land. It has been adapted to OPR in terms of agricultural structure, accessible production activities, soil heterogeneity and agricultural prices. The first objective will be to follow the impacts the AEM has on OPR agricultural structure, all other policy intervention schemes remaining unchanged. Then, we investigate how the decoupling policy actually implemented in OPR could influence the participation of farms to the AEM. As a conclusion, the results provided by AgriPoliS permit the formation of some conclusions about the future of this exemplary AEM in the OPR region.

Material and Methods

Purpose

AgriPoliS is a spatial and dynamic agent-based simulation model of structural change in agriculture (HAPPE *et al.* 2006, HAPPE 2004). The main purpose of the model is to understand how farm structures change in rural areas, particular in response to different policies. AgriPoliS maps the key components of regional agricultural structures: heterogeneous farm enterprises and households, space, markets for products and production factors. These are embedded in the technical and political environment.

State variables and scales

The model comprises different hierarchical levels: farm agent, plots, regions, farm population, the political environment. Farm agents are characterised by state variables such as age, factor endowments (land, capital, labour), ownership structure, location in space, type, managerial ability, full time or part-time farm. In order to produce, farm agents utilize different production factors of different types and capacities. Farm agents comprise the population of all agents in the region. Plots represent physical land units or cells, each of which is 1 ha. Plots exist in different forms: owned/rented, arable and grassland of different qualities, distance to farmstead, non-agricultural land. Together, plots/cells form the region. The political environment is delineated by the predominant agricultural policy setting, which affects farm agents, e.g., by way of direct payments, agri-environmental programmes, or limits on stocking density.

Process overview and scheduling

The model proceeds in annual steps. In each year the following steps are processed for each farm: set policy, land auction, investment, production, update product markets, and assess period results, exit decision.

Design concepts

Adaptation: Farm agents adapt to changing conditions on markets and to policy changes by changing their production mix. Farm agents can engage in production activities, labour allocation, rental activities for land, production quotas, and manure disposal rights. Labour can be hired on a fixed or hourly basis; farm family members can work off-farm. To finance farm activities farm agents can take on long-term and/or short-term credit. Liquid assets not used on the farm can be invested. A farm agent leaves the sector if equity capital is zero or if the opportunity costs of farm-owned production factors are not covered. A successor takes over the farm operation if the expected farm income is at least as high as the comparable industry salary.

Behaviour: Farm agents maximise farm household income. To derive the farms' actions, a mathematical programming approach is used as a means of combining various farm production activities and investment choices given the farm's resource constraints.

Prediction: Farm agents form expectations about future prices based on adaptive expectations. They anticipate the impact of major policy changes one period in advance. A farm agent does not act strategically.

Sensing: Farm agents are assumed to know their own state and endowments so that they can apply their behavioural rule. They take into account expected prices for products. Even though farm agents act individually rationally, farm agents' behaviour is rational because they do not take other agents' actions into account. Farm agents sense the state of all plots in the region, and hence can determine which additional plot they wish to rent.

Interaction: In AgriPoliS, farm agents interact indirectly via markets for production factors land, labour and capital, and on product markets. Markets for products, capital and labour are coordinated via a simple price function with an exogenously given price elasticity and a price trend for each product. The land market is implemented as a land rental a. It is modelled as a sequential first-price sequential auction.

Observation: The model produces results at the sectoral level as well as for each individual farm at each time step on economic indicators, production, and investment. Some results are attached with spatial information.

Initialisation

A region is initialised based on GIS soil maps for the region. The initial population of farm agents is derived from FADN-data in a reference year. Farm agents are further individualised with respect to production costs, location, age, and the age of the assets. Technical coefficients and gross margins of production activities are based from standard indicator sets. Upon reading the data into AgriPoliS, farms are further individualised by assigning different vintages to farm assets and giving farms a random age.

Input

AgriPoliS has been adapted to the agricultural structure in the OPR region in 2002. Three arable land qualities (low, medium-low and medium-high) and two grassland ones (extensive and intensive) have been introduced by the mean of GIS maps linked to the model. This improvement leads to differentiated potential gross margins for the same production activity, as well as labour and machinery requirements, depending on the proportion of land of different qualities one farm manages. Initially, we derived 23 farms from the regional FADN database, and weighted them to reproduce the OPR agricultural structure in the start year 2002. Farm capacities (land, capital, labour input and animal productions) are thus empirical data, evolving from one period to another given the decisions the farm agent has taken to maximize its household income. Their technical orientation and the size class they belong to, coupled to the weight they have been given, respects the regional statistical data best. The starting regional structure is described in the tables below.

Table 1: Farming structure of OPR in 2002

		585
Based on the legal form	Individual farms	426
	Partnerships, other legal forms	156
Based on the technical orientation as defined in the FADN database	Field crops	214
	Dairy	46
	Specialist grazing livestock	294
	Specialist granivores	9
	Mixed	22

Table 2: Agricultural structure of OPR in 2002

	120,957
	88,506
Of which low quality (AZ 25)	3,073
Of which medium-low quality (AZ 38)	83,773
Of which medium-high quality (AZ 50)	1,660
	32,451
Of which extensive grassland	9,472
Of which intensive grassland	22,979
Dairy cows	12,115
Suckler cows	17,176
Beef cattle 1-2 years old	16,743
Breeding sows	4,412
Pigs for fattening	11,648

Policy scenarios

The direct payments distributed in the first series of simulations under the Agenda 2000 policy scheme (Agenda scenario) are summarised in the table 3 below. They will be kept constant in the Agenda scenario simulation series.

Table: Direct payments distributed in the framework of Agenda 2000 in OPR in 2002

Unit	Cereals	Protein plants	Grassland	Dairy cows	Beef cattle	Suckler cows
€/ha or €/head	285	328	0	31	207	316

As regards the dynamic hybrid decoupling scenario (DHD scenario), three kinds of premia per hectare have been calculated respecting the actual implementation of this policy in OPR.

As the temporal component is also important to grasp the evolution of these payments, the table gives an overview of the amount in the DHD scenario simulation series.

Table 4: Direct payments distributed in the framework of the DHD reform in OPR from 2002 to 2013(extended to 2017 in AgriPoliS)

		Period	0 to 2	3 to 7	8	9	10	11	12 to 15
		Year	2002-04	2005-09	2010	2011	2012	2013	2014-17
		Unit							
Arable land	Cereals	€/ha	285	262	265	270	278	288	288
	Protein plants	€/ha	328	318	321	326	334	344	344
Grassland		€/ha	0	88	108	148	208	288	288
Animals	Dairy cows	€/head	31	0	0	0	0	0	0
	Beef cattle	€/head	207	0	0	0	0	0	0
	Suckler cows	€/head	316	0	0	0	0	0	0

In addition to this progressive regional premium distribution, a farm specific payment is distributed to farms based on past animal production. This farm specific payment disappears progressively between 2010 and 2013 to give time livestock farms to adapt their production systems to the future exclusive regional premium distribution.

The AEM "extensive grassland" is introduced as a possibility for the farmer to convert part of its land into extensive pasture. It can de applied on the three types of arable land (low, medium-low and high quality) as well as on the two types of grassland (extensive or intensive). The total area of farmland for this purpose has to be at least equal to 30% of the total UAA for the farmer to receive the AEP payment per hectare as distributed through the AEM. Each hectare of this activity requires labour, machinery, capital but also provides extensive pasture land for ruminants, which stocking density should not exceed 1,4 LU/ha on this type of land. Farmland eligible for the AEP in the framework of the AEM will be named "AEP [land type]".

The decisive advantage of the method used is that each farm takes individually the decision to convert parts of its land into AEP land, given the specificities of its spatial, economical and political environment. This decision process takes place dynamically and provides an original way to grasp the impacts of the AEP programme in the region modelled.

Results and Discussion

This section is divided in two distinct parts corresponding to two series of simulations:

- in the first series, Agenda scenario is implemented. AEP, introduced at the first period of simulation, equal either 0, 70, 130, 200 or 300 €/ha, ;
- in the second series, DHD scenario is implemented. AEP are removed either from 2005, 2009, 2013, or not until 2017.

Overview of impact of different AEP levels on OPR agricultural structure

Figure 1 shows the rate of participation of farms through the simulation, depending on the AEP level. The strong differences between the Agenda scenarios prove that the level of reward for participating to the program is a decisive variable which impact is visible at the regional level.

Figure 1: Proportion of farms participating to the agri-environmental programme "extensive grassland"

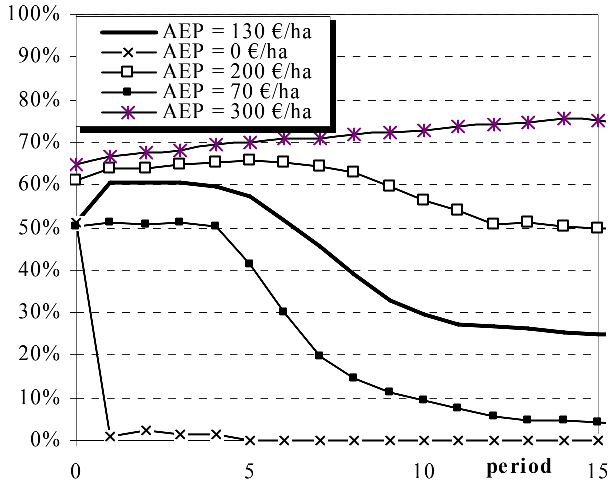
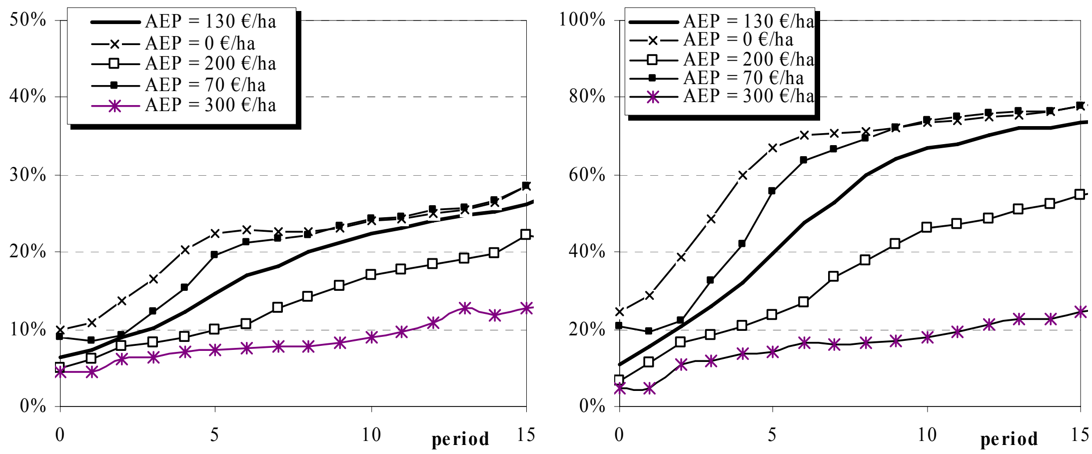


Figure 2 illustrates the rate of land abandonment in OPR. It comes from that during the simulation in AgriPoliS, farms have the possibility to bid for each plot available for rent between two periods. But if some plots are of no economic meaning for any farm in the region, it is simply left idle and no farm uses it.

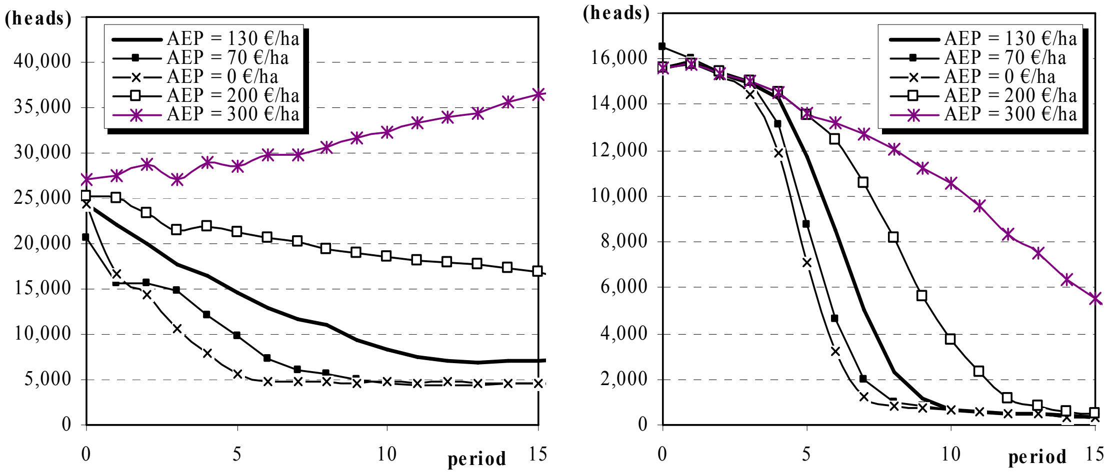
Figure 2: Proportion of total land abandonment (left) and grassland abandonment (right)



The decline in the number of farms in the region partly explains the general increase in land abandonment. However, the high AEP of 300 €/ha results in 15% less agricultural land abandoned from the 5th year of simulation, in comparison with the two lowest levels of each 0 and 70 €/ha. It is to note that differences in land abandonment between the actual AEP of 130 €/ha and the two lowest levels tend to disappear from the 7th period of simulation. Before that, the difference in land abandonment never exceeds 8% between the actual AEP level of 130 €/ha and the situation in which no payments are distributed for the AEM.

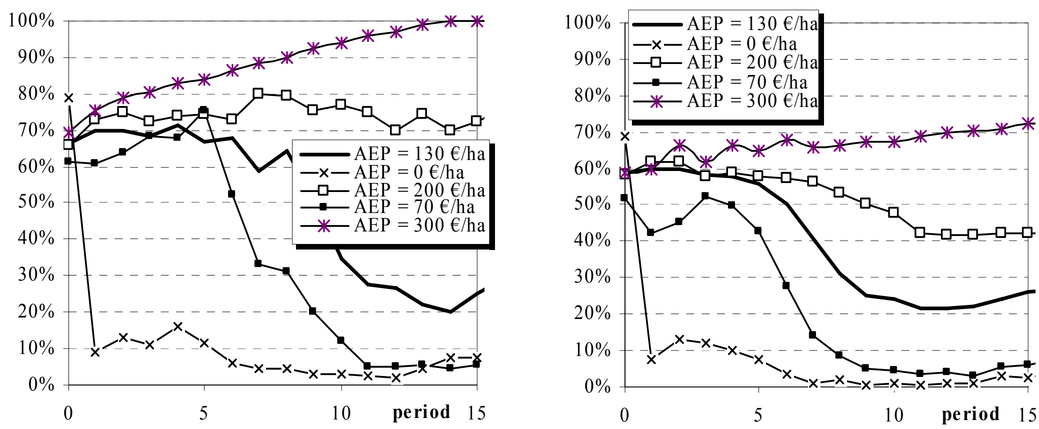
The results delivered per soil type reveal a massive abandonment of extensive or intensive grassland (see Figure 2) rather than of arable land. This is explained by the decrease of the number of herbivores as shown in the graphs below. Only in the Agenda scenario AEP 300 one can observe a constant increase in the number of suckler cows from the 6th period of simulation.

Figure 3: Evolution of the number of animals: suckler cows (left) and beef cattle (right)



Again, the higher the incentive provided by the mean of AEP per hectare, the more grassland stays in production. This grassland is massively used to receive the AEP, which enables to keep or invest in herbivore productions. Pigs and sows show the same figure for all AEP levels: this production is only dependant on market prices. Dairy cows as modeled for OPR are not depending on pastures and not necessarily on grassland productions in general: the regional evolution is the same for each AEP level.

Figure 4: Proportion of extensive grassland (left) and intensive grassland (right) eligible for AEP



One decisive advantage of the method is to follow the evolution of the participation of different farm groups to the AEM. AgriPoliS calculates if more than 50% of the total gross margin of a farm comes from pigs/sows, dairy, field crop or mixed field crop/livestock production, and deliver the individual information. The table below illustrates the distribution of farms in both size and main production classes.

Table 5: Number of farms participating to the AEM per type and size class, Agenda scenario, AEP = 130€/ha and AEP = 300€/ha (in brackets)

Period	Farm type / Farm size	Pig	Dairy	Field crops	Mixed	Total
1	10<ha<50	(3)	1 (8)	15 (9)	196 (281)	212 (301)
	50<ha<100	2	(1)	3 (14)	73 (7)	78 (22)
	200<ha<500		55 (51)	3 (10)	(4)	58 (65)
	1,000<ha<3,000		(1)		1 (1)	1 (2)
5	10<ha<50	1	2 (30)	69 (21)	59 (136)	131 (187)
	50<ha<100	2 (3)	(22)	39 (28)	97 (97)	138 (150)
	100<ha<200		22	9 (2)	3 (1)	34 (3)
	200<ha<500		(29)	(18)	(6)	(53)
	1,000<ha<3,000			(3)	1 (2)	1 (5)
13	10<ha<50		(44)	28 (24)	2 (87)	28 (155)
	50<ha<100		(30)	33 (74)	(57)	30 (161)
	100<ha<200		(2)	3 (13)	(6)	5 (21)
	200<ha<500		(17)	5 (18)	(10)	4 (45)
	1,000<ha<3,000		(3)	(1)	1 (1)	1 (5)

A strong participation to the AEM with the incentive of 300 €/ha explains the diversity of farms observed in the table 5 above. The incentive is of particular interest for smaller sized farms in general, of the mixed type in particular.

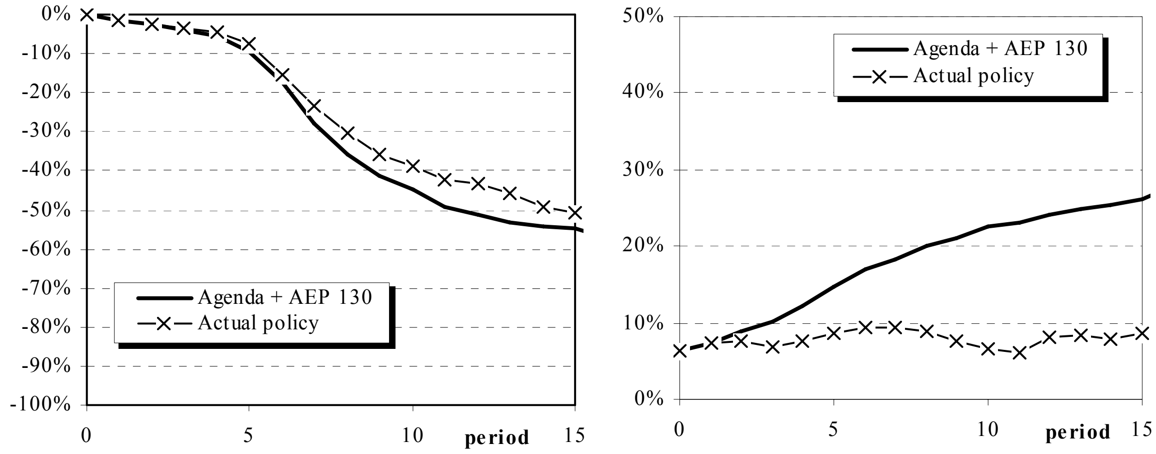
This first series of results show that AEP are far from having a marginal impact on the agricultural structure of OPR as modelled in AgriPoliS. The consequences are manifold. Rewarding farms for maintaining extensive pasture on pieces of land which are not profitable for other agricultural productions, and especially if the level of AEP is high, slows down land abandonment for grassland in particular. Herbivores are consequently a production which is being favoured by this voluntary approach. Slowing down land abandonment means here slowing down the decline of farms: the agri-environnemental payment is also an economical incentive sufficient for some farms to stay further in agriculture. Moreover, the higher the payment, the more numerous and diverse the farms adopting the AEM, in terms of size and technical orientation, making more farmers sensitive to environmental concerns.

Introduction and impacts of the DHD scenarios in OPR

The second series of simulations consist in implementing the dynamic hybrid decoupling model as it is actually the case in OPR since 2005. The results provide elements to be compared with the Agenda scenario with 130 €/ha level of AEP (Agenda 130 scenario), especially under the conversion of land into AEP land aspect. In the following graphs, the policy switch is introduced after three periods under the Agenda 130 scenario. After that, policy settings are the ones described in the material and methods section.

First, it is hardly possible to see differences between the four DHD scenarios implemented, whenever the removal of AEP happens. Therefore we will compare the DHD scenario described in Table 4 with the Agenda 130 scenario: the level of AEP, 130 €/ha, is the same for the two scenarios.

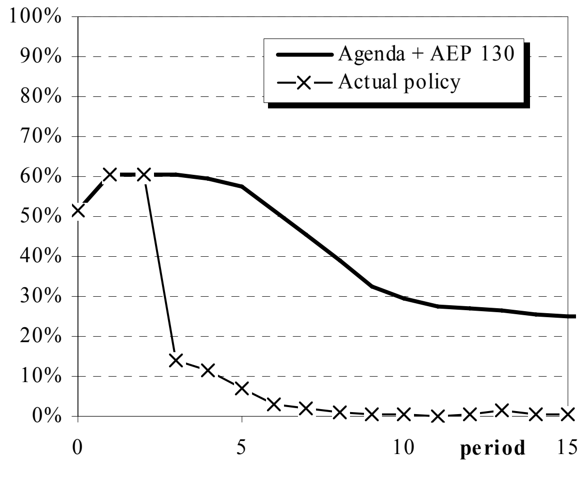
Figure 5: Proportion of farms leaving agriculture (left) and proportion of total UAA abandoned



The DHD scenario does not prevent the decline of farms in the region, but it already does it better than the Agenda 130 scenario. Yet its impact on land abandonment in comparison to the reference scenario is quite striking. Less than 10% of the total UAA is be abandoned during the simulation, while a continuation of Agenda 130 scenario cannot prevent any increasing of land abandonment. Do AEP play here an important role versus land abandonment?

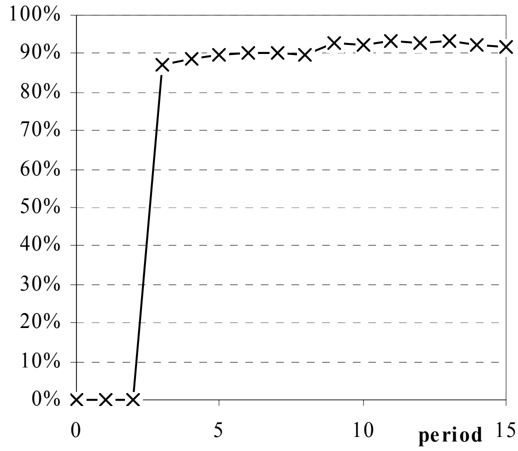
Figure 6 below shows that it is not the case at all. The rate of 60% of farm participation on period 3 falls dramatically down in the DHD scenario just after the policy change and reaches a negligible value from the middle of the simulation. Actually, the answer to why AEP are not directly linked to the maintenance of agricultural land is comprised in the decoupling policy itself, as shown in the next graph (Figure 6).

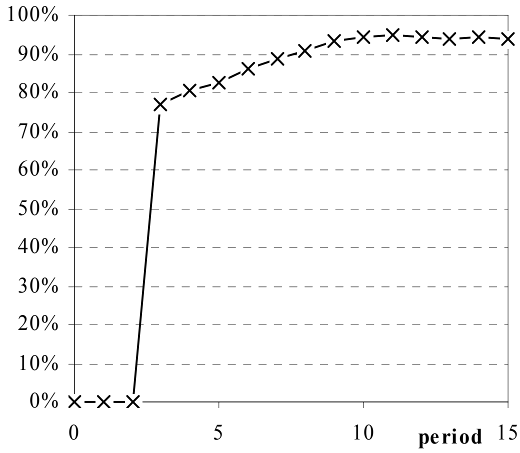
Figure : Proportion of farms participating to the extensive grassland programme.



First, it is necessary to state that neither the intensive nor the extensive grassland is abandoned at rates higher than 20% and even then, not very long. As illustrated below (Figure 7), this is due to the fact that farms can decide to simply keep parts of land under Good Agricultural and Environmental Conditions (GAEC), which is a prerequisite to receive the regional premium.
This is what happens in the case of grassland, to some extent also to low quality arable land.

Figure 7: Proportion of extensive grassland (left) and intensive grassland (right) kept in GAEC in the region in the decoupling scenario





Land eligible for AEP is following the tendency illustrated on the Figure 6. From the introduction of the policy switch from the third period, AEP granted land falls down very abruptly. Farms massively turn the land of no obvious economical interest into land to be kept in GAEC, only requesting some machinery and few hours of labour per year. The consequences on animal husbandry do not require more than few words: beef cattle and suckler cows simply disappear, from the 6th period of simulation for beef cattle and right from the policy switch year for suckler cows.

The decoupling policy implemented here has completely shut down the conversion of land into extensive pasture. This may not be a problem as land abandonment seems to be definitely prevented in this scenario, but animal productions are not a profitable investment for farms anymore.

Conclusion

The first series of simulations showed a quite strong impact of the AEM studied on the OPR regional structure. The impacts are almost proportional to the level of AEP. With incentives to both preserve extensive grassland and stay in agriculture, the simulations proved that the presence of AEP was of interest for many farms. However, this was under stable and constant policy settings. The introduction of the decoupling scheme, granting progressively all pieces of agricultural land, including land not necessarily producing agricultural commodities, has completely shut down farms' participation to the AEM. The removal of AEP, or even their conservation after 2013, did not have any impact at the regional or individual level as regards the AEM adoption. From 2013 in the model, although potential AEP land would be eligible to the normal AEP in addition to the regional premium per hectare (in total, 418 €/ha), no farm took the decision to convert enough land to get the AEP. The massive conversion of non economically profitable land into idle land (which only requires a minimal care) may threat ruminants production and thus question the relevance of AEP. The AEM "extensive grassland" should be kept as it is at least until 2013, but this study provides an occasion to discuss the existence of a measure whose use may become not more than marginal, and the environmental benefits negligible.

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