

# Wind farms and payments to landowners: opportunities for rural development for the case of Galicia

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## Abstract:

Wind development creates a range of economic impacts at different territorial scales and sectors, one of which is the local sector at the rural level. Yet few studies make an in-depth study on the relationship between the implementation of wind farms and rural development. The literature scarcely analyzes the impact of payments to landowners and their potential for revitalizing rural areas above all in areas lacking public property where community wind farms are legally banned. These two circumstances converge in Galicia, a region in the northwest of Spain that currently operates over 3,300 MW of wind power. This paper aims to analyze landowner payments and study their role in the rural development of the Galician territory from the perspective of the current regulatory framework. To this end, it uses different quantitative and qualitative methods such as participatory research tools used in the field work and developed for over 10 years. Our work estimates average payments to landowners and the total flow of wind-generated income reaching the rural areas, which was 0.84 million euros in 1999 and 10.1 million in 2015. It also analyzes final wind revenue destinations and identifies several examples of the dynamization of rural areas based on the innovative use of this income. Rural landowners developed very innovative community initiatives triggering local economic revitalization despite the averse current regulatory framework. The paper concludes that a more advantageous regulatory framework could have had a much greater local impact.<sup>1</sup>

**Keywords:** Wind energy; economic impact; common land; regulatory framework; participatory research

## 1. Introduction

Recent decades have witnessed great implementation of wind energy across the world [1]. Growing scientific interest in several aspects, such as its benefits in the battle against climate change [2,3] and its relevance as a source of energy for satisfying a substantial

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<sup>1</sup> List of Abbreviations: AC, Autonomous Community; ARD, Average Rent by Developer; ARWF, Average Rent by Wind Farm; CMVMC, Comunidades de Montes Veciñais en Man Común; CPI, Consumer Price Index; FOWP, Fully Operating Wind Power; SIDWEG, Socioeconomic Information Database of Wind Energy in Galicia; TAR, Total Average Rent; TAR, Total Average Rent; TWEL, Total Wind Earnings for the Landowners.

part of the national energy demand [4] or its technological improvement [5] has accompanied this strong expansion. Scientific literature focuses on aspects like socio-environmental conflict [6,7,8], environmental impact [9,10,11] and the social and local acceptance of wind farms [12,13,14,15,16].

In recent years, the economic impact of wind farms has increasingly attracted scientific interest. Their impact on the regional economy and the creation of employment opportunities and the way they affect overall economic development [17,18,19] and local economies [19,20,21] are all recurring topics in scientific forums. Although large-scale development of renewable technologies may give rise to significant economic changes at the local level [22] and contribute to the sustainable development of specific territories [23], few studies analyze the relationship between the implementation of wind farms and rural development [22,24,25].

This new path of sustainability is operative in several domains. On the one hand, the transition to less fossil-energy and more dependent models of renewable sources transforms the structural base of economies [26]. Furthermore, as some of these new energy sources develop in the rural world (in many countries, wind turbines, large photovoltaic plants or biomass are almost exclusively developed in these spaces) the role assigned to rural communities and farmers could also lead to structural territorial changes.

The commitment of European institutions and the Spanish and Galician governments to renewable energies, particularly to wind power, was motivated by growing concern over climate change and the need to use non-fossil renewable energy to produce more energy [27]. Nevertheless, the same regulations that promoted these facilities also considered renewable energies capable of providing opportunities for regional development, especially in isolated rural areas [28], to stimulate rural economic development by contributing to rural development, establishing population within the territory and guaranteeing the sustainability of the model [27,29].

Regulatory framework determines opportunities to link wind power to rural development. Payment to landowners constitutes the principal economic impact on rural areas where landownership is predominantly non-public and community wind farms cannot be developed. According to different studies [30,31,32,33], no scientific research has conducted a global study on payments related to wind energy for a large territory like Galicia with plenty of this energy. This is mainly because it is difficult to obtain the necessary information [30,33].

Using participatory research techniques to obtain unique information on the direct economic impact of wind farms in Galicia our work seeks to characterize and quantify the income received by landowners and its contribution to rural development. We conduct the case study in Galicia, a region in the northwest of Spain with a large implementation of wind power in rural areas, throughout the period from 1995 to 2015.

The paper is structured as follows. The first paper first analyzes the scientific literature for background records on the payments made by the wind farm developers to landowners. Then it presents the case study and the methodology. It gives the results, analyzes payments to landowners, and discusses the role of this new income in the development of rural areas in the fifth section and it finally presents the main conclusions.

## 2. Background on payments to landowners

The literature points out that payments to landowners are a component of the economic benefits derived from wind implantation that represents a potential opportunity for rural development [22]. Fast and Mabee [34] indicate these payments may contribute to the feasibility of agricultural holdings and help farmers remain on farms after retirement, promote the conservation of biodiversity and the maintenance of properties, just like Hall et al. [35] do for the case of Australia and Groth and Vogt [21] do for the case Michigan. Using the example of the United States, Brown et al. [36] emphasize that landowners voluntarily accept payments for wind development. This suggests their net benefits are higher than their net costs because wind turbines displace other land uses. Bolinger and Wiser [37] signal that some farms in the United States earn annual rental income from the land used for wind turbines that may even exceed the annual income of all other agricultural activities. Likewise, Ejdemo and Söderholm [18] indicate lease payments in Sweden could be much higher than gross revenue from ordinary agricultural crops. Finally, wind income even implies reaching profitability at some farms in Norway [38]. According to Haan and Simmler [39], in the case of Germany wind development may produce an increase in the price of land, positively related to wind availability, as well as agricultural income.

On the other hand, the literature indicates payments to landowners may also play an important role in the social and local acceptance of wind farm projects. According to Swofford and Slattery [32], leasing land to private landowners to operate wind turbines provides an additional financial incentive for the owners that could influence their attitude toward wind projects. In this sense, Chen and MacDonald [33] assert that academic and technical research must pay more attention to landowners, particularly in terms of leases, because the decisions and concerns of landowners have such an impact on wind farm implementation that they may even lead to project failure. This is the case of Tehuantepec, Mexico, where social opposition to wind farms generally springs from land access issues [40].

However, no study to date has conducted a systematic analysis of the payments made to landowners in a large territory with substantial wind energy development. This research gap is common to other geographic areas. As Walter [31] indicates, no comparative analysis studies the financial participation offered to local residents in Switzerland. Referring to Pennsylvania, Jacquet [30] criticizes the lack of research to identify the actual amount of compensation paid to landowners. This also happens in Texas [32] where it applies more to large-scale wind energy projects, thus implying an even greater amount of potential income for local landowners. Of course, some studies and documents specifically present particular results for wind farms. This is the case of a 40 MW wind farm in Poland [41], a wind farm in Scotland [42] and several wind farms in the USA [43].

As opposed to other countries like Denmark, England, Germany or the USA where the regulatory framework allows for the development of community wind farms, in Galicia the legislation makes no allowance for the development of wind farms by farmers, landowners and/or local communities [44,45,46]. Hence, the amount of the payment to landowners becomes all the more relevant.

The lack of scientific studies on the direct economic impact on landowners is motivated by the presence of constraints that hinder these analyses. Thus, contracts between wind farm developers and landowners usually contain confidentiality clauses, preventing access to the economic information appearing on them, as noted by Groth and Vogt [47] for the case of Michigan or Fast and Mabee [34] for the case of Canada. In Serbia they inform of the payment mechanisms but indicate no amount [48]. For their part, Chen and MacDonald [33] extend confidentiality to the very essence of the wind industry. Lease agreements are occasionally public, so this information could be obtained by mandatory request to the public registry. As Jacquet points out [30], in the case of the United States, this requires conducting an extensive manual search of property records in local government offices, but it entails temporary and human costs because the information is neither aggregated nor digitalized. Thus, it remains undone. Our work fills this research gap for Galicia, a territory with strong wind power development.

### **3. Case study of wind development in Galicia**

The geographic location of our analysis is Galicia, a region in the northwest of Spain with important wind development (see figure 1). Nearly 4,100 wind turbines were installed in this territory from the year 1995 to the year 2015. This accounts for over 3,300 MW of installed power. The wind power installation process in Galicia has several characteristics: first, Galicia is the Autonomous Community with the highest level of wind power intensification, measured in installed power per surface ( $\text{kW}/\text{km}^2$ ). Although the Spanish average is  $45 \text{ kW}/\text{km}^2$ , Galicia reached  $113 \text{ kW}/\text{km}^2$  in 2015. Wind turbines operate in 107 of the 314 Galician municipalities. That is to say, they operate in over a third of the municipalities. Yet some of these municipalities concentrate most of the machines in operation (see figure 2). It is important to note that over two-thirds of the wind turbines are located in 71 rural municipalities with population densities under  $100 \text{ people}/\text{km}^2$  and fewer than 5,000 inhabitants.

Figure 1. Geographic characterization of Galicia on the map of Spain. Source: Own elaboration.

Figure 2: Geographic distribution of the number of wind turbines by municipality in Galicia. 2016. Source: Own elaboration based on SIDWEG [49].

Secondly, this wind energy expansion process happens at a time when a series of rural transformations exacerbate the structural problems of these areas: ongoing abandonment and loss of agricultural jobs, which fell from 230 thousand to 45 thousand throughout the wind energy deployment period [50]; abandoned population entities that have increased by 631 over recent years, specifically from 1,064 in the year 2000 to 1,695 in the year 2016 [51]. Moreover, the aging rate of Galician rural populations is high [52]. In fact, Galicia is the second autonomous community in Spain with the highest age index, namely

190, when Spain's average is 116 [53]. All these factors have led to the progressive abandonment of farmland and forest areas [54]. This generates important environmental problems; the most relevant are forest fires [55].

Thirdly, wind expansion in Galicia focuses on rural forest areas with a unique regime: common property. Certainly, a peculiar feature of the Galician territory is that the public forest area is only present in 2% of its property structure, while 68% of the forest area belongs to individual private owners and the remaining 30% of the forest area belongs to community owners [56]. The latter are organized through the *Comunidades de Montes Veciñais en Man Común* (CMVMC), a specific form of community land tenure and a unique legal category in Galicia [57,58]. These Common Lands are private forests, of Germanic legal nature. They are collective properties exempt from quotas, which belong to their respective local neighboring communities. Moreover, they are subject to the constraints of indivisibility, inalienability, unseizability and indefeasibility [59]. The figure of the CMVMC is akin to the *baldios* in Portugal [60] and reaches 3,215 units. This represents 667,000 hectares or 22.5% of the total of the Galician territorial area [61]. Our case study focuses on this type of communal owner. The average area of community properties is 230 hectares providing potential rural development through forestry, livestock, farming and innovative proposals. However, communal owners face financing problems to manage their properties. This situation contrasts with that of the 672,000 private forest landowners [62] whose average land area is less than 2 hectares [57]. This explains its lower innovative dynamism and manifest abandonment.

In sum, our case study shows that strong wind development mainly took place in municipalities of a deeply rural but transformational nature. That is to say, it developed in a rural world that was losing population and agrarian activity and giving way to transformational industries, rural tourism, sports and urban leisure, and so forth. Thus they formed a new regional economy [63]. This rural space gradually became a consumer space rather than a space for agricultural production [64]. A new economic activity made its appearance in this rural context, giving the agrarian environment and its landscape - particularly the community owners whose land is occupied by many of the new wind industries - the opportunity to transform the rural development model.

## **4. Material and methods**

### **4.1 Database Features**

This research conducted the analysis using a multi-method approach based on different quantitative and qualitative techniques [65,66,67]. The most notable of these techniques fall within the paradigm of Participatory Research [68]. Based on these techniques (semi-structured interviews, workshops and life stories), the work obtained one-on-one information about the direct economic impacts of wind farms in Galician rural areas. Throughout 10 years, a total of 85 meetings were held with agents affected by operating wind farms, principally with entities of community ownership. These meetings resulted in 106 semi-structured interviews and 32 workshops with owners of the lands occupied by wind farms. Initial mistrusts when trying to obtain "reserved economic information" were overcome through progressive approaches, the free delivery of useful information for the

landowners<sup>2</sup> or prior intermediation by trusted people [49]. The Participatory Research process consisted in the following steps: i) identifying the proprietary agents of rural lands occupied by wind farms; ii) establishing contact through administrative entities, other area owners or by posting letters; iii) initiating contact with the owners by explaining the object of study; iv) visiting the landowner, individual or collective, and transferring information to them concerning the legal framework, the wind farm, invoicing, etc; v) obtaining quantitative and qualitative information on the negotiation process for the land occupation.

Our work addresses the constraints indicated in the literature relative to the difficulties in obtaining information and the confidentiality of the sector [33,34,47] by following the guidelines of triangulation processes [70] to directly compile qualitative and quantitative information, unavailable to us in public statistical information, concerning the process and the economic results of the implementation of wind energy in rural areas. The absence of public databases on contracts, agreements, expropriations and purchases linked to the implementation of wind farms in Galicia required the use of these participatory methodologies with the symbiotic collaboration of rural agents. The research complements participatory information by systematically analyzing public statistical databases, specialized public and private entity reports; legislative databases in Galician, Spanish and European domains; the different public registers linked to renewable energies and specific scientific literature collected in the Web of Science.

The compilation and analytical process resulted in the creation of the Socioeconomic Information Database of Wind Energy in Galicia (SIDWEG) [49]. As shown in the following figure, this database consists of 7 sub-databases that collect quantitative and qualitative information at 4 different levels: wind farm, municipality, province and the entire territory of Galicia. SIDWEG also contains aggregate public information that is already disaggregated into technological (unit power, total power, number of wind turbines, technology...), economic (investment, annual production, specific incentives received, local public income...), and territorial fields (affected zones, occupied territory, and wind turbine distribution by municipality...). Although the main novelty that makes it one of a kind for such a broad territory with as much wind power as Galicia, is its social information (identification of actors, role played by each of them, etc) and economic information at the 4 aforementioned levels regarding the income obtained by landowner and destination.

Figure 3: Outline of the structure of the Socioeconomic Information Database of Wind Energy in Galicia.

## **4.2 Calculating wind payments**

In our case study, the most common mechanism used by developers to gain access to wind farms consisted in signing lease agreements, in almost 90% of the cases, as is done

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<sup>2</sup> It is worth noting that "Guide for landowners affected by wind farms", containing useful information for rural agents, was published during the research process in collaboration with the Juana de Vega Foundation [69].

in many other countries [71]<sup>3</sup>. Based on this, landowner income is analyzed: (i) using payments for leasing the land as an estimating mechanism; (ii) compiling 111 contracts corresponding to 83 wind farms with a total power of 1,970.10 MW, that represented almost 60% of the wind power in operation for the year 2016; (iii) facilitating the comparability of payments and the possibility of adding information to any of the 4 levels included in SIDWEG, to transfer as much economic information concerning leases as possible, to a comparative unit that measured the payment in function of the installed power, euros per MW (€/MW) ; (iv) if the amount of the payment received by a single landowner was known, it was made extensive to the wind farm as a whole. In the case of information on different contracts for different landowners and the same wind farm, the rent assigned the weighted average based on the power to the wind farm; (v) the start of the payments to landlords were made to coincide with the year of the wind farm implementation and the annual rent was updated using the Consumer Price Index (CPI); (vi) the Average Rent by Wind Farm (ARWFa) and the Average Rent by developer (ARDa) were obtained both for year "a" and expressed in €/MW; (vii) The Total Average Rent for year "a", TARa, was calculated considering wind farms in operation and grouped by the weighted average of the ARWF; (viii) The result was a dynamic annual sample that varied in function of the wind farms going into operation every year and the availability of economic information on wind yields; (ix) Finally, the following formula was used to estimate the payments received by all of the Galician landowners:

$$TEWLa = TARa \times FOWPa;$$

where, TWELa: Total Wind Earnings for the Landowners for the year "a"; TARa: Total Average Rent for the year "a"; FOWPa: Fully Operating Wind power, measured in MW for the year "a".

The outcome of this procedure represents the whole sector: the wind farms in the sample range from a minimum of 45% to a maximum of 63% per year of the total annual power in operation. Similarly, the sample includes a number of developers operating 95% of the total power in service.

## 5. Results and Discussion

### 5.1. Payments to landowners

This work quantifies the payments received by landowners, in an area of strong wind energy development, and it reduces the gap indicated in the literature [31]. It may be assumed from the participatory research that the developer's most common way to access land is a signed lease agreement, as in other countries. Those annual contracts are based on one of the following 3 payment options: (i) Payment by percentage of wind energy invoicing; (ii) payment by occupied surface and (iii) payment based on installed power. In the first of these modalities, landowners receive a percentage of the wind installation invoicing: this generally starts at 1.5% over the first ten years of the contract and rises to 4% over the course of the following years. This variable payment implies a greater

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<sup>3</sup> The use of lease agreements is also common in countries like Mexico [71], Germany [72], Ireland [73], USA [74] and Canada [75].

vulnerability for the landowner who must assume certain risks given the current decreased energy demand. However, this modality provides the greatest income to the rural world. Unfortunately, only one of the 17 developers participating in the sample provided this option.

The case of annual payment by occupied surface, the second formula used in the lease agreements, we revealed two alternatives: an annual payment per unit of affected surface for all types of surfaces ranging between 0.03€/m<sup>2</sup> and 0.61€/m<sup>2</sup> and payments distinguishing the annual amount by type of occupation (from 8.73€/m<sup>2</sup> for land surface totally occupied by the wind farms permitting no other land use; and up to 0.003€/m<sup>2</sup> for land surface subject to ditch and wiring easement that permitted other land use). A high magnitude of variability may be observed: 20 times and more than 2,900 times between the extremes by type of occupation. This modality, used by 5 wind farm developers, is more widespread than the invoice percentage modality.

The third modality, payment by installed power, is the most widespread among Galician wind farms. As mentioned, with the formula of euros per installed MW our work standardizes the results of all the operating wind farms in Galicia and estimates the TWELa remaining in rural areas as a result of payments to landowners. These payments present a series of peculiarities. In the first place, TARA tend to grow over time: the 1,800€/MW for the year 1999 grew to an average of 3,014€/MW in 2015. Several factors may explain the growing trend of the average annual payments received by landowners. First and foremost is the presence of learning by doing. As wind expansion developed, the flow of information among owners through specific communicative interaction patterns [76] generated collective learning outcomes [77] and the learning by landowners increased, hence reducing asymmetry with respect to developers. This background improvement affected the progressive improvements of the TARA. In addition to this reduction in asymmetry one, must also consider the positive expectations throughout the last expansive phase of Spanish capitalism dating back in the nineties and early into the century regarding electricity demand and the forecasted increases in the sales price of wind energy [78] that permitted greater invoicing and favored higher payments by wind farms developers.

The annual growth of the TARA coexists with an enormous variability in the annual payments received at the wind farm level, the ARWFA: the extremes range between 1,246 and 7,505 €/MW, as shown in the figure 4. Contrary to what was expected [79], the relationship between the ARWFA and the number of hours of equivalent production is inexistent. Wind farms with 2,400 hours of productivity and a doubling ARWFA and wind farms with very different productivities are observed to be paying the same amount to the landowners.

Figure 4: Average Rent by Wind Farm received by landowners based on the equivalent production hours of each wind farm in 2011.

This great variability in payment is also observed at the wind farm developer level. As shown in figure 5, the average payments of the main Galician wind energy developers, representing over 90% of the operating wind power, reveal differences at similar efficiency levels. In this way, the ARD<sub>2011</sub> the landowners receive per wind farm developer ranges from 1,743 to 4,748€/MW, a differential of 2.7 times. A different context of operating hours is no justification for this situation given that payments are distinct despite their similar production hours.

Figure 5: Average Rent by Developer received by landowners based on equivalent hours of production by wind farm in the year 2011.

These results allow us to affirm the absence of a common strategy among developers, who used what was most in line with their corporate social responsibility and business strategy. Participatory research helps us understand some of the differences among them that had a direct impact on landowners and their options for undertaking new rural development projects. This refers to the following cases: only one developer opted for contracts with a percentage of gross turnover, the best option for the owners; only two developers considered including an equality clause in the contracts, i.e., committed to matching annual payments if another developer agreed to pay more under similar technical conditions; finally, one developer installed 13 wind farms in a six year period and imposed an equal initial payment for each wind farm regardless of the moment the wind farm started operating.

In addition to the previous analysis, one may also estimate the flow of total income received by landowners (TWELa). Thus, based on the TARa and according to the methodological guidelines described in section 4.2, we calculated the TWELa for landowners in Galicia. As expected, TWELa grew as installed power grew, i.e., from 0.84 million euros in 1999 to 10.1 million in 2015. How can we index this amount? These rents are low as compared to the global economic activity of wind farms in Galicia. With SIDWEG, the gross turnover of the Galician wind farms was estimated at almost 700 million euros per year in the final years of this case study. If one compares the TWELa with the total volume invoiced by wind farms, these amounts represent a rather scarce participation of about 1.5%. Collins et al. [20] point out that the payment to landowners in the United States is 3.5% of the gross electricity generation revenue, while in Sweden this percentage stands at 4% [80]. Although the figures are not directly comparable, the overall turnover represented 56% of the entire agricultural income of the Galician economy in 2012 [49], which points to the economic significance of wind energy in the rural world.

If we analyze the percentage received by landowners regarding billing at wind farm level, the field work shows that the most beneficial payment method is the one linked to the percentage of turnover. This modality, listed as the usual one in Pennsylvania [30], reaches a maximum of 4% of the invoicing in Galicia. By contrary, the analysis confirms the presence in the sample of many wind farms where landowners receive less than 1%

of the gross turnover of the renewable power installation. Once again, this reveals the strong arbitrariness of the developers and the acute asymmetries among wind business participants.

This reduced amount is even lower as compared to the results obtained in other territories where the legal framework permits community wind farm development. According to Huesca-Pérez et al. [71] and Phimister and Roberts [25], this type of project creates more economic opportunities for those involved than do the conventional wind farms owned by companies with limited local ties. The Scottish cases indicated by Munday et al. [22], reveal highly relevant differences. Thus, a 0.675 MW community wind turbine on the island of Gigha provides annual revenues of almost 90,000 euros (44 times the average MW received by Galician landowners in 2015). In the case of the Fintry wind farm, the community receives around 500,000 for a 2 MW wind turbine once the investment is amortized (83 times the average amount received by what Galician landowners in the year 2015).

On the other hand, the geographic distribution of landowner payments indicates high geographic concentration. A small number of landowners in a limited number of localities receive an important part of the total income derived from wind farms. The case of Muras (Lugo) is the most significant: our estimation indicates that in the year 2015 the landowners of this municipality received more than 900,000 euros, almost 10% of the total, even though the area only represents 0,024% of the Galician population. This is explained by the enormous intensification in this municipality, where the lands comprising it have a total of 381 operating wind turbines and 311 MW. The level of concentration is nearly 900 wind turbines and 22% of total income derived from wind farms for the landowners (see figure 6) if we consider the other three city councils located in the Serra do Xistral, a Zone of Special Conservation included in the Natura Network (Abadín, Oourol and O Valadouro). For several reasons explained herein, this high concentration of wind farms has produced no significant change in the rural development of these territories, which have more abandoned resources and fewer inhabitants.

Figure 6: Geographic characterization of the percentage of annual payment to landowners by municipality in 2015. Source: Own elaboration from SIDWEG [49].

Public policy and the legal framework delimit existing possibilities for landowners and rural agents and determine the opportunities derived from wind deployment that may boost rural areas. Around the world, some public policies have given the landowners the capacity to decide and participate. For instance, in the USA each landowner may decide whether or not to participate in the wind project by leasing their land to a developer, usually in exchange for economic compensation [33]. Thus, obtaining a lease guarantees renewable energy installation business objectives [47]. So, the amount of the economic compensation becomes relevant in reaching an agreement with the landowners [33]. However, this is not the case of rural landowners in Galicia. In fact, the regulations designed by the Galician Government favored the private planning of a small group of companies far removed from the rural world and incorporated no specific element

requiring the active participation of rural owners. Furthermore, the declaration of the wind farms as a public utility and the subsequent expropriation of land, which also takes place in the Italian [81] and Norwegian cases, stripped rural landowners of negotiating strength [82] and granted companies all the guarantees to implement renewable energy projects, regardless of the amount paid to the landowners. In the case of Denmark, where it is impossible to expropriate land to install wind turbines, owners may demand very high prices for wind turbines [83].

As expected, this situation conditioned the economic results of signed lease agreements [84,85]. The low average amount derived from the signed contracts resulted from various asymmetries between the landowners and the wind farm developers, as shown in the following table.

Table 1: Comparative negotiating position of developers and landowners.

Source: Own elaboration from SIDWEG [49] and Montero et al. [86].

The main asymmetry conditioning the entire wind farm settlement process was the declared public utility of the wind farm project, with the consequent expropriation and urgent occupation of the land. This fact conditioned the final economic results of the owners, which at times caused ludicrous amounts of rent previously discussed. Expropriation was always the final weapon that weakened the position of the landowners when they demanded changes in the location of wind turbines, changes in the infrastructure annexed to the wind farms or better economic returns. The absence of external advice (neither public administrations, professional associations nor unions), the scarcity of wind business information available to the rural agents and the lack of deep insight concerning legislation within the context of aging rural societies may explain the extremely negative outcome for some rural landowners. One example is the finalization of negotiations without setting a date to start payment (Fonteavia wind farm). This great risk for landowners was also found in Iowa [87]. In addition, some lease agreements were constituted for the entire property, rather than the part of the property affected by wind installation (Muras II wind farm). Moreover, some contracts included no economic compensation for the loss of productive capacity within a radius of 300 meters from the wind turbines (Coucepenido wind farm). Similarly, fieldwork also uncovered contracts with no updates for annual price variation (Xiabre wind farm).

In sum, the indicated asymmetries resulted in a rather small economic outcome for the landowners. The bottom line is that the regulatory framework granted such great power to wind farm developers that the best results for the landowners largely resulted from the ultimate goodwill of developer firms. As shown, the payment to landowners was quantitatively insignificant. Yet will investing it in rural innovation projects convert it into an important mechanism for transforming the rural world? The following subsection addresses this question.

## **5.2 The role of landowner payments in rural development**

The qualitative impact of payments to landowners on rural development, its ability to promote innovative production strategies or initiatives that improve welfare depends on several factors. One of them is the type of landowner receiving this income. The payment received from developers may stimulate consumption and higher GDP [25] in the case of individual private landowners with no productive links to the countryside, even if these individuals are not professional farmers or they make a living mainly from non-agrarian income in an urban environment. However, it is hard to establish a direct link to their positive impact on rural development. If, by contrary, the farmers or livestock farmers with productive activity or communities of landowners are the ones that collectively manage agrarian resources, a relatively small amount of wind income may generate a new dynamic rural transformation.

As aforementioned, most of the wind farms in Galicia sit on common lands. These entities must put aside at least part of the wind payments they receive to improve the exploitation of the agrarian surface, that is now partially occupied by wind farms. At the beginning of the wind energy expansion in Galicia, regulation determined that at least 15% of the payments had to go to productive investment [88]. Since 2012, this percentage has reached 40% [89]. This coercive measure forces communities to allocate a part of their income mainly to productive investments: new forest plantations along with the care and maintenance of the existing ones; the creation of fire-fighting infrastructures; the recruitment of personnel to prevent and fight forest fires; the creation and maintenance of pastures and livestock infrastructures, etc. In addition to these forestry investments, some communities of owners have developed innovative and dynamizing investment projects in rural territories. These activities consist in innovative initiatives that are more qualitatively important for rural development, and are likely to have multiplier effect, catalyze other investments and generate a new productive dynamic that could transform production and consumption systems. These new initiatives broaden and deepen the nature of the newly developed economic activities [90], which allow them to manage their own local resources in a sustainable way.

Among these initiatives, we found some of the following. CMVMC of Figueiras (Mondoñedo), with 28 MW in the Mondoñedo wind farm and an estimated income of around 50,000 euros per year in the initial operating year, promotes and improves access to the mycological resources of its mountains by creating a mycological reserve that allows community members to use wild mushrooms to obtain a new source of income; It adds value to the communal forest and permits community members to increase their income. The fight against forest fires, the local economic revitalization and the creation of jobs, through the introduction of goat herds, are the base of a silvopastoral initiative in CMVMC of Cabeiras (Arbo). This location is home to 6.5 wind turbines of 0.75 MW of wind farm unitary power on the Montouto wind farm. It obtained an approximate income of between 15,000 and 20,000 euros per year in the first operating year of the wind farm. In the same vein, the CMVMC of San Mamede (Carnota), partly located in the "Carnota-Monte Pindo" Site of Community Importance protected by Natura 2000, introduced a thoroughbred native Galician horse, in danger of extinction, that allows for the control of gorse and other shrubs in an area greatly plagued by forest fires. Two Wind Farms (Paxareiras-Montevós and Paxareiras II-B) sit in this community and part of the rents obtained are invested in

this innovative activity. Finally, the case of the CMVMC of Zobra (Lalín) is paradigmatic. The entire surface of this Community is in the Serra do Candán, a space contained within the Natura 2000 Network, that has 36 wind turbines of 0.66 MW of installed unit power in its mountainside in the Ameixeiros-Testeiros wind farm, which produced annual payments estimated at between 54,000 and 60,000 euros in the first year of operation. With the payments, the Zobra Community made several innovative investment decisions that have transformed the local rural development model. On the one hand it has restored and equipped old mining buildings, and created the only tourist offer resulting from a common land community in Galicia, the so-called "Casas das Minas". With the added complement of hiking trails, this tourist offer has become the most important employing agent of the village. Moreover, this community has developed counseling and support for the aging population within its own premises facilitates institutional relationships and provides different services to its citizens.

The collective owners who carry out innovative productive investments are an exception among the group of landowners affected by wind farms. Among other things, this is owed to lacking dynamism in many of the communities that actually have wind income. Most of them commit to traditional exploitation linked only to forestry activities given the limited support of the administration for alternative uses. In addition to these investments, some rural owners invest in common services like water and social sites. In so doing, they contribute to improving the overall well-being of the community, but not the rural rent. Yet some communities use economic resources from wind farms to bear the cost of local patron saint feasts and other leisure activities that have a positive impact on identity but hardly affect rural development. Even so, this is done only after having invested the legally established aforementioned percentage.

In short, rural areas have been receiving flows of new income since the mid-1990s directly by local agents and, most notably, by community entities. As seen, this income is usually small with respect to global generated earnings generated but in a few cases it creates new opportunities for local revitalization. Regulations have favored the reinvestment of part of this income in agrarian activities and wind income has given some local communities the capacity to generate innovative economic activities. The presence of the aforementioned examples indicates that a regulatory framework favoring higher rent for landowners could have implied further new productive initiatives with a multiplier effect on rural economies.

## **6. Conclusions**

This paper analyzes payments to landowners and the opportunities for rural development derived from implementing wind farms in the case of Galicia, a territory with vast wind implantation. To date, no study has ever carried out a global analysis on the rural impact of the payments to wind landowners in a large territory

The case under study is a territory with strong and intense wind power growth, especially in rural areas. These areas have scarce economic activity and present an abandonment of the rural environment. This is precisely where new economic activity emerges, opening the door to possible changes in the configuration of the rural development model. This is

particularly so when the wind landowners manage common lands as is the case under study.

Through participatory research, our research generated the Socioeconomic Information Database of Wind Energy in Galicia (SIDWEG), a unique tool for economic analysis. Our work concludes that the average payment received by landowners grew over time from 1,800€/MW in 1999 to 3,014€/MW in 2015. However, the Average Canon per Wind Farm varied substantially ranging from the extremes of 1,246 and 7,505 €/MW, in this last year. This new wind income, largely dependent on the goodwill and social responsibility of developers, is unrelated to wind farm efficiency, measured as equivalent hours of production.

On the other hand, the work estimates the Total Wind Earnings for the Landowners which went from 0.84 million euros in 1999 to 10.1 million in the year 2015. This only represents 1.5% of the total volume invoiced by wind farms. The conclusion is that payments to landowners are low as compared to those of other countries. Landowners obtained the best results when the fixed average payments were directly linked to participation in wind farm invoicing. Unfortunately, this mechanism was much less common than payments for installed power, the most widespread, and payments by occupied area. The presence of several asymmetries between developers and landowners, derived from the regulatory framework, explains the bad economic results of the landowners. This paper mentions different levels of knowledge concerning the regulatory framework and business volume, disparate training for developing negotiation processes and the different position of developers and landowners regarding the public utility of the wind business.

In spite of these asymmetries, it shows that the qualitative importance of the payments to the landowners exceeds the quantitative dimension if we consider their potential to transform the dynamics of rural development in Galicia. The income obtained by collective owners, the predominant owners of wind land, was partially coercively allocated to agrarian capital improvements. A part of this income was devoted to developing rural innovative initiatives or supporting social initiatives that increased the quality and standard of living of rural inhabitants. Our research reveals that interesting community initiatives such as those of Figueiras, Cabeiras, San Mamede and Zobra, developed and made economic revitalization possible at the local level by generating employment and mitigating socio-environmental problems like forest fires even despite the detrimental regulatory context.

Finally, this research calls for further work on the rural impacts of payment to landowners affected by wind farms. On the one hand, it would be interesting to conduct new case studies in other countries with strong wind implantation by applying analytical methods to facilitate the comparative study of an issue as complex as the payment to landowners and their potential for rural development. On the other hand, this work has also shown that the amount of rent received by owners is very sensitive to the role assigned by the regulatory framework of wind development. Therefore, further research analyzing the economic effects of the different wind energy regulatory frameworks could boost public policies to advance the transition to a less fossil energy system, as is the case today, and greatly

strengthen the structural transformations required by the rural environment in Galicia and other rural areas across the planet.

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