

PAYMENTS FOR ENVIRONMENTAL SERVICES TO SUPPORT AN IRRIGATED AGROECOLOGICAL PRODUCTION: THE CASE OF THE CRAU AQUIFER IN FRANCE

PAIEMENTS AUX SERVICES ENVIRONNEMENTAUX POUR SOUTENIR LA PRODUCTION AGROÉCOLOGIQUE IRRIGUÉE : LE CAS DE L'AQUIFÈRE DE LA CRAU EN FRANCE

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ABSTRACT

The Crau plain, in South-Eastern France, is a unique area where gravity irrigation of hay meadows provides two thirds of the groundwater recharge used for drinking water, industrial and agricultural purposes. In order to preserve this environmental service, the manager of Crau Aquifers (SYMCRAU) set up a pilot program of payment for environmental services (PES) in 2021, involving 26 farmers. Our assessment of this program combines a literature review and semi-structured interviews with beneficiary and non-beneficiary farmers as well as institutional actors. The analysis focused on compliance with PES efficiency and effectiveness criteria, and addressed the specific challenges identified for the application of PES to aquifers. Results reveal that aid is concentrated among the largest farms, calling into question the fairness and efficiency of the scheme. As the PSE aims to support existing practices, the risk of a windfall effect is difficult to rule out and the changes in practices observed remain limited, compromising the additionality criterion. The monitoring based mainly on declarations, and the absence of real sanctions, encouraging opportunistic behavior, weaken the conditionality of the scheme. Recommendations for improving the scheme include a better targeting of beneficiaries, aid allocation criteria better suited to the region, and the use of measurable performance indicators. Local stakeholders are considering various solutions to ensure the sustainability of funding and its extension to a larger number of farmers, either via drinking water bills or via local authorities' contributions to the upgrading of irrigation canals.

Keywords: Gravity irrigation; drinking water; pilot program; stakeholders; irrigation canals.

RESUME

La plaine de la Crau, situé au sud-est de la France, constitue un territoire unique où l'irrigation gravitaire des prairies naturelles fournit les deux tiers de la réalimentation d'eau souterraine utilisée pour l'eau potable, à des fins industrielles et agricoles. Afin de préserver ce service environnemental, le gestionnaire des aquifères de la Crau (SYMCRAU) a mis en place un programme pilote de paiement des services environnementaux (PES) en 2021, impliquant 26 agriculteurs. Notre évaluation de ce programme associe une revue de littérature et des entretiens semi-structurés avec des agriculteurs bénéficiaires et non bénéficiaires ainsi qu'avec des acteurs institutionnels. L'analyse a porté sur la conformité avec des critères d'efficacité et d'efficacité des PES, et a abordé les défis spécifiques identifiés pour l'application des PES aux aquifères. Les résultats révèlent une concentration des aides dans les plus grandes exploitations, ce qui remet en question l'équité et l'efficacité du programme. Alors que, le PES vise à soutenir les pratiques existantes, le risque d'un effet d'aubaine est difficile à exclure et les changements de pratiques observés restent limités, ce qui compromet le critère additionnel. Le suivi, qui repose principalement sur des déclarations, et l'absence de sanctions réelles et encouragent les comportements opportunistes, affaiblissent la conditionnalité du programme. Les recommandations faites pour améliorer le programme comprennent un meilleur ciblage des bénéficiaires, des critères

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d'allocation de l'aide mieux adaptés à la région et l'utilisation des indicateurs de performance mesurables. Les parties prenantes locales envisagent différentes solutions pour garantir la pérennité du financement et son extension à un plus grand nombre d'agriculteurs, soit par des factures d'eau potable, soit par des contributions des autorités locales à l'amélioration des canaux d'irrigation.

Mots-clés : Irrigation gravitaire; Eau potable; Programme pilote; Partie prenante; Canaux d'irrigation.

INTRODUCTION

Located close to the Rhône river delta in South-Eastern France (figure 1), the Crau plain is the ancient delta of the Durance River, which, when it dried up 18,000 years ago, gave way to a semi-arid steppe known as the 'coussouls'. This is a unique area where gravity irrigation of hay meadows provides two thirds of the groundwater recharge used for drinking water, industrial and agricultural purposes. As Crau hay production uses few chemical inputs and benefits of a protected designation of origin, the groundwater remains of good quality. In addition to providing water in sufficient quantity and quality, this unique agricultural system also ensures the preservation of biodiversity and characteristic landscape of the Crau wetlands. Crau hay producers therefore deliver environmental services.

However, this agricultural system is subject to several threats that call its sustainability into question: falling hay prices and rising production costs undermine the economic profitability of Crau hay farms. In addition, urbanisation and industrial development are increasing pressure on agricultural land. These factors are leading to a decline in hay-growing areas, with urbanization or replacement of hay meadows by intensive tree and vegetable production.

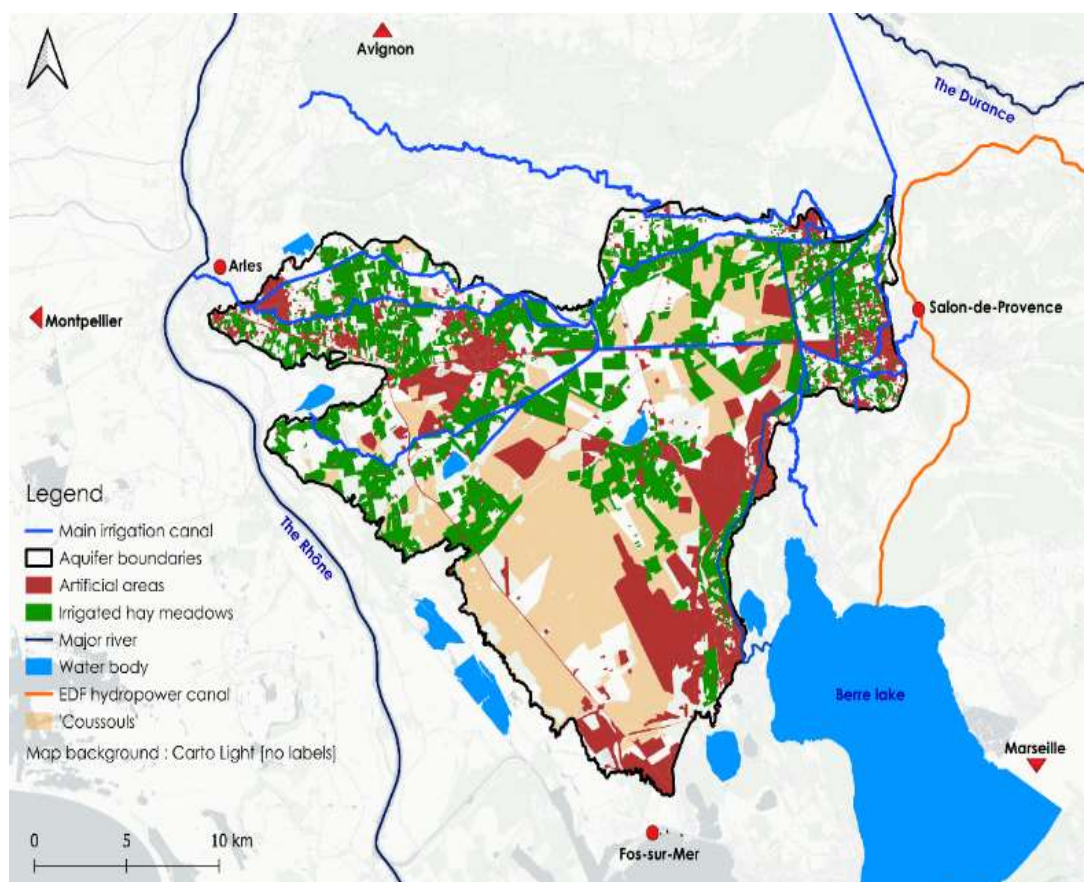


Figure 1. Location of the Crau plain aquifer

To support these farms, the manager of Crau Aquifer (SYMCRAU) set up an experimental Payment for Environmental Services (PES) scheme in 2021, thanks to funding from the Rhône-Méditerranée and Corsica Water Agency (AE RMC). This followed a request from the Minister for the Environment (Nicolas Hulot) to experiment the PSE schemes, which, if successful, could then be incorporated into the Common Agricultural Policy (CAP) or funded through any other long-term funding mechanism, such as water bills... The underlying idea here is that it would be a win-win situation: paying farmers to prevent water pollution and avoiding the costs of treating the water during the drinking water production process. The Crau experiment is a rare case of PES aimed at maintaining the aquifer recharge, which is characterised by the diffuse nature of the services' production and consumption. The scheme differs from pre-existing agri-environmental and climatic measures (AECM) in that there is no cap on the levels of aid granted per farm and it is possible to change the combination of practices remunerated during the contract period.

The objective of this paper is to evaluate PES: are PES able to help hay producers to continue their activities, then to maintain groundwater recharge? What type of farmers opt for PES schemes rather than AECM? Which groups are involved, are disadvantaged by the system? To answer these questions, the paper is structured as follows: first, it provides a brief review of PES literature; next, it describes the Crau PES scheme; then it outlines the method used to analyse them; and finally, it presents the results and draws conclusions.

LITERATURE REVIEW

The literature on PES is extensive; only certain authors will be cited, many of whom have been inspired by others in formulating their definitions or arguments.

A PES is, following Wunder (2005), characterized by five features: « 1. a voluntary transaction where 2. a well-defined environmental service –ES- (or a land-use likely to secure that service) 3. is being 'bought' by a (minimum one) service buyer 4. from a (minimum one) ES provider 5. if and only if the ES provider secures ES provision (conditionality) ». These schemes are based on a 'beneficiary-pays' principle, whereby the parties benefiting from these services (local authorities, companies, etc.) provide funding to farmers who adopt environmentally friendly practices. Unlike the 'polluter pays' principle, PES schemes are based on a voluntary and incentive-based approach, aimed at encouraging the adoption of sustainable agricultural practices whilst compensating for the loss of income associated with these changes (Duval et al., 2020).

From these considerations, the following five basic criteria for PES can be identified (Duval et al., 2020; Muradian et al., 2010; Wunder, 2015) to be efficient and effective: voluntary participation, clear identification of the service, conditionality, additionality, incentive effect, measurability of effects. Additionality means that "PES must ensure that the ecosystem evolves beyond the anticipated and deemed inadequate natural trajectory (baseline scenario). In particular, the commitments made by environmental service providers must go beyond regulatory requirements for environmental protection" (Duval et al., 2020). PES can therefore be viewed in two different ways: either as a means of achieving a better state than would be achieved in the baseline scenario (Isabelle and Moreau, 2025), or as a means of accelerating the transition to a better state (Bour-Poitrinal et al., 2024) (which implies that PES are not permanent).

Applying PES to guarantee aquifer protection or recharge may face specific challenges due to aquifer characteristics. Le Coent (2023) identified the following challenges for the application of PES to aquifers: uncertainties about the relationship between land use and groundwater conditions, spatial and temporal variation in effects, invisibility of aquifers, spatial disconnect between producers and beneficiaries of services, ambient nature of aquifers, trade-offs between effectiveness and efficiency.

DESCRIPTION OF THE CRAU PES SCHEME

As previously mentioned, the SYMCRAU launched a five-year pilot scheme in 2021 in response to a call for proposals from AE RMC. The general functioning of the PES scheme is summarized in figure 2.

The target beneficiaries were mainly farms located in drinking water protection zones. The funds came from water withdrawal fees paid to the water agency by users of the Crau aquifer. AERMC transferred these funds to SYMCRAU, which paid the farmers who have joined the PES. The total budget was limited to 2.65 million euros over 5 years (table 1). However, there was no limitation of total payment per farm, unlike agri-environmental measures, for which amounts are capped at between €5,000 and €10,000 per farm.

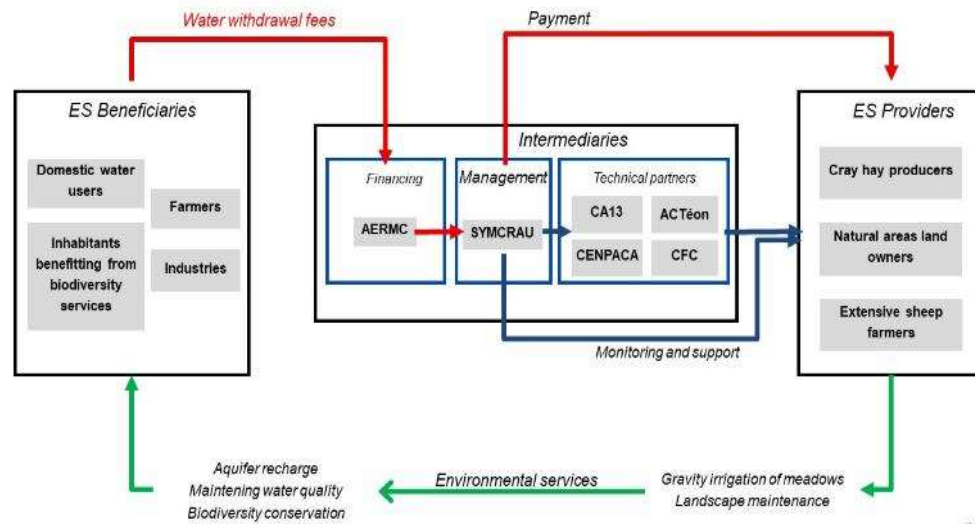


Figure 2. Functioning of the PES scheme in the Crau plain – adapted from Duval & al. (2020)

The SYMCRAU co-designed the scheme in collaboration with the Crau Hay Committee (CFC), which represents the hay producers and manages the Crau Hay protected designation of origin; the chamber of agriculture of the Bouches-du-Rhône district (CA13), which represents all the farmers in the district and helps them improve their economic and environmental performances; the Provence-Alpes-Côte d'Azur Nature Conservation Agency (CEN PACA), managing natural areas and raising public awareness about their conservation; and a consultancy firm that supported part of the legal process (Actéon). Twenty-eight farmers (reduced to 26 after 3 years) representing 2600 hectares (table 1), participated in the PES scheme.

The practices taken into account for payment fell into two categories: agricultural systems (crop rotation diversity, soil cover, amount of mineral nitrogen used, herbicide use, treatment frequency index, percentage of tertiary irrigation canals treated with herbicides); and landscape structures (percentage of agroecological infrastructure, number of different habitats present on the farm). The criterion regarding weed control of irrigation canals is specific to the Crau Plain; the others were included in a list proposed by the water agency.

For each practice, a number of points was assigned based on the specific method used on the farm, weighted by the crop area when the practice applies only to certain crops, and the corresponding score was multiplied by a weighting factor. The payment amount per hectare was calculated based on the total number of points. Farmers had the opportunity to adjust their practices during the commitment period, with corresponding changes in payments.

SYMCRAU monitored compliance through annual visits and random external inspections (2% of farms per year). Global environmental impacts were monitored by SYMCRAU (groundwater levels and quality) and CEN PACA (presence of protected species).

MATERIALS AND METHODS

We conducted an evaluation of this program, combining a literature review and semi-structured interviews with beneficiary and non-beneficiary farmers, as well as institutional actors. We first analysed official documents related to the Crau PES (statement of intent, call for proposals, midterm evaluation) as well as documents elaborated by the Crau Hay Committee on hay production and previous political measures supporting hay producers. We interviewed representatives of all institutional actors involved in the PES design and implementation (CFC, CA13, AE RMC, CEN PACA, and Actéon), except SYMCRAU due to the unavailability of the person in charge.

Institutional actors' interviews were structured around the following themes: context and objectives of the PES scheme, actor's role in the design and implementation of the scheme, opinion on the eligibility criteria, the payment structure and level, factors enhancing or inhibiting farmers' participation, monitoring of contracts and sanctions, monitoring and evaluation of environmental and economic impacts of the scheme, assessment of positive and negative aspects of the scheme, desired improvements in case of a renewal of the scheme.

Thirteen farmers were selected among the 26 farmers who participated in the PES experiment, to cover a diversity of situations in terms of farm area, amount of PES payments and locations. We also interviewed four farmers who opted for the European agri-environmental and climatic measures (AECM). Their number was limited due to time constraints.

After a general presentation of the farm (total area, manpower, main productions, organization and cost of irrigation, economic profitability of hay production), we asked farmers about their adhesion process (source of information and motivations), their understanding and perception of the PES contract terms, their perception of the payment structure and level, as well as the difficulties they encountered in implementing these terms, their opinion about the monitoring tools, and their global assessment of the PES scheme at farm and Crau plain levels. The interviews ended with questions about their expectations regarding the future of the PES.

Interviews were audio-recorded, transcribed and thematically coded for qualitative analysis. The objective of the analysis was to assess to what extent the Crau PES scheme corresponds to the general criteria defined in the scientific literature and how it addresses the specific challenges of aquifer-related PES. We also compared the Crau PES with the Crau hay AECM.

RESULTS

At farm level, the PES appeared to be more profitable than the conventional AECM as the PES amount per hectare was 40% higher than the AECM amount (table 1). However, the interviews revealed several limitations of the scheme.

The tight overall budget reduced the number of beneficiaries (less than 10% of the total number of hay producers were involved, see table 1), limiting the effect on water recharge. The location of the plots receiving subsidy only partially corresponds to the areas targeted by the scheme (figure 3). The absence of a cap on farm payment and of selection of PES beneficiaries led to a concentration of more than half of the total payments in favor of the five largest farms, although they are not the most vulnerable to the pressures affecting hay production. This calls into question the fairness and efficiency of the scheme. Both the institutional stakeholders and the beneficiary and non-beneficiary farmers surveyed highlighted the lack of fairness in the allocation of payments.

The incentive effect of the aid varies from farm to farm, with most farmers considering it insufficient in view of the costs of irrigation or mechanical weeding (used instead of herbicides to treat tertiary irrigation canals). Furthermore, the PES structure of payment was based on average practices and not on real opportunity costs, which vary from farm to farm. As the PSE mainly aims to support existing practices, the risk of a windfall effect is difficult to rule out and the changes in practices observed remain limited,

compromising the additionality criterion (i.e. the provided environmental services are not greater than in the situation without PES).

Table 1. Comparison between PES and agri-environmental and climate measures (AECM) in the Crau Plain in 2021

	PES 2021	AECM 2021
Number of farms under contract	26	315
Total area (ha)	2,843	13,773
Mean area per farm (ha)	109	44
Crau hay area (ha)	1,970	9,876
Coussouls area (ha)	438	3 897
% of total area under contract	12%	59%
% of coussouls area under contract	4%	39%
% of meadows area under contract	15%	73%
Total amount of aid paid in 5 years (€)	2,426,344 €	8,362,510 €
Mean annual amount of aid per hectare (€)	171 €	121 €
Mean annual amount of aid per farm (€)	18,664 €	5,309 €

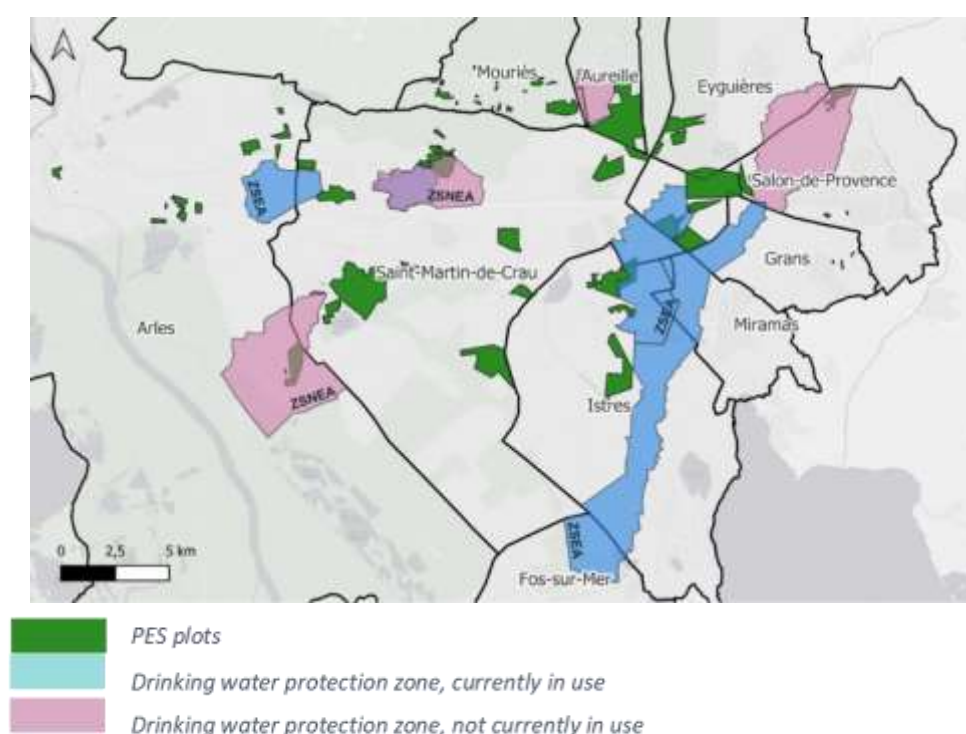


Figure 3. Location of plots owned by PES beneficiaries relative to drinking water protection zones

Institutional stakeholders representing farmers criticized some of the criteria used to calculate the payments. The reduction of chemical weeding in the smallest irrigation canals was perceived as unsuitable for local conditions, due to the cost and labor-intensity of mechanical weeding. The requirement to comply with the hedge certification program in order to receive the corresponding subsidy has also been criticized. Indeed, this certification program, which was originally designed to encourage the replanting of hedges in arable farming regions, includes requirements that are ill suited to local conditions, where windbreak hedges already exist but are managed differently. Local stakeholders

expressed regret over the lack of flexibility to really adapt to the local conditions following the specifications imposed by the water agency in order to ensure comparability of the PES schemes across the entire basin.

The monitoring based mainly on farmers' declarations, rather than on on-farm observations, the difficulty to monitor real practices (such as the use of herbicides and chemical fertilizers), and the absence of real sanctions, may have encouraged opportunistic behavior, which weakens the conditionality of the scheme.

Interviewees' recommendations for improving the scheme focus on better targeting of beneficiaries, aid allocation criteria better suited to the region, and the use of measurable performance indicators.

CONCLUSION

In conclusion, the PES scheme tested in the Crau appears to have allowed Crau hay producers to maintain their livelihoods: it is more flexible than the AECM scheme and bases its assessment on indicators better suited to the territories concerned. This approach to supporting the ecosystem services provided by agriculture appears worth pursuing, taking into account a few recommendations: allow sufficient time for their implementation to enable a better selection of beneficiary farmers, limit windfall effects and seek to involve as many farmers as possible (particularly small farms) and not just large ones (as the measure's effectiveness criteria favour the latter), secure long-term funding to enable farmers to plan for the long term and ensure the continued provision of ecosystem services (in this case, groundwater recharge and the preservation of its quality) over time.

To ensure the sustainability of funding and the extension of PES to a larger number of farmers, various funds may be considered. As groundwater benefits drinking and industrial water consumers, and as they would have to source it elsewhere if it were not available, it is conceivable, based on the principle of avoided costs, to charge them for it via their water bill. As flood irrigation induced wetlands, which will disappear if water recharge is not maintained, it also seems fair that citizens who benefit from this ecosystem service pay for that. It can be done through local or national taxes or, following consumer-payer principle, water agency fees, thereby giving the concrete expression to regional solidarity for the preservation of groundwater, regarded as a common resource. The share of costs between these various stakeholders has to be carefully analyzed.

Finally, there is a need to articulate the different policies (all farmers' subsidies including AECM, food policy, energy policy, environmental policy) targeting the various levels (from the plot, the farm, to the market) (Vincent and Fleury, 2021), in order to avoid rebound and windfall effects.

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