Land degradation, soil conservation and rural livelihoods

A case study of the influence of financial subsidies and access to water in semi-arid Spain

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Semi-arid South-east Spain presents probably the most visible problems of land degradation in Europe, including sheet erosion, rills and gullies, piping and tunnelling, salinity and sodicity, as well as collapse of conservation structures and damage to infrastructure such as roads and dams. Within the Mula basin, Province of Murcia, a field, participatory assessment was undertaken to identify the drivers of land degradation and possible entry points for soil conservation through the Sustainable Rural Livelihood framework. Two neighbouring municipalities were chosen with similar biophysical characteristics but differential economic opportunities arising especially through availability of financial subsidies and access to irrigation water. The transformations of capital assets in the SRL framework have major implications for land use and environmental sustainability. Major findings of this study include the perverse effect of financial subsidies in (1) when available, enabling land users to benefit from non-productive land while causing soil erosion; and (2) when not available, leading to abandonment of land and extremely high rates of soil erosion and damage to the landscape. When water is available, large-scale commercial farmers buy the land of small part-time farmers. They use land levelling techniques which lead to much hidden soil erosion with possibly irreversible effects on the landscape. Subsidies and access to irrigation water are the major drivers influencing both land degradation and rural livelihoods in this semi-arid part of Europe.

Introduction

The province of Murcia in South-east Spain presents major contrasts in soil erosion, land degradation, agricultural use and rural livelihoods. Closely juxtaposed, areas with access to irrigation are vastly different to dryland farming areas. Irrigated agriculture is intensive and highly commercialised. Where there are access rights to irrigation water, the landscape is subject to major modification through land levelling. Drip-irrigated tree crops are especially important and give an apparent image of greenery and high productivity. Intervening dryland sites, often with older systems of bench terraces, are being progressively abandoned and show extremely evident soil degradation. Large gullies, areas of badlands with intense sheet erosion, piping and tunnelling, as well as salinity and chemical degradation, are all commonplace.

As land use changes, communities are also changing, with many of the poorer land users working part-time in agriculture, while commercial companies are buying up areas with irrigation access. This case study was undertaken to understand the drivers of land degradation and the opportunities to promote soil conservation and ensure sustainable rural livelihoods. Its objective is to show how an understanding of aspects of rural livelihoods is essential in the analysis of land degradation processes and designing remedial measures that may benefit both land users and society.

The Mula Basin

Within the Mula Basin a preliminary integrated land degradation assessment using the Sustainable Rural Livelihood (SRL) framework (Stocking and Murnaghan, 2001) was undertaken in two neighbouring municipalities: Yéchar and Campos del Río. Both

municipalities are similar in physical environment. Both traditionally had an economy based on dryland agriculture. Dryland terraces were used for widely-spaced olive trees and some cereal crops. In the 1970s construction of water transfer canals from the Tajo basin in Spain's central highlands to the Segura basin in Murcia offered an important opportunity to expand irrigated agriculture in the area. The National Hydrological Plan of the 1970s determined which field would have access to water and which could be irrigated. Since then, traditional dryland farming has been progressively abandoned while attention has focussed on irrigated fields, progressively introducing more commercial fruit species (largely for export) that need many hours of irrigation during dry periods.

Rates of soil erosion in those agricultural areas had previously been estimated using the USLE at 3-10 t h^{-1} y^{-1} (Ortiz Silla et al., 1999). However, in this study on abandoned agricultural fields with old terrace systems and in recently land-levelled areas, erosion rates of 150 and 86 t h^{-1} y^{-1} respectively were measured following the participatory field methodology of Stocking and Murnaghan (2001). In the first situation, the degradation is very apparent and has given rise to great concern within the community. In the second situation, intensive agricultural practices largely 'hide' the field evidence for erosion by obliterating rills after every intense storm and using drainage ditches to carry runoff and eroded sediments. Nevertheless, careful field examination indicates existing high rates of soil loss even under intensive management

The results of the SRL assessment in the Mula Basin showed that the factors that affect land use decisions are closely related to the resources available to the land user, and these decisions in turn determine the degree and extent of land degradation. The SRL framework divides resources into a number of capital assets: social, financial, natural, human and physical capital. Communities such as those at Yéchar and Campos del Río have different access to each type of capital. Lack of one category of capital may be compensated for by another, and one form of capital can be converted – or substituted - to another (Stocking and Murnaghan, 2001). The process of transformation from one type of capital to another may have unintended effects on land degradation. Further, farmers' perceptions of soil erosion and their ability to seek subsidies influence the transformations they make, as the next section describes.

Farmers' perceptions and the influence of subsidies on soil erosion

The participatory field assessment of land degradation is especially concerned with understanding farmers' perceptions of their own situation, since that largely controls the decisions they make. The two municipalities are strongly contrasted, making their land degradation situation quite different. The SRL framework is useful in depicting the contrasting assets available to land users (Figure 1).

The following analysis of the relative strength of the different capital asset categories is based upon a preliminary and semi-quantitative database compiled during participatory field exercises by participants of two international training courses in April 2004 and 2005, which will need to be verified in a more intensive study. Nevertheless, the differences are clear.

Farmers at Yéchar have enthusiastically organized themselves into an agricultural cooperative (high S) that commercialises agricultural produce and provides access to agricultural subsidies but at financial cost - but low risk - to members (low F). This organization provides important social support and access to information networks (high P). Physical assets (P) are also high because the agricultural plots are easily accessible and farms are mechanized, often thanks to the social network for access to expensive equipment. Farmers do not perceive on-site or off-site effects of soil erosion as a big problem affecting their activities or their lives. Their main worry is about water availability. The farmers are generally well-informed with respect to productivity in the short term, but not with respect to sustainability. Most farmers consider soils in the valley bottoms, derived from soft marl rocks and with few stones, as good soils for agricultural production (high N), provided that water is available (Figure 1). Rapid

formation of gullies is not considered a problem since the farmers of Yéchar have the facilities and social networks to eradicate gullies as soon as they start to form. The cost is relatively small compared to the financial income from the land use. Hence, in terms of the SRL framework, farmers are substituting financial, social and physical capital at the expense of the natural capital in the quality of their soil.

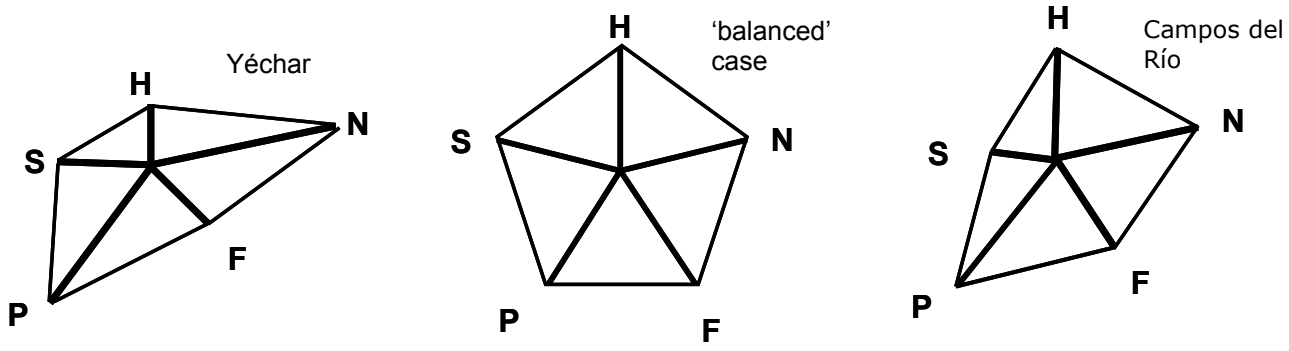

Figure 1. Capital assets polygons representing farmers' perspectives of their agricultural resources – relative strength/abundance of human capital (H): natural capital (N); financial capital (F); physical capital (P); social capital (S)

Further, in Yéchar, the intervening areas of dryland agriculture have very low agricultural production. Young farmers especially look for opportunities in other areas or in other economic sectors and much land is effectively abandoned and unused, leaving erosion processes to accelerate over time causing progressively more land degradation especially on old dryland terraces. The current lack of human capital – H, mostly in labour but also knowledge of dryland farming techniques – explains why few efforts are devoted to rehabilitating these extremely degraded areas. In these abandoned plots soil erosion was measured in the range 100-150 t h^{-1} y^{-1}. There are no penalties for abandoning land use, and no sanctions on downstream effects of large sediment flows, although there is much discussion locally that prevention will need to be enforced. In some cases, dryland plots do attract some environmental subsidies. For example, some unseeded fallow areas are used for grazing sheep while attracting subsidies, but later are abandoned. Erosion rates were measured at 40-70 t h^{-1} y^{-1}, agreeing with results from central Spain where subsidised unseeded fallow was shown to have high susceptibility to soil erosion (Boellstorff and Benito, 2005).

Farmers at Campos del Río have similar perceptions of soil erosion as in Yéchar. However, the economic situation is different. A canning-food factory was established in this village more than 20 years ago and absorbs a large number of the farmers as labour. Therefore, many have become part-time farmers. A few large-scale commercial farmers are buying the fields of the part-timers. They have introduced drip irrigation with new land-levelling techniques by bulldozer in the last 5 years. Therefore, financial capital in these systems is relatively high (higher F; moderate H). Levelled land is perceived as positive for erosion control due to the easy access and movement within a plot with heavy machinery, gullies can be filled up relatively easy and land is again levelled after heavy storms. However, field estimations of erosion rates were between 80-90 t h^{-1} y^{-1}, demonstrating that farmers' perceptions about erosion are not necessarily substantiated by field measurements.

The presence of the canning factory guarantees a secure income at low risk. In Campos del Río there is no agricultural cooperative (low S), although a local development agent facilitates access to subsidies and to extension courses. However, the demand on these

issues is low due to a lack of interest and an inhibition of initiatives related to farming. The access to subsidies is further complicated for part-time farmers since their main income comes from their work at the factory and not from farming, which invalidates their access to agricultural subsidies (Figure 1).

In both municipalities, water scarcity is perceived as the main problem rather than soil erosion. Erosion is seen as a process that can be controlled and the on-site and off-site consequences are generally underestimated. In the cases of Yéchar and Campos del Río the cost of soil erosion on a land levelled for apricot trees on marly lithology was of the order of €70-90 h^{-1} y^{-1}. This is higher than estimates for other areas: e.g. according to Hein (2004) erosion costs €1.1 to 32.4 h^{-1} y^{-1} on dry herb crops and €3.3 to 48.5 for dryland almond trees depending on the slope of the plot.

Overall, the policy of crop and environmental subsidies are counter-productive for prevention of land degradation and the promotion of soil conservation in semi-arid South-east Spain. Depending on the local economic situation and the water availability, farmers will either use the subsidies to bring marginal fields into production that will be abandoned shortly after, or subsidies cannot be accessed because the main income of the farmer does not come from farming. In this case farmers will sell the land to large mechanized farms that use land levelling operations, creating more erosion that is effectively hidden from view. Both abandonment and land levelling therefore have high erosion rates as a consequence.

Influence of access to water on soil erosion

As illustrated above, access to cheap (and subsidised) water in Southeast Spain strongly determines farmers' decisions on land use and agricultural practice. Agriculture in the area is dominated by high productivity irrigated crops, such as apricots, peaches, plums, and irrigated almond trees. Not only does access to water open up choice of crop, it also vastly increases production and therefore the price of the land. All these land use changes also affect erosion processes. In the area access to water was found to determine soil erosion in two ways:

- When irrigation water is unavailable because the fields were not included in the irrigation schemes of the National Hydrological Plan, the fields, which in most cases correspond to bench terrace systems, are abandoned, leading to high erosion rates. In other cases, plots are farmed with subsidies (seeded and unseeded fallow land mainly) but because of low production these fields are finally also abandoned. Both unseeded fallow and abandonment of terraced systems lead to high erosion rates measured in the field at 40 t h^{-1} y^{-1} and between 70-150 t h^{-1} y^{-1}, respectively

- When there is access to water in sloping areas, land is transformed with land-levelling techniques by young farmers who want to maximize short-term benefits in fully mechanized farms. Furthermore, rich farmers and large agricultural companies benefit from their ability to buy large areas of land, transforming the land with land levelling systems and installing drip irrigation. Field estimates of soil erosion ranged from 70-90 t h^{-1} y^{-1} on levelled land, although as noted above this erosion is not as visible as that on dry abandoned terraces.

Discussion and conclusions

The complex and contrasting situations in Yéchar and Campos del Río show that land degradation is a product of many variables that affect the resources for farming available to land users. The SRL framework organises these resources into 'capital assets', and an examination of these assets and how they are transformed assists an understanding of how and why farmers 'cause' degrading or conserving farming practices.

Farmers' perceptions of the value of access to subsidised irrigation water in South-east Spain is the single most important factor determining the occurrence of land degradation and soil erosion. Such access is an immediate addition to natural capital (N) and to financial capital (F) through subsidy. Soil erosion, even though it degrades natural capital, is perceived a relatively minor problem in relation to water, because its impacts on production may be 'hidden' by irrigation water in compensating for lost water-holding capacity of the soil and by fertilisers in replacing lost nutrients in the sediment. The on-site costs of soil erosion, although substantial in terms of requiring technical inputs to correct for them, are relatively insignificant compared to the transformation in land use and production afforded by irrigation water. Off-site costs of soil erosion are inflicted on society, not on the land user generating the sediments, although this may change if policies of subsidies for protecting water courses pass into law and the financial amounts are sufficient to compensate farmers for the lost income ('opportunity costs') in production foregone.

The implications of the use of subsidies in agriculture are very much dependent on the local economic opportunities in each municipality. Transformations taking place within the capital assets polygons (Figure 1) have positive and negative effects on soil erosion. Transformation from natural to financial capital through activities such as leasing the land for grazing and using inadequate subsidies (unseeded fallow) increases soil erosion. On the other hand activities such as urbanisation of land and leasing for cropping reduce soil erosion. Transformation from human to financial capital tends to increase soil erosion. The primary example of this is the selling of the land of older farmers to big commercial farms that introduce land-levelling. Transformations from financial to natural capital through an inadequate policy of subsidies causes increased soil erosion through processes such as the abandonment of plots. Transformations from social to financial capital are causing negative effects on land due to the absence of an understanding of the concept of sustainability in the education of farmers. However, the transformation of social to financial capital through the membership of cooperatives and their role in facilitating access to subsidies and education has a reducing effect on soil erosion.

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References

Boellstorff, D., Benito, G., 2005. Impacts of set-aside policy on the risk of soil erosion in central Spain. Agriculture, Ecosystems and Environment 107, 231-243.

Hein, L., 2004. Final report on the costs of land degradation and the benefits of mitigating desertification. Medaction Work Package 1.3; Deliverable 14. ECEA,FSD (Wageningen), ICIS (Maastricht University) 35 pp.

Ortiz Silla, R., Albaladejo Montoro, J., Martínez-Mena García, M., Guillén Mondéjar, F., Alvarez Rogel, J. 1999. Mapa de riesgos de erosión hídrica en zonas agrícolas. In: Atlas del medio natural de la región de Murcia. Instituto Tecnológico Geominero de España and Región de Murcia, Consejería de Política Territorial y Obras Públicas.

Stocking M.A., Murnaghan, N., 2001. Handbook for the field assessment of land degradation. Earthscan, London, 169 pp.