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Portugal gives green light to pasture carbon farming as a recognised offset

By Lesley Watson

Although agricultural offset projects are minor players in current emissions trading schemes, signatories to the Kyoto Protocol are increasingly embracing sustainable farming practices to help balance their greenhouse gas emissions books. Developed (Annex 1) countries that have committed to reducing their emissions to agreed levels by 2012 can opt to include agricultural projects in their national greenhouse gas inventories.

Under Article 3.4 of the Kyoto Protocol, they may choose agriculture, forestry and other land uses (AFOLU) – including forest management, cropland management, and grazing land management – to offset their emissions.

Most industrialized nations have been hesitant to select all three options as they must account for all carbon movement from the nominated activities, and prove the practices are "additional" to the activities on the land in 1990.

Two notable exceptions are Denmark and Portugal. Denmark is currently exploring the use of its extensive organic soils as carbon sinks, while Portugal has already allocated A$13.8 million (Euro 8.5 million) to pay an estimated 400 participating farmers for improving grassland in an area of up to 42,000 hectares with the aim of sequestering 0.91 million tonnes of carbon dioxide equivalent from 2010 to 2012.

To achieve this, the farmers will use a technique known as sown biodiverse permanent pastures rich in legumes (SBPPRL), a Portuguese innovation that verifiably increases carbon in degraded soils (see box story).

Portugal is one of the EU countries with the lowest per capita emissions (52nd in the world, compared to Australia, for instance, in 12th place). And yet it has been steadily increasing emissions beyond its agreed 2012 target of 27% on 1990 levels.

By 2004, Portugal had registered a 37% increase in emissions, which prompted the government to set up a National Program for Climate Change (PNAC) that looked at drastic measures to reduce the estimated annual deficit of 3.73 $MTCO_{2e}$ per year to 2012. (Failure of EU countries to meet their Kyoto obligations incurs heavy penalties – set at $A162/tonne [Euro 100/tonne] in 2008.)

The PNAC came up with a raft of solutions, including imposing reduced emissions levels on its polluting industries, and established a Portuguese Carbon Fund to buy credits from offsetting projects in developing countries or surplus credits from developed nations, and to back national mitigation projects including agriculture. It allocated A$575 (Euro 354 million), raised through the budget and fees on heating fuel and non-efficient light bulbs, to purchase 14.4 $MTCO_{2e}$ in carbon offsets. A$48.7 million (Euro 30 million) of this sum were earmarked for national projects.

The pasture improvement project was announced in the first carbon funding round in July, and is one of five local projects to receive government support. The other four relate to nitrous oxide reduction projects at national fertiliser factories.

The project comes under the auspices of agricultural company Terraprima, which has already entered into a private carbon reduction contract with Portuguese energy provider EDP (Energias de Portugal) to sequester 7000 tonnes of CO_{2e}/year through agroforestry management and improved pastures. EDP does not receive emissions credits from this project, but is strengthening its green credentials by demonstrating the sequestration potential of AFOLU activities.

The A$812,000 (Euro 0.5 million) deal was the first of its kind in Europe and covers 1500 hectares of SBPPRL installed on eight farms this year in central and southern Portugal. This existing arrangement complements the new publicly funded project which

ABOVE: A sown biodiverse permanent pasture rich in legumes on Quinta da Franca, central Portugal, revives after winter rains. The soil organic matter in these pastures increases on average by 0.2% per year.

LEFT: Terraprima carbon project leader Professor Tiago Domingos says the top 2 million hectares of natural pastures in Portugal could account for 4 billion tonnes CO_2e/year, more than the country's current national emissions deficit.

aims to account for 10% of Portugal's CO_{2e} deficit during the three years of the compliance period.

Under the new scheme, participating farmers will sow selected areas of their farm to SBP-PRL, thus replacing the widespread practice of extensive rotation of annual crops with conventional tilling (ploughing or harrowing) followed by a number of fallow years during which farmers graze livestock on the naturally recurring grasslands.

These grasslands generally have a low carrying capacity and are often dominated by weeds and shrubs, with a corresponding fire risk. As well, farmers routinely use nitrogen fertilisers to improve them, or replant crops directly after tillage which further degrades the soils and leaves them susceptible to erosion. In fact, a study of Portuguese soils in 2004 found 57.1% of Portuguese soils had low or very low organic matter (between 0.5% and 2.0%).

Agronomic studies (referred to in the box story) proved SBP-PRL could dramatically increase soil organic matter in these degraded soils, but it was subsequent studies linked to Project Extensity, led by the Technical University of Lisbon from 2003-2008, that catapulted the concept into the carbon farming arena.

Financed by the European Commission's Life Program, Project "Extensity - Environmental and Sustainability Management Systems in Extensive Agriculture" was conceived to look at ways of stemming the flow from extensive to intensive agriculture, to halt the abandonment of farmland and depopulation of rural areas, and the destruction of traditional rural landscapes.

Its aim was to establish a sustainability standard for the livestock industry (including milking sheep, beef cattle, and field

Table 1: Results showing carbon sequestration in poor schist soils in Agro 74 studies on recovery and improvement of pastures in degraded soils in Alentego from 2001-2004

Method of Seed Bed Preparation for Pasture	Type of Pasture	Soil Organic Matter (%)				Mean Annual Variation (%/year)	Mean Carbon Sequestration (t CO_2/ha/year)
		2001	2002	2003	2004		
Traditional ploughing	Natural	1.10	1.20	1.20	1.33	0.08	2.38
	SBPPRL	0.55	0.83	1.14	1.60	0.35	10.42
Minimum tillage	Natural	0.84	1.06	1.10	1.45	0.20	5.95
	SBPPRL	0.80	1.40	1.54	2.08	0.43	12.80

pigs) that would be rewarded in the market place and help improve social, economic and environmental conditions in rural communities.

In the course of devising a sustainability management system, the researchers carried out comprehensive life cycle assessments of agricultural products from 86 farms across Portugal. The assessment accounted for everything from emissions from live animals, the slaughter, cutting, packaging, refrigeration and domestic processing and eventual marketing, to the production and transport of feeds and fertilisers from other countries used in the farming systems. The researchers concluded "the most important environmental impacts in agriculture were from greenhouse gas emissions and substances that caused acidification and eutrophication".

They also examined the impact of alternative production systems on these processes, comparing natural pastures to biodiverse sown pastures, and conventional seeding to no-tillage. And SBP-PRL again came up trumps in countering negative environmental impacts.

Project Extensity researchers used these findings to present a convincing case for carbon farming on improved grassland that influenced the Portuguese Government to opt for the AFOLU provisions. Co-ordinator of Project Extensity and Terraprima project leader, IST Professor Tiago Domingos, says the new carbon contract is seen as a temporary solution that effectively buys time for the government to come up with further emissions reduction strategies beyond 2012.

Temporary solution

Despite its temporary nature, however, it has been stringently modelled to comply with Kyoto's strict criteria of "additionality" and "permanence".

"We have established a baseline scenario of how much pasture would have been sown each year in the absence of payment of this fund, and this will be subtracted from the 42,000 hectares. This means the fund will only pay for the carbon sequestered above the baseline," Professor Domingos explains. Consequently final payments to farmers will be averaged out across the participating farms.

The payments will also reflect the limited permanence of this soil sequestration, similar to temporary credits on emissions trading markets. There is no differentiation between labile soil carbon and humus which is the more permanent component of soil carbon. The rate has been set at A$15 for 1Mt$CO_{2e}$ per hectare (Euro 9.50 for 1MtCO_{2e} per hectare), about 2/3 of the current price of CO_{2e} on the EU ETS (as of October 30). The farmers will receive about 85% of this amount during three years once administration, technical assistance and monitoring fees are deducted. This means if the goal of 42,000ha is reached, farmers will earn about A$324 per hectare (Euro 200 per hectare) for pastures planted in 2009,

Why legumes and perennials boost soil carbon

Venerated Portuguese agronomist David Crespo devised the Sown Biodiverse Permanent Pastures Rich in Legumes technique while working for the then Portuguese Ministry of Agriculture's Plant Breeding Station in the early 1970s.

His system involves no-till seeding of rainfed pastures with a biodiverse mix of selected legumes (at least 30 per cent) and grasses, followed by careful management with sustainable stocking rates. The mixes are selected according to soil type and climatic conditions and contain up to 20 different species and cultivars, chosen from 50 subspecies and 150 cultivars of self-reseeding annuals and drought resistant perennials of Mediterranean origin including subterranean clover, *Trifolium subterraneum* and annual *Medicago spp.*

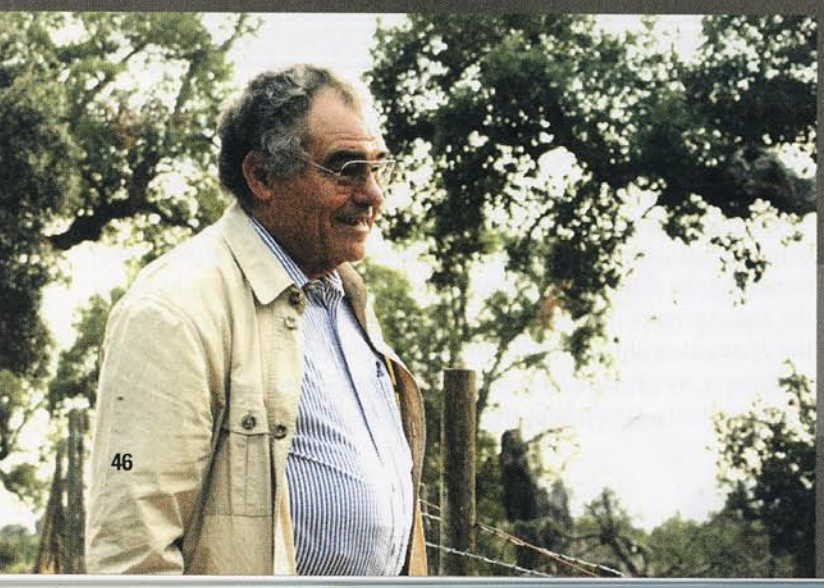
The beauty of the biodiverse mix is it provides a highly productive pasture for grazing, supporting higher stocking rates. At the same time, this encourages the build-up of a bank of resilient hard seeds that withstand drought, and creates permanent pastures that do not need reseeding for at least 10 years ... and up to 25 years as Crespo has demonstrated on his farm Herdade dos Esquerdos in Alentejo, central Portugal.

The legumes fix atmospheric nitrogen making it available for pasture grasses and the biodiverse mix creates a dense root system that is renewed each year. Biomass is also returned to the soil as the herd tramples the herbage and manure into the ground. And this all adds up to a quantifiable build up of soil organic matter (SOM) ... and carbon, as SOM comprises 58% of carbon.

In fact, two major agronomic studies – Agro 87 on *Sown biodiverse permanent pastures rich in legumes – a sustainable option for degraded land use* from 1997 – 2004, and Agro 74 which investigated *Recovery and improvement of pastures in degraded soils in Alentejo* from 2001-2004 – showed that biodiverse permanent pastures accumulate twice as much SOM than fertilized natural grasslands and seven times that of natural grasslands.

In trials of SBPPRL across 84 properties in central and southern Portugal, researchers found SOM increased on average by 0.2% a year which corresponded to five metric tonnes of CO_{2e} sequestered in each hectare per year. Of course in some farms, the increase was much higher and in others there was no increase at all, which researchers directly related to the correct installation of SBPPRL.

Their measurements proved, however, that even in the event of some pasture failure, the average increase is 0.2%



Innovative agronomist David Crespo, pictured on his Alentejo porpoerty Herdade de Esquerdos, devised the sown biodiverse permanent pastures rich in legumes that are now reaping carbon dollars.

and A$243 per hectare (Euro 150 per hectare) for 2010 pastures at the end of the three year contract.

This type of carbon farming is by no means a get-rich-quick scheme, but could be likened to an ecosystems services payment for those who improve their land and contribute to emissions mitigation solutions.

But does this preclude farmers who are already doing the right thing by their land? Professor Domingos agrees the system is particularly suited to soils with low soil organic matter (SOM) and it therefore follows that farmers who have already increased SOM to saturation levels would be ineligible for the carbon payments.

However, he rationalises that farmers who are lucky enough to have their farms in "naturally good spots", or have taken good care of their land using systems such as SBPPRL, "are already reaping the benefits of their management practices in increased productivity, which means they have no need for current support schemes".

As for the new group of farmers adopting SBPPRL for carbon farming, they are under no obligation to continue the practice beyond the contract period which could mean the stored carbon is released back to the atmosphere if they abandon the technique after the contract.

Professor Domingos insists this is not likely to happen. "There is something much stronger than an external legal agreement, and that is the farmers self interest to maintain this system and keep the organic matter there.

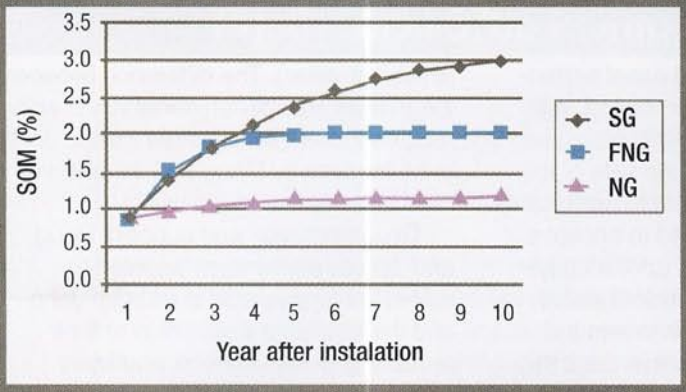
"The big thing about these [improved] pastures, in contrast to god-given pastures, is they require significant upfront investment and after that they are proven to be much better than others. It's completely irrational for farmers to destroy them after they have incurred this cost and, in fact, we have empirically shown in Portugal they are much more productive as time goes by as they accumulate more soil organic matter.

"The point is most of these lands are only fit for use as pastures, as they are rainfed. Even if irrigation became available, and it became economically viable to plant olive groves, for instance, it would still pay the farmer to maintain this system beneath his trees as increasing soil organic matter increases productivity in Mediterranean conditions ... and semi-arid conditions like Australia."

Professor Domingos believes such grassland projects will be part of the emission mitigation landscape beyond 2012 as "there are at least 1.5 to 2 million hectares of natural pastures in Portugal amenable to installing this system". If this happens, farmers could account for more than 4 billion tonnes CO_{2e}/year, more than the current national emissions deficit.

Find out more:
Professor Domingos: tdomingos@ist.utl.pt

Figure 1: How SOM accumulates in several types of pastures



SG – sown biodiverse permanent pastures
FNG – fertilised natural grasslands
NG – natural grasslands
SOM – soil organic matter

A well grazed sown biodiverse permanent pasture during summer dry spell at David Crespo's property in Alentego.

during a period of 10 years, and so demonstrates that SBPPRL are a carbon positive system. Researchers also found soil organic matter tends to stabilise around 3%.

As soil organic matter promotes healthier, more productive soils, farmers also found they didn't require additional nitrogen for pasture improvement. Thus, carbon dioxide emissions from nitrogen fertilisers are also avoided under SBPPRL.

These pastures do, however, require regular phosphate and potassium fertiliser, as well as liming to increase soil pH for optimum functioning of legumes. In their comprehensive carbon modelling studies, the researchers accounted for the CO_2 released in the manufacture of these inputs as well as N_2O given off by decomposing legumes, with the carbon ledger still showing a healthy "positive" credit. Farmers using SBPPRL also enjoyed the environmental spin-offs of greater biodiversity in their pastures, higher soil fertility, higher water infiltration rates, less erosion, less desertification, fewer fires, less floods, improvement in water quality, less dependence on concentrated feed for their herds in protracted dry periods, and better milk and meat quality in their herds.

As the agronomic, sustainability studies and carbon modelling have shown, SBPPRL is a win-win for Portuguese farmers and the environment.

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Cover
Joseph Gutnick is preparing to export rock phosphate from Queensland deposits

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EDITOR'S VIEW

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This edition highlights some stark contrasts in farming systems policy adoption between Australia's federal and state governments and their counterparts in Europe. Despite our obvious natural advantages for farm forestry and dryland perennial pastures as a means for capturing greater amounts of carbon dioxide, policy to encourage their adoption has not been developed to anywhere near the level needed for a range of positive agricultural, environmental and financial outcomes.

The oil mallee initiative in Western Australia is an excellent example of just how slow Australian governments are in recognising an opportunity and running with it. Farmers have known for years that oil mallee plantations provide a host of environmental services as well as boosting cropping productivity. Serious planting began in the mid-1990s but there was never sufficient support for farmers to grow the area needed for the commercial opportunities mallees can provide. As a result, only around 25,000 hectares out of a potential 830,000 suitable hectares in WA have been planted so far.

The same story applies with high-value sawlog production in the eastern states. As Andrew Lang points out, Australia imports about $2 billion worth of timber annually, virtually all of which could be grown in Australia on farmland and in appropriately managed state forests without loss to agricultural output.

It is apparent from the experience of beef cattle and native timber producers John and Jane McLaughlin that with appropriate support most farmers could be contributing to a positive national timber balance of trade while producing food at the same time. Add in productive, perennial pastures with the trees (and shrubs) to rebuild soil organic matter and humus and the result is resilient farm ecosystems that are net carbon sinks. Why is it that the Portuguese government already recognises perennial pastures as a strategy for boosting soil carbon, but Australia's governments don't?

The most likely explanation is that Australian governments adopt 'silo' thinking when it comes to the environment, agriculture and ecosystem services. They cannot grasp that farmers are working with ecosystems that interact. So, unless policy embraces a systems approach it becomes bogged down within the bureaucracy and science of the individual components. Measuring and monitoring trends in whole farm carbon balance has the potential to be the universal tool for understanding and achieving improved farm ecosystem health and productivity.

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