SEARCH

Abstract

Cultivated land can only be left 'idle' temporarily; after a time the carbon sequestered by land left idle renders it unviable for re-cultivation without excessive carbon dioxide emissions. Depending on the increase in carbon footprints of crop products deemed to be acceptable, estimates from FAO cropping data appear to indicate that there were 19- 48 Mha of idle land suitable for return to cultivation in 2007. This represents 1.3 – 3.3% of the global arable area, which could provide over half of the extra cropland estimated by FAO to be needed by 2050. Alternatively, cropping of the 5.3 Mha idle land available in the EU27 could support >40% of the transport energy targeted to come from renewable sources by the EC. These are useful reserves, notwithstanding that improved crop productivity will also be vital in meeting future demands for both food and non-food products.

Keywords: Idle land; carbon sequestration; crop production

Glossary

Carbon intensity: the quantity of greenhouse gas emissions, assessed as carbon dioxide equivalents, attributable to one tonne of crop produce.
Carbon dioxide equivalents: greenhouse gas emissions, summed according to the

global warming potential of each gas as it relates to carbon dioxide (CO_2): methane, 21 x CO_2; nitrous oxide, 298 x CO_2.

Abbreviations

EU, European Union (EU15 refers to members states up to 2004; EU27 refers to all current member states); **EC**, European Commission; **FAO**, Food & Agriculture Organisation; **FSU**, countries of the former Soviet Union; **MPI**, maximum periods of idleness; **ECY**, expected crop yield; **MES**, maximum acceptable carbon emissions from land use change.

More land for cropping?

The spread of famine across the globe will be avoided most feasibly by an increase in crop production of 70% (FAO, 2008), yet crop yields particularly in developed countries are becom- ing increasingly 'stagnant' (Brisson et al. 2010). Thus, attention turns inevitably to land where cultivation might expand. Deforestation and cultivation of grasslands are not desirable because they cause large emissions of carbon dioxide through destruction of vegetation or of soil organic matter (Dawson & Smith 2007).

So how much other land is available? Despite a recent trend to high world prices, previous low crop prices, political and social change and decreased support for farming released some significant tracts of land around the world. For example, the breakup of the Soviet Union and a fall in grain prices caused large tracts of land to be idled in Eastern Europe. It seems possible that much of this uncropped land could be brought back into cultivation without causing excessive carbon dioxide emis- sions. And how much more food might this land grow?

Here we provide some headline con- clusions from a study of FAO cropping data that indicates idle land available in Europe and globally, according to the level of carbon emissions that might prove acceptable. It is intended to submit a full and updated study for review and publication in the next Issue.

Estimating idle cropland with low carbon stocks

Land is never truly 'idle'. Cultivation may stop but, with re-establishment and growth of vegetation, carbon sequestration soon begins, both in the vegetation and the soil, and as time passes it becomes increasingly undesirable to bring the idled land back into production.

Thus, for the purposes of this study 'idle land' is defined as land that has been cultivated previously and can be returned to cultivation without excessive carbon emissions. Fallow land is excluded because it rep- resents part of a cropping system, for instance to conserve water and / or build soil fertility for subsequent crops.

Defined in this way, availability of idle cropland across the world is by no means straightforward or certain. There are two essential criteria: to be evidently cultivable (indicated here by previous cultivation, but adjusted for 'urbanisation') and to have insubstantial sequestered carbon (due to a sufficiently short period of idleness).

Few statistical resources report both criteria. Repeated aerial and satellite images may be most accurate (e.g. Campbell et al., 2008), but are very incomplete. National statistics as collated by the FAO are also indicative, if idling of land can be presumed an infrequent act. We take this approach in our study, and apply a typical rate of carbon sequestration from a recent review (0.6 t/ha/year; Dawson & Smith, 2007) to deduce a more com- prehensive, if less exact, summary.

Idle land was estimated for each coun- try in the world by subtracting the arable land in 2007 from the maxi- mum area of arable land recorded between 1961 and 2007, and then adjusting for urbanisation. The analy- sis was not sensitive to desertification of previous agricultural land, but an element of verification was included through two case studies for the UK and USA, using alternative data sources and methods.

Estimates of idle land were limited to areas with low carbon stocks by calcu- lating 'maximum periods of idleness' (MPI, in years) as given by the equa- tion: MPI = MES x ECY x 20 / RSCA

Thus for each region, estimates of idle land were calculated using three maxi- mum emission scenarios (MES, tC/t), set according to three levels of addi- tional emissions (kg CO_2e per tonne of crop produce) that might be deemed acceptable due to land use change; 100, 200 & 300 – the largest level being sufficient to approximately dou- ble the carbon intensity of cereals grown intensively (400 kg CO_2e/t; Kindred et al. 2008).

Division by 3667 converts from kg of CO_2e to tonnes of carbon. Multiplication by the expected crop yield (ECY), as t/ha/year, and by 20 years accounts for land productivity over a standard period over which one-off emissions are discounted1, and division by the rate of soil carbon accumulation (RSCA), as 0.6 tC/ ha/year, results in the number of years taken to reach a particular MES. ECY was set for the average annual yield of the dominant crop by area in each region from 2006-2008 (sourced from FAOSTAT).

Idle land across the globe

The resulting MPI values varied between 1 and 16 years, giving global idle land totals in 2007 of between 19 and 48 Mha, depending on the MES considered acceptable. These areas are of the same order as estimates made previously by Searchinger et al. (2008) when examining US biofuel expansion and much smaller than estimates exceeding 200 Mha (e.g. Ramankutty & Foley, 1999; Campbell et al., 2008) that did not acknowledge carbon emissions.

They represent pos- sible increases of 1.3 – 3.3% on the 2007 global arable area. Interestingly, these areas have developed over a period when global population and food production have also been increasing. The regions with most idle land are

North America, Asia, the FSU and EU15, and those with least are in Africa and South America. Past changes in areas of idle land are shown in Figure 1 for a MES of 200 kg CO2e/t.

Apparent decreases in idle land in the 1970s and 80s resulted from both the return of idle land to cultivation and the accumulation of soil carbon making idle land unsuitable for use. The global total of idle land has been high for the past decade fol- lowing rapid increases in the 1990s, particularly in the former Soviet Union. Recent data show that land is still becoming idle in major regions of the world (Europe, Asia and North America).

Contribution of idle land to future crop production

This analysis supports the hypothesis that there are significant areas of idle cropland across the world, and that these might be returned to cultivation without excessive carbon emissions. Ideally re-cultivation of this land should be prioritised over destruction for cultivation of virgin forests, grasslands and other land with high carbon stocks.

Our mid-estimate of 37 Mha idle land (Figure 1) can be related to the FAO's estimate of 70 Mha extra cropland required globally by 2050 (Bruinsma 2009). Alternatively, our mid-estimate of 5.3 Mha idle land in the EU27 (MES 200 kg CO2e/t) is 44% of the land required (as calculated by Özdemir et al. 2009) to support the EC 2020 target of 10% transport ener- gy from renewable sources.

However, for idle land to become re- cultivated, it will be important to recognise that some past drivers of land abandonment and idling will need to be reversed. Causes of land idling in Europe have been sum- marised by Rounsevell et al. (2005) as reduced world prices driven by supply surpluses and decreasing trade barriers, decoupling of market support from agricultural production, policies to diversify rural businesses, enhancement of environmental services, EU enlargement, competition for land for instance for bio-energy crops, and climate change (through reduced crop yields). Globally, other drivers are land degradation through drought, fire (Rico & Masedo, 2008), soil erosion (Bakker et al. 2005) or salinisation; also through major political changes (Muller & Munroe, 2008; Muller et al. 2009) and age, health and other sociological problems of farmers and landowners (Azima & Ismail, 2009; Rico & Masedo, 2008). As further data become available, it will be inter- esting to see the extent to which recent world shortages of cereals, and increases in prices, are causing idle land to be re-used.

The most dramatic period of cropland abandonment in recent times, as alluded to above, occurred in the for- mer Soviet, Yugoslav and Eastern Bloc states between 1992 and 1999, fol- lowing the collapse of the Soviet Union. This led to abandonment of isolated and less accessible parcels of cropland (Muller et al. 2009), largely owing to changes in land ownership and the switch to a market-orientated agricultural industry.

Our analysis of FAOSTAT data indicates that little of this abandoned land had been returned to cultivation by 2007. Sudden peaks of idled land in Oceania correspond to periods of drought in Australia; however, unlike changes in Europe, these areas are often returned to cultivation when conditions have improved.

Our analysis indicates that many reserves of idle land exist that may be cultivated without excessive carbon dioxide release. It seems likely that the most significant areas of former cropland that could be returned to cultivation are in the EU, the former Soviet Union and North America.

With pressure mounting to feed a global population, the importance of this land for future production cannot be understated. However, ultimate avoidance of famine must also depend on other options: changing diets, improving crop productivity, or possibly cultivating some grasslands and forests. Hopefully a balance can be struck between these, acknowledging their very different effects on carbon intensities of food and other crop products.

1 Standard procedure in carbon footprinting guidelines such as PAS2050 (BSI 2008)

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Figures

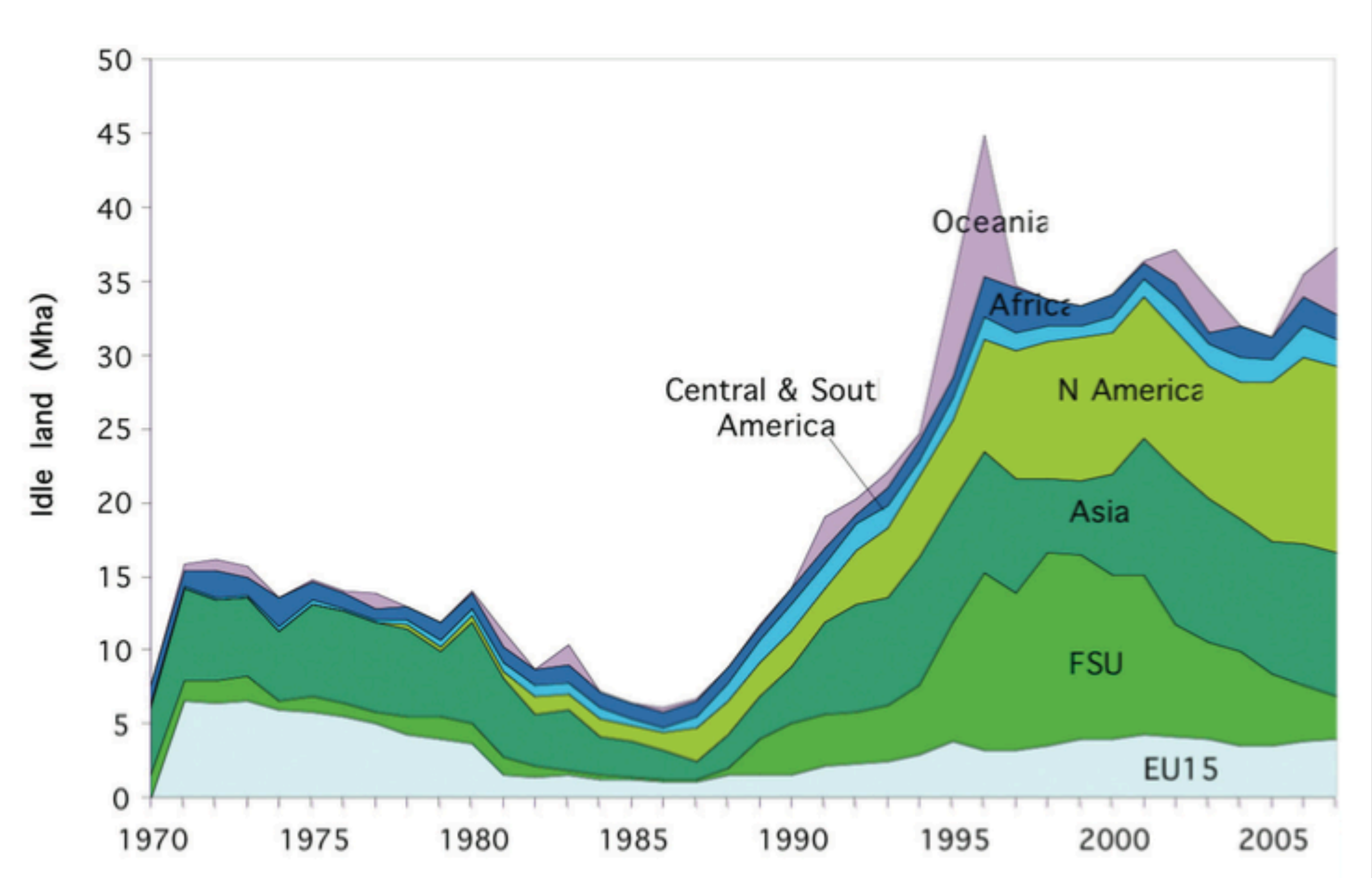

Figure 1.

Figure 1: Estimated changes in availability of idle land for global regions assuming maximum acceptable emissions of 200 kg CO2e/t. FSU = former Soviet Union; EU15 = European Union

Figure 2.

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Comments