



RUNAWAY MAIZE

Subsidised soil
destruction

June 2015



In the decade between 1990 and 2000, total maize acreage in England trebled and has continued to increase



Executive summary

Maize – a growing problem

- Maize is probably the most rapidly growing crop in the UK – up from just 8,000 hectares in England in 1973 to 183,000 hectares in 2014.
- Most maize is used as silage for animal feed, especially for dairy cattle, but increasingly maize is being grown as an energy crop for anaerobic digesters (AD) that are subsidised from public money to produce gas for fuel.
- Maize produces high yields, both per hectare as a crop and per cubic meter of biogas. Because it is the most readily grown bulk product it has become the core feedstock for AD plants.
- The use of maize for silage is now known to have a significant negative effect on the nutritional content of both milk and meat. Eating maize may also make both badgers and cattle more susceptible to TB.
- The National Farmers Union's plans would see an additional 125,000 hectares of maize grown in England by 2020.
- This threatens UK food production - the land the NFU wants to be used to grow fuel could produce over 1 million tonnes of wheat, or over 5.5 million tonnes of potatoes.

Maize damages soils

- Maize crops have severe negative impacts on public goods like soils and fresh water. Many farmers are being paid to cause significant harm to these public interests - this is a national scandal.
- Maize crops leave soil exposed during much of the growing season. Maize is usually harvested late in the year when soils are often wet, so with heavy rain, water runs off the surface of compacted and damaged fields, polluting waterways with pesticides and nutrients, and causing floods.
- Estimates suggest that during the storms and heavy rainfall in the winter of 2013/14, every 10 hectare block of damaged land under maize stubble produced the equivalent of 15 Olympic swimming pools (more than 375 million litres) of additional runoff.
- Research published in 2014 found that 75% of late-harvested maize sites showed high or severe levels of soil degradation.
- The overall financial cost of annual flooding in the United Kingdom is estimated to be somewhere in the region of £1.1 billion; a cost to the public to which maize will be making an increasing contribution.

Better practice

- It is possible to grow maize to better practice standards that reduce the risks to soils and the environment.
- Some farmers are following good practice, but not enough. The Government should introduce clear policy measures that encourage more farmers to meet best practice.

Spiralling rents for farmers

- If nothing changes, the UK is set to follow in the footsteps of Germany, where a boom in AD has changed the economics of agriculture, with 800,000 hectares of land put aside for AD maize (more than four times the current area of maize in the UK). The resulting land grab for maize has driven farmland rents up by 140% in just four years.
- This is already happening in the UK - rising rents hit all farmers producing food, especially struggling dairy farmers needing to rent land to feed their cows.

Double subsidy

- AD plants using maize receive Feed-in Tariff and the Renewable Heat Incentive subsidies. Maize growers are also subsidised under the Common Agricultural Policy (CAP). Maize for AD receives a double subsidy from public money.
- In 2015, the total amount that will be paid to farmers growing maize amounts to almost £33 million. In addition, 'renewable' energy subsidies for maize used in AD plants are costing British energy consumers up to £50 million per year.
- Biogas produced from maize, while described as 'renewable energy' is not providing any net benefit to the environment. Recent research concluded that 'using agricultural crops for biogas production is not environmentally sustainable and policy should not encourage this practice'.

Policy change

- Despite all the environmental damage maize crops can cause, under the EU's Common Agricultural Policy, maize is included as a crop that farmers are allowed to grow to meet the new requirement to grow three crops for 'greening' purposes.

- The last government made a commitment to improve and safeguard British soils: *'By 2030, all England's soils will be managed sustainably and degradation threats tackled successfully. This will improve the quality of England's soils and safeguard their ability to provide essential services for future generations'.*

- To achieve that objective and to end runaway subsidised soil destruction, the Soil Association is calling for:

- saving up to £50 million per year by stopping all the subsidies available for AD digesters fuelled in whole or partly by maize, and increasing the support for biogas from waste;

- removal of maize as a qualifying crop under the greening requirements for 30% of the new Common Agriculture Policy's Basic Farm Payment;

- the EU to remove the Basic Farm Payment for fields growing maize for AD;

- the introduction of strict measures for management of maize crops under cross-compliance (requirements for farmers to be eligible for the Basic Farm Payment) – mandating compliance with officially recognised best practice.

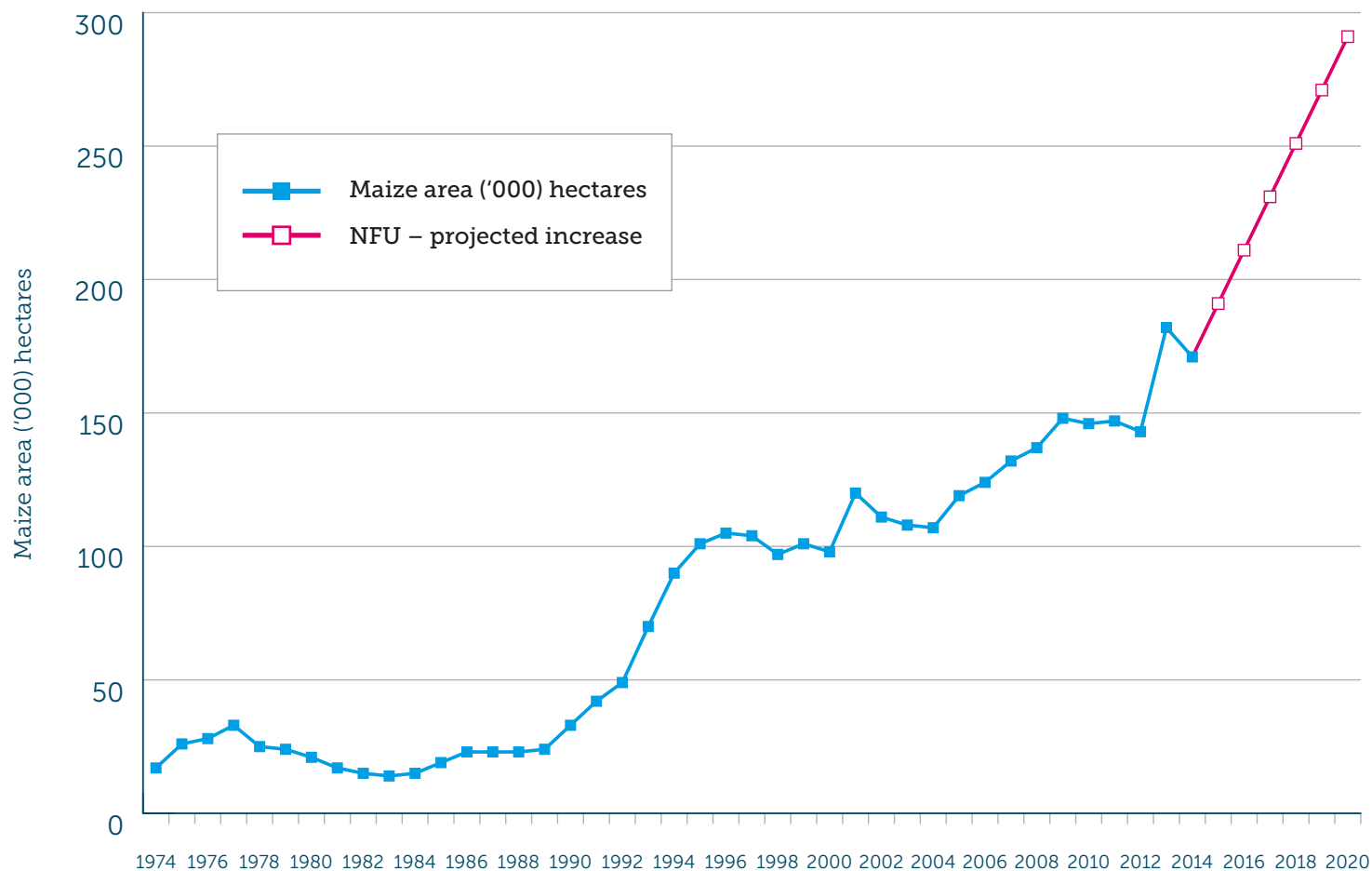
This would remove the double subsidy, reduce the pressure on farm rents and encourage farmers who grow maize for silage to minimise soil losses.



Maize around the world

Originating in Central America, maize is now one of the world's most important cereal crops. It is grown for human and animal consumption, with 184 million hectares grown globally in 2013.¹ With demand for meat and starch increasing around the world, annual maize production is at an all-time high of 992 million tonnes, a figure which is expected to increase by 3% year-on-year.²

Maize cultivation in England: 1973 – 2020

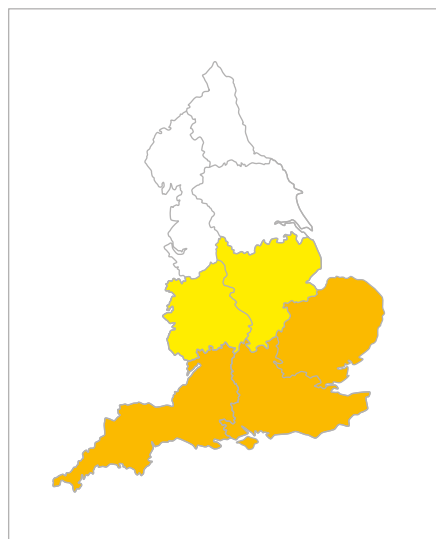


Maize in the United Kingdom

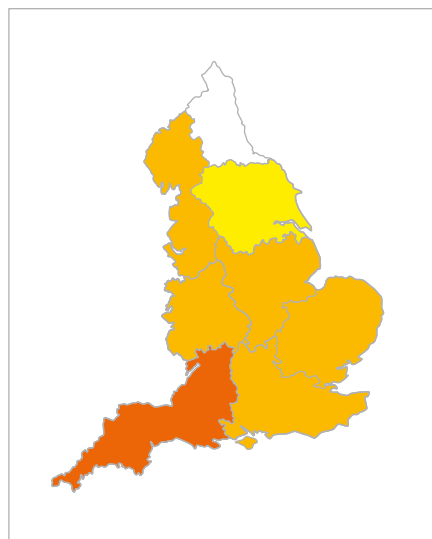
The widespread cultivation of maize in the UK is relatively recent. In 1973, just 8,000 hectares of maize was grown in England. In the decade between 1990 and 2000, total acreage trebled and has continued to increase³ – in 2014, 183,000 hectares of maize was grown in the UK.⁴

The figures in red illustrate the additional area of maize required by the National Farmers' Union's (NFU) stated ambition to increase the number of on-farm anaerobic digestion plants in the UK to 1,000 by 2020⁵

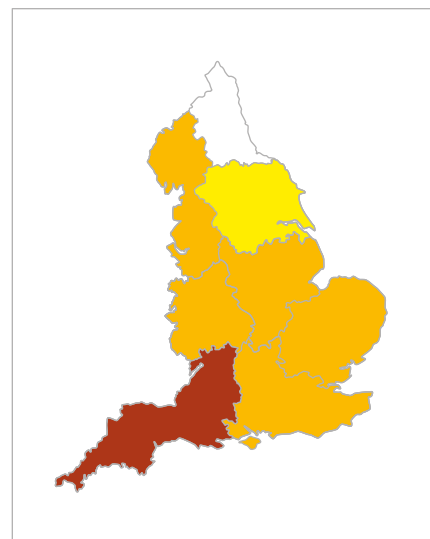
Growth in maize cultivation in England: 1975 – 2013



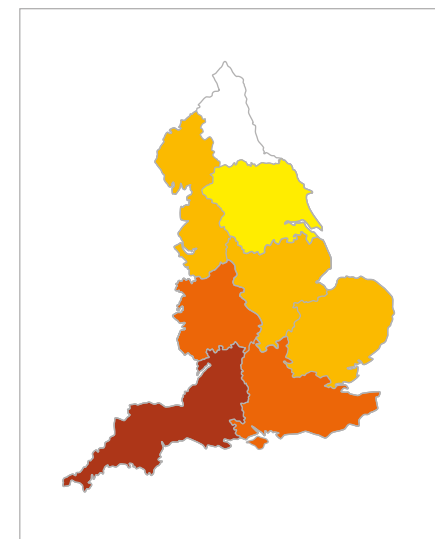
1975



1985



1995



2013


Unchecked, this massive growth threatens to accelerate. The rapid increase is due in part to the introduction of more resilient varieties which has enabled maize cultivation to move into northern England, as the maps above illustrate. Maize is traditionally better suited to warm climates - this has previously limited the extent to which it could be cultivated in the UK. The development of more resilient varieties means that more and more UK farmers are able successfully to grow maize in a variety of climatic conditions.

Maize is a relatively low-cost, reliable source of silage for cattle – mainly dairy cows (although well managed grass-based systems can perform better financially). In the UK, the majority of maize is cultivated for silage for animal feed, especially for dairy cattle. However, anaerobic digestion - the process of breaking down organic matter in the absence of oxygen – is an increasingly popular technology for the production of energy and has become a significant and rapidly growing contributor to the demand for maize.

Maize area (hectares)	
	<1,000
	1,001 – 5,000
	5,001 – 25,000
	25,000 – 45,000
	45,000 +

Harvesting maize involves a high volume of tractor movements





75% of late harvested
maize sites showed
high or severe levels
of soil degradation

Credit Wye and Usk Foundation

Soil erosion and environmental impact

Maize is a tall crop with widely spaced stalks, leaving relatively large areas of soil exposed throughout the growing season – this leaves bare soil vulnerable to erosion, as well as doing little to slow run-off in times of heavy rain. Sown in April or May, maize is harvested late, sometimes as late as November, when the ground is usually already wet. Harvest involves a high volume of tractor movements – a harvester will deliver chopped maize into a trailer pulled by a tractor (or into a lorry) which, due to the bulk of chopped maize, will be frequently rotated. Full trailers or lorries are immediately replaced and the chopped maize taken off the field to an AD plant or silage clamp.

The result of this heavy movement on wet soil is to leave it severely compacted and rutted. The soil is often too wet and damaged, and the maize harvested so late in the season, that sowing a winter cover crop is impossible and the soil is left exposed until the following spring. The effect of bare, compacted soil is seriously to impede the soil's ability to absorb and hold moisture. In times of heavy rain, massive quantities of water simply wash off the surface of the fields, polluting waterways and causing floods. The flooding is caused not only by fast run-off from compacted, damaged soils, but also through the build-up of sediment slowing water flow in rivers.

Estimates suggest that during the storms and heavy rainfall in the winter of 2013/14, every 10 hectare block of damaged land under maize stubble produced the equivalent of 15 Olympic swimming pools (more than 375 million litres) of additional runoff

Maize requires a relatively high input in terms of pesticides and fertilisers, particularly in the early growth period. Some of these chemicals are washed off fields during the growing season. Some will remain after harvest, causing contamination and eutrophication of rivers and other watercourses during heavy winter rain and flooding.

The scandal of the subsidies attached to maize cultivation, and the absence of any enforceable or effective crop management requirements to minimise soil erosion and environmental damage, have been highlighted by a number of researchers and commentators, whose work has informed this report. In particular, journalist George Monbiot has led the way in effectively and

repeatedly challenging the Department of Environment, Food and Rural Affairs and the National Farmers Union on their current policies.⁶

Research published in 2014 found that 75% of late harvested maize sites showed high or severe levels of soil degradation.⁷ Historically, maize growing has been concentrated in the South West of England (as can be seen in the maps on page 6). The research also found that the South West is more susceptible to structural damage to soils than many other agricultural areas of the UK, due in part to more frequent episodes of prolonged or heavy rainfall, and to the steep slopes that typify much of the region's agricultural land.

One of the co-authors of the report, Robert Palmer, estimated that during the storms and heavy rainfall during the winter of 2013/14, 'every 10 hectare block of damaged land under maize stubble has produced the equivalent of 15 Olympic swimming pools (more than 375 million litres) as enhanced runoff'.⁸ Extensive flooding has a devastating and lasting impact on the environment and local communities. The overall financial cost of annual flooding in the United Kingdom is estimated to be somewhere in the region of £1.1 billion⁹, a cost to the public to which maize will be making an increasing contribution.



NEODAAS/University of Dundee

In times of heavy rain,
massive quantities of
water and soil wash off
the surface of the fields,
polluting waterways
and causing floods

Satellite image
shows soil (brown
areas) flowing into
the sea around the
UK following the
2014 floods

Maize and anaerobic digestion

Of the 171,000 hectares of maize grown in England in 2014, 29,000 hectares, (almost 17%), is grown specifically as a feedstock for the production of biogas through anaerobic digestion.¹⁰ The area of maize grown for AD in England doubled between 2013 and 2014. In January 2015 there were 174 biogas plants operating in the UK¹¹, and by 1 March 2015 the figure was 185 according to the National Non-Food Crops Centre's (NNFCC) annual anaerobic digestion report¹², more than half of which use farm-based feedstocks. About 500 plants are in development, of which around half, 250, are likely to become operational, which the NNFCC say will require an additional 3 million tonnes of crops as feedstock.

In fact there is plenty of food waste available to fuel AD plants – only 2m tonnes out of the total of 10m tonnes available are currently treated in AD plants according to the NNFCC. However, even the new sustainability criteria to be applied to new and existing AD plants from October 2015 are not expected to halt the demand for maize.

Earlier this year, one of the industry's biggest players, Tamar Energy, secured a £32 million loan from the Royal Bank of Scotland, demonstrating market confidence in the long-term prospects of the biogas industry.¹³

AD is ostensibly a solution to multiple problems - a means by which not only safely to dispose of the millions of tonnes

of green food, municipal and agricultural waste produced in the UK each year, but also a way to turn this waste into a renewable gas, with the residue used as fertiliser. However, the yield of biogas produced from waste is typically low,¹⁴ and plant owners are increasingly looking to purpose-grown crops as a source of consistent feed for their anaerobic digesters.¹⁵ Maize, with its consistently high yields, both per hectare as a crop and per cubic meter of biogas,¹⁶ and because it is the most readily grown bulk product, has become the core feedstock. Consistent feedstock produces a consistent supply of gas – crucial in a market which has proven to be extremely lucrative, thanks to public subsidies.

Waste driven AD plants can work well, and planning permissions for AD plants include clear restrictions on whether the plant should use waste or plant material, but so far this has not stopped the increase in maize crops (and other crops like sugar beet and forage rye) being grown for AD.

Despite the obvious benefits in the production of genuinely renewable, green energies, the practice of directing food crops to anaerobic digesters is controversial. One of the primary criticisms is that the cultivation of energy crops is a waste of prime agricultural land that ought to be used to produce food. Secondly, there is a concern that the UK will follow in the footsteps of Germany, where a boom in the biogas industry in recent years is

changing the economics of agriculture, with 800,000 hectares of land put aside for AD maize (more than four times the area of maize in the UK). This has resulted in, among other things, a so-called 'land grab', as investors and farmers rush to lease land for maize cultivation. In the period between 2008 and 2012, rents in Germany rose from €250 to €600 per hectare, per year.¹⁷

Concern is already being expressed that a similar situation is developing in the UK.¹⁸ Not only does an increased demand for land push up rents, but the lucrative contracts being offered for AD maize are encouraging farmers to cultivate energy crops, rather than food for either human or animal consumption. With rents rising (up to £400 an acre for land that can grow vegetables or potatoes), livestock farmers are struggling to turn a profit on their land, putting increasing pressure on many farmers.¹⁹ In light of the current crisis in the UK dairy industry, soaring costs and competition for land will only increase the burden on struggling dairy businesses.

A number of government initiatives and funding opportunities mean that the biogas industry (and, as result, the production of AD energy crops) is heavily subsidised. Subsidies include the Feed-in Tariff (FIT), whereby energy companies will pay individuals for the electricity they produce, including electricity that they use themselves, and the Renewable Heat Incentive (RHI). On the basis that around 1,160,000 tonnes of maize are currently

The Soil Association is calling on the Government to save up to £50 million per year by stopping all the subsidies available for AD digesters fuelled in whole or partly by maize, and to increase the support for biogas from waste.



grown in England for use in AD plants (on 29,000 hectares), the combined FIT and RHI subsidies are likely to be costing British energy consumers somewhere between £31 and £77 per tonne of maize, or a total of £36 – 50 million per year.

In addition, under the Basic Payment Scheme, a farm subsidy under the Common Agricultural Policy (CAP), which replaces the Single Payment Scheme from 2015, the total amount that will be paid to all farmers growing maize (on 183,000 hectares) amounts to almost £33 million each year.²⁰ These Basic Payments, when combined with the subsidies paid for the production of biogas, mean that the maize (and other arable crops) grown to feed AD plants is effectively subsidised by the public twice, first on the farm, then in the AD unit. Both the National Farmers Union and the government have been determined to stop other cases of possible 'double-funding' of farm operations from public funds. For example, farmers cannot claim Basic Payment Scheme payments for land used for solar energy, but so far, maize grown for AD has been exempt from such scrutiny.

Maize crops have a number of severe negative impacts on public goods like soils and fresh water, and while some farmers are following best practice (under-sowing and using early maturing varieties) other farmers are being paid to cause significant harm these public interests. This is a national scandal, especially as the biogas produced from maize, while described as 'renewable energy' is not providing any net benefit to the environment.

Scientific research published in 2014 found that biogas yield was higher when using maize rather than waste (and therefore that there was a greater saving in global warming potential), although this may not be true of well-managed waste plants. In any event, the research found that the environmental impacts associated with maize cultivation were so significant as to counter these positive effects – the research concluded that:

*'There is a danger that continuing with the policy of subsidising use of food crops for biogas production will increase other environmental impacts as well as causing competition with food production and related socio-economic consequences. Therefore ... using agricultural crops for biogas production is not environmentally sustainable and policy should not encourage this practice.'*²¹

Research published this year suggests that any claim made by supporters of AD that it cuts greenhouse gas emissions relies on the (clearly false) assumption that when land is used for growing maize, no food is grown elsewhere to replace the lost food production.²² This and other warnings have been ignored by the English National Farmers' Union (NFU), which has called for 1,000 AD plants to be operating in the UK by 2020. By their own calculation, this number of plants would require 100,000 – 125,000 ha of maize, when co-digested with slurry and manure.²³

The NFU are thus proposing that the growth in acreage of maize that occurred over the three decades to 2000 occur again in just five

The biogas produced from maize, while described as 'renewable energy' is not providing any net benefit to the environment because of damage to soils and fresh water

years. Or, in terms of lost food production, the extra 125,000 ha the NFU wants to be used to grow fuel could produce over 1 million tonnes of wheat,²⁴ or over 5.5 million tonnes of potatoes.²⁵ For farmers, the economics of growing maize for AD, supported by public subsidies, is of course attractive compared to the volatile market for grain crops, and given the downward price pressure from supermarkets on other farm produce.

However, the UK currently imports 40% of total food consumed - a figure which is expected to rise - so devoting so much agricultural land to feed AD plants, which use crops that have such a damaging impact on the environment, is something British farmers

should be attacking, not calling for.²⁶ Both the UK Government and the NFU say that they want us to produce more of our own food, but the massive cultivation of maize for AD is an immediate threat to this. This land is not being used to produce food, and, crucially, also threatens the long term future of food and farming – the damage done to the soil and to the wider environment by maize cultivation will have far-reaching, negative impacts on the future of UK food production.

About 500 AD plants are in development, of which around 250 are likely to become operational, requiring an additional 3 million tonnes of crops as feedstock

Others are alive to these threats and are concerned at the amount of public money being put into unviable and environmentally negative sources of energy. In the European Parliament, MEPs have recently backed a draft proposal by the EU to introduce a cap on the use of food-crops in the production of biofuels.²⁷ While the proposed legislation would only apply specifically to transport fuels (as a cap of 6% of final transport fuels coming from crop-based biofuels), it demonstrates both an awareness of the threats posed by the biofuel industry to food and land security, and a willingness on the part of the EU to try and solve at least part of the problem.



Maize is harvested late and involves a high volume of tractor movements. The result of this heavy movement on wet soil is to leave it severely compacted and rutted...

Other issues

Maize is not only the cause of significant soil erosion, but is also linked to a number of other problems for consumers and farmers. The use of maize for silage is now known to have a significant negative effect on the nutritional content of both milk and meat. Maize is relatively high in linolenic acid (omega-6 fatty acid) compared to grasses and legumes, which are higher in alpha-linolenic (omega-3 fatty acid). Western diets generally contain an excess of omega-6 fats which have a negative impact on our ability to produce long chain omega-3 fatty acids. Maize silage increases the omega-6 content of milk and is associated with low levels of omega-3, which has negative implications for the nutritional quality of milk.^{28 29}

There is anecdotal evidence (with some theoretical scientific basis) that maize is responsible for encouraging the spread of bovine TB in badgers (which eat maize cobs), and for making cattle fed on maize more susceptible to TB, because maize is low in selenium. Some farmers believe that TB infection can be successfully managed by feeding selenium supplements to both cattle and badgers.³⁰ It is suggested that maize, deficient in a number of trace elements, including selenium, may result in a greater susceptibility to the spread of bovine TB.³¹ No scientific research has been done to investigate this theory, although the Soil Association has long called for more research to be conducted to establish if any link exists.³²

The use of maize for silage is now known to have a significant negative effect on the nutritional content of milk and meat, decreasing levels of beneficial omega-3

Environmentally speaking, soil erosion and increased flood risks are not the only impacts associated with maize cultivation. The destruction of natural grassland in Europe to make way for maize energy cropping, or to compensate for the loss of land for livestock fodder that energy cropping inevitably causes, has caused significant release of greenhouse gases, and widespread loss of farmland birds. The destruction of grassland is especially ironic, given that maize-based cattle systems are high cost compared to grass silage and grazing based systems.

The massive financial incentives available for biogas production are seen as contributing to the crisis and are fuelling the destruction of natural habitats.³³

Current policy position

The previous Labour government, under EU farm policy, recognised that late-harvested crops (maize in particular), have a significant potential to damage soils. Indeed, they issued specific guidance (below) to farmers on how best to manage maize crops under cross-compliance (satisfaction of which is required to receive subsidies).

Soil guidance code	Land use measures
	Maize & forage crops
C1	Maintain land drainage. Heavy and medium soils that are regularly cultivated often require land drainage to increase opportunities for working the land without drainage.
C2	On fields that are vulnerable to compaction, runoff and soil erosion, choose early maturing varieties to allow an early harvest.
C3	Undersow maize.
C4	Manage the grazing of forage crops and crop residues to minimum poaching and runoff. This can be done by limiting periods of access, providing run-back areas, strip grazing, cultivating strips across the slope to reduce runoff and by avoiding slopes vulnerable to erosion and runoff.
C5	Where necessary, cultivate as soon as conditions are suitable after harvest or grazing to remove wheelings and compaction.
C6	Rough plough sandy and silty soils following harvest to produce cloddy coarse surface that is less likely to cap and slump.
C7	Following harvest, sow the next crop within 10 days of having been prepared as a seedbed where weather conditions allow.
C8	The field is sown with a temporary cover crop throughout winter.
C9	Other – please state:

Cross Compliance Guidance for Soil Management 2010 edition

It seems unlikely that these 'land use measures' would be effective in reducing soil loss from many maize fields, but the last coalition government removed even these recommendations. It then went much further, and provided a specific exception for maize from the protective measures farmers have to take with other crops following harvest.³⁴ As of January 2015, this exception has been removed and replaced with a requirement that minimum soil cover must be provided, but that this may be by maize stubble.³⁵ The new standards also state that penalties (unspecified) will be imposed in instances of soil erosion. However, the 'cover' provided by maize stubble is wholly inadequate to protect against soil erosion – just as maize's widely spaced stalks do very little to protect soils throughout the growing period, they also offer no effective cover at all to rutted and compacted post-harvest fields.

Not only is stubble an ineffective method of protecting soils, but the establishment of an effective cover crop may also carry a financial benefit to farmers - it has been estimated that 40kg of nitrogen, the equivalent to £30 per ha, would be retained if cover crops were established following maize harvest.³⁶ Indeed, some farmers are now seeing the advantages of undersowing maize with a green winter cover crop, and are using early maturing varieties to reduce damage to soils at harvest.

Another recent development (this time by the EU) has been to introduce greening requirements - a measure introduced under the latest reform of the CAP in response to

The last government provided a specific exception for maize from the measures farmers have to take to protect soils following harvest

increasing risks posed by unsustainable farming practices to soil biodiversity and fertility, and to water resources. Under these rules, 30% of the Basic Payment Scheme is conditional on farmers meeting mandated requirements (organic farmers, considered green by definition, are exempt from these rules). Crop diversification (also referred to as the 'three-crop rule') requires that a farmer with over 30 hectares of arable land must grow at least three crops on their holding (farmers with 10 – 30 ha must grow at least two crops). Despite the environmental impact of maize cultivation, it is nonetheless included as a crop for greening purposes.

Given the singularly harmful impact of maize, the Soil Association believes it should be removed as a qualifying crop under these requirements. It is, demonstrably, not a 'green' crop, and thus has no justifiable place in an incentive which is aimed to promote and encourage good farming practice and responsible management of agricultural land.


The old Entry Level Stewardship (ELS) - a voluntary, incentivised, agro-ecological land management scheme under Pillar 2 of CAP - had options designed by the Department of

Environment, Food and Rural Affairs (Defra) to encourage less irresponsible farming practices (above and beyond the very basic rules under cross compliance), and offered two tiers of maize management aimed at reducing soil erosion.³⁷ The basic option required, among other things, that maize be harvested no later than 1 October, or the establishment of a cover crop post-harvest. The enhanced option required both. The Soil Association believes, as a minimum, these standards should be mandatory, and would reflect current best practice by some maize growers. Under the old ELS scheme, take-up was remarkably low – just 4,463 ha under the basic option, and just 773 ha under the enhanced option. That equates to a total of 5,236 hectares of maize, or just less than 3% of the total maize area in the UK, being farmed in a manner that mitigates the damage caused to soils and the environment.³⁸

The Government has made a commitment to improve and safeguard British soils:

*Our vision: By 2030, all England's soils will be managed sustainably and degradation threats tackled successfully. This will improve the quality of England's soils and safeguard their ability to provide essential services for future generations.*³⁹

The Soil Association will challenge the new government to end the contradictory approach to the protection of soil and the safeguarding of the future of our food production.



Many farmers are being paid to cause significant harm to soils and fresh water – this is a national scandal

Credit © Natural England/Jane Uglow

Soil Association's key policies to end subsidised maize soil destruction:

- 1** Save up to £50 million per year by stopping all the subsidies available for AD digesters fuelled in whole or partly by maize, and increase the support for biogas from waste;
- 2** Remove maize as a qualifying crop under the greening requirements for 30% of the new Common Agriculture Policy's Basic Farm Payment.
- 3** Urge the EU to remove the Basic Farm Payment for fields growing maize for AD digesters.
- 4** Introduce strict measures for management of maize crops under cross-compliance (requirements for farmers to be eligible for the Basic Farm Payment) – mandating compliance with recognised best practice (as recommended by the Government in ELS Handbook EJ10, and already practised by some farmers).

Endnotes

¹ FAO statistics <http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor> [accessed February 2015]

² Statistics from the International Grains Council <http://www.igc.int/en/grainsupdate/sd.aspx?crop=Maize> [accessed February 2015]

³ Defra Archive: Observatory monitoring framework – indicator data sheet http://archive.defra.gov.uk/evidence/statistics/foodfarm/enviro/observatory/indicators/c/c2_data.htm

⁴ Defra June Survey 2014 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/388470/structure-jun2014final-UK-18dec14.pdf

⁵ NFU Briefing, 'Anaerobic Digestion: can we attain NFU's aspiration for 1000 on-farm plants?' December 2013

⁶ <http://www.theguardian.com/commentisfree/2014/feb/17/farmers-uk-flood-maize-soil-protection>; <http://www.theguardian.com/environment/georgemonbiot/2014/mar/14/uk-ban-maize-biogas>; <http://www.theguardian.com/environment/georgemonbiot/2014/jun/05/the-farming-lobby-has-wrecked-efforts-to-defend-our-soil>

⁷ Palmer, R and Smith, R P, (2013) Soil structural degradation in SW England and its impact on surface water runoff generation' Soil Use and Man. 29:567 - 575

⁸ The Guardian, 'Maize farmers must take some of the flood blame' 25 February 2014

⁹ Parliamentary research briefing 'Flood defence spending in England - Commons Library Standard Note' 17 November 2014

¹⁰ Defra Farming Statistics: Final Land Use, Livestock Populations and Agricultural Workforce at 1 June 2014 – England https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/368373/structure-jun2013final-eng-30oct14.pdf

¹¹ Official biogas map, last updated January 2015 <http://www.biogas-info.co.uk/maps/index2.htm#>

¹² NNFCC Report - Anaerobic Digestion deployment in the UK; NNFCC; 22 April 2015; <http://www.nnfcc.co.uk/tools/nnfcc-report-anaerobic-digestion-deployment-in-the-uk>

¹³ Tamar Energy press release, 'Tamar Energy secures £32m in landmark financing agreement with The Royal Bank of Scotland plc' - <http://www.tamar-energy.com/news-press/press-releases/tamar-energy-secures-32m-in-landmark-financing-agreement-with-the-royal-bank-of-scotland-plc>

¹⁴ Biogas yield statistics sourced from <http://www.biogas-info.co.uk/index.php/biogas-yields.html>

¹⁵ Farmers Guardian, 'Taking maize for energy production to the next level' 31 October 2013

¹⁶ <http://www.biogas-info.co.uk/index.php/biogas-yields.html>

¹⁷ Der Spiegel, 'Corn-Mania: Biogas Boom in Germany Leads to Modern-Day Land Grab' (via Spiegel Online International) 30 August 2012

¹⁸ Farmers Guardian, 'Anaerobic digestion plants forcing up rents, claims TFA' 21 July 2013

¹⁹ Western Morning News, 'Land prices pushed too high for food producers' June 21 2014

²⁰ Based on an estimate of £180 p/ha x 183,000 = £32,940,000

²¹ Whiting, A and Azapagic, A (2014) 'Life cycle environmental impacts of generating electricity and heat from biogas produced by anaerobic digestion' Energy 70: 181–193

²² Searchinger, T., Edwards, R., Mulligan, D., Heimlich, R., Plevin, R., 2015 Do biofuel policies seek to cut emissions by cutting food? Science, DOI: 10.1126/science.1261221

²³ NFU Briefing, 'Anaerobic Digestion: can we attain NFU's aspiration for 1000 on-farm plants?' December 2013

²⁴ Based on an average annual yield of 8.4 tonnes of wheat per hectare <http://www.rothamsted.ac.uk/our-science/2020-wheat>

²⁵ Based on a yield of 45 tonnes per hectare:
<http://ecmltd.co.uk/education/>

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Report by

Georgia Farnworth
& Peter Melchett

Contact

South Plaza
Marlborough Street
Bristol BS1 3NX

t +44 (0)117 314 5000

Soil Association Scotland
3rd Floor
Osborne House
Osborne Terrace
Edinburgh EH12 5HG

t +44 (0)131 666 2474

f +44 (0)131 666 1684

www.soilassociation.org

t @SoilAssociation

f facebook.com/soilassociation