INTRODUCTION - ARE SOILS BEING FORGOTTEN IN THE SUSTAINABLE FOOD DEBATE?

This piece is written by Stuart Meikle. It is in response to the #SoilMatters article series on the ARC2020 website. ARC2020 is an independent NGO that gives a platform to a range of stakeholder voices on agri-food and rural matters.

Food production must account for climate-change and GHG's, provide good nutrition, ever-improve animal welfare, minimize pollution, enhance biodiversity, reward farmers and rural communities, and, too rarely mentioned, restore and maintain soil health and fertility. But it is only through the latter that we can link everything else together to create a truly sustainable food system.

If there is a universal panacea for our food systems, it lies within the way we now go about restoring the health and productivity of our soils. By saying such one could however be guilty, as is often the case, of allowing a single issue to dominate, whereas identifying a sustainable food system, differing as they must region by region, is a complex process that requires the joining of numerous dots across a broad canvas. Focus on one issue alone and consequences happen elsewhere. Nonetheless, as one looks at soil regeneration, the solutions for many of our other problems emerge.

The following summarizes my own ideas; albeit they are derived from researching the work of many others. What brings it all together is my own diverse knowledge of farming and food. They are not 'evidence-based' in the narrow, scientific definition of the term, as too much necessary research has been neglected over the years, so, to a degree, they result from careful thought and logic.

Instead of ending with a conclusion, the paper starts such and presents how that by addressing soil restoration in a specific way, we also address a myriad of other food-related issues. It concludes with seven policy suggestions for how a farming support scheme should look.

Food system transformation for our soils

We are told that our arable soils have sixty to a hundred years' harvests in them. From walking some of the fields of Eastern England in recent years, it is a statement that it is difficult to disagree with. If we are now to rely on natural weathering to rebuild soils, we are talking thousands of years to create very little. It is, however, the loss of soil organic matter that is of real concern because along with it goes both the microbial life that creates a healthy plant-growing environment and the very bottom of the food chains for so much of our declining fauna.

The soils of most of the World's broad-scale arable regions were formed under ancient forests or grasslands. The drainage of marsh and river flood plains created others. Of these, the peat within, say, the English fens has long been disappearing whilst those soils naturally regenerated by riverine action are limited or, worse, now urbanized. Although we focus on tropical forest clearance, much of which is linked to palm oil and soybean production, there should be no less a concern for the loss of

ancient savannah or grasslands. As a human society, we are still unsustainably consuming soil fertility by 'ploughing out' 'old' soils; not to mention releasing yet more highly stabile soil-carbon.

We could and should be looking to recreate new, 'ancient' forests, to sequester and store carbon, to create forest-grown timber resources and to regenerate soils. It may never be necessary for future people, centuries hence, to exploit these soils as we have done, but they should have the option. If they do, they will probably have learnt their lessons from history. We must, nonetheless, not overlook forests as food sources and there are plants and animals that can thrive in a woodland environment. We should not see forestry and food as mutually exclusive, it should be about both.

Rebuilding soil organic matter can mean vast composting operation to recycle organic materials and nutrients from the point of food consumptions [urbanizations] to food production zones. The latter may be rural and remote so while it may be feasible at a local level, it is hardly realistic on a global scale. We have been very successful at using artificial nitrogen to 'cycle' nitrogen, albeit with vast and polluting seepage and fossil fuel costs, but where does this leave the cycling of organic matter into our plant-growing soils? And it is the loss of soil organic matter that is so destructive, be it in terms of soil fertility and health or, crucially, its ability to hold and store moisture. And we should not overlook how vital healthy soils are to the broader water resource management issues.

From a practical perspective, the only instrument we have available to restore soil organic matter, soil health and soil fertility is the farmed animal. It is, nonetheless, not about farming animals in isolation of the land that provides their feed and fodder, it is about maintaining them near the land that sustains them. Further, they must be reintegrated, preferably through grazing, with the soils that we use for direct-for-human-food, plant production. The latter itself being unsustainable on a large-scale without constant regeneration. 'Regenerative agriculture' is no hollow term, it describes the food systems that we must reach sooner rather than later. This is, nevertheless, nothing new, it is to return to the farming husbandry that we understood for Centuries, and only recently forgot.

Food policy must begin with integrating livestock

The last significant writings specifically about British farming and food policy were published either side of the Second War and they make interesting reading. In them, the fundamental principle behind any policy was the maintenance of soil fertility. The foundation of food and farming policy had to be soils; and there was no debate about it. It was only since around 1960 that we have, policy wise, neglected the soil. The consequences have been massive and, if not soon rectified soon, will be even greater for coming generations. Simply, we have compromised their food security.

From here on it must again be all about soils. Surprisingly for some, the changes to our food system that soil regeneration will dictate, will begin to resolve numerous other food-linked issues; many of which will be highlighted below. Although some will continue to promote a simplistic 'eat plants for a sustainable food system' solution, we must return to integrated, nutrient-cycling, mixed farming. We cannot, however, continue to be profligate with animals in food systems and they need to be outdoors as much practicable and grazed in ways that regenerate and maintain soils, period.

Ruminants are a strategic resource that we must husband and use with care. How and where we use them must become the central pillar to farming and food policy; for wherever it is being written. If there is a universal panacea for our soils and, henceforward, our food systems, it lies with how we

manage farmed livestock going forwards. 'Eat less meat and dairy and eat better' is a positive approach, at least for the overly-nourished, but by 'better' we must recognize that the core principle of 'better' is that the food comes from farming systems that fully restore soil health and fertility.

To provide what for some will be a radical, even controversial conclusion, a sustainable food system is not about reducing animal-product consumption so to 'free-up' land for direct-for-human-food plants, it is about using the land now used for feeds for shipping to animals confined elsewhere, for grazing livestock, be they ruminants, pigs or poultry. Long-term we must live without divorced-from-the-land confined-animal 'farming', but we cannot live without soil-regenerating mixed-farming, livestock inclusive. It is all about returning to mixed farming systems on arable land [as per ley-farming] or soil-focused, pastoral, grazing livestock systems on permanent, multi-species pastures, including 'agro-forestry' woodland and orchard pastures.

PART ONE – THE BENEFITS TO SOCIETY OF SOILS-FOCUSED FARMING

The conclusive statement within Part One was that "we cannot live without soil-regenerating mixed-farming, livestock inclusive". It will be controversial for some but only to those who are single-issue focused. To create a sustainable food system is complex as it is about finding the best fit to resolve many issues, even if in doing so we do not find the perfect answer to any one of them. Focusing on soil-regeneration as the catch-all will, however deliver a multitude of benefits.

1. Reducing the GHG emissions from producing our food

As eating is a day-to-day necessity, is there an acceptable level of GHG emissions from food systems? With so many humans living within urban conurbations it is unlikely that food-system emissions will ever be zero. It may be feasible to minimize production emissions but there is still processing, packaging, transportation and distribution to consider; all necessary when taking food from rural to urban areas. Carbon-neutral farming must, at least, be a goal.

Transporting food creates nutrient flows that are rarely closed cycles as little human waste is returned to the land from which the food was sourced. The same goes for when we locate farm animals close to human urbanizations: the farm 'waste' occurs far from the place where the animals' feed, which is usually grain but there are major movements of fodder too. Whereas weeds may be plants in the wrong place, nutrients so become pollutants. As a society we pay to replace nutrients lost from the production location and to handle the various pollutants created elsewhere.

We have mined nutrients for years as we have broken cycles; but as with carbon loss from soils, such is no longer an option. With nitrogen it has been artificial nitrogen fertilizers that have allowed humans, their pets and disconnected farm animals, to live lives independent of the soils that produce their foods. With carbon, it has been through the exploitation of fertility [as soil organic matter] built up in the soils over millennia under forests or native grasslands; the latter being grazed by equally native fauna. Urbanization is fact, so we now must seek to sustainably feed populations living in 'unsustainable' locations.

There is a heavy fossil fuel cost associated with nutrient replacement into food production systems, not least with the Haber-Bosch process and, thankfully, much is being done to get smart with the production and application of nitrogen fertilisers. Their use, however, does little to rebuild the

organic matter in soils, often so depleted by continuous plant cropping. It is also time we asked, just how detrimental an impact does artificial nitrogen have on the functioning of the soil biome?

Realistically, the only low GHG emissions mechanisms to replenishing organic matter and nutrients is by using legumes to fix atmospheric nitrogen and to return composts and 'processed' manure to the soils. Given urbanization, compost-based recycling opportunities are very limited. Hence, it is only through managed grasslands and forests, that we can rebuild secure, robust food systems founded again upon fertile, healthy soils. The bonus is, of course, that in restoring our soils we also return carbon from whence much of it came.

For those approaching the issue one-dimensionally as per, say, GHG or promoting plant-only diets, it may be difficult to grasp, but we can only approach carbon neutrality through judiciously using livestock raised on forages supplemented by locally-sourced feeds and food-processing by-products to produce nutrient dense foods that can be efficiently transported from rural food-producing areas to urban, food-consuming areas. Sustainable feeding urbanized humans and their pets is difficult enough, but we have exacerbated the issue by also 'urbanizing' too many farm animals.

Methane is, nonetheless, a major GHG problem and that must be reduced, captured and utilized as a fuel, or its carbon recycled within the farming system. Methane is a part of the process by which some indigestible-by-humans plants are converted to digestible foods [by ruminants], not least in environments unsuited to the growing of crops that can be directly utilized by humans. When methane is necessarily produced, we must ensure that the farming system is designed to cycle carbon back into the soil efficiently and effectively.

If, as more farmers are coming to believe, carbon can be effectively sequestered into soils while rebuilding organic matter, we must encourage farmers to do so. Meanwhile they must grow crops, be they rotated or permanent, food or forages, to minimize carbon losses. Grazing livestock, which predominately means ruminants, are going to be vital to these systems. We must not, however, in the pursuit of GHG reductions in isolation, look to plant-only diets as our soils will not sustain them.

2 Better nutrition and health and lower healthcare costs

What we eat and what we are recommended to eat has a major impact upon our environment. 'Eat less meat' is an increasingly common statement. However, 'eat less meat and dairy but of better quality' may be the statement that results in a more resilient food system. That's f by 'better', we mean animal-derived products that are sourced from farming systems that regenerate soils.

There have been many nutritional messages provided by governments over several decades, but there is rising controversy over what constitutes a healthy diet. With so many eating-related disorders around, further dietary guideline change is almost inevitable. Creating a sustainable food system when such flux exists is not easy. If it is to be evidence-based, it may be the case that we are still years away from even having a technically-sound starting point.

Fats are a necessary part of a diet. All fats are, nonetheless not equal, and, over the years, people have been recommended to consumer different fats. At its simplest, it has been about moving away from consuming animal fats to vegetable fats. One result has been the massive expansion in palm oil production, a crop associated with massive tropical forest deforestation and extinction risks for numerous species reliant upon such habitat - unforeseen but definitive consequences.

Many people would like to consume quality plant-derived fats like those from olive or avocado, but severe production limitations mean that their availability and affordability is limited [nuts are widely seen as nutritionally positive, but the same applies]. Can we all live on beans? Maybe, but we must look closely at the environmental costs of vast-scale, mono-cultured beans; albeit many of the costs are attributable to producing proteins for pigs and poultry rather than directly consumed beans.

We frequently see chicken promoted as the healthiest of meats [as it is low in fat]. Thus chicken [and pork] consumption has risen sharply [also helped by industrialisation driving down costs]. The availability and cost of chicken meat has been possible due to the expansion in soybean production in South America. This has happened at the expense of savannah and the Pampas grasslands [not to mention the chickens]. Apart from habitat destruction, monocultured soybean has released carbon from what were previously long-term carbon stores; a recent example of what long-since happened in northern hemisphere, temperate grasslands. Again, unforeseen but definitive consequences.

Obesity and its associated illnesses has become rampant. It is placing massive pressures upon health service budgets around the world. Of course, that means greater scrutiny is being placed upon what we eat, in lifestyles and nutritional guidelines. A common response has been the promotion of plant-based diets. It is assumed that they are both healthier and more sustainable - but are they? If one factors in the necessity to regenerate soils, that have often been depleted by continual plant production, questions should be asked about the actual sustainability of plant-only diets.

The finger is increasingly pointed at sugar. It is also pointed at fats. If, however, one considers that all highly refined carbohydrates swiftly convert to glucose and should be considered as ‘sugar’ one wonders where our energy will come from. Fruit juices are now seen as a concentrated source of sugar but how long will it be before potatoes, bread, pasta and rice are added to the list? Wholemeal versions may be better from a fibre perspective, but they still have a high glycaemic index and will look less healthy if the focus switches to eating lower GI foods. And when the focus does change, it will turn the whole ‘what is a sustainable diet’ conundrum on its head.

As dietary management focuses on managing blood sugars and the avoiding of blood sugar spikes within normal eating patterns, dietary recommendations will change again. It appears that the human system can handle high, multiple-times-a-day, blood sugar surges for less than a handful of decades until a rising inability to do so triggers numerous health issues. Few are likely to escape the consequences of excess blood-sugar loading. Exercise may help but not if it is being fuelled by the over-consumption of the ‘easy-sugars’ complex of foods.

Often overlooked is the impact of frequent ‘hunger’ during the day and there is an associated link. Foods that leads to being sated, will become a key aspect of fighting obesity. Counting calories will not help if those calories still trigger significant blood-sugar fluctuations and, thus hunger.

The combination of the above will change our approach to foods and it will emphasis nutrient dense, lower GI foods over high-GI carbs. They will be plant based and animal derived and focusing on their production will change perceptions of what is now considered sustainable food production. As we move away from a diet where the calorific ‘weight’ comes from high-GI carbohydrates, the focus will fall upon high-quality fats and proteins from both plants and animal sources.

If one is to predict what a sustainable diet is going to look like in 10 or 20 years' time one would suggest that it will be about low-GI carbohydrates, with the emphasis on vegetables, plant-derived proteins and fats and a more selective approach to animal-derived proteins and fats. For the latter, it will be about nutritionally higher quality products from pasture-based systems that use minimal quantities of 'imported' grains. One's expectation is that there will be an increasing evidence base that animal-products derived from animals that graze diverse pastures [as opposed to just having access to outdoors 'free-range' space] will provide healthier sources of fats and proteins.

For the last half a century we have endured all sorts of nutritional guidance. This has meant, for example, that eggs have been good, then very bad and now good again. Another is that we have gone from butter to margarine and back. Certain animal's fats are now in vogue [although there are those who argue that they shouldn't be]. For some, red meats are an invaluable food source that has been falsely maligned and that 'red meat' is a term that encompasses the good, the bad and the ugly. They, along with a selected class of 'better' animal fats will be an important part of human nutrition going forwards; we just need to be far clearer in our understanding of their qualities.

Perversely to many, the cropland freed up from grain production for animal feeds should not be used for more human-consumption crops; it must be grazed by livestock within rotational farming systems. The rationale here is that a sustainable diet can only be followed if its foods are derived from sustainable, soil-fertility-maintaining farming; and that means keeping pasture-living animals. If that is indeed to be the case, we need to recognize that a sustainable diet and, hence, food system must be built from the ground up, or more literally, the soils up. There is no alternative.

3 Reducing the pollution from our food production systems

Is there a direct correlation between the separation of animal farming away from the soils that grow their feeds and forages? Is this responsible for a wide array of the pollutions attributable to human food production? As we have pursued means to supply large, urban populations with affordable animal-derived fats and proteins, has pollution become inevitable? Are we now deluding ourselves by ignoring externalities and the true cost?

Not only does geographically separating feed and forage production from farm animals incur transport costs, it also means that nutrients end up in the wrong place. As a plant in the wrong place can be called a weed, a nutrient in the wrong place can become a pollutant. Leaching from a broken cycle can be into the atmosphere and into the waterways. The 'dead zone' in the Gulf of Mexico is a case in point. Many others of lesser magnitude certainly occur around the globe. When it comes to our marine and fresh water environments, drinking water inclusive, at what point will nitrates become the next 'plastics'? It will happen, and it will have a massive impact upon food production. And it will not just be about leakage from large-scale animal-confinement farms, it will be about emissions from spreading manures, slurries and artificial fertilisers.

An issue that one is still to hear much about is how these nutrient-rich farming wastes, sometimes more rightfully called fertilisers, and artificial fertilisers impact upon the health of the myriad of organisms that reside in our soils. We are short of knowledge about the importance of such life to crop production and we are as equally at a loss when it comes to understanding the impact that manures, slurries and fertilisers have on soil health. We are probably still treading a fine line between fertilising our crops and polluting the environment of a myriad of invaluable organisms.

Are we guilty of assuming that all manures and slurry applications are beneficial? Are we only looking upon them as vital nutrients to feed crop plants? Do we forsake the health of all other organisms in the pursuit of fertilizing our crops? Do our dosages of 'artificial' inhibit natural mechanisms from providing for crop growth? Yes, we are getting smarter in their use, and their rising cost will only encourage us to do so further, but how strong is the correlation between our reliance over the last sixty years on 'artificials' and the decline in our soil fauna and, hence, soils?

Taking it one step further, many farmers are being encouraged to inject slurry into soils to minimize GHG emissions. Investing in equipment is often cited as an example of 'smart' agriculture and a way that food production can reduce its GHG footprint. In some circumstances, the tax payer is even funding the low-emissions equipment used. In the natural environment, most animals 'wastes' are discarded upon the surface and nature has mechanisms to process them, they are not injected below the surface. Are we, therefore, injecting untreated animal wastes into our soils without considering the impact it will/may have upon the soil biome? Is this another case of not joining the dots and spotting the unforeseen consequence? Are we blissfully unaware that we are polluting another environment, albeit one that we too often consider to be inert?

Rebuilding our soils must be about recycling nutrients to our soils in a fashion that is beneficial to soil health. We must do in way that minimizes nutrient/pollutant leakage and in a fashion that minimizes the costs of transporting nutrients and/or replacing those that have been lost from our food-production localities. At the centre of all is the choice of food production system and how well it can mimic the natural cycle of nutrient harvest and return. When people talk about carbon-neutral food production, it is these systems that we must aspire to, but what are they? Sadly, it is a journey upon which mainstream 'conventional' agriculture has hardly started out on.

Although some are against animal farming on principle, grazed animals are vital components to sustainable food systems. Realistically, mega-scale composting aside, grazing animals are vital to nutrient recycling. Further, they are vital to returning carbon and organic matter to soils on a broad-scale. There is just no other solution. It is far easier to mimic the natural cycles with them than without them. It is such systems, allied to nitrogen-fixing legumes [to GHG-effectively recycle nitrogen lost in human foods back to cropland via the atmosphere], that will allow a move towards farming systems that are carbon neutral and soil benefiting.

As a footnote, this is not about using 'grass-based' livestock systems, it is about managing multi-species swards. It is also about adopting specific grazing practices that focus upon soil health and returning carbon and organic matter to soils. It will be about very careful use of externally-sourced nutrients, be they artificials or animal 'wastes' from winter housing. Within crop rotations, it will be about building fertility that can be later harvested from human-food crops. It will be about reducing carbon loss from excessive cultivations. Where pastures are permanent, it will be about maintaining permanency and not regularly reseeding swards, exhausted by successive and excessive defoliation.

Finally, in the context of total food systems, fossil fuel usage must be increasingly scrutinized. From a dietary perspective, nutrient dense foods will become the preferred choice, not least to stave off the constant obesity-causing, Type-2 diabetes-inducing hunger that comes with high-GI-carbohydrate dependency, but their production must not be at the expense of polluting our air, water and soils. Such nutrient-dense foods must not, however, come from 'out-of-a-natural-context', large-scale, confined-animal systems. We must focus upon minimizing the footprint from transporting nutrient

dense food products from where they can be most ‘naturally’ produced to urbanizations. Our current system of placing farm animals in convenient, intermediate, ‘financially-efficient’ locations creates far too many polluting externalities and it must change.

PART TWO – THE ON-FARM BENEFITS OF SOILS-FOCUSED FARMING

1. Restoring and enhancing our farmland biodiversity

Nobody can be unaware of the severe biodiversity loss that has occurred on and above our farmland. The plight of the larger species inevitably draws more attention, their disappearance is obvious as they are no longer seen or, as in the case of an iconic species like the corncrake, heard. Nonetheless, is their loss directly detrimental to our food systems? They may not be; albeit the answer is more likely to be that we do not know. We must not, however, rely on ignorance as a justification for inaction. We should not assume that our current approaches are right simply because we have not researched the consequences; or even attempted to logically construct a flow of implications accruing from actions. We, as a species, also have no right to drive others to extinction in the name of our own food security. It is also about our moral responsibilities.

Pollinator decline is a major threat to human food security, period. While there is widespread public awareness that climate change will impact upon our food systems and little about the grave risk posed by soil degradation, the precarious position of the pollinators falls midway between the two. Those in the know do, nonetheless, appreciate that human food production is not sustainable unless we swiftly reverse the decline in the numbers of those that pollinate our food crops. One can also assume that their decline is having an impact upon the food supplies of other, less adaptable, species. Farmers can source bees to pollinate, but no other species can act in such a manner.

Minimizing the use of insecticides directly linked to pollinator loss is important and it is unfortunate that it requires legislation to bring about change. For food security reason the concern is about pollinators, but do we truly know how damaging the array of insecticides used is to those creatures that inhabit our soils? Just how much damage are our chemical cocktails doing to the bottom of so many food supply chains? It is quite possible that we are losing entire farmland food systems but only just seeing the tip of the iceberg with birdlife loss. To say so may be ‘anti-farming’ but, it is a view shared by more farmers as many again increasingly focus upon understanding nature.

There is no such thing as a sustainable food system that places short-term expedience ahead of the long-term interest. Our food is not just for today, it is about all our tomorrows. Judging by the reported state of our soils, we have yet to learn this lesson; albeit it is one that has been well documented by others that a civilization that ignores its soils sooner or later falls into decline, even disappears. Our modern variation, is however, more extensively damaging in that we have gone beyond simple soil degradation to harm other core components of our food-producing capacity.

Recent concern for our soils has rarely gone beyond their nutrient status as per the immediate needs of the growing crop, the availability of sufficient water or its removal in times of surplus, and accessibility for machinery and livestock. Anecdotally, from a very young age I was aware that far more power was being required to cultivate the soils, a sure sign of changes to our soils. Conservation tillage, no-till and cover crops are in increasing use [often with a focus on minimizing soil carbon loss] so farmers are becoming more aware of their soils than probably 20 years ago, so it is not all negative. We still, nonetheless, need to be focused more on the ecology within out soils.

I am not an ecologist, although I now wish I was. I am, however, confident in my belief that serious biodiversity loss has occurred on farmland over the last seventy years or so and that it can be traced back to a disrespect of our soils. My supposition is that the soil biome provides the very foundation

of all farmland food chains and the visible above ground biodiversity loss is only a reflection of what is happening below the surface. Hence, we must regenerate the one to recover the other.

To restore soil biodiversity, we need to restore diversity to our farming systems. There is no longer room for growing monocultures or monocultural thinking within arable cropping or grassland management. The latter is often no better that the former, albeit it is less visible to the untrained eye. We cannot continue to see a separation between farmland and ecological focus areas. We must integrate one with the other. Soil regeneration and fertility-farming must be central to productive farming and food systems going forwards. Thankfully the farming practices needed will also regenerate biodiversity above and below ground. If we restore the wellbeing of our soil fauna, most likely it will be accompanied by a recovery of our visible flora and fauna. Simply, farming needs to target restoring bio diversity every-which-way to our farmland. And while doing so, we need to ensure that the systems utilized are the best at producing the right foods and viable farm incomes.

Thus, there is a positive biodiversity scenario, but it will only happen if we recreate our farm-to-fork-to-farmer food systems to ensure that they present the most sustainable option for farmers. We must stop thinking in terms of separate environmental schemes and address how to mainstream ecologically-based farming practices. They must be linked to markets that reward farmers. Soil restoration is not about providing financial support to farmers in the name of food security, it is about ensuring that normal market rewards provide the resources to protect and enhance our soils. Investigating the how does, nonetheless, highlights how much food-system change is needed.

2. Water catchment, retention and flood management

There are benefits from a soils-focused approach to farming and food that will deliver benefits to society and to the farmer. Improved soil retention is one of them.

Notwithstanding trafficability, improved water-holding capacity can only improve the productive capacity of soils, not least during periods of drought. The use of minimum tillage on arable soils should also deliver trafficability, a more dynamic soil fauna and better water retention. All will be necessary if we are to live by eating more plant products directly. Agroforestry and growing permanent trees for food should be an obvious expansion. With grasslands, we must be looking to minimize soil disturbance and to build diverse, highly-persistent swards. Long-season trafficability will be a problem on arable-rotation leys but it should be less so if our pastures are truly permanent.

Employing practices on farm to minimize soil run-off must be an absolute priority. Cropping and cultivation practices that result in soil loss and silting of waterways must end, period. Not only do they incur downstream costs, it is probable that where farms are losing topsoil to water erosion, they are not employing any soil rebuilding practices. Relying in the natural erosion of subsoil to replace losses takes millennia to generate very little and it is not an option. That soils are still being exploited to the point of erosion by wind and rain is a failure of our times and illustrates how slow we can be to learn lessons. Simply, all farmers must adopt soil regenerative practices and encouraging and supporting them to so must be a keystone of food and farming policy. Sadly, it appears that regulation through cross compliance is likely to remain necessary.

Upland soils may yet prove to be a different issue again. At some stage soon, their role in producing food will change. For the present lamb consumption in northern Europe is in decline and will for upland sheep farmers to continue it will be about producing specialist meat products. More so if we

find that sheep must return to lowland arable farming to support human-food growing soil restoration and, for example, blackgrass control. Upland farming support will then be channelled in the direction of water catchment management, ecological hot-spot management and landscape preservation. Food production will become a specialist product business integrated with these 'public service' activities. One would hope that agroforestry comes to the fore in a way that food can be integrated with upland woodlands effectively. When it comes to upland soils, their management will first require society to identify the role they and their farmers are to play going forwards.

3. Enabling us to further enhance farm-animal welfare

As food markets develop within a media-rich environment, meeting the animal welfare expectations of consumers and society will only rise in importance. It is an important food product differentiator; an importance that will only continue to rise. The farmers who wish to maintain a presence in the upper echelons of the food markets, will have to react accordingly. And society must ensure that they are rewarded for doing so; ideally through efficiently market mechanism. Not least because farming system change means investment and the rewards must make that investment feasible.

Our ambitions to enhance animal welfare must be integrated with our yet to be fully recognized ambitions to restore soil health and fertility. Indeed, they must be integrated with our need to rebuild soil humus and carbon and capture carbon and return it into long-term, below-ground storage. At times we will have to utilize these stores for food production, but that must [again] happen within the context of cycles as opposed to 'mining'. If one believes that animal-derived products must come from animals that lead as natural a life as possible, free-range, grazed and farmed within a soils-first system must become the default choice. And those animal-derived-products must be sold to the consumer as such. We need to change farming systems but, equally, consumers must be willing and able to support [and pay for] that change. We do forget the able, in that it must be both affordable and accessible. For that we need to review our food-supply chains.

If we consider that soil restoration is the priority of food production and a necessity for food security going forwards, it comes with every opportunity to enhance animal welfare. Is it a coincidence that systems that compromise animal welfare are also those that have led to the creation of 'farming' systems that have major negative impacts upon our wider environment? It is not well-managed, pasture-based animal-farming that has led to planetary degradation; a point that many have yet to appreciate. We need to fully understand their role and to return to them; it will benefit our climate, our soils and, if humans continue to choose to exploit them, the welfare of farmed animals.

4. Returning to farming systems that allow Nature to work

There is no single reason for soil degradation around the world. Within pastoral systems it may be through over-grazing, although in places it may be due to poor grassland management. Within arable systems it has been the use of continuous cropping. Our ancestors, when few, were able to employ 'slash and burn' land clearance for their food-plant growing. They would clear an area of its native plant cover and exploit the latent fertility built up by naturally regenerative processes. After a while the fertility decline meant it was time to move on and to allow Nature to regenerate the soils. It was exploitive but human population pressure was such that it remained sustainable.

It may seem improbable, but I have seen this occur within the boundaries of the European Union. There is at least one location where land is sufficient and populations low, that the arable land has

been rotated in and out of cropping. It is in a region where native legumes are abundant, and the land is farmed in narrow strips; thus, allowing the highly-diverse plant life to swiftly recolonize arable strips when left idle. The soils or course remain alive. It is, however, very rare to be able to witness the regenerative powers of Nature where human interference is sporadic and relatively minimal.

The last wholesale 'slash and burn' probably happened in western Europe in the Second World War with the ploughing up of pastures that had never previously been cultivated. Their fertility was utilized to sustain populations during a period of dire food insecurity. Even then it was noticeable how swiftly that fertility, built up over generations, was lost. It is likely that very few of those soils have ever been allowed to recover naturally as post-war food-security orientated policy coinciding with the rapid development of agricultural chemistry meant that mixed farming fell out of vogue.

Whereas 'slash and burn' was employed over small areas, lasted for a few years and happened within an environment rich enough in native species to allow swift natural recolonization of exploited lands, are we now seeing the results of the same exploitive practice, albeit we have been able to manage the decline for long enough to convince ourselves that our 'modern' food systems are sustainable? Has agricultural chemistry allowed us to create a Fool's Paradise where abundance appears to be everywhere but where the abundance is still really time limited? It is a question that must be asked bluntly and answered truthfully. We can only then plan how to go forwards.

5. Farming to preserve our valuable food-system technologies

An aspect of our modern farming solutions that should be of major concern is their resilience. We are increasingly aware of the declining efficacy of antibiotics within human healthcare and their use within agriculture will be constrained. Few will question the necessity. The same efficacy decline is happening with animal health products and pesticides within plant-production. Apparently, we have under-estimated the ability of natural evolution to resist our man-made 'solutions'.

The efficacy of weed-killers, wormers and fungicides is declining. As, for example, herbicide-resistant blackgrass becomes prevalent, are we able to develop new herbicides fast enough. Can we approve them fast enough? Should we? There are advocated for short-circuiting the approval process, but will doing so ignore the lessons of history? Just how many agrochemical products are no longer allowed on safety grounds. Solving one problem often seems to create another.

For the mainstream farmer in the UK, it will have come as a shock that an elder statesman of farming journalism could suggest that sheep may have to return to arable-crop rotations to control blackgrass. It will be of no surprise to those in the organic sector or well versed in the many pre-1960 writings about agricultural husbandry. Another interesting idea is the growing of wildflower strips within arable fields to provide havens for those creatures that naturally control insect pests.

There are many such solutions emerging and we will come to recognize that the major benefit of an organic movement that provides only a few percent of our food, is that the sector has also moved husbandry research forwards outside the mainstream of conventional farming. The transfer of ideas from organic to conventional will now help combat efficacy decline. Profligate use of agrochemical will not be a part our future food system and they will be applied with caution or only preserved for 'emergency use' only. Saving antibiotics is only the start.

The use of genetic modification has its advocates. It is nonetheless a technology that is associated with destructive monocultural crop-growing and herbicide resistance. As a technology it almost certainly got off on the wrong foot and has been fighting a losing public relations battle since. Its future use in general food production will likely be marginal. Within mainstream crop-growing, declining-over-time, varietal disease resistance can be common, so one should never under-estimate the importance of plant breeding to rejuvenate the natural resistance to, for example, fungus diseases. Hence, we need to be discerning when discussing the important role of plant breeding.

In addition, while being concerned about efficacy we must ensure that our food-producing technologies are not counterproductive. Do we truly know the impact nitrogen fertilisers or untreated animal 'waste' or regular insecticide use have on the soil fauna? We probably do not. We must be more diligent in finding out what is happening within our soils and while deploying 'smart' solutions to reduce agrochemical usage. It is almost certainly necessary for soil health, to minimize farming's impact upon the wider environment, and to improve farm incomes.

Thankfully many of the agricultural practices needed for soil regeneration are also able to counter Nature's evolving resistance to manmade solutions. For example, with the animal health, just how much can be achieved by returning stock to outdoor, more extensive environments, using mixed-species grazing and grazing multi-species, herb-rich swards? If it is accepted that crop rotations are again a necessity to combat herbicide and fungicide resistance, at least the accompanying more extensive use of legumes will come with positive, soil-improving, nitrogen-fixing benefits.

When it comes to antimicrobial usage in farming there is significant differences between cattle and sheep and pig and poultry farming. The former may generate more GHG emissions per unit of produce but that should be balanced against the carbon that can be sequestered by pasture-farmed cattle and sheep, their minor usage of brought-in feed grains, an ability to thrive on multi-species, biodiversity-enhancing pastures and a much lesser need for antibiotics. Well managed within arable systems cattle and sheep will also rebuild soil fertility, carbon and organic matter. They can also play a role in weed and disease control. Food is all about complex husbandry and not simplistic solutions.

PART THREE – MAKING THE TRANSITION TO SOILS-FOCUSED FARMING

When one looks at what is sustainable production from a soils-first perceptive, one realizes that while climate change as food production is a major source of GHG emissions, focusing on soil restoration offers a multitude of benefits. If there is such a thing as a silver bullet when it comes to how we produce our food, returning our focus to building and maintaining soil fertility is it.

Also, given that a significant proportion of our increased atmospheric carbon has originated from our arable soils, it is where it must return. For many decades now, we have exploited the carbon deposits of millennia, be they from cleared forest or ploughed grassland and that must halt. We have continued to release carbon accumulated in soils and we must stop. Farming now must all be about how to regenerate our soils and accumulate soil-carbon stocks again.

I, like others, have concluded that some populations do need to eat less meat. Simultaneously, it must be about wide access to better quality meat and dairy produce. And by better one means its eating and nutritional qualities, ethical and rural-society-supporting properties, and the way its production delivers for the environment while regenerating and maintaining our soils.

However, where I differ from others is to say that eating less meat and dairy is not about freeing up the land used for grains to feed livestock so it can grow direct-from-the-plant human foods. It is about using that land, managed within cropping rotations, to graze livestock. In the extreme that we do not consume animal-derived products, we will still have to graze animals to build soil-fertility, such is their importance. There are also vast areas only suited to pastoral systems and there it is about how that land is best managed with livestock. Removing them is not the answer. There are few locations where stockless farming is the most appropriate system and where it is practiced its impact is often severe.

My rational is that it is only by so integrating pasture-reared cattle, sheep, pigs and poultry with food crops that we can efficiently close nutrient cycles and return organic matter and carbon to soils, restore degraded soils and produce nutrient-dense foods for a growing human population [noting that nutrient density is about food transport efficiency and our nutrition and health]. Categorically, food and farming must be foremost about soil restoration and maintaining soil fertility. The alternative is to rely on ‘synthetic’ foods that may yield unknown consequences for health and resource-usage.

One can say that our food systems are facing the most complex array of problems in human history. There will be further global population growth, but the problems are such that intensifying current food production systems will not work. In too many ways their resilience is already failing. It is also extraordinary that population growth is cited as a reason to intensify production in land-limited regions while land-rich countries have failing food systems, often due to endemic corruption. Feeding the World in 2050 is about resolving the latter, not further stressing the environments of the former. Of course, if one ignores many of the externalities, the intensification option can look attractive.

Nevertheless, the magnitude of the difficulties only truly come into focus when one accepts that soil degradation and loss is so great that their future productive life can now be measured in decades.

Thus, 'crisis' is a major understatement for what will face the younger humans who are already alive today. Tinkering around the edges is no longer an option, we must change significantly and change swiftly. If not our children and grandchildren face a bleak future. As for us of the older generations, we must face up to the responsibility of repairing our damaged food systems now, not later. And for that, we must start with prioritising the fertility of the soils and the health of all that live within them.

1. Support for building robust, soil-first food systems

Implementing major change will incur significant costs to food producers. Within a European context, support is provided to the primary producers, often to the extent that it is the main provider net farm income. It is not an acceptable position, but it exists because prices have moved towards 'global' levels, albeit the products of concern are entirely produced and sold within a local or national market, while farms frequently remain small and cost inefficient. As the Sustainable Food Trust, recently pointed out, the externalities of food production are massive and not reflected in retail prices. Hence, cheap food on a total cost basis is a myth. Food is also not just about cost, it is more complex, and consumers can value numerous quality characteristics; locally produced and traceable being but two.

It is therefore reasonable to assume that taxpayers will retain a willingness to support farmers but in doing so they will demand a greater say in the production methods employed. Food security is often given as a justification for on-going farm support, but it is fatuitous argument if it is not recognized that support must be exchanged for the restoration of soils and the maintenance of soil fertility.

For farming to return a soil-fertility-first approach to food production will inevitably mean change. It will mean less single farm enterprise specialization and more 'mixed' farming. It will mean returning farm animals to land that may not have carried stock for half a century or more. It will be a radical change and have cost implications. The multiple benefits from doing so should, nonetheless, outweigh the costs. If one accepts the necessity for change, farm support needs re-focusing to encourage it.

We must not, nevertheless, replace one support system with another. A failure would be to change farming systems and remain in a position where annual payments are still needed to provide farmers and growers with sufficient for farm household income. Change needs to be comprehensive, but it must occur alongside reformed and improved linkages between the consumer and primary producer.

There is the argument that public goods should be paid for. We must, nonetheless, reach a point where soil maintenance, biodiversity preservation and water catchment are integral to normal farming system rather considered a public service. There will be exceptions to the rule in terms of public access, landscape management and specific, 'hot-spot' ecologically-focused schemes, but we should ensure that into the longer-term, markets reward farmers; albeit that there will have to be a transitionary period to get there. Agricultural policy must now be about managing that transition.

2. We must focus upon change and not the status quo

The Common Agricultural Policy is due for another reform and the UK is going its own way and will create its own farming and food policy. Will either deliver much-needed radical change? It is unlikely due to the lobbying power of many involved. There are also vested interests that would prefer the

status quo. The position of some farming lobbies is an interesting one; why do they so voraciously support the continuation of a system that apparently does not deliver a sustainable farm income for the farmers that pay them? Is it just that they lack the vision to see better, viable alternatives?

The fear is that CAP reform and/or the development of new UK policy will neither recognize the need for change or introduce radical enough mechanisms to support farming through necessary change.

The car industry is now providing an example of the change required with its intended departure from the internal combustion engine to electric and/or fuel cells. It has reached a point where Society and its consumers are demanding change. The difference between car manufacturing and farming is one of scale and that individual farmers are unlikely to be adequately capitalized to handle such change. Hence, within the farming-food mix is the consumer-taxpayer. Eventually, it will be their combined purchasing and lobbying power that will be the dictating force behind policy. It is only a case of when. Farmers must prepare for change, embrace it, and ask for support to make the transitions needed.

Four principles should govern future payments made to farming and rural communities under a new food, farm and rural policy. They are, a) that they compensate farmers and land managers for income forgone, b) they reward the same for achieving public-interest-targeted actions, c) they must be tapered to allow business adjustment during transition periods, and d) they offer capital investments grants to encourage policy-identified changes to both farming systems and food supply chains.

A key objective must be to break the linkage between food production and annual payments. Farm incomes must be derived from the consumer and route-to-market mechanisms must operate to transfer a fair proportion of the retail price to the farmer. It is not about under-writing the uneconomic but ensuring that farmers who produce what consumers demand are rewarded for doing so. It is about ensuring that trading-relationship imbalances within the food system do not distort the connection between resource usage and investment and the financial rewards.

In recent decades, farmers have seen their influence over their routes to market dramatically eroded. Policy and support must be focused upon redressing this. While many farming organisations continue to resist any erosion of direct support, it is their failure to protect the farmers interests within their routes to market that has led to the farmers' dependency on production-support payments. If we are to demand that farm and food systems change, we must also support route-to-market change. It is the 'new' consumers desire for local, traceable, eco and animal-friendly food that now also provides the opportunity for reconnecting the farmer with the consumer and the consumer with the farmer.

3. What should new farming support mechanisms look like

To conclude this document, seven suggestions for farming support mechanisms are suggested. To facilitate change, the emphasis must move from annual payments to providing capital grants to support system changes. These could be in the form of grants for initial capital investments and capital allowances for asset renewal. Such a methodology would promote changes that directly focus upon policy-desired deliverables whilst not putting in place any long-term food production subsidies.

Further, capital grant availability must not be limited to farming and it should be accessible to those seeking to remove impediments to change within routes to market. It should also be available to those who wish to create products that are defined by how they are produced as it is only with such products that farmers and supply-chain intermediaries can fairly and honestly communicate with consumers.

After decades of support payments, it will be necessary to operate transitionary periods. Anything else will not be 'politically' acceptable. Into the long-term, annual payments must only relate to delivering environmentally-linked services like, for example, climate-change mitigation, rainwater catchment, biodiversity enhancement or landscape preservation. They must not be linked to food production.

Going forwards, direct farming-related payments must encourage specific farming-system change. These must be tapered as the changes must, in time, substitute one productive farming system for another. The market should provide the returns needed to reward the farmer for adopting changes.

Conversion-to-organic-farming payments provide an example. They offer 'compensation' for yield falls during conversion and because produce cannot be sold as 'organic' until conversion is complete. The rational used for organic farming should be used with, for example, adopting zero-tillage arable, integrating livestock into arable rotations, or establishing silvo-pastoral or agroecological systems.

The following provides a few specific pointers, but they are only a few as, like changing the food system itself, policy and policy mechanisms will be complicated. The whole must be amalgam of policies to address the many issues. It cannot be simplified even if the actual final objectives are.

a) Transitionary annual payments schemes

Farming-system change will take time and incurs costs. It is why countries where the belief in organic farming is greatest are willing to support farmers through that transitionary period. Such schemes now need to extend beyond organic to encompass regenerative-agriculture, agro-ecology, soil-first farming etc. It will be difficult in that some countries are still reluctant to support organic even though it is now a well-established and widely recognized approach to food production. That must change.

In theory, one could say that the future is 'organic'. That will, however, stifle innovation. It is also unlikely that organic as it is now defined is the complete package. Nevertheless, it will be challenging to develop and define farming systems that can be packaged so that the consumer at the time of product purchase can identify with the farming-system objectives. It will be difficult to create complex food-production solutions while defining them in a consumer-friendly way. It has been achieved with organic. so new farmer-consumer connections must not now be limited by a lack of ambition.

Transitionary changeover payments should be calculated according to the likely impact on production during any transition period when output is depressed and when there is no likelihood that the market will pay any 'new-farming-system' premium. Payments should be tapered and short to medium term.

b) Reintroducing mixed, rotational farming

Reintroducing grazed farm animals to arable land [from where directly-consumed plant-derived food products come] will, in many countries, be the single greatest change that has occurred in agriculture for a century. Such a change will require capital investment; especially so when grazed animals must be housed in GHG-emissions-minimizing winter accommodation. Technologies will play a part in reducing fencing costs, but drinking water is always needed. There will also be innovative solutions to animal ownership, land access and stock management but, whatever, the capital costs will be high.

The change will also have local employment implications. Farm animals require people and often the agricultural housing stock in arable regions has long since been sold off. Hence, policy changes must go beyond food and farming to include local planning and housing policy. A focus on 'better', higher-value animal-products should offer an often-long-awaited opportunity for rural regeneration.

Realizing a sustainable food system is not only going to be about policy changes at government level. It will require a mindset change by the many whose policies have been to persuade people that they must stop consuming animal-derived products. That manmade alternatives are not biodegradable often seems to go unnoticed. Thankfully, many environmental and food campaigners are now aware that it is about 'regenerative agriculture' and that it is about being highly selective when choosing which animal-derived products to purchase. We must, however, focus on creating policy mechanisms that make 'better' affordable to all and not just to the wealthier few. Beyond that there now needs to be a strong educational message about the importance of grazing livestock to soils regeneration, soil fertility, nutrition, healthcare, re-establishing biodiversity to farmland, and farm-animal welfare.

c) Housing farm animals to create products

Temperate locations where farm animals can be outwintered are few. It is almost inevitable that stock will have to be housed for a winter period; thus, incurring capital costs and the problem of 'waste' storage and handling. The term 'waste' is, of course incorrect in that farm manures, correctly used, are a valuable fertilizer. When it comes to their application to agricultural soils, it is likely that jury will be sitting on whether the spreading of unprocessed manures and slurry is beneficial or detrimental. Will their plant nutritional properties outweigh any damage they do to the soil biome? If it is the latter, there will be major problems for the entire livestock industry but especially for 'industrial-scale', year-around confined operations. If we find that we must soon look at livestock housing from a soils-first perspective, we may be staring at some of the largest investment needs in farming history.

Manures and slurry are currently looked upon as plant-nutrient sources. Their value as such partially offsets the costs of storing and handling. Well-rotted farmyard manure and composts are, however, also valuable as sources of organic materials for soil conditioning. Where livestock are reintroduced to arable regions, it is likely that housing will favour composting barns over slurry systems. They may also eventually become the default build in traditional livestock areas. In addition to compost, biogas systems must become the norm where livestock are housed, along with solar panels on the roof.

D. Providing capital re-investment grant aid

Governments must encourage change by offering precisely-targeted investment grants. If farming is to help mitigate climate change, restore soils and the natural environment, improve animal welfare

and reduce its reliance on production techniques that are losing their efficacy, major change over the coming years is inevitable. It means investment and support should encourage and facilitate such.

Governments should choose to offer capital investment grants [as opposed to open-ended annual payments]. As with the proposal for tapered, transitionary payments, capital grant provision is about encouraging and supporting system change, not replacing one set of direct payments with another.

After years of over-complicating grant provision, new grant schemes must be simple and efficient. We must move away from over-complicated, often business plan and cash-flow-based grant applications to schemes where those who offer the grants know what farmers need and what the typical costs are. Grant scheme management must shift to on-the-ground monitoring of expenditures and asset usage.

As mentioned below, ensuring that we have robust and resilient food systems means that farms must be economically sustainable. In light of recent experience, that will mean route-to-market investment in, for example, local, small-scale abattoirs to ensure that farmers and consumers have greater choice. Hence, capital grant provision should support both on-farm and route-to-market investment.

E) Scrappage schemes for dated technology

Scrappage schemes have become common place in the automotive sector as governments seek to see highly-polluting internal combustion engines with new generations of less polluting ones. One can imagine that when 'zero-emission' cars become widely available, such schemes will usher in the changeover. More so in urban areas. if we wish to see major system changes in agriculture, we should also consider a similar approach to aid the removal of highly polluting farming systems.

Adopting change will mean that the existing technologies will be obsolete sooner than anticipated. As an illustration, the widespread adoption of minimal and zero tillage will bring to end centuries of using deep cultivations. Such a change will have consequences for machinery manufacturers and farmers. There has also been massive investment in confined animal systems that Society may choose to make obsolete sooner rather than later. It will largely depend on lead-in time, but when swifter change is demanded the stronger is the case for introducing a scrappage schemes to help facilitate change.

F) Support to modify existing supply-chains

A central objective of any policy reform must be to avoid a repetition of a situation whereby annual production support becomes the norm. Annual support will be necessary where the provision of public goods occurs but that must occur independently of food production. That said, the *quid pro quo* of such a major change must be that food supply chains are capable of effectively linking the consumer to the farmer when it comes to rewarding the farmer for providing multi-characteristic foods that deliver upon multiple objectives. Inevitably, producer groups, co-operatives and designated-origin schemes will have to be revisited to provide effective supply-chain entities and linkage mechanisms.

There are occasional attempts to ensure that food supply chains are fair and equitable. Indeed, the EC is currently voicing its intention to regulate upon trading practices. Will that, however, be

sufficient? Recent decades have seen post-farm gate consolidation to the degree that there is a major trading imbalance between retailer and farmer. The consequences have been inevitable. It is not realistic to think that regulation can now bring about great change. From here on it is about supporting farmers and producers to introduce new routes to markets over which they have greater control. Inevitably they will be small-scale and local, but it is about ushering in more choice for farmer and consumer.

G) Farm-focused research and development

British farming's history is one of innovation. It was from the county of Norfolk that the four-course cropping rotation came, a system that was to underpin soil-fertility-focused farming for generations.

Over the last half-a century, research and development has moved away from the farm. As it has become more science-based its costs have risen and its very nature has taken innovation out of the hands of the farmer and into the hands of the scientist. A consequence of the later 20th Century agricultural revolution is farming that is now reliant on external research and bought-in inputs. It does not appear to have delivered in terms of farm incomes. Its resilience is now also in question.

As farming has become more reliant on technologies manufactured outside the farm-gate, we are discovering that many have high natural resource and environmental costs. The twin problems of these costs and efficacy decline means that food systems must become less reliant on off-farm technical solutions. This fits with a soils-first, husbandry-orientated approach to food production.

Recently, husbandry-focused research has been limited largely to the organic domain. There is also a body of non-mainstream research which has focused on alternative grassland management, carbon sequestration and soil regeneration. Farmers have also certainly not given up their own informal on-farm research. Sadly, there is often little financial incentive for agri-input suppliers to get involved with such work, thus little is being done. The question of who funds research therefore must be revisited. Simply, a future robust and resilient food system needs extensive public funding of farming research.

Reducing farming's reliance on the present suite of technologies does not mean turning away from innovation and technology. For example, precision farming techniques will reduce nitrogen fertiliser and pesticide usage and plant breeding will have no less a role going forwards than now. We must, however, again realize that technology plays a subsidiary role to farm management and not *vice versa*.

About the author

Stuart Meikle is an agricultural management and policy specialist, an economist, a writer and an advisor. He was brought up with agriculture and studied at the University of London. He joined the faculty on graduating and spent several years teaching, researching and consulting. His last 25 years have seen him advising governments, the World Bank and the IFC, NGOs, universities and private businesses in places as far afield as SE and Central Asia, the Caucuses, the Levant, SE Europe and the UK. Over the years he has developed a particular focus on agricultural and food sector strategy at the national and regional levels and linking rural development initiatives with the consumer through the food supply chains. He first arrived in Romania to work on a Commission project in 1997 and he lived in Transylvania for more than a decade from 2002; a location to which he was appointed as the United Kingdom's first Honorary Consul. Nowadays he and his family live in the Republic of Ireland.