Nanotechnologies and Food
Evidence to House of Lords Science and Technology Select Committee

Introduction to the Soil Association

The Soil Association was founded in 1946 to achieve sustainable and healthy agriculture. It is now the main organisation of the organic movement in the UK and certifies about 56% of organic farmers and 70% of the organic food sold in the UK. Organic farming is a management-based system which harnesses natural ecological and biological processes, rather than using synthetic chemical inputs. Organic farming now accounts for about 4% of UK farmland. Sales of organic food are worth almost £2 billion per year.

The Sustainable Development Commission has called organic farming the "gold standard" for agricultural sustainability. Research shows that it has significant environmental advantages over non-organic farming. It supports higher levels of wildlife, whilst reducing agrochemical pollution, waste, and halving the amount of fossil fuels needed to produce food. Because of these benefits the Government wishes to expand organic farming. Defra adopted an action plan for organic food and farming in 2002, with a target of 70% of the UK organic food market to be supplied by UK farmers by 2010, and public procurement to include organic food.

Soil Association standard on nanotechnology

As of January 2008, the Soil Association banned the use of man-made namomaterials from all Soil Association certified organic products. We were the first organisation in the world to take a practical stance on the use of nano particles to protect the public, ahead of any governments. Our lead has since been followed in Australia, where the Biological Farmers of Australia (BFA), the country's largest organic body, have now banned manufactured nanoparticles in certified organic products.

Under the Soil Association standard, organic producers and processors must **not** use ingredients containing manufactured nanoparticles, where:
• the mean particle size is 200nm or smaller, and
• the minimum particle size is 125nm or smaller

We recognise that this standard will have implications for some established manufacturing processes that produce nanoparticles incidentally, such as milk homogenization. However, we are not in a position to prohibit these now for many reasons: these processes are currently well established, there is relatively little awareness of this issue among the general majority of organic consumers and licencees, we currently do not know which processes produce nano-particles and to what extent. Until we research these more fully, we will not apply this standard to them.
There are many cases of naturally occurring nanoparticles, for example from volcanic eruptions or in wood smoke; these fall outside the scope of this standard.
The standard does apply to engineered nanoparticles.

Summary of reasons for the ban

The following section outlines the key issues and documentary evidence that led the Soil Association to develop the nanotechnology standard.

Organic farming methods are based on the use of natural biological and ecological processes. The use of synthetic nano-particles which would not exist in nature and whose basic physical structure has been modified at a very fundamental level is incompatible with this important organic principle as well as unnecessary. Specific concerns are based on information from:

1) the The Action Group on Erosion, Technology and Concentration (ETC Group)
2) reviews of nanoparticle safety undertaken by the European Commission and European Parliament and Swiss Reinsurance
3) the nanotechnology report by the Royal Society (RS) and the Royal Academy of Engineering (RAE), and
4) the UK government response to the RS and RAE report.

The RS and RAE state in the recommendations section of their report that '*The lack of evidence about the risk posed by manufactured nanoparticles and nanotubes is resulting in considerable uncertainty….We recommend that the UK research councils set up an interdisciplinary centre to research the toxicity, epidimiology, persistence and bio-accumulation of manufactured nanoparticles and nanotubes as well as their exposure pathways.'* The report also recommends a prohibition on environmental releases of nanoparticles and strict regulation of new nanomaterials. For details of the full report see http://www.nanotec.org.uk/report/chapter10.pdf

The UK government response to the RS & RAE report :
(see http://www.ost.gov.uk/policy/issues/nanotech_final.pdf) The UK government acknowledges the need for regulation of and the lack of scientific knowledge about nanotechnology. It places a moratorium on use of nanoparticles for environmental remediation and states that "*As a precautionary measure, in the interim, exposure in the workplace and releases to the environment should be minimised until the possible risks posed by nanoparticles and nanotubes are better understood*"

In a report commissioned by the European Parliament's committee on Industry, External Trade, Research and Energy (ITRE) it is noted that '*The release of nano-particles in the environment should be avoided. The state of research concerning [sic]...the behaviour of nano-particles is actually rather limited, preliminary as well as contradictory. Nevertheless, the advice to avoid the release of nano-particles to the environment might be appropriate and would be in accordance with the Precautionary Principle."*
(Haum, Petschow, Steinfeldt, *Nanotechnology and Regulation within the framework of the Precautionary Principle.*
Final Report. Institut für ökologische Wirstschaftforschung (IÖW) gGmbH. Berlin).

A subsequent preliminary risk analysis of nanotechnologies carried out by the Health and Consumer Protection Directorate of the European Community:

- highlighted that some engineered nanoparticles may have the potential to pose serious concerns ,the most significant ones relating to nanoscale technologies within the next 3 -5 years and require further studies (Subsection 1.1.1.2)
- revealed that panel experts were of the unanimous opinion that the adverse effects of nanoparticles cannot be predicted (or derived) from the known toxicity of normal bulk material
- exposed the limits that preclude a complete risk assessment today, in particular the present scarcity of dose-response and exposure data (Subsection 1.1.1.3)
  http://europa.eu.int/comm/health/ph_risk/events_risk_en.htm

Swiss Reinsurance, in a 2004 review of risks associated with nanomaterials (and nanoparticles in particular) noted that:
"Nanomaterials are already contained in numerous products worldwide and occur in various applications. There are indications that certain nanomaterials are potential health hazards. The danger is most probably not of an acute but chronic nature and it could be some time before it manifests itself. This is where the real risk for insurers lies, and the comparison with asbestos should be seen in this light."
They recommended that:
"In view of the dangers to society that could arise out of the establishment of nanotechnology, and given the uncertainty currently prevailing in scientific circles, the precautionary principle should be applied whatever the difficulties"
(Nanotechnology, Small Matter, Many Unknowns, May 2004)

ETC Group articulate further concerns that:
- there are biosafety risks of using DNA, viruses, prions and bacteria in novel ways through nanobiotechnology
- nanotechnology will impact on labour, including farmers, especially when related to self-assembly, crop surveillance and the replacement of agricultural commodities with new artificial nanomaterials.
- nanotechnology increases the scope for patents on nature and wide matter monopolies
- there is strong potential for new 'nano bioweapons' through nanotechnology.
- there are significant cultural and ethical concerns that flow from altering nature at this fundamental level
- nanotechnology is currently an example of where there is little democratic governance over technologies that determine our future.

HRH The Prince of Wales (Soil Association Patron): "*My final point concerns the apportionment of benefits and risks. The benefits will largely accrue to those who invest successfully in these technologies and to those who can utilise them. But these new applications will inevitably displace existing technologies. Who will lose from that process, and will it widen the existing disparities between rich and poor nations? What exactly are the risks attached to each of the techniques under discussion, who will bear them, and who will be liable if an when real life fails to follow the rose tinted script."(* Independent on Sunday, July 11th 2004).

ETC has published a report listing ten areas where research has uncovered significant cause for concern over the safety of engineered nanoparticles. (see document link http://www.etcgroup.org/documents/GT_TroubledWater_April1.pdf)

Fit with organic principles
Nanotechnology does not fit with organic principles which state that:
- organic is a whole system approach to farming and food production and recognises the close interrelationships between all parts of the production system from the soil to the consumer.
- new or novel technologies, ingredients and processes are not automatically applied to organic food manufacturing.

The lack of accountability of nanotechnology does not fit with organic principles in which there is:
- respect for natural systems
- ecological responsibility in food production, and
- consideration of the social impact of agricultural systems.

Impact on the environment

Nature, in 2003 reported "….nanoparticles could easily be absorbed by earthworms, possibly allowing them to move up the food chain and reach humans", see document link http://www.etcgroup.org/documents/GT_TroubledWater_April1.pdf).

The European commission has noted that *"In the environment, natural enzymes can change the surface properties of nanoparticles such as fullerenes—the C60 molecule consisting of 60 carbon atoms bonded in a nearly spherical configuration also nicknamed "buckyballs". Fullerenes can form aqueous suspended colloids …termed nC60 and become re-suspended after evaporation. In their native form, the small size, colloidal characteristics, and reactive surfaces of colloidal fullerenes make them ideally suited to carry toxic material over long distances. Thus, potentially, colloidal fullerenes could pollute aquifers."* See "Nanotechnologies: A preliminary risk analysis" subsection 1.1.1.1.1 Toxicology and ecotoxicology - http://europa.eu.int/comm/health/ph_risk/events_risk_en.htm

Impact on human health

Titanium dioxide/zinc oxide nanoparticles used in some sunscreens have been found to cause free radicals in skin cells, (see document link http://www.etcgroup.org/documents/GT_TroubledWater_April1.pdf). The toxicity of particles is increased the smaller they are and they can cross the blood brain barrier. Gold nanoparticles have been found to cross the placenta from mother to foetus. Cadmium selenide nanoparticles can break down in the human body potentially causing cadmium poisoning (see document link http://www.etcgroup.org/documents/GT_TroubledWater_April1.pdf). Both the Trades Union Congress and the UK Health and Safety Executive have raised concerns about the impact of nanomaterials on worker health during manufacturing and use. The TUC believes that the production and use of nanoparticles should be carried out in a contained process so that employees are not exposed to the potential health risks. Presently there are no agreed safe handling guidelines. See www.**tuc**.org.uk/h_and_s/**tuc**-8350-f0.cfm

Impact on animal health/welfare

All the concerns of impacts on human health (above) should also be of concern in relation to animal health. In addition, research in 2004 found that buckyballs [carbon nanoparticles] cause brain damage in juvenile fish along with changes in gene function **(see document link** http://www.etcgroup.org/documents/GT_TroubledWater_April1.pdf).

Consumer acceptability and benefits

Some concern has been reported in the national media as a result of the work by Jim Thomas/ETC and the speech on this issue by HRH The Prince of Wales. However, it appears that other than a small, informed minority, there is little awareness of the technology amongst consumers. **The use of nanoparticles does not currently have to be declared on labelling although this was a recommendation of the RS & RAE report and the UK Government accepts this may be necessary.** The report entitled: *Market research on public attitudes to Nanotechnology* carried out by the BMRB (British Market Research Board) and published on 15th March 2004, can be found at http://www.nanotec.org.uk/PressMediaMar042.htm The report mentions that **The overwhelming majority of people have not heard of nanotechnology.** Participants drew a parallel with GM when considering the ethical implications of nanotechnology because of the perception that both involve changes at the most fundamental level to form something that does not occur in nature. Both GM and nanotechnology could be seen as "messing with nature" in a specific way by "manipulating the building blocks of nature". They expressed concerns about whether scientists are trying to "play God".

Soil Association concerns on regulatory process

Case-by-case approval

We do not agree with controls based on case-by-case assessment of the scientific evidence as the principal regulatory response for the forseeable future for free nano-scale products, at least for products to which people are exposed to regularly and directly via food and health and beauty products. Such controls *cannot* in practice be reliable, evidence-based, cost-effective, or proportional. This is because of the lack of both a history of experience and a robust body of scientific understanding of the impacts of such materials on the biology of organisms, and on ecological interactions, and because it is completely unrealistic to imagine that the full range of required safety data could and would be generated for each and every product (and it would normally be completely disproportional to do this even if it were possible). Inevitably, with such an approach, decisions will be strongly based on personal judgements, and thus open to the bias of expert advisers, politicians and influence by commercial lobbyists, whilst being presented and defended as 'evidence-based'.

A supposedly 'evidence-based' approach is how GMOs are being dealt with now by the Food Standards Agency. We and very many others see this as totally unsatisfactory because of the poor level of scientific knowledge and shortage of relevant, independent evidence, and we consider that the risks to the public are significant. With every GMO submitted for approval, despite the long list of scientific uncertainties about the health impacts in each case and the emerging evidence of *general* health risks with the genetic engineering process, the benefit of the doubt is *always* given to the GM company (not a single product has been rejected despite scientific concerns always being raised). This deeply flawed approach is, in our view, the basis of the high controversy and public and market rejection of GMOs. We believe the same will occur with nano-scale materials, if they are regulated in the same way. We and others would certainly raise these concerns in public, in the way we have GMOs.

We instead propose that the principal regulatory approach must be a <u>generic assessment</u> of the safety of engineered nano-scale materials, at least for products to which there is direct and regular public exposure. This should comprise (i) a review of whether there is an adequate and reasonably robust body of scientific understanding to enable case-by-case assessment and approval; (ii) an assessment of whether the current understanding and evidence suggests there *could* be health or environmental risks in at least some cases (though which cases would not be known); (ii) and an assessment of the viability and cost-effectiveness of generating the required range of data to enable comprehensive reliable case-by-case assessment.

There should lead to <u>a general decision</u> on the use of free engineered nano-scale materials, at least for nano-scale materials in food and health and beauty products. Because of the inevitable negative outcome of this generic review, we believe there should be <u>a general prohibition against the use of free engineered nano-scale particles in agriculture and the food chain and in health and beauty products. Only where there is a clear and specific societal benefit</u> (excluding economic benefits which can always be delivered in many other ways)<u>, should the necessary data be generated and case-by-case assessment considered</u>

This should not be considered a lost opportunity. Unnatural products introduce new chemical and biological interactions and therefore have a comparatively high likelihood of disrupting natural processes with negative effects, compared to natural processes. They also have a high likelihood of displacing as yet unidentified benefits of existing natural substances. Artificial products also generally involve a high level of embodied energy in their production, compared to management approaches and natural processes. Moreover and importantly, there is no significant general societal need for nano-scale materials in food, agriculture, or health and beauty products.

Voluntary reporting

It is not reasonable for the public or other stakeholders that the reporting scheme is voluntary. This will mean that the results will not be reliable as a basis for developing appropriate controls as the results will under-represent any negative effects. It is very likely (and must be assumed) that

evidence showing negative impacts from products already on the market will sometimes be withheld or not clearly communicated (as is the case with GM research). A voluntary approach would there go against the aim of the scheme to gather evidence of the risks and produce a reliable basis for controls to allow 'responsible development'.

A voluntary approach would also not be reasonable with respect to the companies involved, as it would create an unlevel playing field. It would effectively reward companies that withhold evidence of negative effects - and facilitate those applications, and penalise companies who release evidence of negative effects – and discourage those applications.

Commitment to research

There is a major need to build up a robust and comprehensive general body of scientific understanding of the impacts of nano-scale materials on the biology of organisms and on ecological interactions, aside from whether there are any identified toxic effects. (The lack of a basic body of understanding of the biological impacts of GMOs has been the major weakness of the GMO regulatory regime, as the scientists have little general information on which to decide on the implications of the inevitable numerous gaps in knowledge for individual products. Commercial and political pressures means they have therefore always decided in favour of the products, with no scientific basis).

Good practice must include product labelling, product registers, the quality of safety studies (eg. sample sizes and time-scales that are adequate for protecting public health) and complete transparency with regard to the results for any commercialised products and products being submitted for approval. However, at the moment, only moratorium is acceptable for products to which the public would have regular direct exposure, ie. in food, health and beauty products.