



**Joint FAO/WHO Meeting
Nanotechnologies in Food and Agriculture
FAO Rome, 27 March 2012 – Queen Juliana Room
Meeting Report**

Background

A number of emerging forms of nanotechnology potentially could provide significant benefits in various sectors, including food, water and agriculture. The current applications in the food and agricultural sectors are relatively few, because the science is still newly emergent. However, the number of nanotechnology-derived products and applications in these sectors has been increasing steadily in recent years, and they are predicted to grow in the future. New and emerging applications such as water purification systems, rapid detection systems for pathogens and chemical contaminants, and nano-enabled renewable energy technology applied along the food chain may contribute to addressing some of the challenges pertaining to sustainable agricultural development, as well as the food safety and food security issues that many countries are facing today – particularly developing countries.

Many countries have identified the potential use of nanotechnology in the food and agriculture sectors and are investing significantly in its application to food production. However, owing to our limited knowledge of the human health effects of these applications, many countries recognize the need for early consideration of the food safety implications of the technology. Given that the issues pertaining to food safety continue to evolve, and new issues and technologies continue to emerge, it is critical that FAO and WHO keep abreast of these new developments and remain in a position to support Codex and their Member Countries in understanding the implications of such developments and the actions required. It is in this context that FAO/WHO convened a joint meeting on nanotechnologies in food and agriculture. The agenda of the meeting is attached, as Annex 1.

Objectives

The aims of the meeting were for participants from FAO and WHO:

- to understand new developments in the application of nanotechnology to food and agriculture;
- to present the newly developed FAO/WHO draft paper entitled “State of the art on the initiatives and activities relevant to risk assessment of nanotechnologies in the food and agriculture sectors” in order to obtain feedback from experts and FAO/WHO colleagues from various divisions;
- to understand the objectives, scope and progress of the initiatives of other international organizations;
- to identify areas of future activity and the key roles for FAO and WHO.

Invited speakers

- Dr Dora Pereira, Medical Research Council (MRC), Cambridge, UK;
- Dr Alessandro Chiodini, International Life Science Institute (ILSI) Europe, Belgium;
- Dr Manfred Lützow, FAO/WHO consultant, Switzerland;



- Ms Mar Gonzalez, Organization for Economic Cooperation and Development (OECD) Working Party on Manufactured Nanomaterials (WPMN) Secretariat, France.

The full list of participants is attached, as Annex 2.

Meeting proceedings

1. Opening remarks

Dr Barbara Burlingame, Officer-in-Charge of the Nutrition and Consumer Protection Division (AGN) of FAO, provided the opening remarks on behalf of the Assistant Director General (ADG) of the Agriculture and Consumer Protection Department (AG), Dr Modibo Traore.

She welcomed all the participants on behalf of FAO and WHO and emphasized the long-term collaborative work between the organizations. In particular, the joint FAO/WHO Food Standards Programme, which is the Codex Alimentarius, was highlighted as the cornerstone of the collaboration. She also stressed that equally important collaborations between FAO and WHO have been established in the provision of scientific advice, as well as for capacity development in the area of food safety.

She explained that FAO and WHO recognize the potential of nanotechnology applications, but that FAO and WHO are also mindful of concerns about the potential implications of nanotechnology for human and environmental health, agricultural production and the development of legal frameworks, together with the challenges for developing countries, as well as the social and ethical issues. The need for adequate attention to be paid to the regulation of nanotechnologies before their application is one of the crucial additional issues that need to be addressed at the international level, if the expected gains from nanotechnology in the areas of food, agriculture and human health are to be realized.

She concluded her remarks by stating that the meeting would provide FAO and WHO with more insight into some of these aspects for use in planning their next collaborative steps, in terms of providing their members with the support they need to work on this emerging technology.

2. Introduction to the meeting

Dr Masami Takeuchi (FAO) provided the introductory presentation on the background to the meeting, information on the Joint FAO/WHO Expert Meeting on the Application of Nanotechnologies in the Food and Agriculture Sectors: Potential Food Safety Implications held in Rome on 1–5 June 2009, and the scope and objectives of the meeting. The presentation is attached, as Annex 3.

3. FAO/WHO Open Seminar – Presentation 1: “Nanomaterials and food safety risk assessment: methodologies, feasibility and challenges”, by Dr Pereira

Dr Dora Pereira, Senior Researcher, MRC Human Nutrition Research, Cambridge, provided a presentation entitled “Nanomaterials and food safety risk assessment: methodologies, feasibility and challenges”. First she introduced a few examples of prospective applications of nanotechnology in food production (e.g. water-in-oil-in-water double emulsion, nano-ferrhydrite as a supplement). Second, she explained the different methodologies used to characterize nanomaterials in different



states – as manufactured, in foods, as tested *in vitro*, after simulated digestion, *in vivo* and *ex vivo* – by means of electron microscopy and other non-invasive technologies such as MRI (magnetic resonance imaging), PET-CT (positron emission tomography – computed tomography) and EDX (energy-dispersive X-ray spectroscopy). Next, she introduced the European Food Safety Authority (EFSA) “Guidance on risk assessment of the application of nanoscience and nanotechnologies in food and feed” and provided details of current state-of-the-art methodology for safety assessment. The methods are divided largely into *in vitro* and *in vivo* studies. In *in vitro* studies, gastrointestinal cells are used to investigate the effects of nanoparticles on monolayer integrity, cell cytotoxicity and immunotoxicity. In the *in vivo* studies, which use animals, the effects of acute and chronic exposure can be investigated. Dr Pereira drew attention to the fact that both *in vitro* and *in vivo* studies have their limitations: for example, *in vitro* studies alone cannot be used for bioavailability studies, and *in vivo* studies cannot be used to determine a toxic endpoint such as the 50% lethal dose (LD₅₀) because the animals would need to be fed an unrealistic dose of nanoparticles. She also emphasized that non-digestible, biopersistent nanoparticles are of particular concern, and that the triggering of the safety assessment of nanoparticles should depend on the properties of digestibility and biopersistence of the nanoparticles. The presentation is attached, as Annex 4.

4. Presentation 2: “FAO/WHO analysis paper: State of the art on the initiatives and activities relevant to risk assessment of nanotechnologies in the food and agriculture sectors”, by Dr Luetzow

Dr Manfred Luetzow, FAO/WHO consultant, presented the draft FAO/WHO paper entitled “State of the art on the initiatives and activities relevant to risk assessment of nanotechnologies in the food and agriculture sectors” (available for public review at: http://www.fao.org/fileadmin/templates/agns/pdf/topics/FAO_WHO_Nano_Paper_Public_Review_20120608.pdf). First he introduced the key conclusions that were agreed during the meeting in 2009, and explained the way in which the paper had been drafted. Second, he explained the need for an update, because there have been a number of developments since the first FAO/WHO expert meeting in 2009. For example, 181 patents have been requested between 2009 and 2011 and there are major national/regional projects that involve sampling of consumer products in the USA and EU. In addition, the area of nanoemulsions in food has been developing rapidly since 2009. Dr Luetzow introduced some regulatory frameworks (national and regional) that have been put in place, and highlighted the fact that there has been no attempt at international harmonization of nano-related regulations, or of the relevant definitions. However, a considerable number of activities have been driven by opportunities for research and industry, as well as safety concerns. The Institute of Food Technologists (IFT), International Life Sciences Institute (ILSI) and OECD have made progress with testing methodology, risk assessment and communication/education. The scientific reviews state that there have been a considerable number of scientific articles published, and the most common route of exposure has been identified to be inhalation. Studies on oral/gastrointestinal exposure, while they exist, have been limited. Dr Luetzow concluded that, while there are no new concepts or ideas being introduced, there is a certain amount of hype that continues in research and in the media.



Exposure to nanoparticles via food may be increasing with the introduction of novel applications, and thus a tiered approach should be considered for nano risk assessment. The presentation is attached, as Annex 5.

5. Presentation 3: “OECD activities on the safety evaluation and risk assessment of manufactured nanomaterials”, by Ms Gonzalez

Ms Mar Gonzalez, from the OECD’s Working Party on Manufactured Nanomaterials (WPMN) Secretariat, provided a presentation entitled “OECD WPMN work on the safety of manufactured nanomaterials”. First, she introduced the work of the OECD’s division of the Environment, Health and Safety (EHS) on chemical safety. The objectives of this division are to protect humans and the environment, to increase efficiency in the management of chemicals and to avoid non-tariff trade barriers. The aims of the division are: 1) harmonization, 2) coordination and 3) outreach to stakeholders and non-member countries (global harmonization). Second, she described how the activities of the WPMN are organized. She also introduced the OECD database on research into the safety of manufactured nanomaterials (www.oecd.org/env/nanosafety/database). Ms Gonzalez explained that, among all the activities of the WPMN, two areas, addressing: 1) safety testing of a representative set of manufactured nanomaterials (MNs), which includes a Testing Programme, and 2) Test Guidelines for manufactured nanomaterials, could be relevant to FAO/WHO activities in the food and agriculture sectors. So far, 13 nanomaterials are being tested for 59 endpoints that are relevant to environmental safety and human health. From these testing activities, WPMN is expecting to produce harmonized approaches for assessing the safety of MNs. A key guidance document is on Sample Preparation and Dosimetry (GNSPD). The GNSPD includes general and common issues (e.g. terminology, appropriate dose-metrics) as well as specific consideration of sample preparation and dosimetry for the safety testing of manufactured nanomaterials. The section on specific considerations is composed of four parts: 1) physical and chemical properties; 2) ecotoxicity studies; 3) degradation, transformation and accumulation; and 4) health effects. A preliminary document was published in 2010 and a revised version will be available in 2012. The presentation is attached, as Annex 6.

6. Presentation 4: “ILSI Europe activities on nanotechnologies in the food sector”, by Dr Chiodini

Dr Alessandro Chiodini, Scientific Project Manager of the International Life Sciences Institute, European Branch (ILSI Europe), presented the current activities of ILSI Europe with regard to nanotechnologies in the food sector. Following a summary of general background information on ILSI and ILSI Europe, he introduced their work on the development of the “Practical guidance for the safety assessment of ENM in food (http://www.ilsilife.org/Europe/Pages/TF_NovelFoods.aspx)”, which aims to provide guidance on how to conduct a practical, systematic and robust safety assessment of engineered nanomaterials (ENM) in food. This activity was supported by the ILSI Europe Novel Foods and Nanotechnology Task Force. This guidance suggests that the four-step risk assessment paradigm of FAO/WHO is also applicable to ENM. It is proposed that the risk assessment of ENM should be conducted according to the following steps: Step 1 – Identification of ENM (e.g. From a known bulk



material? Does an appropriate comparator exist?); Step 2 – Physico-chemical characterization of ENM (e.g. solubility, agglomeration/aggregation); Step 3 – Decision tree to determine the necessity of re-evaluation of an existing risk assessment or tiered risk assessment, depending on the resolvability under gastric conditions and solubility of the ENM; Step 4 – A tiered approach, consisting of Tier 1: Screening for potential hazards of ENM, and Tier 2: Determination of the effects of the ENM that are different from those of a comparator; Step 5 – Exposure assessment and risk characterization (overall consideration of the ENM in the food matrix). This guidance is available online as an article in the journal *Food Chemical and Toxicology* (2011, Dec 29. Epub ahead of print). Following this, Dr Chiodini explained two other nano-related activities that focus on specific areas: “Workshop on Outlook and Challenges of Nanotechnologies for Food Packaging (<http://www.ilsa.org/Europe/Pages/ViewEventDetails.aspx?WebId=84D7FA4A-0FD5-40CD-A49A-2DA6FCDFD654&ListId=178B3510-408A-4E59-ADE5-DF09F4E38F03&ItemID=97>)” (organised by the ILSI Europe Packaging Materials Task Force) and “NanoRelease Project (<http://www.ilsa.org/ResearchFoundation/Pages/NanoRelease1.aspx>)”, which is developing methods to measure the release of nanomaterials from solid matrices (coordinated by the ILSI Research Foundation Center for Risk Science Innovation and Application [RSIA]). The presentation is attached, as Annex 7.

7. Round-table discussions

Animal production/health sector and nanotechnologies (FAO/AGA)¹

Given that animal health has both direct and indirect implications for food safety and eventually human health, it is important to identify key areas of application of the technology and to assess the real benefits of nanotechnology for the global public good, not only the industrial benefits. There are many areas of potential application of nanotechnology in animal production (pathogen removal, veterinary drugs, feed production, vaccines, etc.), and the role of FAO/WHO is to identify applications that have both social benefits and economic feasibility.

Plant health sector and nanotechnologies (FAO/AGP)

Nano pesticides may have implications for food safety and the environment. It is difficult for national authorities to differentiate between nano and non-nano pesticides because there is no specification for nano pesticide formulation. So far, the applications of nano pesticides show minor differences in their efficacy. In addition, performing environmental risk assessment for developing countries is a challenge because there are no internationally harmonized standards/criteria for nano pesticides. Occupational health is another important issue in the area of pesticide use. JMPR has provided guidance on field trials of pre-approved pesticides, however the guidance does not include specific points with regard to pesticides with nano components. Some nano pesticides have been approved through the same process as non-nano pesticides, and there is no specific parameter used to identify nano variants. Farmers usually do not recognize the benefits of nano application in pesticides because they usually compare costs only. Possible benefits that farmers may recognize would be applications

¹ Acronyms in the parentheses are the names of the divisions/departments of FAO and WHO.



that have same results but required smaller amounts or less frequent application. Use of a smaller amount of pesticide will contribute to a lower risk of residues, and thus contribute to safer produce.

Water sector and nanotechnologies (FAO/NRL+AGN, WHO)

Waste water treatment technologies for removing bacteria, viruses and any other contaminants are needed by many countries, especially developing countries with limited access to water supplies (there is an international guideline on the safe use of wastewater as a result of a collaborative work among FAO, WHO and UNEP). However, there is usually a high cost associated with water treatment, and therefore there is a significant level of interest in low-cost water purification systems.

Nanotechnology certainly has potential application here, and FAO (NRL and AGN) is implementing an analytical study in Swaziland to determine whether the technology can be applied at low cost, with the prerequisite of safety assurance of the technology. If successful, this could be of benefit to many other developing countries.

Fisheries sector and nanotechnologies (FAO/FI)

There have been some experimental studies in this sector, in particular in the areas of feed/aquaculture and vaccines for fish. In addition, a product called "Omega 3 bread" that does not have a fish flavour, and "Nanolce", which claims better preservation of seafood; however, the legitimacy of these products has not yet been established. Finally, a comprehensive list of the nano-based products in this sector has not been produced.

Agro-industry and nanotechnologies (FAO/AGS)

Currently, few applications relevant to the agro-industries sector are available. The potential areas could include packaging technologies that prevent food losses, and technologies that prolong shelf-life and traceability.

Nanotechnology and social benefits (FAO/WHO consultant)

Nutrition is an area in which nanotechnology may play a significant role. There are also some advantages for food safety to be gained from certain nano applications (e.g. nano sensors, nano packaging). However it seems that big food companies do not think that the word "nano" is a marketing tool. Unless the public is convinced that the products are absolutely safe AND better than other products, they do not sell. Once again, absolute safety is not something that national authorities can guarantee for any products (nano or conventional). Public perception can be an obstacle in this regard, but mandatory assessment (for all nanomaterials) and mandatory labelling are also obstacles. The social benefits of nanotechnology applications have to be clear to the public, and stakeholder confidence has to be maintained with appropriate regulatory measures (sufficient and scientific).

Legal aspects of nanotechnologies (FAO/LEG)

Consumers have a right to know what they are eating. Legal aspects have to be considered carefully when discussing nano applications in food. A state-of-the-art document from FAO and WHO is needed to address the currently available definitions, safety assessment and capacity issues for national authorities that are adopting the development and application of nanotechnologies, as well as providing details of risk assessment (food safety, public health and environment). Technical assistance in setting up regulatory frameworks to deal with nanomaterials may be necessary for many developing countries. "Nano", as an additional claim, has to be controlled legally, though



mandatory labelling (including claims) can be a trade barrier. The WTO, SPS and TBT must be checked with regard to this aspect.

International standard setting (Codex) and nanotechnologies (FAO/AGN)

Current standards for food additives may include nanomaterials because some non-manufactured nanoparticles may be present as well as ENMs; there is currently no size specification in the Codex standards. EFSA has started to investigate nano structures in food additives, and this may become one of the common approaches. The EU is considering mandatory labelling and, as mentioned by the LEG colleagues, this may be a TBT issue.

Scientific advice on food safety and nanotechnologies (FAO/AGN)

JECFA experts have discussed the need to include the topic of nanotechnologies in the future agenda. It is possible and indeed likely that there are many chemicals that have already been evaluated that would be defined as nano. JECFA needs to consider the question of whether a separate procedure of risk assessment for nanomaterials is necessary. If it is, it may be necessary to introduce another approval procedure at national level. This could create a need for collection of data on the particle size of each chemical. However, according to the earlier expert meeting, the major issue is not the particle size itself but the structure and the characteristic properties of each nanomaterial. Therefore the parameter(s) needed for the risk assessment data may vary significantly among cases. Scientific experts must also address this issue in the context of the entire food chain, including livestock feed, the primary production environment (water, soil, etc.), agricultural inputs (pesticides, fertilizers, veterinary drugs, vaccines), food processing, food packaging, public health (pharmaceutical agents, diagnosis/treatment) and material/food waste.

Risk assessment for nanomaterials (OECD, ILSI, Cambridge)

It makes great sense to use a tiered approach for nano safety assessment, because some nanomaterials (for application in food) do not maintain their nano-specific structures when they are consumed. Thus it is not practical to use rigorous risk assessment methodologies to assess all nanomaterials. Decision trees that incorporate the tiered approach are used in several countries to manage these issues. International organizations such as FAO and WHO could consider developing such a decision tree, in order to provide assistance to countries that lack the capacity to develop such a tool. Mandatory assessment and mandatory labelling without application of the tiered approach are not wise options for national authorities, because they are costly and are not based on sound science. For example, in the case of “natural” nano structures that already exist, such as emulsions, a mandatory assessment scheme is a clear regulatory obstacle. All regulatory measures must be implemented on the basis of sound science.

Nanotechnologies and national competent authority (Health Canada)

In Canada, there is a relatively large working group on nanotechnology with three sub-groups: 1) a group working on methodologies, 2) a group working on issues related to risk assessment and 3) a group working on risk communication. The second group deals with novel foods in general (including genetically modified organisms [GMOs], those produced using ultra-high pressure processing, etc.). Toxicological risk assessment relies largely on animal studies; however, the work on nanomaterials has altered the mindset on toxicological risk assessment methodologies. Traditional toxicological risk assessment uses an extremely large portion of the substance for testing, but in reality it is very



unlikely that nanomaterials would be consumed in large amounts. Currently, *in vitro* testing methodologies are being developed for application in the assessment of nanomaterials.

Environmental issues and nanotechnologies (OECD)

Nano-waste is a topic that OECD has started to investigate recently. This topic has wide implications for policy. More research and collaboration at international level are needed.

Multi-agency collaboration at the international level (OECD)

FAO/AGN and OECD have been collaborating closely on the issue of nanotechnology. It is recommended that AGN (food safety) should be involved more in the mechanism of the Inter-Organization Programme for the Sound Management of Chemicals (IOMC) so that the FAO activities related to nanotechnology can be recognized by the members of the IOMC. The IOMC members will meet in Nairobi in September 2012 and the FAO representative should be able to present the work that AGN is leading.

Claims and categories for nanomaterials (general discussion)

Some traditional additives are already available at nano scale, but no claim has been made so far that they involve “nano”. Currently, to claim the presence of “nano” is not an advantage unless the product is a medicine (ILSI). The concept of “acceptable risk” is different in the pharmaceutical sector and the food sector, for many topics, including nanotechnology. Currently a size difference does not make a food product “novel” in many countries, therefore safety assessment of a product specifically on the basis of its size (e.g. nano) has not been common practice. This may be altered as a result of changes in public perception in the near future (OECD).

Conclusions

- FAO and WHO are in the best position to identify challenges and opportunities for developing countries in adopting applications of nanotechnology in the food and agriculture sectors. For example, low-cost and practical applications for water purification systems (with assured safety) could be beneficial for developing countries. Other opportunities could include nano packaging for safer food, nano-sensors to detect contaminants, etc.
- FAO and WHO will need to identify any relevant trade issues: when there is limited capacity and knowledge to deal with nanomaterials, trade-recipient countries should at least be informed of what they are receiving.
- FAO and WHO should make an effort to ensure that developing countries have access to the benefits of nanotechnologies for their consumers (not only for industry).
- FAO and WHO could assist national authorities to identify sustainable and effective monitoring systems. For example, if people are unaware of the components of the food packaging materials they use, they will find it difficult to manage wastes.
- It was strongly recommended by the participants that FAO and WHO should continue their effort to develop a decision tree incorporating a tiered approach for the risk assessment of nanomaterials. It is important that FAO and WHO consider the specific point that nanomaterials will never be consumed in large amounts, therefore traditional toxicological assessment methods (which use extremely large amounts of test substance) will not be realistic.



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References

FAO website on Nanotechnologies: <http://www.fao.org/food/food-safety-quality/food-safety-quality/topical-issues/nanotechnologies0/en/>

WHO website on Nanotechnologies: <http://www.who.int/foodsafety/biotech/nano/en/index.html>

FAO/WHO expert meeting report on the application of nanotechnologies in the food and agriculture sectors: potential food safety implications: <http://www.fao.org/docrep/012/i1434e/i1434e00.pdf>

FAO Report of the International Conference on Food and Agriculture Applications of Nanotechnologies: http://www.fao.org/fileadmin/templates/agns/pdf/NANOAGRI_2010.pdf



Annexes

Annex 1: Meeting agenda

Tuesday 27 March 2012		
Opening session		
09:00 – 09:20	Opening (10 min) <ul style="list-style-type: none"> Welcome: Opening remark 	Dr Barbara Burlingham on behalf of ADG/AG
	Introduction (10 min) <ul style="list-style-type: none"> Background, objectives and scope of the Seminar Participant introduction 	Dr Masami Takeuchi Dr Kazuko Fukushima
09:20 – 10:30	FAO Open Seminar - Presentation 1: “Nanomaterials and food safety risk assessment: methodologies, feasibility and challenges” (45 min)	Dr Dora Pereira
	Discussions (25 min)	All
10:30 – 11:00	Coffee break	
11:00 – 12:45	Presentation 2: “FAO/WHO analysis paper: State of the art on the initiatives and activities relevant to risk assessment of nanotechnologies in the food and agriculture sectors” (45 min)	Dr Manfred Luetzow
	Presentation 3: OECD Activities on the safety evaluation and risk assessment of manufactured nanomaterials (30 min)	Ms Mar Gonzalez
	Presentation 4: ILSI Europe activities on nanotechnologies in the food sector (30 min)	Dr Alessandro Chiodini
12:45 – 14:00	Lunch	
14:00 – 15:00	Round-Table discussions AGA: Daniela Battaglia, AGP: Yong Zhen Yang, AGN: Renata Clarke, Sarah Cahill, Masami Takeuchi, Jeff Farber and Vittorio Fattori, AGS: Joseph Mpagalile, FI: Iddya Karunasagar and Jogeir Toppe, NRL: Javier Mateo Sagasta, LEGN: Carmen Bullon and Deupmann and WHO/FOS: Kazuko Fukushima	Chaired by Renata Clarke and Sarah Cahill
15.00 – 15.30	Coffee break	
15:30 – 16:30	Round-Table discussions, continued	All
16:30 – 17:00	Conclusions and follow-ups <ul style="list-style-type: none"> Final remarks from participants 	FAO/WHO



Annex 2: List of participants

External speakers

Dora Pereira (Cambridge)
Alessandro Chiodini (ILSI Europe)
Manfred Lützwow (FAO/WHO expert)
Mar Gonzalez (OECD WPMN)

FAO/WHO Round-Table invited participants

Daniela Battaglia (FAO/AGAS)
Annamaria Bruno (FAO/AGNC)
Camelia Bucatariu (FAO/AGS)
Carmen Bullon (FAO/LEGN)
Renata Clarke (FAO/AGND)
Sarah Cahill (FAO/AGND)
Peter Deupmann (FAO/LEGN)
Jeff Farber (FAO/AGN and Health Canada)
Vittorio Fattori (FAO/AGND)
Iddya Karunasagar (FAO/FIPM)
Rainer Krell (FAO/NRL)
Harinder Makkar (FAO/AGAS)
Javier MateoSagasta (FAO/NRL)
Joseph Mpagalile (FAO/AGS)
Jogeir Toppe (FAO/FIPM)
YongZhen Yang (FAO/AGPM)

Seminar participants

Peter Karim Ben Embarek (WHO/FOS)
Barbara Burlingame (FAO/AGND)
Marisa Caipo (FAO/AGND)
Catherine Bessy (FAO/AGND)
Julien DeMeyer (FAO/OEKR)
Kakoli Ghosh (FAO/AGPM)
Mary Kenny (FAO/AGND)
Caroline Merten (FAO/AGN)
KwangSuk Oh (FAO/FIPI)
Patrick Otto (FAO/AGA)
Jean-Michel Poirson (FAO/AGND)
John Ryder (FAO/FIPM)
Carmen Savelli (WHO/FOS)
Nadia Scialabba (FAO/NRDD)
Jessie Shen (FAO/NRL)
Harry Van der Wulp (FAO/AGP)

FAO/WHO secretariat

Kazuko Fukushima (WHO/FOS)
Takeuchi, Masami (FAO/AGND)



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Annexes 3-7 are available upon request.

Annex 3: Introduction to the FAO/WHO Meeting on Nanotechnologies in Food and Agriculture

Annex 4: Nanomaterials and food safety risk assessment: methodologies, feasibility and challenges

Annex 5: FAO/WHO analysis paper: State of the art on the initiatives and activities relevant to risk assessment of nanotechnologies in the food and agriculture sectors

Annex 6: OECD activities on the safety evaluation and risk assessment of manufactured nanomaterials

Annex 7: ILSI Europe activities on nanotechnologies in the food sector