Food and Agriculture Organization of the United Nations

National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport

International Workshop on Feed Risk Assessment – Chemical Safety

10 and 11 March 2025, Utrecht, The Netherlands

Report

Introduction

The International Workshop on Feed Risk Assessment – Chemical Safety was organized by the Dutch National Institute for Public Health and the Environment (RIVM) and the Food and Agriculture Organization of the United Nations (FAO), supported by the Dutch Ministry of Agriculture, Fishery, Food Security and Nature (LVVN). After a first workshop held in 2013, the purpose of this workshop was to revisit and explore the state of art in methods and tools for the risk assessment of chemical contaminants in feed for farmed animals. The focus was on possible health risks for the consumers of animal-source food as well as animal health risks. New developments and challenges related to feed sources, contaminants and technologies of increasing relevance were discussed. Current techniques and methods for feed safety risk assessment were explored during case studies and interactive simulations. The workshop was attended by approximately 65 participants from about 20 countries from different world regions. The participants were risk assessors, risk managers and other experts in the field of feed and food safety from governmental organizations, academia and the feed and livestock private sector. A summary of the workshop and the recommendations are presented here.

Opening

The session was officially opened by Sandra Doevendans, Senior Policy Officer Animal Nutrition at LVVN. She welcomed the participants and provided an insightful overview of the agricultural industry in the Netherlands. She noted that the country has a significant animal population, making feed safety a crucial issue. She also highlighted the importance of international collaboration in ensuring safe feed and food production. She referenced past incidents, such as Bovine Spongiform Encephalopathy, as examples of the severe consequences of lapses in feed safety. She stressed that ensuring the safety of feed is fundamental to both animal and human health, given the interconnected nature of the food chain. LVVN actively supports research and international cooperation to enhance food security and safety

Daniela Battaglia, Livestock Production Officer at FAO, spoke about the critical role of animal feed in global food production. She pointed out that feed safety is not only a fundamental component of food safety but also a key factor in ensuring animal health and welfare. She described the FAO's ongoing efforts to promote international collaboration in feed safety and risk assessment. Many countries still lack the necessary capacity for risk assessments, making FAO's work in strengthening these capabilities essential.
She referenced past food safety crises that underscored the need for rigorous feed risk assessment and management. She expressed FAO's commitment to supporting regulatory

frameworks, conducting research, and facilitating knowledge-sharing among countries and stakeholders. The upcoming Global Forum for Animal Feed and Feed Regulators on 2 and 3 October 2025 at FAO Headquarters will provide a platform for continued discussion on these issues.

Astrid Bulder, Senior Risk Assessor at RIVM explained the importance of assessing potential contaminants in feed and how risk assessment serves as a foundation for effective risk management. She recalled that the first workshop on this topic was held in 2013, and the current session was an opportunity to review progress since then. One of the key outcomes of previous discussions was the creation of a manual on feed risk assessment. This manual, currently under public consultation, aims to provide clear guidance for risk assessors, regulators and industry stakeholders. She encouraged participants to review the document and provide feedback to enhance its effectiveness.

Frans Verstraete, Senior Policy Officer from the European Commission and the chairperson of the workshop, emphasized the importance of feed safety and risk assessment.

Codex Alimentarius work on feed risk assessment and other animal feed related matters

Annamaria Bruno, former Senior Food Standards Officer at Codex Secretariat, spoke about the work of Codex in feed risk assessment and animal feed. She explained that Codex sets international food safety standards and related texts, which aim at protecting consumer health and ensuring fair practices in the food trade. Codex texts are based on sound science and risk analysis. According to Codex risk analysis principles, risk management is the responsibility of Codex, while risk assessment falls under the FAO and WHO provision of scientific advice programme. She highlighted that, according to its mandate, Codex work on animal feed focuses on those aspects that impact human health and trade. Codex work on animal feeding is addressed by several subsidiary bodies, including the committees on contaminants in foods, residues of veterinary drugs in food, pesticide residues, and food hygiene.

Codex has developed Guidelines on risk assessment for feed, which are based on the Codex principles of risk analysis. The feed risk assessment process involves four steps: hazard identification, hazard characterization, exposure assessment, and risk characterization. The exposure assessment is a two-step process: first, evaluating the exposure of the food-producing animal to hazard(s) through feed; second, if such exposure is present, assessing the transfer of hazard(s) to edible product(s) of the food-producing animal. Risk characterization then considers the outcomes from the hazard characterization and the exposure assessment to derive a risk estimate for food safety.

She emphasized the fundamental role of safe feed in the production of safe animal-source food and the importance of supporting international risk assessment efforts. She stressed the need to assist countries in implementing the Codex guidelines.

Feed risk assessment in the United States of America

Timothy Schell, Director of the Office of Surveillance and Compliance at the US Food and Drug Administration (FDA), presented an overview of feed risk assessment in the United States. Animal feed safety in the United States is a cooperative effort of the US FDA Center for Veterinary Medicine, state feed regulators and the animal feed industry. Under the US regulations, the animal feed industry is responsible for manufacturing, processing, holding and distributing safe feed. Identifying and controlling potential animal feed hazards is the cornerstone of the US animal feed safety system. FDA's role is to set industry-wide expectations through regulations and policy and then work together with regulatory partners, both domestically and internationally to ensure that the animal feed supply is safe. Surveillance sampling and inspecting are used to identify potential hazards and evaluate industry compliance. Reviewing new animal feed ingredients premarket, conducting recalls, and communicating hazards are regulatory tools used to mitigate risks. Animal feed safety in the

United States is based on using science to cooperatively identify risks and successfully mitigate them.

Feed risk assessment in the European Union

Elena Rovesti, Scientific Officer at the European Food Safety Authority (EFSA), provided an overview of feed risk assessment in the European Union. She explained EFSA's role in evaluating the risks associated with contaminants in feed and how this process informs regulatory decisions. EFSA is the reference body for risk assessment of food and feed in the European Union, covering with its work the entire food chain – from field to fork. Among other responsibilities, EFSA provides scientific advice and carries out risk assessments on a wide range of chemicals that can be present in food and feed due to production, distribution and packaging, as well as those that might be present in the environment naturally or as a result of human-made activity. The risk assessments are conducted with several scientific panels and working groups composed of external experts from across the European Union who have specialized knowledge and experience in their respective fields. The Panel on Contaminants in the Food Chain (CONTAM) is responsible for assessing the risks posed by contaminants in food and feed; the Panel on Additives and Products or Substances used in Animal Feed (FEEDAP) focuses on evaluating the safety and efficacy of additives and substances used in animal feed; the Panel on Genetically Modified Organisms (GMO) is responsible for assessing the risks associated with GMOs in food and feed, as well as their potential environmental impact. Within their remit, these three Panels perform feed risk assessment to protect animal health and the potential impacts onto human health. The risk assessment for chemical contaminants in feed is performed following the typical risk assessment paradigm of Hazard identification, Hazard characterization, Exposure assessment and Risk Characterization. Each of these elements is needed in order to be able to conclude on the risks connected to the presence of a specific compound (or a family of compounds) in feed in the European Union. EFSA is also analyzing emerging risks in the context of food and feed safety. In particular, EFSA is currently identifying the importance of the design phase of future innovations in a circular economy, as without systems-thinking, even beneficial innovations may have unintended consequences for food and feed safety.

Feed risk assessment in Brazil

Vivian Palmeira, Official Auditor at the Ministry of Agriculture and Livestock of Brazil, shared insights into the risk assessment process in Brazil. She described the country's extensive feed production industry, which includes thousands of registered feed establishments. Given the scale of the industry, Brazil has developed a risk-based approach for inspections, prioritizing facilities based on their compliance history and the intrinsic risks associated with their products. The methodology of feed risk assessment in Brazil is that a Total Establishment Risk is estimated to each production unity, through the combination of Intrinsic Risk and Compliance Risk. While the compliance risk is related to the possibility of noncompliance with legislation, the intrinsic risk is related to the criticality and complexity of the products and the production processes applied by one establishment. She explained that the intrinsic risk is based on seven risk factors. Each risk factor has a score correlated and proportional to the severity of the risk involved. Three of the seven risk factors are related to chemical contaminants. One of these is 'Types, subtypes and quantities of manufactured products' and to define it, chemical, biological and physical hazards of complete feed, complementary feed, additives, coproducts and ingredients are collected from literature and from Brazil's database. The other two risk factors related to chemical hazards are: 'Authorization to manufacture medicated feed' and 'Use of growth promotors and coccidiostats'. In these cases, the hazards are intentionally introduced and the potential of cross contamination is increased, allowing that a veterinary drug residue, coccidiostat or a growth promotor is transmitted from a target feed to a non-target feed.

It was highlighted that the score obtained from the risk factors is used to determine if the establishment has a very high, high, moderate, low or very low risk in terms of the probability of causing harm to animal and human health and the magnitude of adverse effects, if they occur. The estimated value for the total risk of a given establishment will dictate the interval between inspections. On the other hand, the compliance risk must be calculated at each inspection and defines if the interval between inspections should be maintained or increased.
It was also shown that the work with risk assessment began in 2017 and what was the evolution since then, including training provided to inspectors.

Feed risk assessment in Thailand

Julaporn Srinha, Expert Veterinary Officer at the Department of Livestock Development, Ministry of Agriculture and Cooperatives of Thailand, provided an overview of Thailand's feed risk assessment practices, emphasizing the role of government regulations in ensuring food safety. Thailand puts importance on risk assessment and management in animal feed due to its significant livestock industry. Thailand produces livestock products such as meat, milk, and eggs for domestic consumption and is also among the top five global exporters of poultry products. Consequently, strict regulatory oversight is implemented throughout the food production chain.
To ensure feed safety, Thailand has established the Animal Feed Quality Control Act, which regulates hazards in feed across three aspects: physical, biological, and chemical. In terms of chemical hazards, the focus is on monitoring and controlling potentially harmful chemicals in animal feed, which could pose risks to both animal and human health. These hazards include pesticide residues, dioxins, mycotoxins, heavy metals, processing contaminants, and feed additives. The control and management of chemical hazards in animal feed are crucial for safeguarding consumer health and animal health, and for mitigating risks associated with the consumption of animal products. Thailand follows international risk assessment standards for chemical hazards in feed, such as Codex Alimentarius.
The Department of Livestock Development, under the Ministry of Agriculture and Cooperatives, plays a key role in animal feed safety through risk assessment and hazard control in both raw materials and the feed production process. Its responsibilities include establishing standards and safety regulations, inspecting and controlling feed quality, issuing permits, regulating feed production and monitoring and managing potential hazards in feed manufacturing. In addition, Thailand integrates Good Hygiene Practices and Hazard Analysis and Critical Control Points (HACCP) in animal feed production systems. The government also provides training and disseminates information to feed producers, farmers, and relevant stakeholders on chemical hazard control, safe chemical use, risk assessment, and prevention measures. This ensures the production of safe and high-quality animal feed, effectively regulated under the law.

Feed Risk Assessment in Nigeria: A Regulatory Perspective

Jane Ikediobi, Regulatory Officer from the National Agency for Food and Drug Administration and Control (NAFDAC) in Nigeria, provided insights into Nigeria's feed risk assessment framework.
Feed risk assessment is crucial in ensuring food safety, public health, and sustainable livestock production in Nigeria. With a population exceeding 200 million and a growing livestock sector contributing significantly to the economy, effective regulatory oversight of animal feed is imperative. NAFDAC plays a pivotal role in regulating animal feed, feed additives and supplements to mitigate risks associated with contamination and ensure compliance with both national and international safety standards. She provided an overview of the regulatory framework governing animal feed in Nigeria, including legislative measures and risk assessment strategies. She highlighted key regulatory initiatives such as the enforcement of traceability systems, hazard identification, and surveillance programs to address compounds like mycotoxins, heavy metals, and pesticide residues. Additionally,

she presented recent policy actions, including bans on harmful substances, demonstrating the commitment to safeguarding animal and human health.
Despite these efforts, challenges such as inadequate private laboratory infrastructure, informal feed production, and limited compliance among small-scale producers persist. To address these issues, NAFDAC is strengthening enforcement mechanisms, enhancing laboratory surveillance, and promoting stakeholder engagement through training and awareness programs. Going forward, emphasis is on digital tracking systems, data-driven decision-making, and international collaborations to enhance feed safety.
By implementing robust risk assessment measures, Nigeria aims to ensure the production of high-quality, contamination-free feed, thereby enhancing food security and public health while supporting the growth of the livestock industry.

Feed quality and safety: an academia/research perspective
Luciano Pinotti, Full Professor in animal nutrition at the Department of Veterinary Medicine and Animal Sciences of the University of Milan, presented on the role of academia in feed quality and safety research. He emphasized that universities have three key responsibilities: teaching, research, and contributing to society. He indicated that the European Union has high food and feed safety standards to protect consumers, animals, plants and the environment. Despite this, incidents are reported every year when products or ingredients in food and feed fail to meet these standards. This triggers farmers, nutritionists, industry, academia and governments to pay serious attention to feed production, thereby acknowledging that feed safety is an essential prerequisite for food safety. In this context it is essential to integrate knowledge on feed nutritional quality, safety and availability. Consequently, the use of alternative and innovative feed sources is an emerging issue in livestock production system. These sources should be traceable, conform to quality and safety standards and ensure environmental sustainability. He provided a brief overview of the potential contribution of academia in this context.

An industry perspective on feed risk assessment
Arnaud Bouxin and Alexandra de Athayde from the International Feed Industry Federation (IFIF) provided an industry perspective on feed risk assessment. The feed industry's proactive risk assessment and management approaches are pivotal to ensuring feed safety and protecting public health. Performing a risk assessment for a feed business requires the evaluation of large amount of data, considering the many ingredients that make a feed, the frequent modifications of feed compositions, the various origins and types of process undergone and the number of hazards to be addressed. In addition, a feed manufacturer usually produces feed for different animal species and categories, each requiring a specific risk assessment. The increasing pressure put on the livestock chain to use ingredients not in competition with food for the sake of increased sustainability and circularity results in an increasing number of hazards (chemical contaminants like PerFluorinated Alkylated Substances (PFAS)) to be tackled and/or increased occurrence. This combined with evolution of contamination patterns linked to e.g. climate change requires from feed business operators a constant attention, to maintain an effective and up-to-date risk management system underpinned by a robust feed safety risk assessment.
Because of the magnitude of the task and associated costs, as well as the shared interest by authorities and food chain actors, the development of generic risk assessments (performed by public bodies) is a crucial pillar of feed safety. Training and implementation of methodologies such as HACCP and emergence of artificial intelligence tools to help analyzing data, especially for emerging risks, is an essential key pillar of feed safety. This may result in information generation (monitoring, audits, certification, good practice) that may be used for updating and refining existing risk assessment and facilitating risk management.
Cooperation among operators along the feed supply chain and between operators and authorities remains fundamental to addressing emerging challenges and sustaining trust in the global food chain. This is valid at local, national and international level. In this sense, the continued collaboration

between IFIF and FAO is extremely beneficial to help the feed chain adopting best practices and sharing knowledge on emerging risk and risk assessment methodology, contributing to the significant improvement of feed safety globally.

Hazard assessment

Jenny Murphy, Deputy Director for Foods in the US FDA Center for Veterinary Medicine - Office of Surveillance and Compliance, provided a comprehensive overview of FDA's approach to hazard assessment. She emphasized the importance of a collaborative effort between industry, regulatory bodies and research/academia to ensure the safety of animal feed. FDA's role is to set science-based regulations and guidance that enable industry stakeholders to effectively identify, assess, and control potential hazards. FDA's guidance document #245, tailored for animal feed hazards analysis, categorizes chemical hazards into ingredient-related, process-related, and facility-related hazards. Ingredient-related chemical hazards are for instance contaminants and residues from pesticides or veterinary drugs. Process-related chemical hazards may arise from manufacturing errors or inadequate cleaning leading to the presence of unapproved or undesirable substances in feed. Facility-related hazards may occur due to unintentional introduction of contaminants in the facility (cleaners, sanitizers, heavy metals leaching from utensils).

The industry is encouraged to manage these hazards through good manufacturing practices and targeted preventive controls. The FDA's risk assessment involves narrowing down potential hazards to those that require controls, based on their severity and likelihood. Compliance with safety standards is monitored through risk-based surveillance systems and inspections. FDA uses risk-based factors for prioritizing animal food facility inspections.

Emerging hazards are addressed through gathering scientific data and setting new expectations when appropriate and sufficiently substantiated. A recent example is the emergence of highly pathogenic avian influenza A (H5N1) in cat and dog feed. The FDA has directed manufacturers to reanalyze food safety plans to consider H5N1 as a known or reasonably foreseeable hazard.

Overall, the FDA's approach combines scientific evaluation, regulatory compliance, and industry cooperation to uphold feed safety standards, with a flexible strategic framework that adapts to new and emerging risks.

Animal exposure and health assessment

Elena Rovesti from EFSA delivered a presentation focusing on animal exposure and animal health assessment methodologies. She detailed the process EFSA follows in risk characterization for animal health, which involves identifying potential hazards, assessing exposure, and evaluating health risks to animals. The EFSA CONTAM panel approach to derive Animal Dietary Exposure Assessment to contaminants is in line with the FEEDAP/CONTAM statement published in 2024. The updated methodology allows two scenarios, one scenario considers the use of compounds feeds (complete and/or complementary) with contaminants occurrence data submitted to EFSA data warehouse by Member States, industry and other stakeholders. The other scenario allows the use of example diets, feed intake rates and occurrence data in feed materials, also submitted in EFSA's data warehouse. The FEEDAP/CONTAM Panel 2024 statement was aimed at updating the approach to calculate animal dietary exposure to contaminants in feed, by aligning with contemporary feeding practices, incorporating updated animal diets in accordance with current recommendations and utilization patterns. The work included consultation with animal feed industries representatives. The diets are defined in terms of groups of feed materials, in order to provide the adequate nutrients with the composition of feed materials which can vary within each group. It is possible to include one or more of the relevant feed materials of the group, depending on the need (i.e., occurrence of contaminants reported in specific feed materials). During Hazard Characterization, Reference Points for adverse animal health effects are selected taken into account the severity of effects and their relevance to animal health, following scientific judgement. The comparison between the Reference Point and the contaminant concentration in mg/kg complete feed calculated in the Exposure Assessment is used to characterize the risk, using where possible, the two scenarios (Compound Feeds and/or Feed

Materials + Model Diets + Feed Intake Rates). The exposure can be expressed as a percentage of the Reference Points: a percentage below 100 is considered a low risk for adverse animal health effects for the current occurrence levels in European Union. In concluding, she encouraged greater collaboration in data-sharing initiatives to further enhance the reliability of risk assessments.

Proposal for a feed consumption tool for animal dietary exposure assessment

Luciano Pinotti from the University of Milan gave a presentation on the EFSA Feed Inventory Database as a tool designed to improve dietary exposure assessments. Accurate information on the individual amount of feed consumed is the basis for proper estimation of animal dietary exposure to hazards. In the absence of a comprehensive database, regulators and competent bodies/authorities and other stakeholders from the industry and academy use different approaches to estimate feed consumption, mainly relying on the selection of default values for body weights, daily intakes and diet/ration composition. In this context, EFSA has funded a project for the development of a feed consumption database using a standardized feed classification system, in support of a more accurate estimation of animal dietary exposure. He provided a brief overview of the project results and their potential contribution in improving animal feed consumption refinement.

Overview on Joint FAO/WHO Expert Committee on Food Additives (JECFA) work of relevance for feed risk assessment, and future perspectives

Magdalena Niegowska Conforti from FAO presented the work of JECFA and its relevance to feed risk assessment. JECFA is an independent scientific expert committee that evaluates the safety of food additives, contaminants, residues of veterinary drugs, and naturally occurring toxicants in food. These evaluations form the scientific basis for setting food standards by the Codex Alimentarius, making JECFA's activities crucial for protecting consumer safety and facilitating the trade of food commodities and products.

She provided a brief overview of JECFA's work and its relevance to feed. Contaminants can transfer from feed to food, posing potential health risks to humans through indirect dietary exposure to contaminated animal-source food. Therefore, JECFA's contaminant assessments include evaluating the occurrence of chemical hazards in feed and the transfer of residues to food.

Climate change and emerging contaminants present significant challenges to ensuring food safety. As agrifood systems transform towards more sustainable solutions, the interconnectedness of circular practices can pose health risks due to contaminants that may persist and accumulate in these processes. Considering and addressing these challenges will be critical in JECFA's future work. Risk assessment based on One Health approach, global collaboration to strengthen partnerships with national agencies and industry stakeholders, and harmonization of international standards for food/feed safety are some of the areas where continued commitment is required.

New developments and challenges related to feed sources and technologies of increasing relevance

Daniela Battaglia from FAO gave a presentation on feed sources and technologies of increasing relevance and the associated feed safety challenges, highlighting the increasing diversity of feed ingredients and the growing emphasis on sustainability in feed production. She illustrated how increased consumption of animal source food requires an additional amount of feed to be produced in a sustainable manner, which maximize the use of locally available feed resources and the use of feed sources from circular economy (agro-industrial by-and co-products, former food products, food waste, insect-based products, algae, rendered products, etc.). Current knowledge could allow to convert a broad range of products into animal feed using proper risk-based measures, innovative technologies and processing methods to ensure their safety and nutritional value for the needs of the animals and their products.

She stressed that while the use of circular feed may increase the overall efficiency and sustainability of food production; reduce the livestock/feed sector's contribution to Green House Gas emissions as well as alleviate pressure on the world's natural resources; minimize the loss of resources and nutrients and food/feed competition for the use of grains; and reduce food losses and waste while enabling the livestock sector to meet the growing demand for animal source foods in a more sustainable manner. However, at the same time, given the diversity of inputs, the range of hazards relevant to feed from these sources could be very broad and they may transfer new (and old) hazards, posing safety and nutritional challenges and possibly requiring new hazard detection methods and risk assessment approaches. It is critical from a safety perspective that the feed chain is not used to dispose of degraded or contaminated material. Attention should therefore be given to their safe use, inclusion rate, and emerging risks.

Interactive case studies on animal exposure and health assessment

Francesca Mercogliano, from the University of Milan, presented interactive case studies on assessing the exposure and possible animal health risks of ochratoxin A (OTA) contamination in animal feed. The exposure assessment followed EFSA's framework, using default values for animal body weights, feed intake, and OTA occurrence data. Risk characterization was based on comparing exposure levels to the Reference Point, with risks below 100 percent of the Reference Point considered low. To illustrate the methodology, the participants worked on three cases highlighting how changes in feed formulation influence OTA exposure and risk characterization, and stressing the importance of flexible risk assessment approaches.

FAO Manual for Feed Risk Assessment

Astrid Bulder from RIVM introduced the FAO Manual for Feed Risk Assessment, explaining that its development involved international collaboration with experts in chemical and microbiological risk assessment. She underscored the manual's primary purpose, which is to provide structured practical guidance on conducting feed risk assessments, indicating methods and tools available. She highlighted that the manual was developed to support implementation of the Codex guidelines on risk assessment of feed, support harmonization of assessment practices globally, and assisting professionals who are less familiar with the process.

She elaborated on the manual's coverage, explaining that it followed the principles described in Environmental Health Criteria 240. She described the separate risk assessment stages, i.e. hazard assessment, hazard characterization, exposure assessment, and risk characterization and that these were applicable to both chemical and microbiological risk assessment. She also emphasized that, while the manual described these as distinct processes, in practice there may be differences in interpretation and timing of the work involved, which were described in the manual. Additionally, the manual included a tiered approach, enabling flexibility in its use depending on the available data and the urgency of the assessment.

It was important to distinguish between risk assessment and risk management as part of the risk analysis paradigm, explaining that while they are interconnected, and sometimes in practice performed by the same team or person, they should remain distinct processes to ensure objectivity and scientific rigor. She emphasized the importance of communication between all parties involved in a feed risk assessment, to provide clarity on its context and the type of results to be provided. The manual was presented as a living document that would be revised in future to incorporate new methodologies and findings.

Transfer modelling

Ron Hoogenboom, Toxicologist at Wageningen Food Safety Research and Jordi Minnema, Mathematical Modeler and Exposure Scientist at RIVM gave a presentation on the use of transfer modelling in feed risk assessment. Various incidents with persistent contaminants in feed and food have shown the importance of getting a better insight in the behaviour of these compounds in food-producing animals. This has triggered animal studies and follow-up studies of incidents. To better understand the observations and to extrapolate to other incidents, kinetic models have been developed. In the Netherlands this started after the discovery that municipal waste incinerators released dioxins into areas where dairy cows were grazing, resulting in elevated levels in milk. This dairy cow model was further improved after various feed incidents, such as potato peels contaminated with dioxin containing clay used in the production process of potato products, and contaminated flood-plains of the Dutch rivers. In recent years, various other kinetic transfer models have been developed. Examples are a model for dioxins and dioxin-like polychlorobiphenyls in free-ranging laying hens and a model to predict PFOS levels in ewes and in their offspring which were exposed via milk from the mothers but were themselves not grazing in the contaminated area. A variety of feed incidents that led to the development of transfer models were presented. Furthermore, without delving into the mathematical details, the core concepts of transfer models and the essential components and considerations for developing and applying them were discussed. Finally, the newly developed transfer model for free-ranging cattle grazing in the floodplains, which has recently been published on www.feedfoodtransfer.nl, was highlighted.

Human exposure and health assessment

Gunnar Sundstøl Eriksen from the Section for mycology, chemistry and toxicology of the Norwegian Veterinary Institute explained in his presentation how human exposure and human health is assessed for contaminants present in feed.

Human diets are a mix of a large numbers of different food items. To assess the human dietary exposure to contaminants, the exposure from all dietary sources, including drinking water, has to be taken into consideration. The exposure to contaminants resulting from occurrence in feed has therefore to be evaluated in combination with the exposure from all other dietary sources, including drinking water.

For the health assessment, the estimated dietary intake is compared with a Health-Based Guidance Value (HBGV) such as a Tolerable Daily Intake or Tolerable Weekly Intake, or with a Benchmark Mark dose to determine the Margin of Exposure (MOE).

The first step is to make an estimation of the dietary exposure of the contaminant. This is done by combining data on the intake of each food item from food consumption studies with the occurrence of the contaminant in food. As it is important to also protect consumers with a high consumption, the dietary exposure estimations may be estimated by combining data on the distribution of the occurrence of a contaminant in each food item with the distribution of the intake of the food items for each individual.

The contribution of contaminants in the feed to human exposure is dependent on transfer from the feed to the animal and to animal-source products such as milk, meat, egg, muscle and edible organs (liver, kidney). Aflatoxins, deoxynivalenol and dioxins and dl-PCBs are examples where the feed has very different contribution to the total human dietary exposure, largely dependent on the toxicokinetics in animals. Aflatoxin B1 in feed is metabolized to aflatoxin M1 which is secreted in milk. Milk and dairy products are the only major source for dietary exposure of AFM1, and in children, these are also the main source for intake of the sum of aflatoxins. The dietary intake of aflatoxin M1 has a MOE < 10.000 in children, which indicates a concern for this type of genotoxic compounds. The feed concentration has to be low in order to limit the human exposure to aflatoxin M1 through consumption of milk and dairy products. The mycotoxin deoxynivalenol is rapidly excreted from animals with very little transfer to food products and the feed concentrations are set to protect animal health. Dioxins and dl-PCBs are very lipophilic compounds and accumulate in fat.

The distribution in the animal is therefore dependent on the fat in the species of concern. Dioxins and dl-PCBs from feed are transferred to fat-containing food products. Milk and dairy products, meat, eggs and fatty fish are main sources for dietary exposure to dioxins and dioxin-like PCBs.
In conclusion, the intake of contaminants from animal-source food needs to be assessed taking into account the intake from other food groups, by comparing to the relevant HBGV. Contaminants from feed may or may not contribute to the total dietary intake and the risk to human health need to be assessed as a part of the total dietary exposure.

Interactive activities and case studies on current issues – dioxins
Ron Hoogenboom from WFSR and Jordi Minnema from RIVM presented an interactive case study on free-ranging cattle grazing in Dutch floodplains. In 2020, increased dioxin levels were discovered in the meat fat of free-ranging cattle that are grazing in Dutch floodplains as a means of nature preservation. This raised concerns on potential health risks related to the consumption of contaminated meat of these free-ranging cattle. During this session, the participants used the transfer model for dioxins in free-ranging cattle on www.feedfoodtransfer.nl to answer questions on the expected dioxin levels in meat based on measured levels in grass and soil.

Interactive activities and case studies on current issues – PFAS
Astrid Bulder from RIVM presented the interactive case study 'PFAS – (role)playing with fire'. Some time ago, an accidental fire was detected and fought. The fire was in open air, leading to a smoke plume that covered the surroundings. In the surrounding area dairy cows were grazing. Investigations were started to determine the impact of the local environmental contamination to feed and food from the surrounding area, with a focus on PFAS. The participants looked at this problem from different angles, taking up the role of farmer, risk assessor and/or risk manager.

Conclusions and recommendations
Since the previous workshop in 2013 there have been important developments in feed risk assessment. One example is the increased availability of open-access transfer models, which has facilitated their use at the international level. The increased harmonization of feeding regimes at national and regional levels has also contributed to greater harmonization of risk assessment approaches. These improvements have resulted in more accurate feed risk assessment, leading to more effective decision-making processes.

However, despite these advancements, several challenges remain. One of the key concerns is the gap in international feed risk assessment related to animal health. Many countries and organizations operate under different frameworks, which creates inconsistencies in data collection and risk evaluation.

The upcoming FAO manual on feed risk assessment will provide clarity and help to harmonize currently applied methodologies.

It was pointed out how the scarcity of animal health toxicity studies makes it difficult to perform comprehensive risk assessments. This also highlights the urgent need for more structured research and information exchange. Participants discussed the potential for in vitro methods to improve kinetic models and to fill gaps in toxicity data. These developments may reduce reliance on traditional animal testing.

The discussions also highlighted the importance of considering additional factors in feed risk assessment, such as contaminants in drinking water and soil. These environmental factors can contribute to feed safety risks, yet they are often not considered in traditional assessment models.

Another recurring theme throughout the workshop was the necessity of fostering better international collaboration in sharing high quality data. Data on feed hazards are not always widely shared, thus limiting the effectiveness of global collaboration efforts. Participants emphasized the need to develop a centralized, user-friendly quality data-sharing platform that could facilitate more seamless integration of hazard and occurrence data from various sources. Such platform would not only improve the quality of risk assessments but also enhance transparency and cooperation among stakeholders.

The workshop also addressed feed sources and technologies of increasing interest. Given the broad range of possible new feed sources, these may introduce new hazards and challenges to risk assessment.

The One Health approach was recognized of paramount importance to integrate the human and animal health perspectives in feed risk assessment and to ensure food safety and sustainability. Continuous monitoring and international collaboration are also musts to address the evolving challenges in feed risk assessment. Within a One Health approach, communication among all stakeholders in the feed sector on the importance of the feed to food continuum and how to guarantee human, animal and environmental health and welfare is important.

Moving forward, continued research and collaboration will be essential to ensuring that feed risk assessments are both effective and adaptable to evolving challenges.

The workshop served as a valuable platform for stakeholders for exchanging insights and discussing new developments in feed risk assessment. With emerging challenges, such as the potential risks associated with the use of feed sources from circular economy and the need to reduce greenhouse gas emissions by livestock, thorough risk assessment of contaminants in animal feed remains crucial. It was encouraging to see the progress made in recent years in various areas, such as transfer models and the availability of standard feed regimes. The workshop was closed by stressing the need for enhanced international collaboration, quality data sharing and capacity development to further advance feed risk assessment. FAO and other relevant stakeholders will remain committed to supporting these efforts through ongoing discussions, research initiatives, and capacity-building and training programmes.

Annex 1 – Program

Monday 10 March (Chair: Frans Verstraete – European Commission)

08.00 – 08.30 Registration and coffee

08.30 – 08.50 Opening on behalf of organizers and chair
Sandra Doevendans, Dutch Ministry of Agriculture, Fishery, Food Security and Nature; Daniela Battaglia, Food and Agriculture Organizaton of the United Nations (FAO); Astrid Bulder, National Institute for Public Health and the Environment (RIVM); Frans Verstraete (European Commission, Chair)

Setting the scene
What's happening and where? The state of the art in feed safety risk assessment, with a focus on contaminants in feed, and its role in in feed safety policies in different countries and regions, as well as at intergovernmental organizations.

08.50 – 09.15 Codex Alimentarius work on feed risk assessment and other animal feed related matters
Annamaria Bruno, Codex Alimentarius
09.15 – 09.40 Feed risk assessment in the United States of America
Timothy Schell, Food and Drug Administration (US-FDA)
09.40 – 10.05 Feed risk assessment in the European Union
Elena Rovesti, European Food Safety Authority (EFSA)
10.05 – 10.30 Feed risk assessment in Brazil
Vivian Palmeira, Department of Inspection of Products of Animal, Ministry of Agriculture, Brazil

10.30 – 11.00 Refreshments and networking break

11.00 – 11.25 Feed risk assessment in Thailand
Julaporn Srinha, Department of Livestock Development, Thai Ministry of Agriculture and Cooperatives
11.25 – 11.50 Feed risk assessment in Nigeria: A regulatory perspective
Jane Ikediobi, National Agency for Food and Drug Administration and Control (NAFDAC), Nigeria
11.50 – 12.15 Feed quality & safety: An academia/research perspective
Luciano Pinotti, University of Milano
12.15 – 12.40 An industry perspective on feed risk assessment
Arnaud Bouxin and Alexandra de Athayde, International Feed Industry Federation (IFIF)

12.40 – 13.30 Lunch break

Methods and tools
Current methods and tools for risk assessment of contaminants in feed, addressing both animal and human health risks – Hazard assessment, animal exposure assessment, animal health and welfare.

13.30 – 14.15 Hazard assessment
Jenny Murphy, Food and Drug Administration (US-FDA)
14.15 – 15.00 Animal exposure and health assessment
Elena Rovesti, European Food Safety Authority (EFSA)

15.00 – 15.30 Proposal for a feed consumption tool for animal dietary exposure assessment
Luciano Pinotti, University of Milano

15.30 – 16.00 Refreshments and networking break

16.00– 16.30 Overview on Joint FAO/WHO Expert Committee on Food Additives (JECFA) work of relevance for feed risk assessment, and future perspectives
Magdalena Niegowska Conforti, Food and Agriculture Organizaton (FAO)
16.30- 17.00 New developments and challenges related to feed sources and technologies of increasing relevance
Daniela Battaglia, Food and Agriculture Organizaton (FAO)
17.00 – 17.30 Interactive case studies
Francesca Mercogliano, University of Milano
17.30 – 17.40 Wrap up and closure
Frans Verstraete, European Commission

Tuesday 11 March (Chair: Frans Verstraete – European Commission)

Methods and tools – continued
Current methods and tools for risk assessment of contaminants in feed, addressing both animal and human health risks – Transfer/kinetic modeling, human exposure assessment, human health.

8.30 – 8.45 Opening and recap of day 1
Chair: Frans Verstraete, European Commission
8.45 – 9.45 FAO Practical manual for feed risk assessment
Astrid Bulder, National Institute for Public Health and the Environment (RIVM)
9.45 – 10.30 Transfer modelling
Jordi Minnema, RIVM and Ron Hoogenboom, Wageningen Food Safety Research (WFSR)

10.30 – 11.00 Refreshment and networking break

11.00 – 11.30 Human exposure and health assesssment
Gunnar Sundstøl Eriksen, Norwegian Veterinary Institute

In practice

11.30 – 12.30 Interactive activities and case studies on current issues - dioxins
Jordi Minnema (RIVM), Ron Hoogenboom (WFSR)
12.30 – 13.30 Lunch break
13.30 – 14.30 Interactive activities and case studies on current issues – PFAS
Astrid Bulder (RIVM)

Wrap up
Recap of the workshop and the available information, methods and tools. Discussion on possible common approach, resolving gaps.

14.30 – 15.30 Discussion
15.30 Concluding remarks and closure
Chair: Frans Verstraete, European Commission