

SUSTAINABLE IMPROVEMENT OF ANIMAL PRODUCTION AND HEALTH

Edited by N.E. Odongo, M. García & G.J. Viljoen

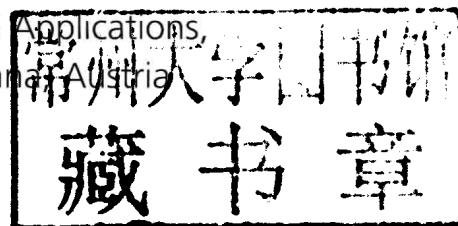


Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

SUSTAINABLE IMPROVEMENT OF ANIMAL PRODUCTION AND HEALTH

Edited by N.E. Odongo, M. Garcia & G.J. Viljoen

Animal Production and Health Subprogramme
Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture,
Department of Nuclear Sciences and Applications,
International Atomic Agency, Vienna, Austria



Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Food and Agriculture Organization of the United Nations
Rome, 2010

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) or the International Atomic Energy Agency (IAEA) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO or IAEA.

ISBN 978-92-5-106697-3

All rights reserved. FAO encourages reproduction and dissemination of material in this information product. Non-commercial uses will be authorized free of charge, upon request. Reproduction for resale or other commercial purposes, including educational purposes, may incur fees. Applications for permission to reproduce or disseminate FAO copyright materials, and all other queries concerning rights and licences, should be addressed by e-mail to copyright@fao.org or to the Chief, Publishing Policy and Support Branch, Office of Knowledge Exchange, Research and Extension, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy.

© FAO and IAEA 2010

PREFACE

The world's poorest people, some one billion living mostly in Africa and Asia, depend on livestock for their day-to-day livelihood. To reduce poverty, fight hunger and ensure global food security, there is an urgent need to increase livestock production in sustainable ways. However, livestock production in developing countries is constrained by low genetic potential of the animals, poor nutrition and husbandry practices and infectious diseases. Nuclear techniques, when applied in conjunction with conventional methods, can identify constraints to livestock productivity as well as interventions that lead to their reduction or elimination in ways that are economically and socially acceptable. The challenge is how best to exploit these techniques for solving problems faced by livestock keepers within the many agricultural production systems that exist in developing countries and demonstrating their advantages to owners, local communities and government authorities.

This publication is a compilation of the contributions emanating from an international Symposium on 'Sustainable Improvement of Animal Production and Health' organised by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture in cooperation with the Animal Production and Health Division of FAO. It provides invaluable information not only on how nuclear and related techniques can be used to support sustainable livestock production systems, but also about the constraints and opportunities for using these techniques in developing countries; it also attempts to identify specific research needs and gaps and new options for using these techniques for solving established and emerging problems. As such, it is hoped that the information presented and suggestions made will provide valuable guidance to scientists in both the public and private sectors as well as to government and institutional policy and decision makers.

The Symposium comprised a plenary session and four thematic sessions, covering (i) interactions among nutrition, reproduction and genotype, (ii) livestock-environment interaction / productivity / climate (water / land / plants / heat / altitude), (iii) detection and control of transboundary animal diseases, including zoonoses, and (iv) animal product safety and food quality. The Symposium was attended by approximately 400 delegates from 100 Member States as well as representatives of international organizations including FAO, WHO, OIE and ILRI who presented and discussed strategies for the sustainable improvement of animal production and health, with particular emphasis on global food security, poverty alleviation and hunger reduction. The seriousness with which these topics were being tackled by Member States was shown in the results of their studies, presented in 53 oral presentations and 163 poster displays by an assorted group of researchers, veterinarians, policy makers, students and other animal scientists who attended the symposium.

Qu Liang
Director,
Joint FAO/IAEA Division of Nuclear Techniques
in Food and Agriculture

Samuel Jutzi
Director,
Animal Production and Health Division, FAO

ACKNOWLEDGEMENTS

The Symposium was organised by a Scientific Committee comprising P. Boettcher (AGAP); G. Viljoen, K. Schaten, J. Crowther, M. Garcia Podesta, M. Lelenta, A. Luckins, M. Malek, H. Unger and N.E. Odongo, all of AGE of the Joint FAO/IAEA Division. The contributions of K. Long, A. Garner, C. Muller and J. Seybold, and L. Dimailig, S. Piedra-Cordero and R. Schelländer before, during and after the Symposium and the public information section comprising Mr G. Verlini, G. Webb, L. Potterton and A Evrensel are gratefully acknowledged. Special thanks are also due to Ms E. Fraser, C. Manica and M. O.Bruyker for their support in organising the Symposium and exhibitions.

The Animal Production and Health Section of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture thank the FAO and IAEA and the following organizations and companies for their cooperation and support in organising the Symposium:

- World Organisation for Animal Health (OIE)
- World Health Organization
- United Nations
- European Commission ConFluTech Project
- AMEX Export-Import GmbH
- LABSCO Laboratory Supply Co.GmbH&Co.
- Merial
- GALVmed
- Smith Detection
- Cambridge University Press

The contributions to these Proceedings were peer-reviewed by independent outside experts, edited for the English language and consistency of style by Dr. J. Dargie and type-set by Mr E. Izewski. We thank all reviewers for their meticulous work and suggestions which improved many of the papers.

OPENING STATEMENTS

Ana María Cetto

Deputy Director General, Department of Technical Cooperation, IAEA

Dear Colleagues, Ladies and Gentlemen,

On behalf of the Director General of the International Atomic Energy Agency (IAEA) and on my own behalf, I have the great pleasure to welcome you to the Vienna International Center for this International Symposium on 'Sustainable Improvement of Animal Production and Health'.

Let me start by briefly highlighting the mandate of the IAEA, and in particular, the Department of Technical Cooperation which I head. The IAEA, a specialised organization within the United Nations system, was set up as the world's 'Atoms for Peace' organization in 1957. The Agency works with its 146 (as of September 2008) Member States and multiple partners worldwide to promote the safe, secure and peaceful use of nuclear energy thus contributing to the United Nation's Millennium Development Goals for social, economic and environmental development.

The IAEA has three main areas of work or pillars underpinning its mission: Safety and Security, Science and Technology, and Safeguards and Verification. The IAEA is best known for its statutory roles in nuclear safety and security and the verification of international safeguards agreements relating to the non-proliferation of nuclear weapons. It is less known, however, for its role of helping countries mobilise peaceful and safe applications of nuclear science and technology for sustainable development. The Department of Nuclear Sciences and Applications is charged with the responsibility of implementing one of the Agency's Major Programmes, i.e. Nuclear Techniques for Development and Environmental Protection. The five key thematic areas of Water, Energy, Health, Agriculture and Biodiversity and ecosystem management that were identified in the Millennium Declaration of 2000 and reaffirmed in the Agenda 21 Action Plan and the World Summit on Sustainable Development in 2002 drive the Programme. The main programmes within Nuclear Techniques for Development and Environmental Protection are food and agriculture, human health, water resources, environment and radioisotope production and radiation.

These priorities are reflected in the structure of the Department of Nuclear Sciences and Applications, which utilises nuclear and isotope techniques, alone or integrated with other technologies, to assist countries in providing unique solutions to help solve the relevant Water, Energy, Health, Agriculture and Biodiversity topics. These techniques are employed in programmes addressing agricultural productivity and wider food security, improvement of human health, increased availability of water resources, assessment and management of the marine and terrestrial environments and industrial applications.

Of course, the Department of Nuclear Sciences and Applications focuses on those nuclear techniques and technologies that are indispensable to the Agency's mission or that have a comparative or competitive advantage over non-nuclear techniques in terms of cost-effectiveness, or are complementary to non-nuclear techniques. In developing and implementing this vision, there is a need for appropriate coordination within the Agency and with Member States, flexibility in adapting Agency programmes and activities to meet changing needs and to incorporate emerging technologies, the development

of the necessary infrastructures, and the timely dissemination of information.

More than half of the Agency's activities in Nuclear Sciences and Applications are implemented through the Technical Cooperation (TC) Programme which helps to transfer nuclear and related technologies for peaceful uses to countries throughout the world. Through training courses, expert missions, fellowships, scientific visits, and equipment disbursement, the TC Programme provides the necessary skills and equipment to establish sustainable technology in the counterpart country or region i.e. Africa, Asia and Pacific, Europe and Latin America. The other half of the Agency's activities is implemented through Coordinated Research Projects (CRPs). The CRPs are research networks that stimulate and coordinate research, and foster the exchange of scientific and technical information by bringing together research institutes in both developing and developed Member States to collaborate on the research topic of interest. Currently, the Department of Nuclear Sciences and Applications is providing technical and scientific support to 901 TC projects and cooperates and collaborates in research and development activities in 77 CRPs across the globe. The research that is supported encourages the acquisition and dissemination of new knowledge and technology generated through the use of nuclear technologies and isotopic techniques in the various fields of work covered by the Agency's mandate. These programmes are supported by the FAO/IAEA Agriculture and Biotechnology Laboratory, situated at Seibersdorf, 35 km south of Vienna which provides scientific and analytical services to research projects, and training and quality assurance services in the area of technical cooperation.

To enhance cost effectiveness and efficiency, inputs from various stakeholders (Member States, donor agencies, UN organizations etc.) must be harnessed, for example, through cooperation, collaboration and information sharing. In order to take these factors into account in the development, review, and implementation of the strategy, the Agency needs a mixture of inputs from Member States and from technical experts. Of particular importance are international conferences, symposia and other meetings, which bring us to the topic of this Symposium: 'Sustainable Improvement of Animal Production and Health'. This Symposium will address aspects of:

- interactions among nutrition, reproduction and genotype;
- effects of environment on animal productivity;
- detection and control of transboundary, emerging and zoonotic diseases;
- achieving food safety and security in the 21 century

But why livestock?

Throughout history, science and technology have been powerful tools for human development and poverty reduction. For decades, the IAEA, in partnership with FAO, has assisted its Member States to produce more, better and safer food. The on-going 'Livestock Revolution', a demand-driven increase in livestock production, especially in developing countries, presents both opportunities and challenges. As countries experience economic growth, higher incomes and increasing urbanisation, consumers are able to diversify their diets to include more meat and dairy products. Livestock production is therefore one

of the fastest growing sub-sectors in developing countries, where it already accounts for a third of GDP and is predicted to become the most important agricultural sub-sector by 2020 in terms of added value. The increasing demand for livestock products is creating opportunities for improving the welfare of millions of poor people who depend on livestock for their livelihoods. However, changes in production, procurement, processing and retailing of food, along with environmental and food safety concerns, erosion of animal genetic resources and the threat of zoonotic and other emerging infectious diseases, threaten the potential of the poor to benefit from the on-going livestock revolution.

The food crisis — which began last year with soaring prices and food shortages — continues today in many countries. However, it has been overshadowed in recent months by the global economic

crisis. Today, one in six people in the world is food insecure; almost one billion people. The choices we make now will determine how or whether we can feed ourselves in the future. If we get it right, we can have a thriving food economy. Speaking at the end of the two-day Madrid 'High Level Meeting on Food Security for All' — UN Secretary-General Ban Ki Moon said: 'We worked hard to bring food assistance to those that most needed it in 2008. This year it is going to be harder because of the financial crisis which impacts on food security, but we must remain focused on improving food production' which is the theme for this Symposium. Increasing agricultural productivity remains one of the most effective ways to combat hunger and poverty.

Ladies and gentlemen, I wish you fruitful discussions and a successful participation at the Symposium.

be taken to arrest the destruction and degradation of the natural

resource base.

Currently, seventy percent of the world's poor live in rural areas

and are dependent on agriculture. Although global food prices have

fallen in recent months, because of years of under-investment in

agriculture, coupled with the increasing threat of climate change,

future food security is not guaranteed, and in fact, the situation is

likely to worsen. Urgent action is needed to prevent hundreds of mil-

lions more people from slipping into hunger because of the volatile

food prices, increasing energy and water scarcity and the economic

and financial crunch. Beside its direct benefits, agriculture also has

important linkages with the rest of the economy and creates jobs in

other sectors. Increased agricultural productivity would result in lower

food costs, which in turn would help reduce poverty in both rural and

urban households by lowering the high proportion of their household

income currently spent on food.

But why livestock?

Approximately one billion people in the world today depend on

animals for their livelihood. Animals provide protein, natural fertilizer

and a cash income, and are also a source of draught power (plough-

ing, traction, irrigation). Because many developing and transition

countries have realised high economic growth in recent years cou-

pled with an expanding urban population, income growth is altering

spending and consumer preferences. Global food demand is shifting

from grains and other staple crops to processed food and high value

agricultural products, such as vegetables, fruits, meat, and dairy.

The increasing demand for livestock products e.g. increased demand

for meat and dairy products from the growing middle classes of

countries such as China and India as well as heavy demand for feed-

stock from the biofuel industry is creating opportunities for improv-

ing the welfare of millions of poor people who depend on livestock

for their livelihoods. However, changes in production, procurement,

processing and retailing of food, along with environmental and food

safety concerns, erosion of animal genetic resources and the threat

of emerging infectious diseases, threaten the potential of the poor to

benefit from the on-going livestock revolution.

The world has about 5 billion hectares of agricultural land. Whilst

90 percent of the world's 1.4 billion hectares of arable land are

increasingly being devoted to agro-export crops, biofuel and trans-

genic soybean to provide fuel for cars and feed for livestock, millions

of smallholder farmers in the global South still produce the majority

of staple crops needed to feed the world's rural and urban popula-

tions. In Latin America, about 20 million peasant production units

occupying close to 60 million hectares, or 40 percent of the total

arable land with average farm sizes ranging from 1–2 hectares, and

producing 51 percent of the maize, 77 percent of the beans, and 61

percent of the potatoes for domestic consumption. In Africa, arable

land comprises some 213 million hectares farmed by approximately

33 million smallholder farmers, representing 80 percent of all farm

holdings in the region. Although Africa now imports large amounts

of cereals, the majority of African farmers (many of whom are

women farming less than two hectares of land), produce a significant

amount of basic food crops with little or no usage of fertilisers and

Dear Colleagues, Ladies and Gentlemen,

It is a great honour and pleasure for me to participate at this

timely International Symposium on 'Sustainable Improvement of

Animal Production and Health'. I wish to convey my sincerest thanks

to Mr Burkart and the IAEA for the invitation and the opportunity to

share the FAO, and other role-players', view on sustainable livestock

production and health. I also wish to acknowledge and congratulate

all those who have been involved in our successful and longstanding

partnership of over 40 years since the inception of the Joint FAO/IAEA

Division in 1964. As many of you are aware, the focus of this joint

initiative is to support both FAO and IAEA Member States in the area

of food and agriculture through the development, adaptation and

transfer of nuclear and nuclear-related technologies in the areas of:

- sustainable intensification of crop production systems;

- sustainable intensification of livestock production systems;

- strengthening compliance with food and environmental safety

standards through good agricultural practices.

However, Ladies and Gentlemen,

The challenges facing us in food and agriculture are enormous.

The 2008 FAO report on 'The State of Food Insecurity in the World'

shows that in 2007 — mainly because of soaring food prices —

the number of hungry people in the world rose by approximately

75 million. With an expected increase of another 40 million people

in 2008, it is currently estimated the world has 963 million mal-

nourished people. This implies that almost one billion of the world's

6.5 billion people face hunger and are 'food insecure'. Global food

security is becoming an issue for the first time since the Second

World War. The UN Secretary-General Ban Ki-moon recently warned

at the Madrid 'High-Level Meeting on Food Security for All' that

the situation is likely get worse unless more is done to tackle the food

security problem.

In the past, famine conditions usually affected only one country

or region and the crisis was a result of a particular circumstance, such

as drought, floods or civil unrest. The current food crisis, although

overshadowed in recent months by the global economic and financial

downturn, is a worldwide phenomenon and cannot be attributed to

one single factor. It's the perfect storm of the increasing demand and

variety (consumer preference) from emerging markets in Asia and

Latin America, extreme weather cycles linked to climate change, and

the diversion of food crops (maize in particular) from the human food

chain to the production of biofuel. Our challenge is not only how to

ensure adequate food for the current 963 million hungry people, but

also how we are going to feed a world population of over 8.3 billion

people by 2030. If food demand is to be met in future, increased

outputs will have to come mainly from intensified and more efficient

use of the land, water and plant and animal genetic potential, fisher-

ies and forestry resources that smallholder farmers in developing and

transition countries have at their disposal. Smallholder farms around

up one third of global population thus representing a vital part of

local and national consumption and international trade. A lack of

water to meet daily needs is also a reality for many people around

the world today. Water availability and access are key constraints to

poverty reduction and food security. At the same time, action must

improved seed. In Asia, arable land comprises slightly more than half a billion hectares is occupied by the majority of the more than 200 million rice farmers. Few farm more than two hectares of rice but they produce 91 percent of the world's production, with China and India growing more than half the total crop. Small increases in yields on these smallholder farms that produce most of the world's staple crops will have far more impact on food availability at the local and regional levels than the doubtful increases predicted for distant and corporate-controlled large monocultures on commercially managed farms incorporating such high tech solutions as genetically modified seeds.

The FAO/IAEA partnership, mandated through the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture, has greatly contributed knowledge and assistance in capacity building activities for our Member States over the years. This longstanding collaboration, which began as a visionary initiative within the United Nations system, is being recognised increasingly by other international organizations as an excellent example of striving to work more closely together under 'ONE UN', to meet the Millennium Development Goals. The Joint FAO/IAEA Programme provides a synergy of resources and common aims in promoting the IAEA mandate on peaceful uses of nuclear technologies along with the FAO mandate

in food and agriculture. Furthermore, the interdisciplinary approach of the Joint FAO/IAEA Programme plays a major capacity building role in these areas and supports the efforts of FAO directly. Sustainable livestock production systems require an integrated management approach to farming practices that take account of complex interactions between soil, water and crops, their linkages to livestock and plant pests, and their relationship to the efficient use of agrochemicals. Sustainable farming systems rely not only on the conservation and efficient use of resources that protect our environment, but also on other factors such as agricultural investment, government policies and meeting consumer's demands and perceptions related to rural development and farming operations.

However, current technologies for enhancing crop productivity, animal production and health, food quality and safety, and controlling plant and animal pests and land degradation may have to be modified in response to these new emerging global issues and our efforts re-directed. It is imperative that we rise up together as an all inclusive community to meet these challenges on food security and agricultural sustainability, and I look forward to the continued strengthening of our FAO and IAEA collaboration in providing solutions to these problems.

Thank you for your kind attention.

David Nabarro

UN System Coordinator for Influenza and Global Food Security

Dr Traoré, Excellencies, Colleagues,

I am most grateful for this opportunity to address you today. In January 2009 I was appointed by the United Nations Secretary General, Ban Ki-Moon, to serve as Coordinator of the United Nations System High Level Task Force for Global Food. This Task Force was established in May 2008 in response to the urgent need expressed by United Nations Member States for coherent efforts in response to both short and long term elements of food security. The Task Force brings together the work of UN system bodies, International Financial Institutions and the World Trade Organization.

The members of the Task Force are committed to supporting national and regional responses to food insecurity through a Comprehensive Framework for Action that covers a broad spectrum — first, on reducing the vulnerability of households and communities at risk of food insecurity (as manifested by hunger and high rates of malnutrition); second, encouraging investments in sustainable and productive agricultural systems that improve the resilience of smallholder producers; third, improving opportunities for marketing with the participation of producer organizations and engagement of private sector partners as appropriate; and fourth promoting trade in agricultural products that works fairly in the interests of all communities and countries.

Why the emphasis on smallholder farmers? In much of the world they produce the majority of the food that is consumed. They tend to have been left aside in agricultural development efforts — especially so in recent decades as investment in agriculture generally has fallen. Yet more than two and a half billion people depend for their income and nutrition on the efforts of smallholder farming households, particularly on the work of women farmers. They live in rural areas and also in the outskirts of cities, farming plots of less than two hectares. Some of them depend entirely on livestock, others farm with a mix of livestock and crop production. They make difficult choices in the face of uncertainty about climate, access to inputs, disease, crop losses and their opportunity to market their produce at a reasonable price. Most of them are women whose children are at risk of nutritional insecurity: frequently they have to choose between caring for a child that is unwell, and has special feeding or health care needs, and working on their land or tending the animals. Much animal rearing is done by children themselves.

The Comprehensive Framework reflects a three track approach. The starting point is a recognition of the absolute importance of people being able to enjoy their right to food. Then the emphasis is on actions to realise immediate outcomes — hunger reduction, immediate boosts to agriculture, sound policies on export restrictions and import tariffs and balance of payments support on the one hand, and the third emphasis is on longer term social protection, agricultural development, attention to regional and global trade, and action on complex policy questions on the other.

The framework, which reflects the combined food security aspirations of the whole of the UN system, highlights the importance of strong partnerships involving producer organizations and civil society, businesses, professional groups (including agricultural extension and veterinary services), and researchers at national, regional and global levels. It emphasises the need for those representing the interests of

hungry people and smallholders in policy debates on short and long term aspects of food security.

The Task Force is chaired by the UN Secretary General with the Director General of FAO as Vice-Chair.

This meeting comes at a critical time. There is widespread concern among governments, farmers' organizations and civil society groups, reflected by members of our Task Force, that too many people are unable to enjoy the right to food and nutrition, to have the wherewithal to feed themselves and their families, and to be resilient in the face of economic shocks, climatic events or acts of violence. The UN Secretary General is deeply concerned that food insecurity and hunger are being experienced every day by at least one billion of the world's inhabitants. That is one person in six, or 14 percent of the global population, with a child dying of malnutrition every six seconds.

Much of your work is destined to improving the performance of the livestock sector. Unhealthy animal rearing practices in medium scale commercial operations can affect all who earn their living from animal rearing, especially those who keep a few animals in their back yards. They can also undermine the prosperity of the whole livestock sector, one which is growing at an extremely rapid rate. The prompt diagnosis of, and response to, diseases in animals is vital both for disease control and for assessing practices that are most likely to result in risks to animal health. This, in turn, is important not only for those who rear animals but also for the wider population given the importance of animal illness as a source for emerging disease in humans. At least two new pathogens capable of harming humans emerge each year, and 75 percent of these come from the animal kingdom. Frequently we do not know the potential pathogenicity of such organisms when they first emerge.

The work in which you are involved will have important repercussions for the short and long term health of people and their communities, and may also have implications for wider national prosperity and political stability.

Within our Task Force we work with nations as they contribute to national, regional and global partnerships for agriculture, food security and nutrition. We seek to help them mobilise and improve access to the resources that are necessary to initiate and sustain improved production, with Financial Coordination Mechanisms that gives them a better chance to access the investments they need in an integrated rather than piecemeal manner.

We will be guided in our work by the extent to which we are able to demonstrate reductions in hunger and poverty reduction as laid out in the Millennium Development Goals (especially MDG 1) through demonstrable improvements in production, agriculture-related income, and the contribution of agriculture systems to mitigation of and adaption to climate change.

I would like to focus now on the specific challenges to both animal and human health posed by influenza viruses, and the ways in which different national governments, regional bodies, political organizations and international institutions have worked together to address them.

During the last few years we have witnessed the agreement and application important standards for animal and human health to

the trans-boundary threats posed by disease. I refer specifically to the World Organisation for Animal Health (OIE) animal health standards and the Revised International Health Regulations (IHR 2005) developed by member states of the World Health Organisation. The IHR, for example, is an important intergovernmental framework and series of instruments for collective responses to infectious disease. The proper implementation of IHR 2005 depends on the full participation of national authorities and other stakeholders. Some of them question the extent to which systems for global governance on health reflect the interests of poor people and their nations: they question the value of globalised thinking and working.

A word on my own involvement in this field. I started out thirty years ago as a public health doctor working in rural communities in the Middle East and in South Asia, especially in Nepal. I focused on the determinants of resilience and nutrition in communities, and particularly on the problems experienced by women and children during the tough rainy months leading to harvest, when the demands of the fields and child care tended to compete, when money supply was tight, and when the health centres often lacked necessary medicines. For about five years I taught public health and nutrition, and for another ten years I worked as a civil servant with the British Government, in Africa and then in London. I joined WHO and served in various roles between 1999 and 2005. In September 2005 I was asked by the late J.W. Lee, the then WHO Director General, and Kofi Annan, the Secretary General of the United Nations, to move to New York. My remit was to help different parts of the UN system react to increasing political concern among Heads of State and Government, particularly from Southeast Asia, about the potential political, societal and economic impacts of a severe influenza pandemic.

I was asked to establish a temporary mechanism to ensure that the capacities of the whole UN system (technical human health and agriculture bodies, as well as our full range of social, political and economic bodies) are made available, in a coherent way, to the governments of our Member States.

During 2005 there was broad agreement on the scientific basis of work being undertaken on avian and pandemic influenza; outstanding research questions were also clear. These include a better understanding of risks associated with the movement of highly pathogenic avian influenza among poultry (particularly in ducks); the relative roles of wild birds, trade, and cross border movements in spreading H5N1 among birds; and the behaviour patterns that increase risks for human infection still needing some work.

WHO, FAO and OIE had established clear strategies for national actions to be undertaken: stamping out Highly Pathogenic Avian Influenza (HPAI) when identified — through quick and thorough action; reducing the threat to poultry through introducing biosecurity; monitoring wild birds and charting their movements so that where possible wild birds that might be infected with this virus could be separated from domestic birds; reducing the risk of human sporadic cases by limiting the degree to which humans would be in contact with infected birds, and then preparing to contain and then mitigate the next influenza pandemic when it happens.

The challenge for us was to ensure that governments gave these strategies the impetus necessary for their implementation, leading to the control of HPAI and preparedness for an influenza pandemic. The technical work had to be taken forward within the momentum of the emerging political environment. As well as ASEAN, the USA, the EU, Canada and Japan took political initiatives.

Within the UN Influenza Coordination Office we sought to align different international institutions — including the World Bank, the international organizations of the UN, the regional development banks, other international, regional and local research bodies and so on — and to encourage the collective pursuit of international normal

and standards, with the specialized organizations (WHO, FAO and the OIE) charting a path for the rest of the UN system and the myriad of other organizations becoming engaged in work on avian and pandemic influenza.

From the start most of those who were involved in this work demonstrated unity of purpose and synergy of action. In general, coordination between the bilateral donors, the foundations, national governments, regional bodies and international non-governmental groups (including the Red Cross movement) was strong.

We have subsequently sought to identify the incentives that brought many disparate groups to work together. Finance was important, and the partnership mobilised over US\$ 3 billion in assistance for avian and human influenza actions between 2005 and 2009. But this — on its own — cannot explain the extent to which national authorities have worked together on these issues. The funds that have been pledged are primarily made available to governments: they have moved comparatively slowly.

An International Partnership on Avian and Pandemic Influenza was established as a basis for this cooperation. Other partnerships were organised at regional level through the European Union, APEC, ASEAN and other regional groupings. Few of these partnerships were formal: most had real impact on the alignment and ways of working of their members.

We concluded that most of the groups working together on this issue recognised the value of working together, in synergy. They found it both operationally useful and reassuring in a situation where there was considerable political urgency and need for concerted action by institutions. Stakeholders from the public, private and voluntary sectors have valued the opportunity for coherence, joint working and participation. They have worked together on disease surveillance, reporting and response. They have joined together to support the evolution of an inclusive movement that enables hundreds of different stakeholders to feel at home within it.

Pandemic preparedness work has moved forward over the last four years thanks to the efforts of this broader movement, and the effort has been tracked through annual global progress reports using information from countries. The reports, which have involved the full range of UN system agencies and the World Bank, have served as the basis for collective accountability. The reports reveal that over the four-year period there has been more rapid reporting of HPAI and more effective, sustained responses to outbreaks of the disease in poultry. The OIE is now pursuing the elimination of H5N1 in the next few years. There has also been a massive effort to initiate pandemic preparedness work which we believe has stood us in good stead as the world faces up to the first outbreak — potentially pandemic — of a novel influenza virus of this century. Once again, our preparedness is being tested by the uncertainties around which way this particular threat will go.

Our Annual Reports identify seven factors for success. These are:

- consistent political commitment;
- resources and capacity to go to scale in response to a threat;
- interdisciplinary working (particularly animal health and human health) within countries and across borders;
- predictable, prompt, fair and sustained compensation schemes for those who lose property or animals as a result of control measures;
- strong engagement of public sector, private sector and voluntary agencies;
- clear and unambiguous communication of reliable information (and sharing of uncertainty as appropriate);
- the need for a viable and scientific response strategy.

Experiences with SARS and other diseases suggest that if information is kept from people they will not feel empowered to be part of the response.

What are the incentives for success? First is the availability of good quality and accessible information about HPAI outbreaks — based on good mapping of issues, tracking of progress and risk analysis. The information that is available has been synthesised and made available to those who need it through the efforts of international organizations in response to the needs of their primary clients. Without well functioning surveillance and reporting systems we are stuck: OIE and FAO have played major roles, working with the support of a number of Member States to establish better diagnostic surveillance and reporting capacity.

A second incentive is the ready availability of instruments, services and assets needed for effective action. These include the Global Outbreak Alert and Response Network (GOARN) in WHO and the FAO-OIE Crisis Management Center for Animal Health that provide a backbone for solidarity and international action. This encourages countries and other stakeholders to be engaged — they know that dependable systems exist that can help them.

A third incentive is the existence of the right legal codes (and means for enforcement) at country level — for controlling movements of animals, for ensuring compensation when animals have to be killed and for enabling the consistent nation-wide implementation of public health functions (especially in decentralised political systems).

A fourth incentive is the widespread appreciation among the public, of the pandemic threat and the need to be prepared. Unfortunately it has not proved easy to sustain the appreciation that animals, and ways in which they are cared for, can pose a risk not only for their own health but also for human health. The risk can be reduced by changed behaviour. The information and compensation needed to encourage behaviour changes are often not sufficient. It is vital that the potential for animals to serve as the source for diseases in humans, and *vice versa*, result in better attention to the animal-human health interface — what we tend to refer to as the 'One World, One Health' movement following the groundbreaking work of the wildlife conservation movement.

A fifth incentive is empowered and professional government servants — people in government who feel that they are in a position to take the initiative in the face of a disease threat. They sometimes do not believe that their own authorities, or international authorities, are working in their interests. This is a challenge. H5N1 — and other diseases — will not be controlled through compulsion and sanctions. It doesn't work. People start to hide, they do not explain, they do

their best to avoid involvement. So it is absolutely essential to build the necessary trust for effective action.

There are a number of continuing challenges for our collective effort to control HPAI caused by the H5N1 virus and to prepare for pandemics.

The first is the continuing lack of adequate systems and capacities for data collection and surveillance, laboratory services and analysis, and for the management and use of information derived from the data. This applies to both animal and human health.

The second is the reality that some key groups (in some countries) are not fully engaged into the movement for pandemic preparedness. How to ensure that those who run the poultry industry in a HPAI-affected country see it as in their collective self interest to work together with the NGOs, the researchers, and governments on control and prevention of HPAI? This requires a continuous effort to build and sustain a movement. Movements wither away if they are not persistently supported and kept going.

The third challenge is to maintain trust. Committed professionals from countries in South East Asia worked with the Rockefeller Foundation to build the Mekong Basin Disease Surveillance Program over many years. This covers several different disease issues. It has generated trust between technicians across borders, has survived and continues to do well despite occasional difficulties at the ministerial or high political level. Similar systems are being established between Bangladesh, India and Nepal following their HPAI outbreaks in 2008 and 09.

We are all involved in this effort to build trust. We should ask ourselves, from time to time, whether we are contributing to trust as effectively as we could.

In conclusion, we who are involved in this work tend to want to implement the most appropriate (or 'right') actions. These norms must be well publicised, continuously reinforced in a very positive and embracing and open way and backed with good quality literature.

We need viable animal and human health services based on the best available technologies, and to be sure that the incentives for them to work well are the right ones. The OIE's PVS scheme offers us some valuable pointers.

It is worthwhile getting the incentives right so that pandemic preparations are successfully put in place. The reward may well be that when the next severe influenza pandemic strikes, millions of people survive who might otherwise be expected to die.

I acknowledge the contribution of my many colleagues in UN system agencies to the development of these ideas. The responsibility for the way in which I have presented them is mine alone.

Qu Liang

Director, Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture, IAEA

Dear Colleagues, Ladies and Gentlemen,

I am delighted to see that we have been able to attract such a high calibre of livestock scientists, practitioners and managers from all over the world. Welcome to Vienna and to this International Symposium on 'Sustainable Improvement of Animal Production and Health'. I would also like to record my appreciation to the private sector for the support given to this Symposium which has enabled us to channel more resources than would otherwise have been possible into ensuring that so many researchers and decision makers from developing countries are here this week. I believe we all share a common vision — the Millennium Declaration to 'spare no effort to free our fellow men, women and children from the abject and dehumanising conditions of extreme poverty.'

Ladies and Gentlemen,

The current food crisis is unprecedented. A staggering one billion of the world's 6.5 billion people face hunger and are 'food insecure'. These are tough times for everyone, but they're especially desperate times for many poor communities and smallholder farmers in developing countries. The global food crisis has been blamed on a combination of the increasing demand and variety (consumer preference) from emerging markets in Asia and Latin America, extreme weather cycles linked to climate change, oil prices, and the diversion of food crops (maize in particular) from the human food chain to the production of biofuel. All this is true, however, in the past seven to ten years; the world has consumed more grain than its farmers have produced thus relying more and more on grain reserves. As a result, grain reserves are currently at their lowest level in the past 50 years. Furthermore, for decades there has been a decline in global agricultural scientific research and development funding in both developing and developed countries. Because it takes on average 15 to 20 years for a new piece of science and technology to be researched, developed and disseminated to end-users, the challenge facing today's farmers is how to overcome obstacles to sustainable food production and double the world's food production using less land, less water, fewer nutrients, and less technology.

The Joint FAO/IAEA Programme assists Member States of FAO and IAEA to develop improved strategies for sustainable food production through the use of nuclear and nuclear related techniques and is comprised of five sub-programmes covering: Soil and Water Management & Crop Nutrition, Plant Breeding and Genetics, Animal Production and Health, Insect Pest Control, and Food and Environmental Protection.

Briefly, the Soils and Water Management and Crop Nutrition sub-Programme assists national institutions in developing countries involved in agricultural production to develop integrated strategies and technologies using nuclear and nuclear related techniques to improve the efficiency of nutrient and water use within selected cropping systems, while conserving the natural resource base (soil, water, biodiversity, etc.). The Plant Breeding and Genetics sub-Programme assists Member States in the implementation of modern and competitive plant breeding programmes using radiation induced mutation and efficiency-enhancing biotechnologies to ensure food security through sustainable crop production. The Insect Pest Control sub-Programme assists Member States in implementing environmentally friendly and sustainable methods to control major insect pests of plants, animals and humans by focusing on area-wide integrated pest management approaches involving the sterile insect technique (SIT)

to enhance food security. The Food and Environmental Protection sub-Programme assists Member States in their endeavours to ensure the quality and safety of food and agricultural commodities and facilitate international trade. The focus is on strengthening Member State capacities for applying international standards on irradiation and on using nuclear and nuclear related analytical techniques in the management of food and environmental hazards.

Last but not least, the Animal Production and Health sub-Programme contributes to the enhancement of global food security through the implementation of sustainable livestock production systems using nuclear and nuclear related techniques. Sustainable livestock production systems require an integrated management approach to farming practices that takes account of complex interactions between soil, water and crops, their linkages to livestock and plant pests, and their relationship to the efficient use of agro-chemicals. We assist Member States to improve livestock productivity through the efficient use of locally available feed resources, adequate management practices and breeding programmes for indigenous and upgraded animals, and diagnostic tools and prophylactic measures for the control and prevention of animal and zoonotic diseases.

In all areas, support and guidance is provided in the formulation and implementation of activities that underpin Member States' national, regional and global development objectives through strategic, applied and adaptive research, technology transfer, capacity building, policy advice and information management. In all our activities, the overall objective is the development and use of novel nuclear and nuclear related technologies for a more profitable and sustainable agriculture, a secure food production system and a healthier environment.

How is this achieved?

This is accomplished by co-ordinating and supporting research, providing technical and advisory services, providing laboratory support and through scientific training and by collecting, analysing and disseminating balanced scientific, technical and policy-relevant information.

Co-ordinating and supporting research

Approximately 600 research institutions and experimental stations in Member States co-operate in 40 Co-ordinated Research Projects. Each project attempts to solve practical problems of economic significance for developing countries and involves collaboration among 10–20 institutions including those belonging to the Consultative Group on International Agricultural Research (CGIAR). Institutions in developing countries are normally awarded Research Contracts with nominal financial support, whereas those in the more developed countries participate through Research Agreements with financial support only for attendance at Research Co-ordination Meetings. These projects normally last for five years and the results are published either as an IAEA TECDOC or a special issue of a journal.

Providing technical and advisory services

The Joint FAO/IAEA Programme is also responsible for providing scientific and technical guidance and support to over 200 national and regional Technical Co-operation Projects, as well as for Inter-

regional and Regional Training Courses. These projects are financed by the Agency's Technical Co-operation Fund, FAO's Technical Co-operation Programme and through trust funds provided by donor countries and international funding agencies for the procurement of equipment and provision of expert advice and training (through fellowships and scientific visits).

Providing laboratory support and scientific training

The Joint FAO/IAEA Programme is supported in its activities by the FAO/IAEA Agriculture and Biotechnology Laboratory, situated at Seibersdorf, 35 km south of Vienna. The laboratory specialises in research, development and transfer of nuclear and nuclear related techniques including training of scientists through individual fellowships and inter-regional and group training courses in various disciplines. The laboratory also provides guidance on the introduction of analytical quality control and assurance into counterpart laboratories, and training in the maintenance of laboratory equipment and instruments.

Collecting, analysing and disseminating information

In addition to encouraging the direct transfer of skills and technology, the Joint FAO/IAEA Programme provides a variety of information services including conferences, symposia, seminars and advisory group panels, and the publication of technical and public informa-

tion documents that arise from these meetings as well as from Co-ordinated Research Projects and Technical Co-operation Projects. The Programme also maintains contact and collaboration with Member States through joint scientific publications and other publications, such as newsletters, periodic reviews, and computer databases.

Going back to Animal Production and Health, let me re-emphasise the importance of the issues raised by Dr. Traoré in his address. Approximately one billion people in the world today depend on animals for their livelihood. We know that the global food demand is shifting from grain and other staple crops to more processed food and high-value agricultural products, such as fruits, vegetables, meat and dairy products in several transition economies such as Brazil, China and India which have enjoyed high economic growth in recent years coupled with an expanding, wealthier urban population. Although we tend to associate these changes with urban centres, the same change is happening in rural areas as well. Visit any small town or village in these transition economies and some developing countries and you will see a booming business in milk and other livestock products. This increased demand can only be met through the protection of animals from diseases, the selection of animals that give more meat and milk, and the optimal utilisation of local resources whilst protecting the environment to which the Animal Production and Health sub-Programme contributes through the use of nuclear and nuclear related techniques.

Thank you for your kind attention.

SUMMARY AND CONCLUSIONS

I. PLENARY SESSION

Two keynote addresses were presented: Historic role of nuclear techniques in solving problems of animal health & production by Wyn Richards, and Decline in available world resources – implications for livestock production systems by Ron Leng. The relevant points that emerged from these talks were:

- The world demands more and healthier animals and animal products produced in an 'environmentally safe, clean, and ethical' way. This is imposing new challenges for animal scientists whose primary concern has been improving livestock productivity. Improving understanding and technologies in animal nutrition, animal reproduction and breeding, and animal health is critically important for food security, poverty alleviation and environment protection on a global scale. The Animal Production and Health Subprogramme of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture has developed, validated, and transferred to IAEA and FAO Members States sound, low cost and easy-to-use nuclear and nuclear related techniques coupled with convenient strategies to improve animal productivity and to efficiently manage diagnostic laboratories.
- These nuclear applications have undoubtedly spearheaded modern biotechnological research. For example, the most used disease monitoring technology is the enzyme linked immunosorbent assay (ELISA). ELISA assays were developed through research using radioactive isotopes (radioimmunoassay, Western blot), and many still use gamma irradiated pathogens as safe antigens (e.g. Rift Valley fever IgG and IgM ELISA's). Similarly, molecular diagnosis and characterisation techniques were founded using radioisotopic applications. In fact, the most sensitive and cost effective pathogen detection and characterisation applications (1-100 protein or nucleic acid molecules) still demand the use of isotopes. In modern biotechnology, nuclear applications will continue to play a major role.
- The IAEA was instrumental in the success of the global rinderpest eradication campaign through transfer of technologies, improvement in laboratory infrastructure and staff proficiency, and provision of methodologies and operational guidance. The laboratory groundwork laid then, now forms the basis of an increasingly successful animal health control programme in developing countries, demonstrating the sustainability of the interventions fostered by the IAEA in partnership with FAO.
- The world is faced with three simultaneous and interrelated crises that if not responded to appropriately will create chaos, i.e. climate change, increased oil demand and global resource depletion. There is an urgent need to respond to these challenges in order to produce and deliver food to maintain the present world population. The Food and Agriculture Organization of the United Nations (FAO). FAO has indicated that one billion of the world's 6.5 billion people face hunger and are 'food insecure'.
- The primary resource depletion is fossil fuel energy as the world has been using more fossil energy than is being discovered. Several countries have opted to cover part the demand by using bio-ethanol and bio-diesel, thereby impacting on land use and grain availability, and contributing to increasing world food prices. Cereal grain availability for industrial livestock production (pig, poultry and feedlot beef) will be highly restricted and the resulting shortfall in meat production will only be replaced by expanding ruminant animal production. Grain based animal production will become increasingly expensive. There is a greater need to intensify ruminant production on crop residues by applying better

methods of treatment to improve digestibility and to prioritise protein supplementation that increases feed conversion efficiency.

- Water, the other major resource required for agriculture has also been depleted. Many of the world's large river systems are being drained for urban and industrial water supplies or for irrigating crops. Humans, animals, and plants compete for water and it is by far the most important limiting factor in livestock production. Although much research is being done, it needs to be focussed on overcoming the significant obstacles to sustainable food production in order to create the means to double global food production using less land, less water, fewer nutrients, and less technology to satisfy the expected demand.
- Global warming is causing serious deleterious effects to the environment. There is an evident increase in the incidences of extreme weather events such as storms, droughts and floods and, at the same time, changing temperatures may support the occurrence or recurrence of agricultural pests, diseases and their potential vectors.

II. ANIMAL PRODUCTION

- Much of the activities of the Animal Production and Health Subprogramme of the Joint FAO/IAEA Division of Nuclear and Techniques in Food and Agriculture will have important repercussions on people and their communities, as it was clearly revealed through the various sessions in the symposium. To meet the demands and need of food of animal origin, to improve the efficiency of the large number of production systems in more than 20 livestock species reared under various environment and climatic conditions, and to provide sound surveillance disease programme, as well as national control and eradication programmes for trans-boundary and zoonotic diseases have to be the result of coordinated and joint efforts from several international organizations.
- The paramount of work ahead cannot be underestimated and therefore cannot be solved by few people or institutions. Livestock population is predicted to increase dramatically over next 40 years with an important impact on land use; but also, there is an annual loss of 150 million cattle and small ruminants from parasitic and infectious diseases and even greater losses in production from inefficient husbandry practices. These facts must be highlighted and that should be bear in mind when designing future activities. Besides this, papers and talks presented during the symposium showed that the coming world food crisis has three important factors to consider: the end of inexpensive energy era (and beginning of expensive inputs), global climate change, and global resources depletion including mineral fertilizers, irrigation water, soil fertility, and land use. Research work is highly needed to solve or alleviate much of these problems, and certainly the IAEA contribution with the development and application of nuclear and nuclear related techniques are utmost relevant; however, we must differentiate the target audience for application of nuclear techniques as the users in many cases are different from beneficiaries - but both of these are members of a much larger value chain. Research is highly needed but the results and its application in large scale has to be balanced, as proper evaluation and consideration to public needs, beliefs and cultural heritage are different within countries, regions and continents.
- Facts, data, results, and recommendations given by experts have resulted in a long list of valuable ideas, proposals, and procedures that can be used at various levels to boost livestock production, reduce hunger and improve health conditions in animals and