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# EXPERIENCES AND STRATEGY IN INTERNATIONAL AGRICULTURAL RESEARCH IN THE NETHERLANDS

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*Martin C.Th. Scholten* is a member of the Board of Directors of Wageningen UR since 2008, responsible for the Animal Sciences (including Livestock Research and Central Veterinary Institute) and for the marine institute IMARES.

He is co-chairman of the Livestock Research Group of the Global Research Alliance (GRA) on Agricultural Greenhouse Gases since 2010; chairman of the European livestock research alliance Animal Task Force (ATF) since 2012; and chairman of the section “Aquaculture” of EFARO (European Association of Fisheries & Aquaculture Research Organisations) since 2004.

# ABSTRACT

The global demand for food production is expected to double by 2050, especially regarding animal proteins. Feeding the world within the carrying capacity of planet earth requires smart and highly efficient agroproduction producing more and better food with less resources (land, water, nutrients, energy, biocides, antibiotics, etc.) and no draw backs to the environment.

The Netherlands is renowned for its efficient agroproduction, based on tradition, stockmanship, innovative entrepreneurship and scientific approach. The small (42,000 km<sup>2</sup>) and densely populated (17 million people) country is the second largest exporter of agricultural products in the world. Top class farmers and strong multinational agribusiness partners are closely linked to top science, with Wageningen University rated as the best agrofood faculty of the world by the National Taiwan University Ranking in 2013. The yield per hectare is five times the European average, four agrofood companies are amongst the world top 40.

It will be explained how the so-called triple helix governance model of interaction between business, science and government has resulted in the evolution of the agrofood sectors in the Netherlands and what the forecast of the future development might be.

In the presentation, it will be illustrated how in the Netherlands the scientific support to the agrofood business is being organized by implementing efficient precision farming practices, including smart breeding programmes, customized fertilization and nutrition, specific animal care in modern housing, environmental greenhouse technologies, information and sensor technology, biological control of pests, eradication and control of disease, and quality control throughout the chain of custody from producers to consumers, etc.

These principles will be illustrated for sustainable production of animal-source food, based on a concept named “Livestock Farming with Care.” This concept is founded on care ethics with an integrated approach following four basic principles: 1) One Health (i.e. healthy and safe for animals and humans); 2) customized care (i.e. from the individual animal’s perspective and integrity); 3) no nuisance (i.e. from an environmental and societal perspective); and 4) credible performance (i.e. from an economic and public prospect).

The presentation will be concluded with an overview of global initiatives to come to a sustainable, responsible and climate smart agriculture on basis of joint research and technology transfer in an international context.

## KEYWORDS

Food Security, AgroFood Sciences, Smart Agriculture, the Netherlands

## REFERENCES

Scholten, M.C.Th., I.J.M. de Boer, B. Gremmen and C. Lokhorst, 2013: NJAS Wageningen Journal of Life Sciences, 66, 3-5.

## Experiences and Strategy in International Agricultural Research in the Netherlands

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## Feeding the World within the Capacity of Planet Earth

2 x 2

- Doubling Production
- Halving Ecological Footprint

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## The Perspectives of Animal Protein Production 2050

People	Food	Feed
<p>World Population: 1950-2050</p>	465 MT +70% 1045 MT +60% 110 MT +60%	1000 MT +35% 1,6 Gha +15% 3,4 Gha +0%

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## Responsible Agricultural Production

Ecological Footprint

C: CO<sub>2</sub>

H<sub>2</sub>O:

Land:

P:

Social Needs

Animal Welfare

One Health

Livelihood

Fair Trade

Ecological services

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## Food security: More

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## Sustainable Food Security: More with Less

Less Inputs → Efficiency → More Food

- resources
- waste
- impacts

**Sustainable intensification is most effective**

Producing 1 billion kg of milk: 2007 versus 1944

Requirement	1944	2007
Land	21%	3%
Water	34%	1%
CO <sub>2</sub>	19%	37%

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### Responsible Nutrition Security: More with Less and Better

- resources
- waste
- impacts

- nutritious
- diverse
- customized

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### Adaptation is Essential

ECO SOCIO

Adaptation

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### From Incremental towards Radical Improvement

- Implementation of best practices  
Short term
- Improvement of farm management/chain governance  
Medium term
- Breakthrough of innovations  
Longer term

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### The Netherlands Approach

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### The Netherlands: an AgroFood Economy

- Small country in size (42,000 km<sup>2</sup>), densely populated (17m people)
- Second largest exporter of food & flowers in the world
- Major sectors: horticulture (greenhouse) and livestock (dairy, pork, poultry)
- Key-characteristics: highly productive, very efficient, knowledge-intensive
- Top-class farmers: added value per ha 5 times the European average
- Strong agribusiness: 4 companies in world top-40

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### Efficient and Innovative by Tradition

- High output, low cost
- Modern precision farming
- Climate smart practices
- Smart breeding
- Customized feeding and fertilization
- Focus on plant /animal health and welfare
- Systematic quality control
- Science based!!!

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### Triple Helix: *the* Key Behind the Success

The diagram illustrates the Triple Helix model with three overlapping sectors: Government (purple), Business (orange), and University (green). It features logos for Wageningen UR and 'The Triple Helix' by the Netherlands Organisation for Scientific Research.

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### Wageningen UR: Science for Impact

**9,400 students (106 nationalities):**  
3,800 BSc / 3,700 Msc / 1,900 Ph

**Wageningen University**  
staff: 2,600

**Research Centre**  
staff: 2,700

The slide shows two circular images: a modern university building and a large-scale agricultural greenhouse. A map of Europe highlights Wageningen UR's international reach.

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### Science for Impact: the Shortcut

This slide features a book cover titled 'LEARNING HOW TO EAT LIKE A PIG...', a map of Wageningen Campus with a red circle highlighting a specific area, and two photographs: one of a farm building and another of a pig in a field.

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### Linking Life Sciences with Social Sciences

Our domain: **healthy food and living environment**  
health, lifestyle, livelihood

A Venn diagram with three overlapping circles representing 'food and food production', 'living environment', and 'health, lifestyle, livelihood'. Below the diagram are images of a farm, a city skyline, and a natural landscape.

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### Scientific Position of Wageningen UR

NATIONAL TAIWAN UNIVERSITY RANKING | NTU RANKING  
PERFORMANCE RANKING OF SCIENTIFIC PAPERS  
FOR WORLD UNIVERSITIES 2013

Rank	University	Score
1	Wageningen University	94.0
2	University of California, Davis	87.5
3	Cornell University	86.7
4	University of Florida	85.3
5	University of California, Berkeley	85.2
6	University of Wisconsin, Madison	82.9
7	University of Minnesota, Twin Cities	81.2
8	Ottawa University	79.9
9	Michigan State University	78.1
10	University of Copenhagen	77.1
11	Harvard University	76.2
12	The University of British Columbia	75.2
13	University of Queensland	75.2
14	Swedish University of Agricultural Sciences	75.0
15	Georgia State University	74.6
16	Karlsruhe University	73.9
17	University of Georgia	72.8
18	University of Toronto, Ontario, Canada	71.2
19	Polish Federal Institute of Technology - Lodz	70.8
20	University of Wageningen, Arnhem	70.7
21	University of São Paulo	70.5
22	University of Arizona	69.8
23	Duke University	69.7
24	South Carolina State University	68.4
25	The University of Tokyo	61.2

The slide includes images of Wageningen UR buildings and a landscape view. The table shows Wageningen UR at the top of the ranking.

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### International Cooperation

- Joint Research
- Shared education
- Data sharing
- Capacity sharing
- Joint programming
- Alliances

A globe surrounded by various national flags and a world map showing Wageningen UR's global network.



Offices in:

- ❖ Brazil
- ❖ China
- ❖ Chile
- ❖ Ethiopia
- ❖ Saudi Arabia

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### Wageningen UR: connected to Japan

- 3 collaborative projects
- 4 MSc students
- 2 PhD students



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### Contribution to Global Initiatives





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### Global Research Alliance

GLOBAL RESEARCH ALLIANCE  
ON AGRICULTURAL GREENHOUSE GASES

- Increase agriculture production with lower emissions
- Improve global cooperation in research
- Work with farmers and partners to provide knowledge



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### GRA: Research Groups

GLOBAL RESEARCH ALLIANCE  
ON AGRICULTURAL GREENHOUSE GASES

**Cross-cutting Groups**

- Livestock Research Group  
- Croplands Research Group  
- Paddy Rice Research Group  
- Inventory and Measurement  
- Soil Carbon and Nitrogen Cycling  



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### GRA: Livestock Research Group

GLOBAL RESEARCH ALLIANCE  
ON AGRICULTURAL GREENHOUSE GASES



**Livestock Research Group**  
website: [www.globalresearchalliance.org](http://www.globalresearchalliance.org)



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### Global Agenda of Action for a Sustainable Livestock Sector

- Closing the efficiency gap
- Restoring value to grassland
- Waste to worth



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### Wageningen example: Livestock Farming with Care

M.C.Th. Scholten, I.J.M. de Boer, B. Gremmen, C. Lokhorst; Livestock Farming with Care: towards sustainable production of animal-source food *NJAS - Wageningen Journal of Life Sciences, Volume 66, November 2013, Pages 3-5*

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### Not a One Issue Approach

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### This Results in Sciences Based Farming

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### Foster the Pigs with Enriched Environment

- Reduced food neophobia
- Higher preweaning growth
- Higher feed intake after weaning

WEANING

- Higher growth & feed efficiency
- Reduced diarrhoea
- Less damaging behaviours
- More play behaviour

nature *BRINGING HOME THE BACON*

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### Foster the Chicken with Early Feeding

- Growth performance ↑
- Immune response later life ↑
- Long term effects microbes composition

% chicks hatched

Incubation time (h)

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### Our contribution to feed the world

More with Less and Better

Thank You!

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**Chair Yamaoka:** Thank you for your kind introduction, Ms. Imahigashi. My name is Kazumi Yamaoka. I am a Research Coordinator of JIRCAS. This is the final session of our symposium and the task of moderator is assigned to me. This session is regarded as a wrap-up session in the form of a panel discussion in which we put together each presentation, speeches, views, and discussions during the previous sessions in two days.

The purpose of the panel discussion is to find out new directions of strengthening international competitiveness in Japanese agriculture, forestry, and fisheries, taking into consideration the deepening of globalization and the rapid change in the structure of food demand and supply, and the rural society in Asian countries. And the purpose is also to discuss the way of applying outcomes of international research to the new directions.

To make an approach to the purpose, I have got ready an agenda of this session as show on the screen.

This is our purpose of the wrap-up session. Next, please. The usual things for us to do first is to take a lesson from foreigners. In this case the best model is the Netherlands. Therefore, before starting the panel discussion, I would like to invite a special speaker, Prof. Martin Scholten, from Wageningen University in the Netherlands. I expect that the professor will provide instructive ideas for us with the governance model of the triple helix among the business circle, governments, and the academic world, as a key behind Dutch success story. So please start your presentation, Professor.

**Martin Scholten:** I'd like to thank you for the invitation to come to Japan to share the experience with you about agricultural research, how we organize that in the Netherlands, and how we bring our agricultural research from the Netherlands to the world in an international scope.

The background of all our research is this idea, is this objective, is this challenge: feeding the world within the carrying capacity of planet Earth. And that means that we have to produce more food, some people say double production of the food, and at the same time we have to halve the ecological footprint of our food production. I understood that in the seminar yesterday some introductions were given by FAO people on this principle.

This producing more food is especially there when it comes to animal protein production. This is a prospect for 2050 and it shows that the production of meat, milk, and eggs will increase enormously and we have to take up that challenge, and we have to provide as agricultural researchers support to this global production, and we have to do that in a responsible way.

So we have to take into account the ecological footprint, which is more than only the carbon footprint related to the climate impacts, but also the water footprint, the land footprint, and the phosphate footprint. And also, we have to take care about social needs, social needs related to animal welfare but also to the one-health problem, animal health in relation to human health, the livelihood of people, the fair trade over the world, and ecological services that agriculture can fulfill.

So it means food security as a key issue producing more foods, but that's not enough. It's produced more with less resources, less waste, and less impacts, and it is the way of sustainable intensification, which is the most effective to come to more efficient agriculture because more with less means efficiency; that is the key. And you can have enormous progress, you can have enormous benefits when you come to sustainable intensification.

But there is more. This afternoon we had a lecture on how important the food as a nutrition source is. Malnutrition in the world is a big thing. That means that we also produce better foods. We have to produce better food, and better food is nutritious food, but it's also diverse food and it's customized food, customized to the needs of young people, elderly people, people in various parts of the world. *Food for all* is a publication that Wageningen University launched early this year at our 95th birthday.



It is more than less inputs, more food, and better food; it's also a question of adaptation. Adaptation is important. It is no one-size-fits-all. That is the lesson we learned from the green revolution in the last century. Every part of the world is different in ecological perspective, but also in economic perspective, and every part of the world is different in sociological perspectives. So that means when we speak about availability of food, access to food, and consumption of food, we have to take into account that global diversity, and adaptation is really an important key to take into consideration.

So that means efficiency, upgrading, adaptation, that is the three parts of the challenge for the agricultural research to serve the world.

That can be from incremental towards radical improvements, and it is those three lines that come along together.

On the short term we can benefit a lot by implementing the best practices and sharing the best practices and working on knowledge transfer from one place to the other place.

On the mid-term level it's a matter of improving the farm management or improving the chain governance, so to come up with efficient agri-production and food production without waste.

And finally, the breakthrough of innovations, the really scientific new understandings that you bring into practice, and sometimes that needs a little bit longer time before the new insights and the new technologies find their way to the agricultural practice, especially when it's in the rural areas with small-holder farms.

So this is our context, and I think the context in the Netherlands is not different from the context in Japan or in any other country of the world, but let me explain to you our Netherlands approach.

I'm coming from a very small country, a very, very small country, densely populated, 17 million people, and we have to produce food, we have to find places for nature, for leisure, for our people. And we do that in a very efficient way. We are the second-largest exporter of food and flowers in the world. Only the USA exports more agro products. So for a very, very small country that's a big thing.

Our major sectors are horticulture and it's livestock, and that is exactly the two sectors where you find the sustainable intensification, where you can produce more on the same square meters land.

The key characteristics are it's highly productive, very efficient, and knowledge-intensive. And the top-class farmers in the Netherlands produce five times more per hectare than the average in Europe. That's because we are such a small country and we have an ambition to produce food.

We also are connected to a strong agribusiness. Four companies are amongst the world's top 40.

So what's the key to success and beyond that?

- Well, efficiency again, high output, low cost.
- Modern precision farming, so bringing in the biotechnology, the genomics, but also the informatics and robotics into the farming practice.
- A climate-smart practice, so with a low carbon footprint and a maximum of carbon sequestration that you could find in agriculture.
- Smart breeding, good materials to start with, to work with, but also customized feeding and fertilization, feeding and fertilization that is really customized so that you can have the highest output with the lowest inputs.
- Focus on plant and animal health and welfare is very important in that because that's the main cause of

losses.

- A systematic quality control throughout the food chain.
- And science-based. Our agribusiness is very close to science.

And that is what we call the triple helix. That is the reason why the Netherlands agribusinesses are strong, and that's also the reason why the Netherlands agricultural research is so strong.

There is only one university related to agriculture, and that's Wageningen University, and Wageningen University has only one faculty, and it is an agro-faculty, an agro-food faculty. So that means that concentration of all the efforts so that we can be a real partner for the agribusiness. It is the support of the government to bring those three together. And we are working on programs. Our research programs are set up, are steered, are directed, by the agribusiness. So it's not science for science, not science for curiosity, it's science for impact. And a strong connection helps us, all the three.

When you look at Wageningen University you will see that it is, on the one hand, a one-faculty university, it is not probably not that big with less than 10,000 students. It's growing every year. But you see when you look at the students that the number of master's students is the same as the number of bachelor students. Why is that? Because there are so many international students coming to Wageningen at the master's phase. And I do not know one university where the number of PhD is half the number of the master's students, and that's in Wageningen, but 70 percent of our PhD students come from outside the Netherlands.

And there is another thing. The red dot is the compass of Wageningen University on the map, the yellow dots are research centers, research centers that are very close to business around the Netherlands. Where you have the livestock business, there you have the livestock research institute; where you have the horticulture business, there you have to horticulture institute; there where you have to fish business, there you have the fish institutes. And a close connection between the university and those institutes because they have one director. For instance, I am myself the director of animal sciences at the university but also three institutes, the livestock institute, the veterinary institute, and the fisheries institute. By the close connection we can bring science to practice, we can bring science to the practice, we can bring science to the farmers.

Science for impact: the shortcuts. This is one example, a cum laude PhD study thesis was transferred into a new concept for pig-raising, for pig farming in the Netherlands with a small/medium enterprise and with vocational students working on that practical transfer. It cost, it was only three weeks in between the launching of the cum laude thesis and the first new systems on the market for pig farming.

Another thing probably is that we link up the life science with social science, social science related to food production, food production in a living environment, for the health, the lifestyle, and the livelihood so that we have that close connection, because in the final end, it's all about people. People are the farmers but people are also the consumers, so we have to understand how the social system works.

And I think this is the reason and it's the only reason why Wageningen University was ranked a couple of months ago by the Taiwan University Ranking as the No. 1 agro-food faculty in the world. That can only be there because of the triple helix.

And then, noblesse oblige, then the world is asking Wageningen for leadership, it's asking Wageningen for sharing our experience. And we do that. International cooperation is important. It's not only international students coming to Wageningen; it's also Wageningen going out, like JIRCAS, going out into the world to do projects, to do projects together with sister organizations and with farmers and with dairy producers and other chain players in the agro-business around the world.

Joint research, shared education, data-sharing, capacity sharing, joint programming, alliances, you know it also. And you see that most of our activities are in Africa, in Southeast Asia, and in Latin America. Not that much yet with Japan. At the moment only three projects that we are doing together with Japanese partners, and only six students at the moment studying in Wageningen. That's low compared to the other countries in East Asia, but I'm sure that when we find a way, a further way to cooperate, that this number can increase.

What is our contribution to the global initiatives? I'll give you one example because I'm fairly closely involved in that. We are heavily involved in GRA and other kinds of international cooperation. But this is the one which is quite new, the Global Research Alliance. It's only there for three years. It was an alliance to join the research related to agricultural greenhouse gas emissions, to improve the global cooperation in that research, and to work with farmers and partners to provide that knowledge.

There are three research groups in that. I'm the co-chair of the Livestock Research Group. Kazuyuki Yagi is the co-chair of the Paddy Rice Research Group, so Japan is a very active member in this Global Research Alliance. Your institute is a very active member in the Global Research Alliance. There are some cross-cutting groups. And here you see again that a triple helix approach is brought in the Global Research Alliance as well.

This is a picture of the Livestock Research Group. It has six important things related to livestock production, and we have workshops working and networks for that, but here in red you see that there are industrial partnerships, but also the world farmers organization is working with us on the research, on the global research agenda.

And it brings me also to an FAO initiation, the Global Agenda of Action for a Sustainable Livestock sector, and the Global Research Alliance is one of the multi-stakeholders from the research part to this multi-stakeholder platform. Closing the efficiency gap, restoring the value to grassland, and waste-to-worth for manure management are important factors, and in manure management, Vietnam and Malaysia and Thailand are very active members in that international cooperation.

I have to finish up but I only finish up when I tell you a little example on how it works in practice, and I do that in my domain of livestock farming. It's Livestock Farming with Care where we really concentrated on a multi-issue approach on One Health, Customized Care, One Health to the livestock production, Customized Care to the animals, No Nuisance to the environment, and a Credible Performance, and it is really an integrated approach that every researcher works on all the issues at the same time. It is not a one-issue approach; it's a multi-issue approach. And that results in science-based farming like this poultry farm which is based on that one approach, one health, care for the animals, no nuisance to the environment, and credible performance for the farmer.

And two examples beyond it, fostering the pigs with an enriched environment, just simple research that investigated and showed that a little bit of straw in the stables helps to come to more abused animals, which need less medicines, less antibiotics, and have better welfare than without this enrichment. Or foster the chicken in the early feeding. When you immediately start feeding the chickens, you come up with more chickens which are less sensitive to health problems later in their life.

And also here you see that *Nature* publication is being transferred, conferred that into a practical design of something which is on the market. In the top level, it's the hatchery where the eggs are being hatched, and as soon as the chicken comes out of the egg it falls down to the lower level, and then it really starts feeding immediately and does not have to wait for its latest brother or sister.

So that's my end of my contribution. That's my end of explaining to you how we in the Netherlands try to make our contribution to feeding the world within the carrying capacity of planet Earth. Thank you.

**Chair Yamaoka:** Thank you very much for your valuable presentation, Prof. Scholten. I am very impressed

about the list presented by National Taiwan University. Your university is at the top of the list and the University of Tokyo is at the bottom of the list I think. Yes, yes. Okay, thank you very much. And please take your seat here next to mine. And from now on I want you to allow me to speak in Japanese because I want to facilitate discussion among the Japanese panelists to be introduced hereinafter.