How can Innovation Systems contribute to Stimulating Economic Recovery in Agribusiness?

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Presentation Outline I

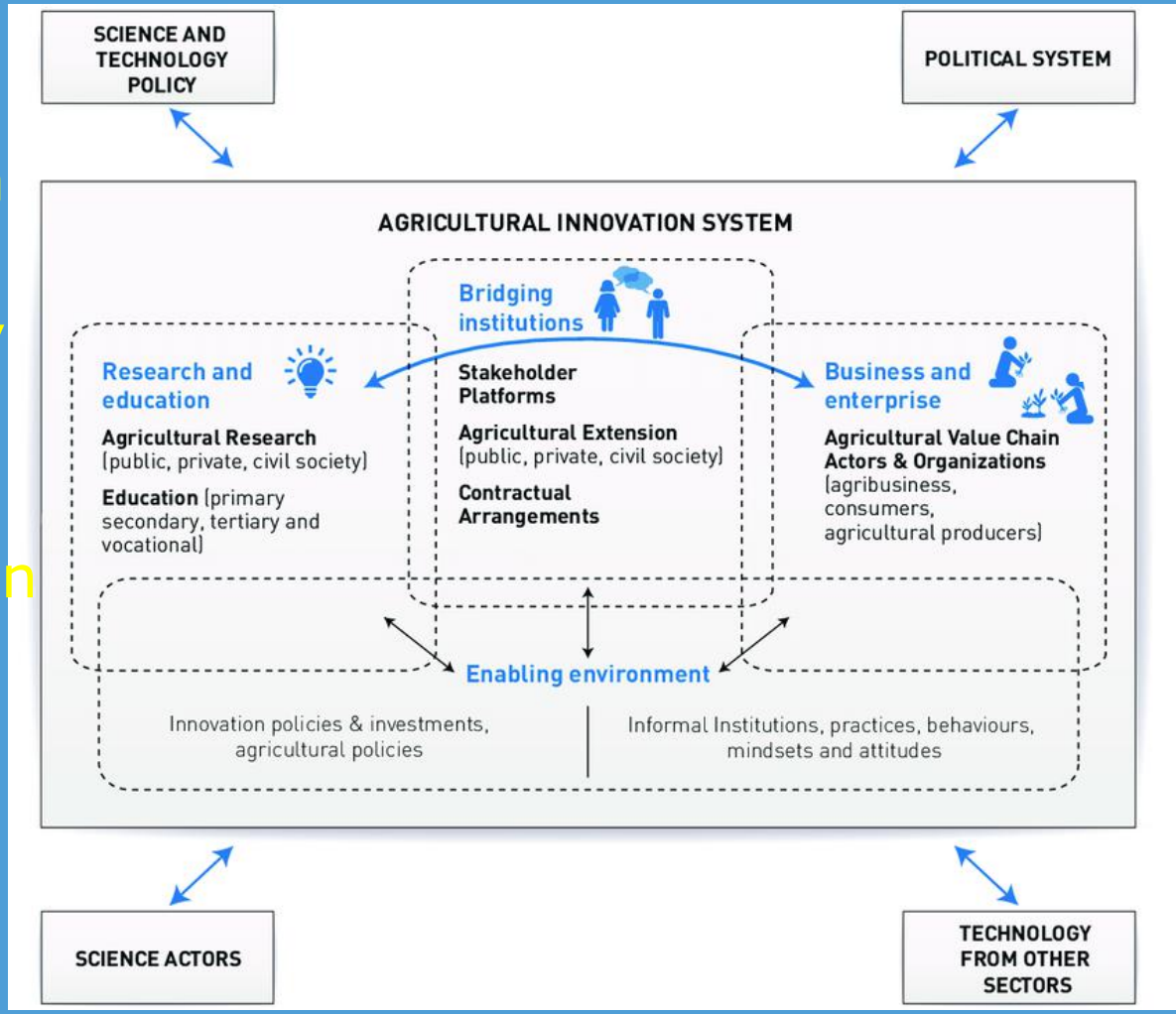
- Indonesian agriculture faces unprecedented change, driven by climate change, and threats from pests and diseases, so the question is: How can the Indonesian agricultural innovation system contribute to mitigate these challenges
- To answer this question, I will first present the agricultural innovation system model
- Then I will focus on the business and entreprise side of the model at a global scale, when I answer the question, whether-or-not innovation is really vital for the long-term survival of agribusiness companies, also in more traditional sectors
- And I will discuss 5 breakthrough innovations that might become essential to feed the world in the years to come
- I will then move from to the global level to Indonesian agriculture that has to feed 138 million people in Java alone

Presentation Outline II

- I will do so by focusing on the research side of the model by answering the question whether the Indonesian agricultural sector is basically dependent on innovation in large scale agriculture or if there is also potential for innovation in its own traditional small-scale agriculture
- To answer this question, I will first look at the innovation potential of traditional crops grown in small-scale agriculture by stepping back in time to 1977-1978 to my own research, together with my wife Frances, on the potential of the traditional fruit- and leave vegetable Leunca (Solanum nigrum) at Indonesia Vegetable Research Institute (IVegRI)
- Then I will move to the innovation potential of Indonesian small-scale agriculture by focusing on the results of research of Etriya Etriya, former PhD student of Emiel Wubben, Victor Scholten and me, on entrepreneurship of smallholder farmers in Java
- And I will end with the conclusions and recommendations

Agricultural Innovation System

Innovation Systems can be defined as societal subsystems with actors, networks and institutions contributing in any sense to the emergence or production of innovations (Hekkert et al.; Bergek *et al.*)



Focusing on the Business and Entreprise side

Is innovation indeed vital for agribusiness, also in traditional sectors?

- For agribusiness MNEs innovation has become essential (Karen Janssen).
- E.g. Nestlé has filed more than 800 patents to protect its Nespresso coffee-making system. As an R&D director stated: *Especially in the last three years, the patenting of products and processes has expanded so rapidly that this can be called the biggest development in the past decade*
- But also in more traditional, artisanal sectors, such as Italian cheeses and hams, Belgian beer, French wines and Hungarian sausages, innovation has become essential (Bianca Kühne, Mytelka and Goertzen)

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Five Agricultural Breakthrough Innovations to Feed the World: 1. Stem Cells

Winston Churchill already wrote in 1932: *We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium*

Realize, one single muscle stem cell can produce an unlimited amount of meat without harming any animal

And it is happening right now! In Singapore you can already order chicken nuggets developed by the US-based company Just-Eat

Finless Foods produces Salmon and other fish species using stem cells. This way, the ocean's ecosystems are not exploited

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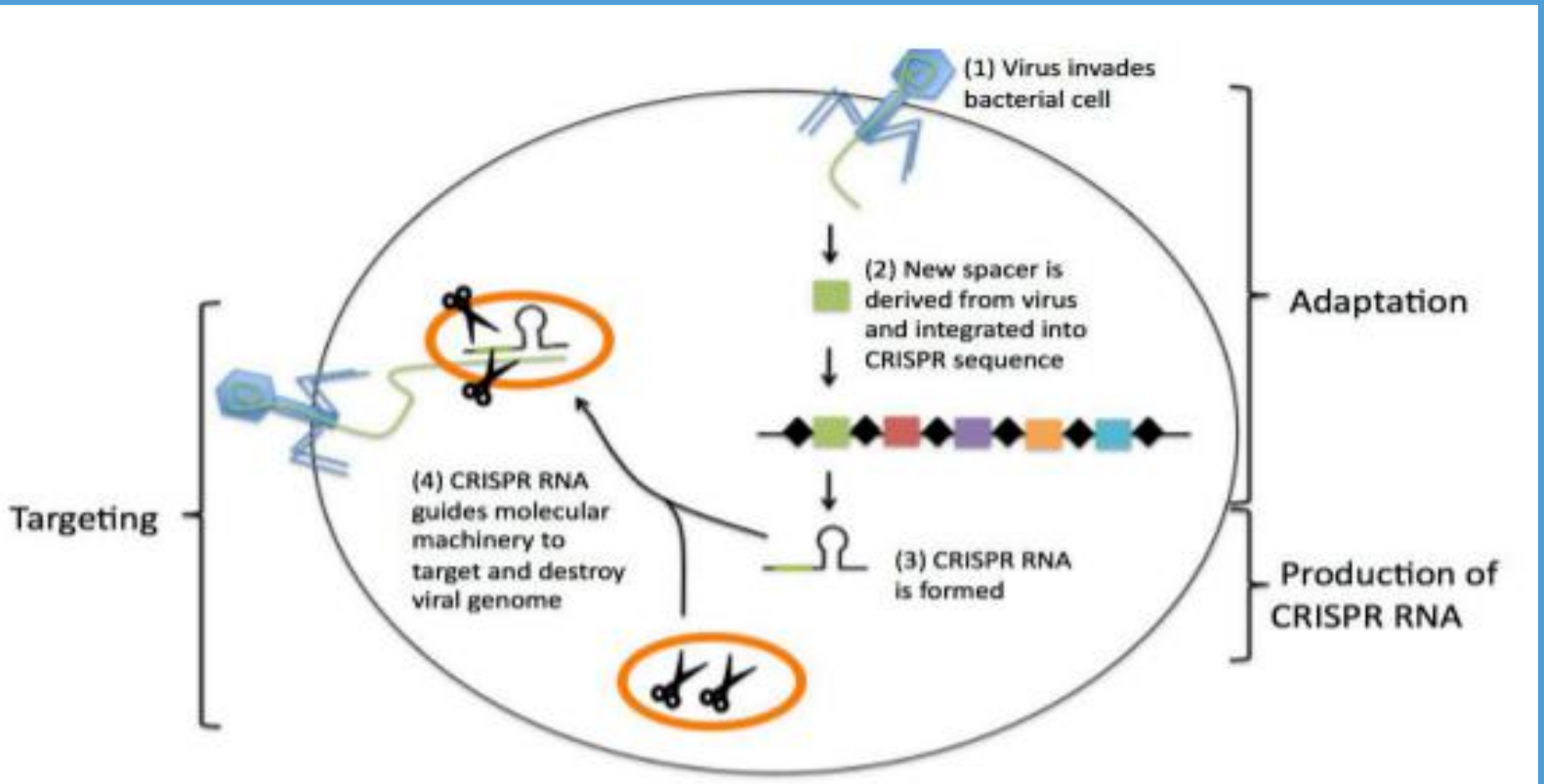
2. CRISPR-Cas

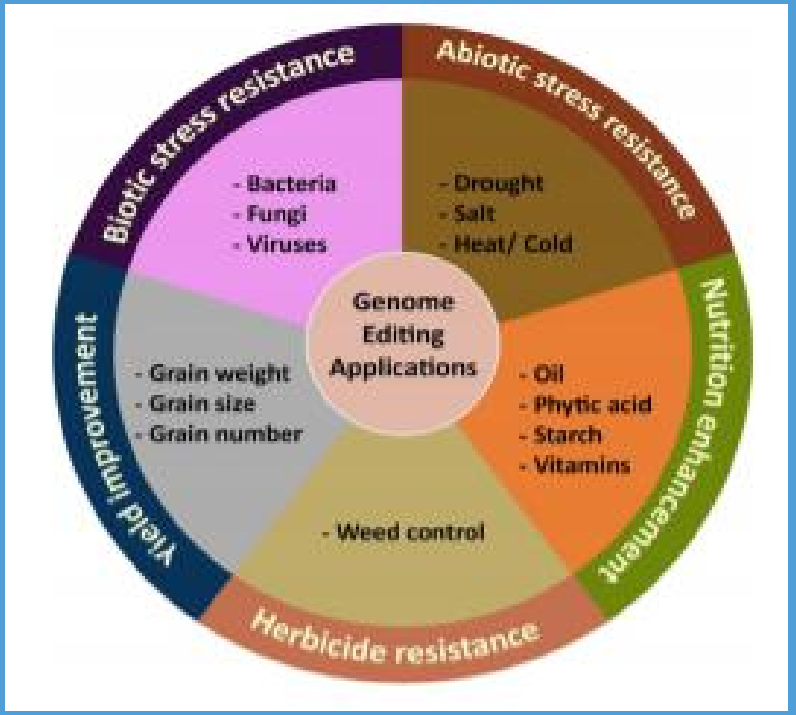
CRISPR-Cas is a type of bacterial immune system. CRISPR is the 'molecular memory' and Cas the 'molecular scissor'. When a virus infects a bacterium, the bacterium can 'steal' sections of the virus's genome and filing them away in a 'library' in its own genome. If it encounters the same virus again, the bacterium can use this stored information to target and destroy the virus



Potential of CRISPR-Cas

CRSPR-Cas is currently used to generate biotic and abiotic pest resistance in wheat, enhanced herbicide resistance in tobacco, and increase of rice yield (Scheber et al.)

CRISPR-Cas is also used to explore the complex symbiotic relationship between legumes and their rhizobia, with the goal of recreating this relationship in other crops and reducing our dependence on fertilizers



3. Vertical Farming

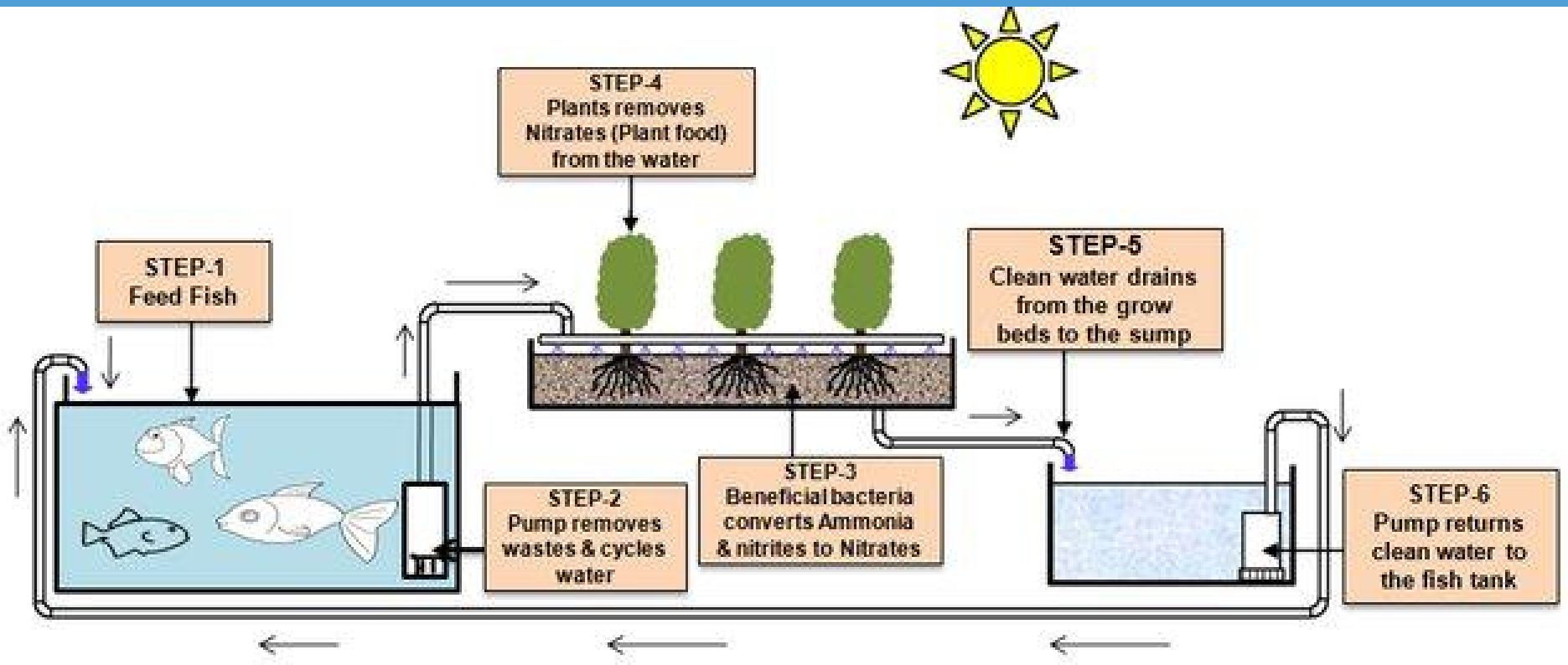
- The practice of producing food in vertically stacked layers utilizing artificial control of light, humidity, temperature and gases is producing large amounts of food in highly populated areas in China and Japan
- 30% more lettuce and tomatoes can be produced using led lamps than under normal conditions with less use of water, while special light recipes improve aroma, taste and vitamin C content

4. Precision Agriculture with use of Drones

The use of drones is steadily growing as part of an effective approach to precision agriculture, allowing fine-scale monitoring, and providing more efficient cultivation, which can help farmers to optimize their fertilizer and water treatments and identifying crop diseases before they become widespread

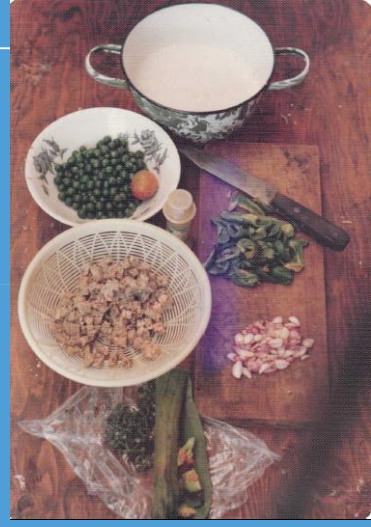
5. Aquaponics

Aquaponics links aquaculture (e.g., the culture of fish, crayfish, snails or prawns in tanks) to hydroponics (cultivating plants in water). This system has clear benefits over soil-based agriculture: it lessens environmental impact by reducing the consumption of resources, showing faster plant growth, and providing higher yields



The Innovation Potential of Traditional Crops

Research on Leunca at IVegRI



- Solanum nigrum is considered a poisonous weed in the temperate zone, but is a popular vegetable throughout the tropics
- To comfort you, we found no poison (Solanine) in the green unripe berries that are eaten in Java, nor in those in Holland
- In Java an abundant number of local varieties are grown:1.5 to 4.5 feet in heigh-t with white and bluish violet flowers and with 0.2 to 0.4 inch green (unripe) and purple (ripe) berries

Cultivation, Harvesting and Yield of Leunca

- The seeds germinate after 1 week; the seedlings are transplanted after 2 weeks; planting on the field after 6 weeks; harvesting starts after 8 weeks; the fruits are harvest-ed green on a weekly basis for 2-3 months
- Positive is the high yield: the Leunca seeds obtained from a local farmer produced an average yield of 31 tons/ha. In comparison, average tomato yield varies from 20-25 tons/ha. High-yielding tomato varieties may yield up to 50-60 tons/ha, but these are hybrids, so to get this yield, new seeds have tot be bought annually, creating dependence on Western seed companies
- Negative is that harvesting is labour intensive, but that is not a big problem in Java

The Innovation Potential of Indonesian Small-scale Agriculture: Focusing on Javanese Smallholder Farmers

- Research on innovation and entrepreneurship of Etriya Etriya showed that:
- Part of the smallholder farmers is very innovative and entrepreneurial and genuinely interested in inventing and/or adopting new practices
- Together with the other participants across the agriculture value chain they are constantly improving their practices to drive profitability
- And they are sufficiently supported by research and extension services

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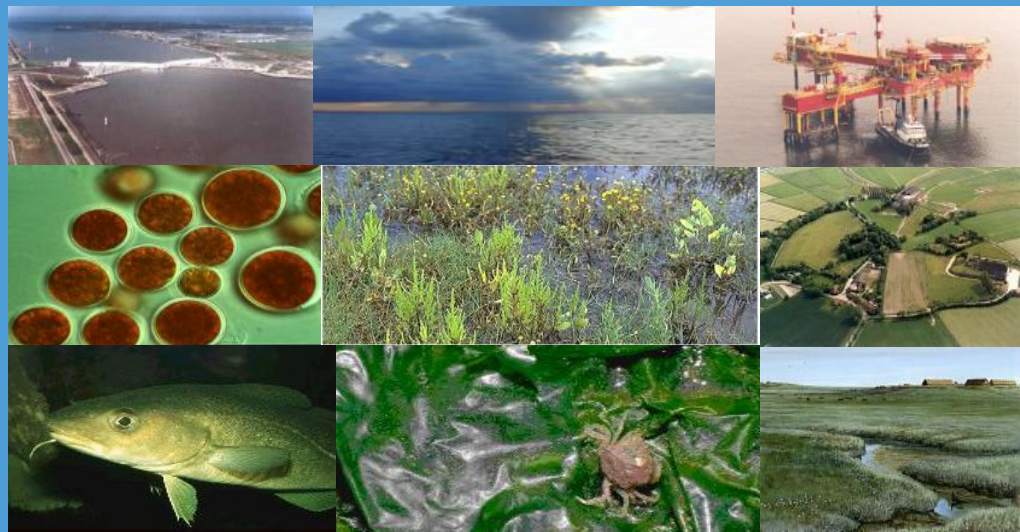
However, her research also showed that:

- A risk averse culture limits the potential for the adoption of innovations, e.g., only one in three Indonesians is wiling to even try meat produced by stem cell technology
- Lack of information and uncertainty about benefits are barriers to the adoption of innovation
- Regulatory complexity hinders the potential for ideas to be quickly developed, tested, and commercialized
- And most importantly: Lack of coordination within the agricultural innovation system discourages collaboration and innovation investments

Conclusions

- Indonesian agriculture faces unprecedented change, driven by increasing international competition, climate change, and threats from pests and diseases
- Etriya's research showed that to foster innovation, a world class agricultural innovation system, that stimulates communication and optimal coordination among the key partners, is essential
- And they should work closely together to reduce regulatory complexity and provide optimal information to battle the risk averse culture in Indonesia



Recommendations

- Policymakers are recommended to initiate multi-stakeholder platforms that can work as bridging institutions between research and extension institutions on the one hand, and value chain partners and consumers on the other
- Realizing that we just took Leunca seeds from a local farmer, there is ample room for improvement through innovation in smallholder agriculture. It is worthwhile for agricultural universities, research institutes, extension services together with the agricultural value chain partners to pay attention to the hundreds of fruits and vegetables that are grown in tropical small-scale farming
- To feed 138 million people of Java, all partners in the agricultural innovation system, should look at the potential of the breakthrough technologies to increase productivity while maintaining diversity of food crops

Thank you for your attention!

I am happy to answer any question you may have