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Good Food, Good Life

Rice Oryza

Overview, challenges from a food quality and safety perspectives

XIII International Rice Conference for Latin America and the Caribbean

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Piura, Peru, 15 May 2018

Feeding 9+ bn people by 2050 *Threats or opportunities*

Soils & Soil Health

Biodiversity & Genetics

Water in Agriculture

Energy & GHG

Training & Assistance

Policy Interventions

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Sustainable Agriculture Initiative Nestlé *SAIN*

LAND

WATER

ENERGY

CLIMATE

PEOPLE

To ensure supply we have to smarter use natural resources by

- **Not wasting**
- **Not polluting**
- **Not destroying**

and a good start is eradicating the worst and promoting better

Sustainable Agricultural Practices.

Producing more food from the same area of land while reducing the environmental impacts requires what we call **"Sustainable intensification of Agriculture"**.

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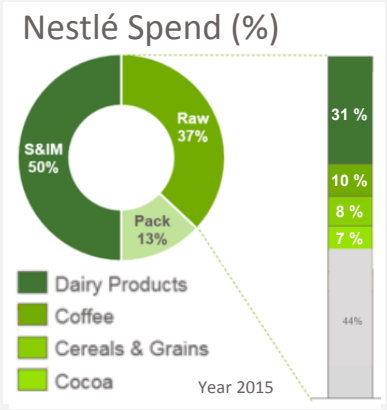
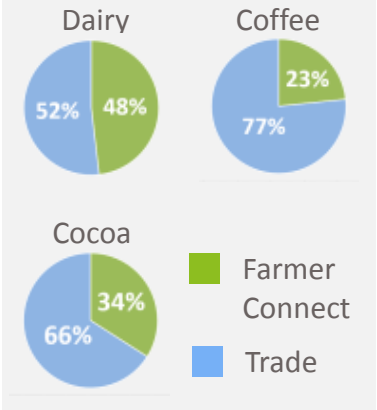
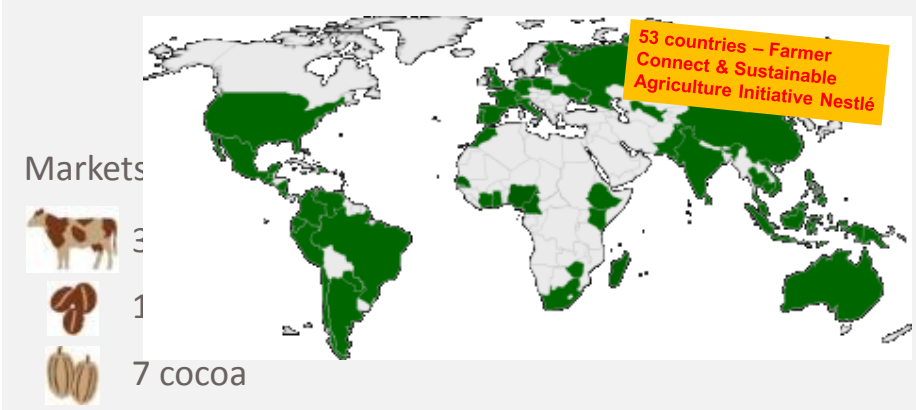
Nestlé *Farmer Connect & Direct Sourcing Programs*







Key Figures Farmer Connect (FC)	2015	2016	2017
Direct sourcing staff:	1’200	1’010	970
Supply chain support staff:	10’940	10’680	8’910
Farmers supplying directly to Nestlé:	760’000	719’000	685’000
Farmers received training:	**400’000**	**363’000**	**431’000**

Source: CSV Reports 2014, 2015, 2016; SAIN: Sustainable Agriculture Initiative Nestlé

FC investment into training

- Risk management
- Insurance police for ensured supply of safe & quality assured agricultural raw materials
- Compliance

Rice genetics and biodiversity

- In 1960s, IR8 the first high yielding rice variety was developed by combining an Indonesian and Taiwanese variety
- IR8 became the symbol of the green revolution in rice
- International Rice Research Institute (IRRI) in the Philippines is home to the International Rice Gene bank: 127,000 rice accessions and wild relatives from all over the world
- IRRI has produced 843 rice varieties that have been released in 77 countries

Genetics and biodiversity

- Through ‘The International Rice Genome Sequencing Project’ a vast catalogue of more than 40,000 rice genes has been mapped in 2005
- New Rice for Africa (NERICA), program implemented by Africa Rice Center develops interspecific hybrid rice to improve the yield for Africa
- Breeding yield progress in major cereals including rice recently started to reduce
- Closing the yield gap (potential yield – farm yield) becomes more important also in rice

Nutritional values

- Rice is the staple food of over half the world's population
- World's dietary energy supply through major cereals
  - Rice – 20%
  - Wheat – 19%
  - Maize (corn) – 5%
- Rice is the predominant dietary energy source
  - 17 countries in Asia and the Pacific,
  - 9 countries in North and South America and
  - 8 countries in Africa
- Nutrient value changes according to a number of factors for instance
  - Rice varieties e.g. white, brown, red, and black rice
  - Soil and plant nutrition
  - Processing e.g. polishing, parboiling, fortification, preparation

Nutrient content of rice

	Rice (white)	Rice (brown)
Component (per 100g portion)	Amount	Amount
Water (g)	12	10
Energy (kJ)	1528	1549
Protein (g)	7.1	7.9
Fat (g)	0.66	2.92
Carbohydrates (g)	80	77
Fiber (g)	1.3	3.5
Calcium (mg)	28	23
Iron (mg)	0.8	1.47
Magnesium (mg)	25	143
Manganese (mg)	1.09	3.74
Phosphorus (mg)	115	333
Potassium (mg)	115	223
Sodium (mg)	5	7
Zinc (mg)	1.09	2.02
Selenium (µg)	15.1	n.a.
Thiamin (B1)(mg)	0.07	0.4
Riboflavin (B2)(mg)	0.05	0.09
Niacin (B3) (mg)	1.6	5.09
Pantothenic acid (B5) (mg)	1.01	1.49
Vitamin B6 (mg)	0.16	0.51
Beta-carotene (µg)	0	n.a.

Source: Nutrient data laboratory, 2014

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Nutritional values *Challenges*

Deficiency in bioavailable nutrients
Deficient in many bioavailable vitamins, minerals, essential amino- and fatty-acids and phytochemicals that prevent chronic diseases like type 2 diabetes, heart disease, cancers and obesity

Arsenic concern
Rice and rice products contain arsenic, a known poison and carcinogen. The amount of arsenic in rice varies widely. The arsenic originates from residues in soil, water, pesticides, fertilizers

Bacillus cereus
Cooked rice can contain Bacillus cereus spores, which produce an emetic toxin when left at 4–60 °C. Rapid cooling required if rice is to be used next day

Water

- Water and the world's rice production
  - Irrigated: 93 million ha lowland rice supply 75%
  - Rain-fed: 67 million ha lowlands/upland supply 23%
- Irrigated area occupied by rice
  - Southeast Asia: 64–83%
  - East Asia: 46–52%
  - South Asia: 30–35%
- Rice receives up to 2–3 times more water per hectare than other irrigated crops, but uses no more than other cereals e.g. wheat
- Assuming a reuse rate of 25%, irrigated rice receives about 34–43% of the world's irrigation water
- Water not used gets again available for crops downstream

Water

- Water use reduction technologies
  - SRI (System of Rice Intensification), a climate-smart, agro-ecological methodology for increasing productivity of rice, changing the management of plants, soil, water and nutrients.
  - AWD (Alternate Wetting and Drying), irrigation water is applied a few days after the disappearance of the ponded water i.e. alternate flooding and non-flooding.

  Save up to 30% of the water while maintaining or sometimes even increasing rice yields
- Realistic global water use reduction potential is about 10% (Dr. Bas Bouman, Director GRiSP, IRRI)

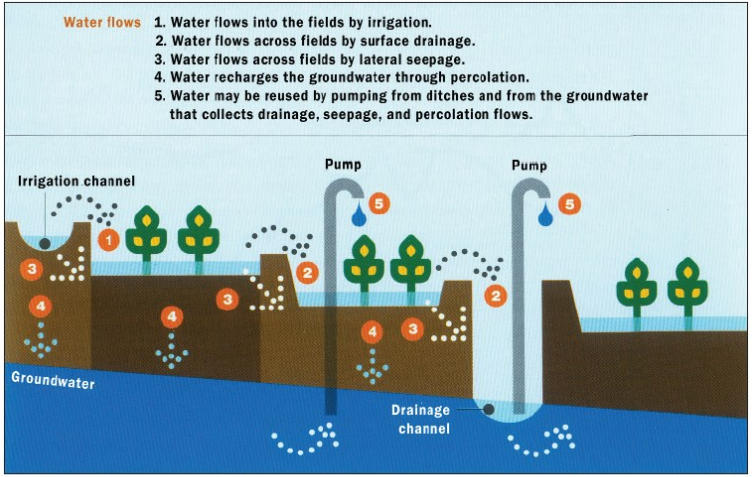
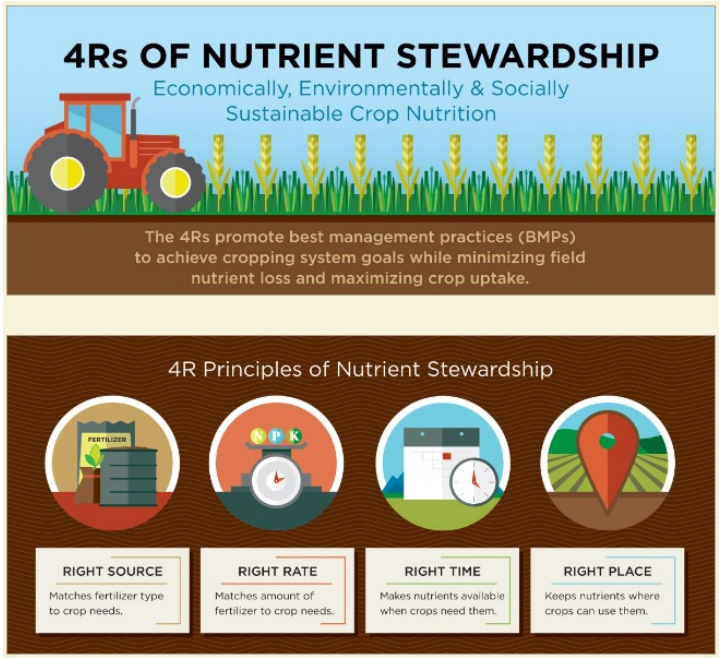


Fig. 4.5. There is great potential for reuse of water flows in a rice landscape of interconnected fields.

Source: GRiSP (Global Rice Science Partnership). 2013. Rice almanac, IRRI

Environment

- Rice production emits approximately 20–40 Mt of CH4 per year (10% of anthropogenic emissions from agriculture)
- GHG emission potential (methane and nitrous oxide)
  - Methane: organic matter decomposition under anaerobic condition in the rice field
  - Nitrous oxide: nitrifying and denitrifying bacteria under the anoxic condition
- Factor affecting GHG emission
  - Land preparation
  - Seed preparation
  - Rice varieties
  - Fertilizer application (fertilizer type)
  - Water management
  - Harvesting and fallow period



Source: The Fertilizer Institute

Select the best variety *Our practices for rice quality and safety*

- The final product defines the quality and safety parameters of raw materials and ingredients
- Varieties are selected according to nutritional properties and the ability to accumulate nutrients, micro-nutrients, heavy metals and pesticides

- Project geographies: Chile, Madagascar

Identify best practices *Our practices for rice quality and safety*

- Agricultural practices strongly influence quality and safety of raw materials
- General good practices exist but for each production site the best practice has to be identified
- Production approaches such as “System of Rice Intensification” (SRI) and Direct Seeding of Rice (DSR)

- Project geographies: Chile; Pakistan; India

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Minimize input use *Our practices for rice quality and safety*

- IS/IT/Digital System provide new insights into production system
- Industry investments into automation in agriculture, internet of things, cloud platforms, and artificial intelligence make tools/services affordable for small farmer
- Forecast and early warning systems will help to identify pockets of pests and diseases
- Drones and field robots will offer new means for targeted interventions leading to strong reduction of pesticide use
- Project geographies: China

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Build capabilities *Our practices for rice quality and safety*

- The most appropriate variety, the best practices identified and the most advanced IS/IT/Digital system in place will not deliver expected results if people cannot operate them
- Training on good agricultural practices and the use of new support tools remain key to prepare farmers for new challenges
- Farmer-field-schools and clubs i.e. «Paddy Club», «Club Agripreneur» are vehicle to build strong producer communities
- Project geographies: All

Agri-Organica 100% NATURAL

Nestlé Paddy Club

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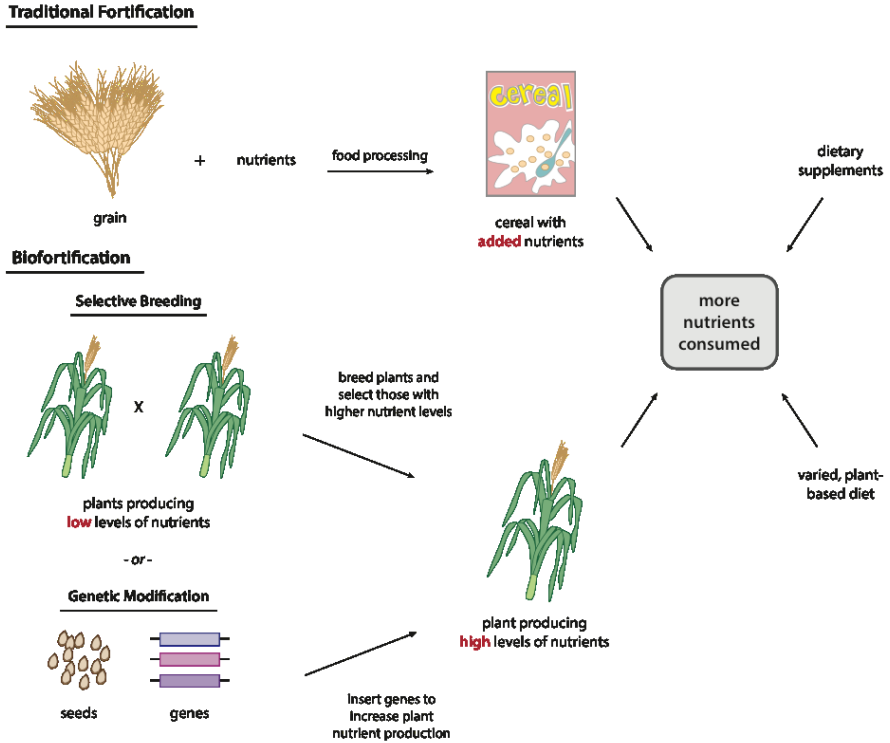
Outlook *Raw material quality and safety*

Nutritional constraints

- Golden rice
- Bio-fortification
- Expression of human proteins



Source: www.geneticliteracyproject.org

Outlook *Resilience to climate change*

Perennial Rice Breeding

Wild Perennial Rice

X

Annual Domesticated Rice

=>

Perennial Domesticated Rice

Economic issues

High-yielding varieties

Perennial rice

- Less soil erosion
- Increased drought resistance and better plant nutrition due to improved root network
- Better resistance to weed invasion due to growth (light) advantage
- Reduced work (no transplanting, weeding, and other backbreaking labor)
- More efficient use of applied fertilizer
- Increased gross margin

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Outlook *Resilience to climate change*

Environmental issues

Flood-tolerant rice

- Standard rice varieties cannot withstand stagnant flooding > 1 week
- Flooding affects many rice growers face (20 million ha)

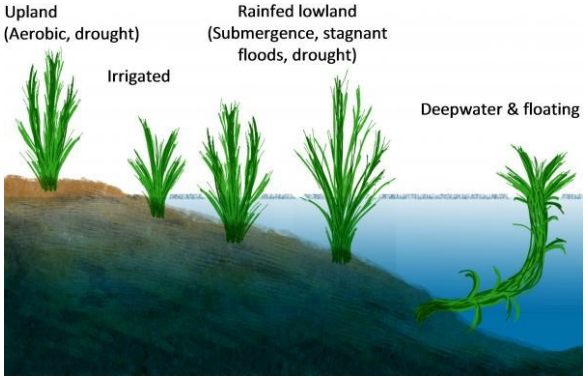
Drought-tolerant rice

- Drought stress affects 19–23 million ha of rain-fed rice in South and South East Asia

Salt-tolerant rice

- Soil salinity threatens rice crop productivity, particularly along low-lying coastal areas

Rice ecotypes and systems



Environment-friendly rice

- Paddy rice production leads to methane release
- Produce rice with less water avoiding water logging
- Better control of fertilizer application
- Breeding for increase harvest index

Conclusion

Food quality and safety issues in rice are strongly interlinked with crop varieties and agricultural practices in a particular production environments

Research and development is needed for traditional and potentially new rice growing region. Areas of research are:

- Exploration of species diversity and breeding of varieties that deliver nutritional benefits as per consumer needs
- Development of best agricultural practices to maximize nutritional benefits, quality and safety of raw materials

Research and development should be carried through innovative new collaboration platforms allowing academia, civil society organisations and the industry to work on a common challenge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Thank You