Sustainable food systems in a changing climate

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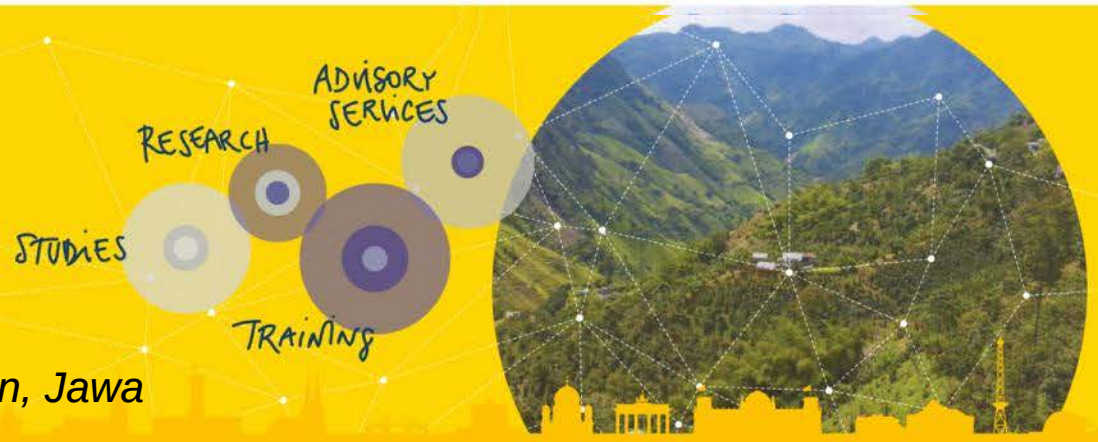
Brot für die Welt – Evangelischer Entwicklungsdienst



Climate resilient investigation and innovation project –Sulawesi Selatan, Jawa Barat / Jawa Tenggah

Outline of presentation

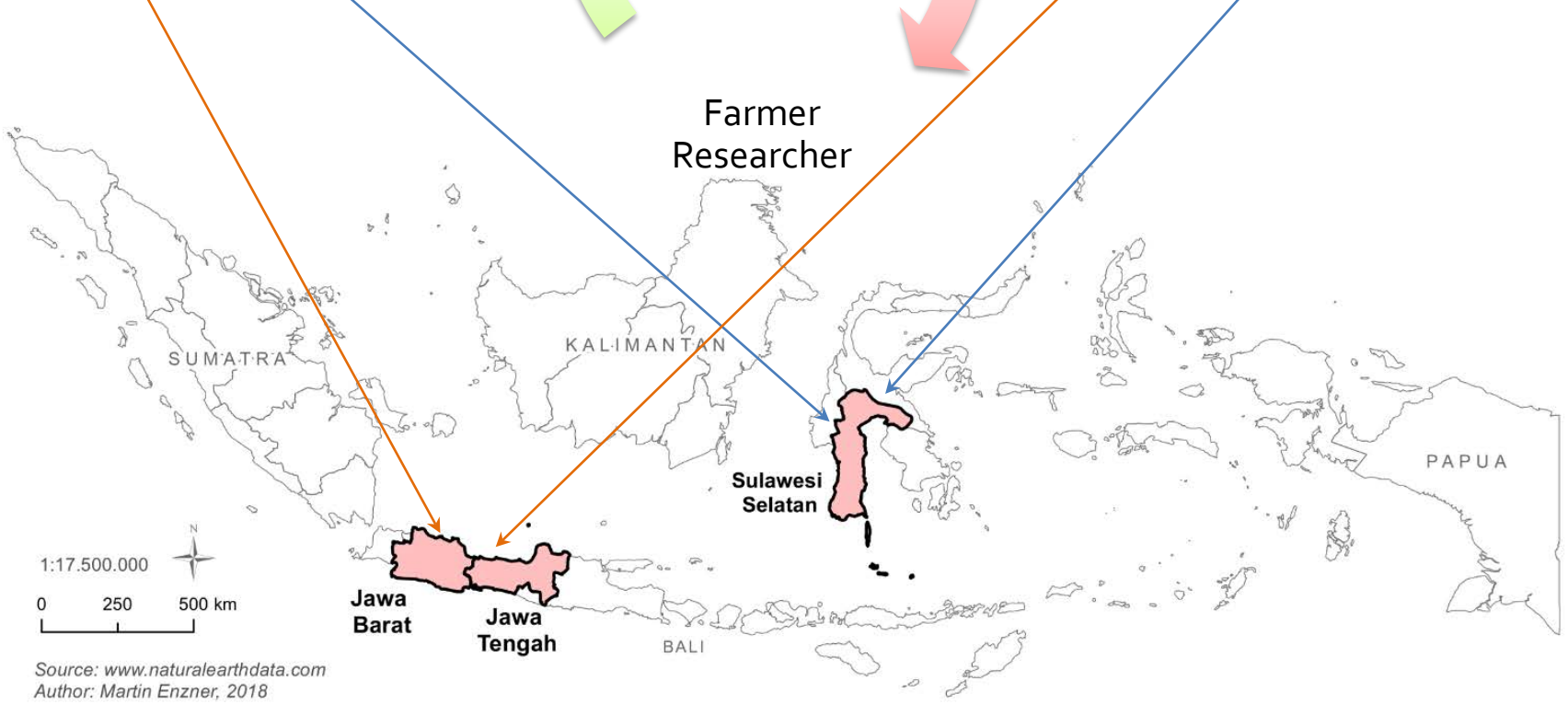
- Background CRAiiP
- Food security and sustainable agriculture
- Impact of climate change on farming in Indonesia
- Academia and Farmers together (integrated knowledge)
- Linking to farmer to consumer and markets
- Approach and field experience from Java Mr Kustiwa Adinata

CRAIIP- Climate resilient agriculture investigation and innovation project

NGO/CSO

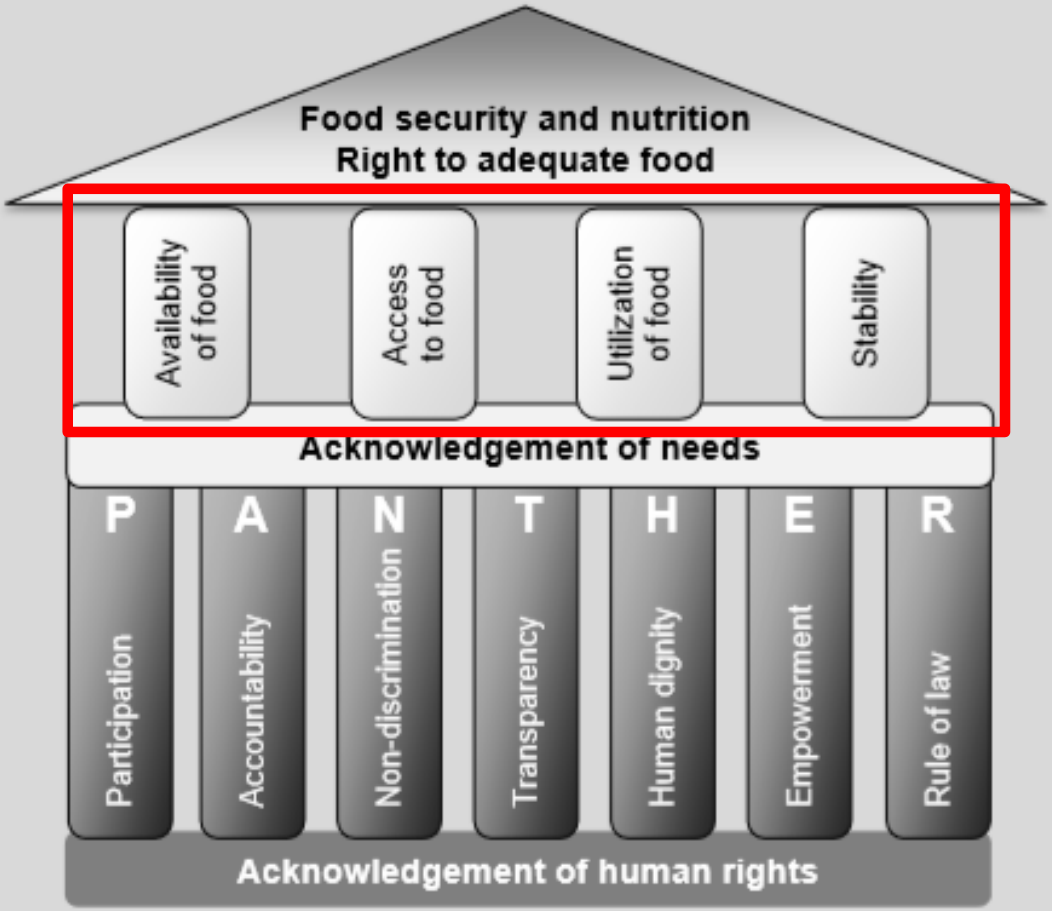
University Reasearcher

Farmer Researcher



http://jamtani.org/public/vidio/5/craiip-climate-resilience-agriculture-innovation-and-investigation-program

Figure 1 FSN in a human rights-based framework

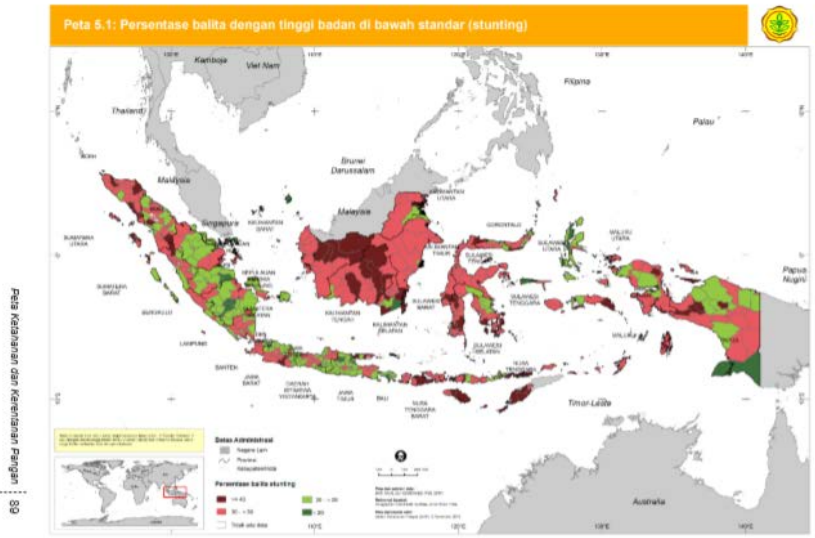


Source: adapted from Ekwall and Rosales (2009)

Source: HLPE 2019

Triple burden of malnutrition

1. Undernutrition:
Stunting: (Height for Age): 29.6%
Undernutrition (Weight for Age): 17.9%
Wasting (Weight for Height): 9.6%
Life expectancy 71 years

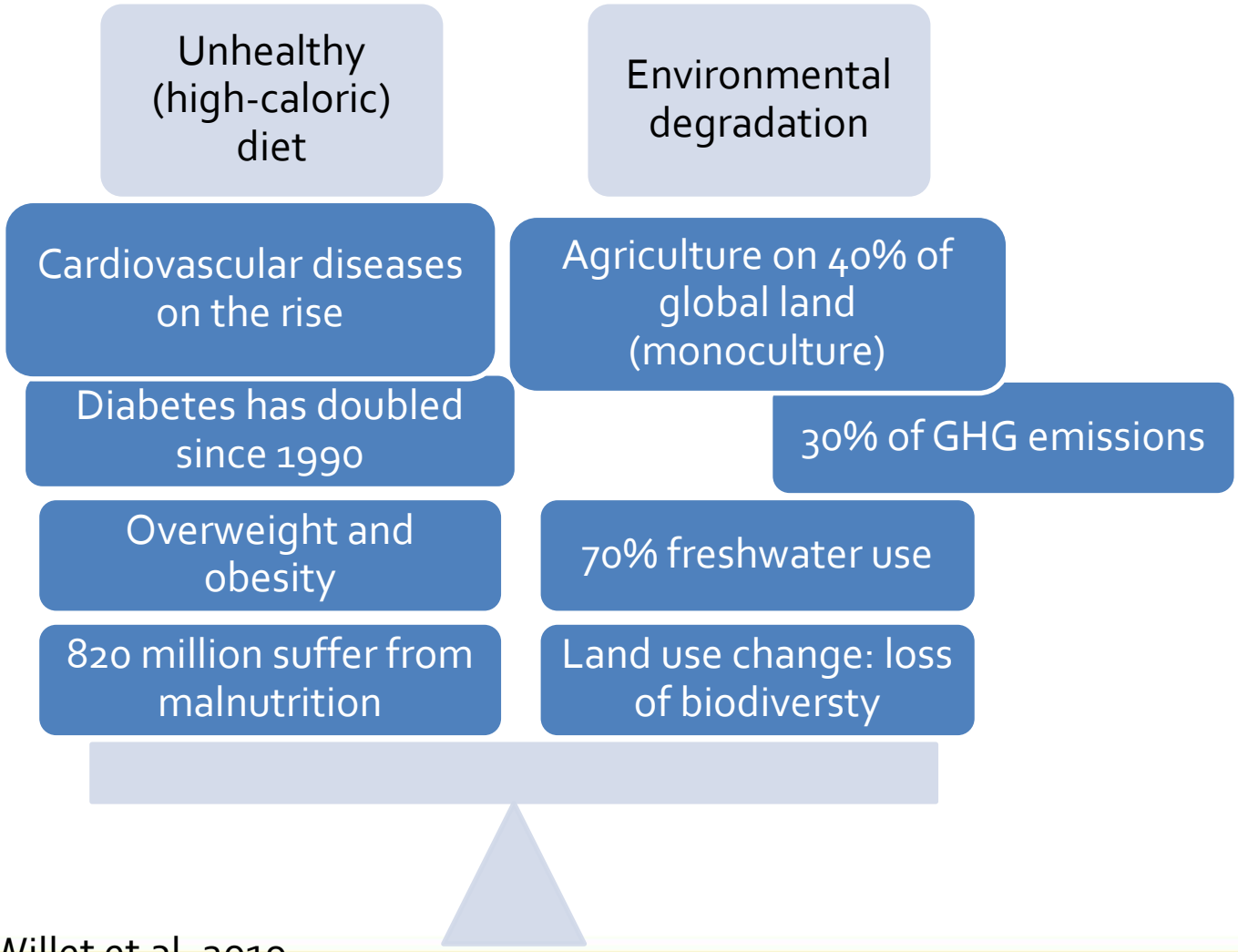


2. Overnutrition:
Obesity: from 14.8% in 2013 to 21.8% in 2018

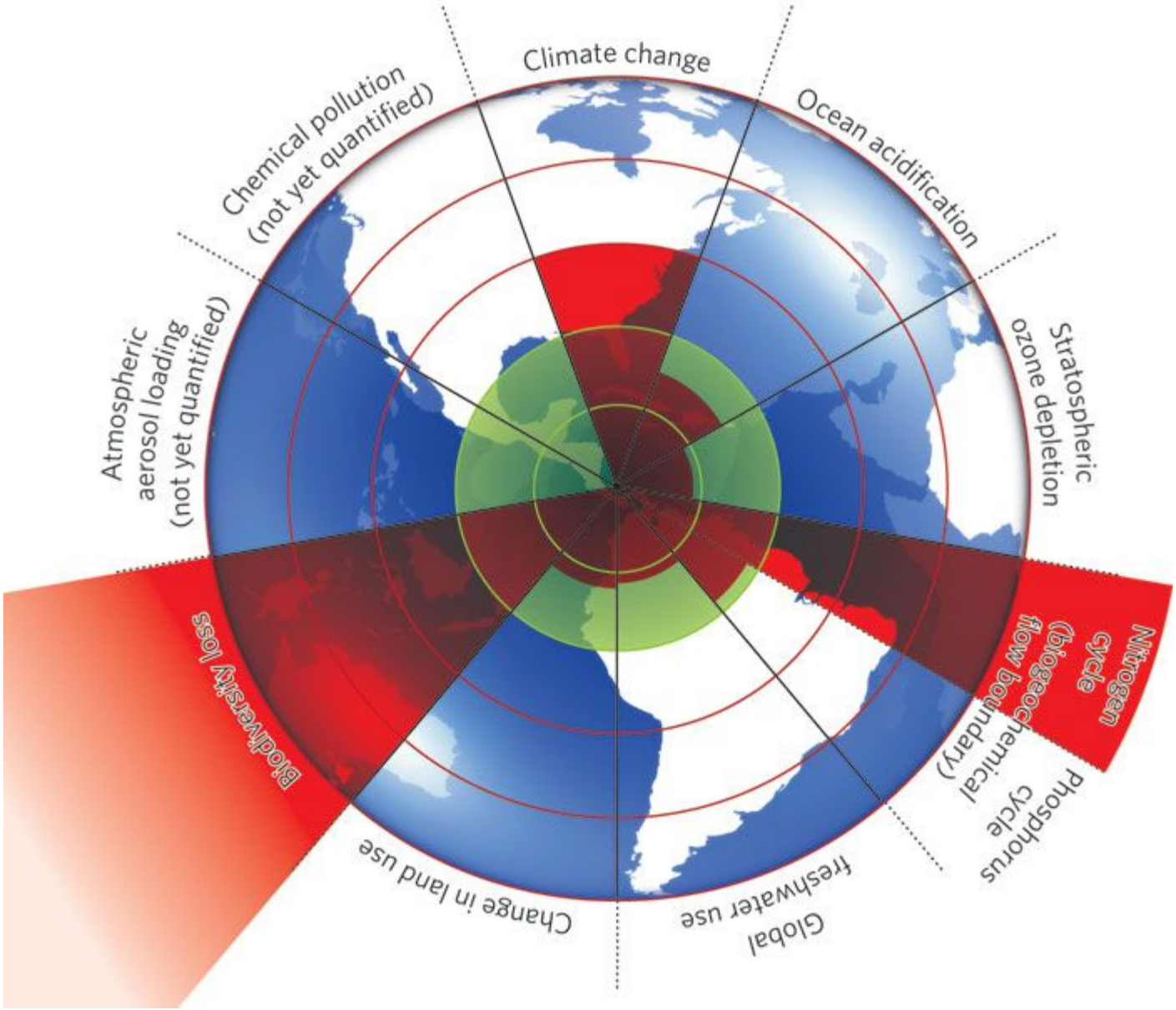
3. Micronutrient deficiencies (hidden hunger)
e.g. Anaemia: 45% children <5 (iron deficiency)
Vitamin A and iodine deficiency

Source: RISKESDAS 2018, PETA KETAHANAN DAN KERENTANAN PANGAN 2018, FAO 2017

Risk: from healthy traditional diet (even if lack of nutrients) to diet high in red meat, processed food, unhealthy saturated fats, sugar)



Source: data from Willet et al. 2019



9 planetary boundaries

Source: Röckström et al. 2009: A safe operating space for humanity

Hotspots Agriculture and Climate Change

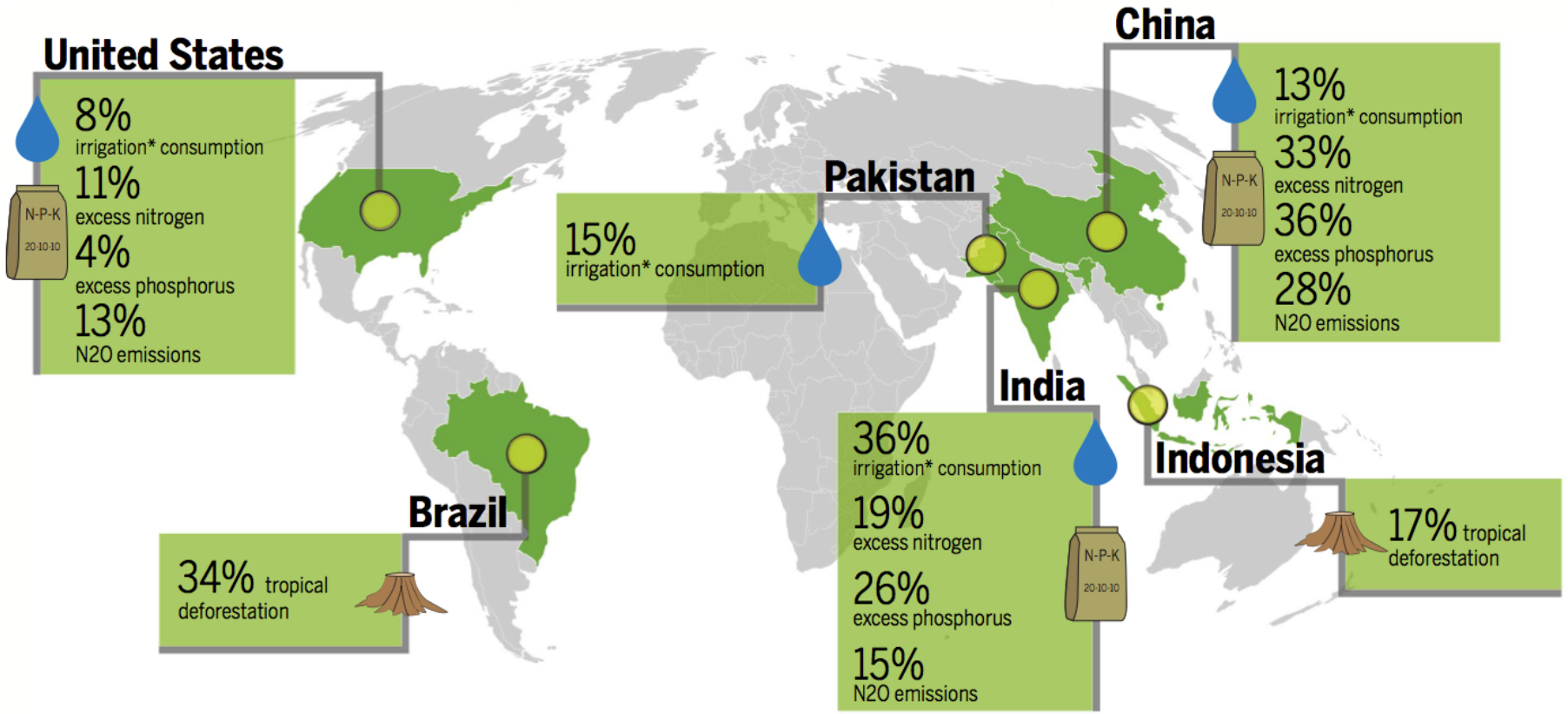
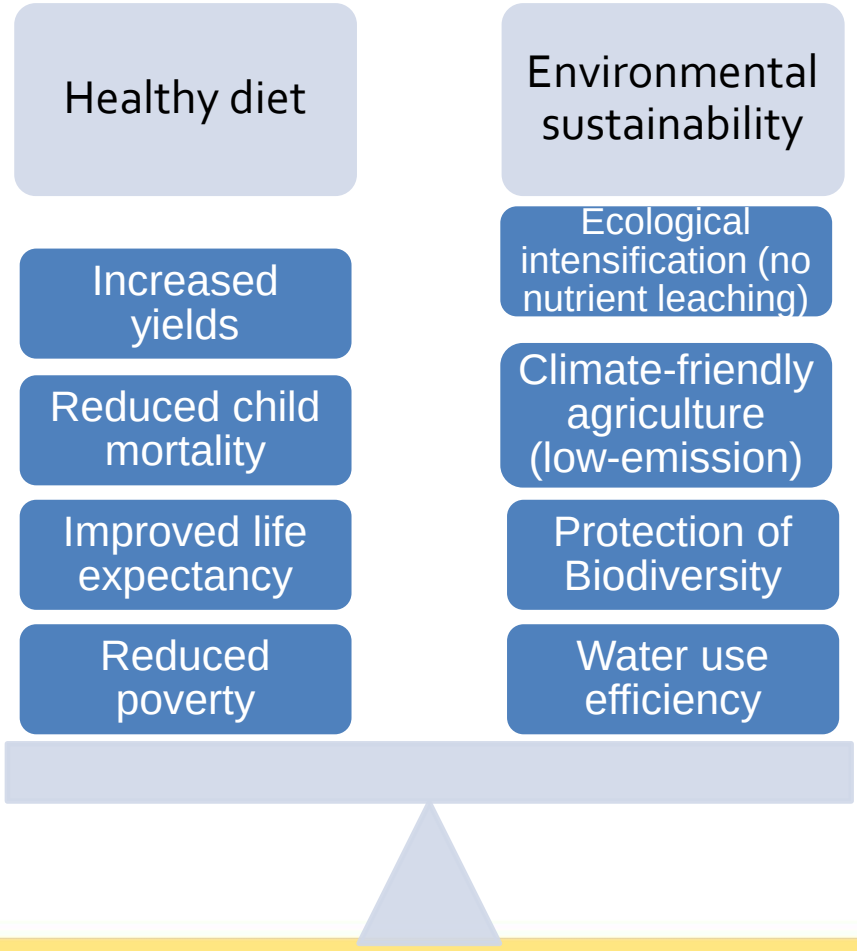


Fig. 2. Leverage points to reduce agriculture's effect on climate, water quality, and water consumption. The majority of global environmental effects of agriculture are in a few countries, driven by a few commodities. All nutrient and irrigation values are relative to the 17 major crops in this study. Figures S1 to S3 provide maps of N_2O emissions, nutrient input and excess, and water consumption, respectively. Irrigation consumption is relative only to precipitation-limited areas.

Sustainable food systems

Our food systems contribute to human health and environmental sustainability



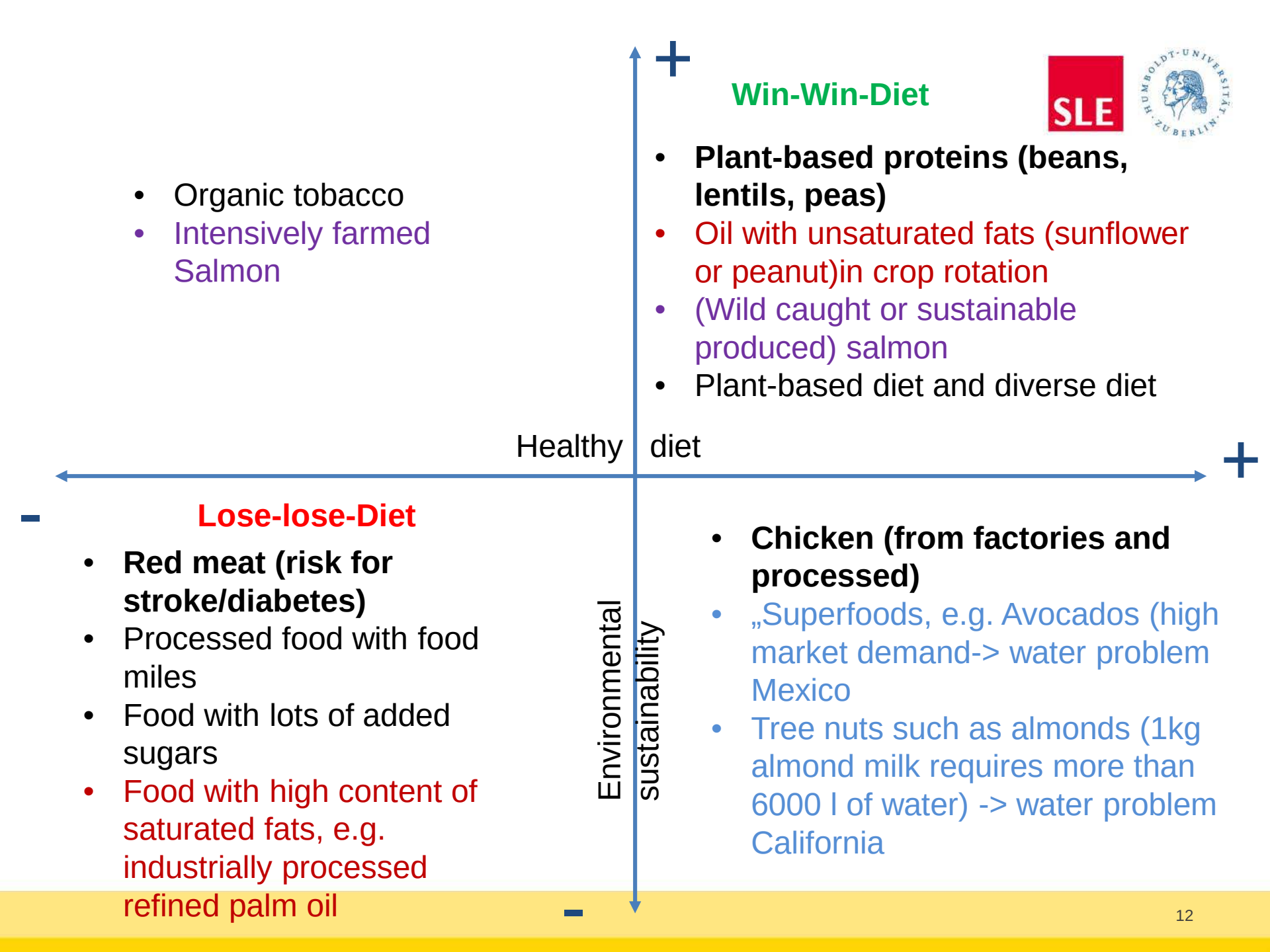
Source: adapted from

Principle	FAO's ten elements	Scale application*
Improve resource efficiency		
1. Recycling. Preferentially use local renewable resources and close as far as possible resource cycles of nutrients and biomass.	Recycling	FI, FA
2. Input reduction. Reduce or eliminate dependency on purchased inputs and increase self-sufficiency	Efficiency	FA, FO
Strengthen resilience		
3. Soil health. Secure and enhance soil health and functioning for improved plant growth, particularly by managing organic matter and enhancing soil biological activity.		FI
4. Animal health. Ensure animal health and welfare.		FI, FA
5. Biodiversity. Maintain and enhance diversity of species, functional diversity and genetic resources and thereby maintain overall agroecosystem biodiversity in time and space at field, farm and landscape scales.	Part of diversity	FI, FA
6. Synergy. Enhance positive ecological interaction, synergy, integration and complementarity among the elements of agroecosystems (animals, crops, trees, soil and water).	Synergy	FI, FA
7. Economic diversification. Diversify on-farm incomes by ensuring that small-scale farmers have greater financial independence and value addition opportunities while enabling them to respond to demand from consumers.	Part of diversity	FA, FO

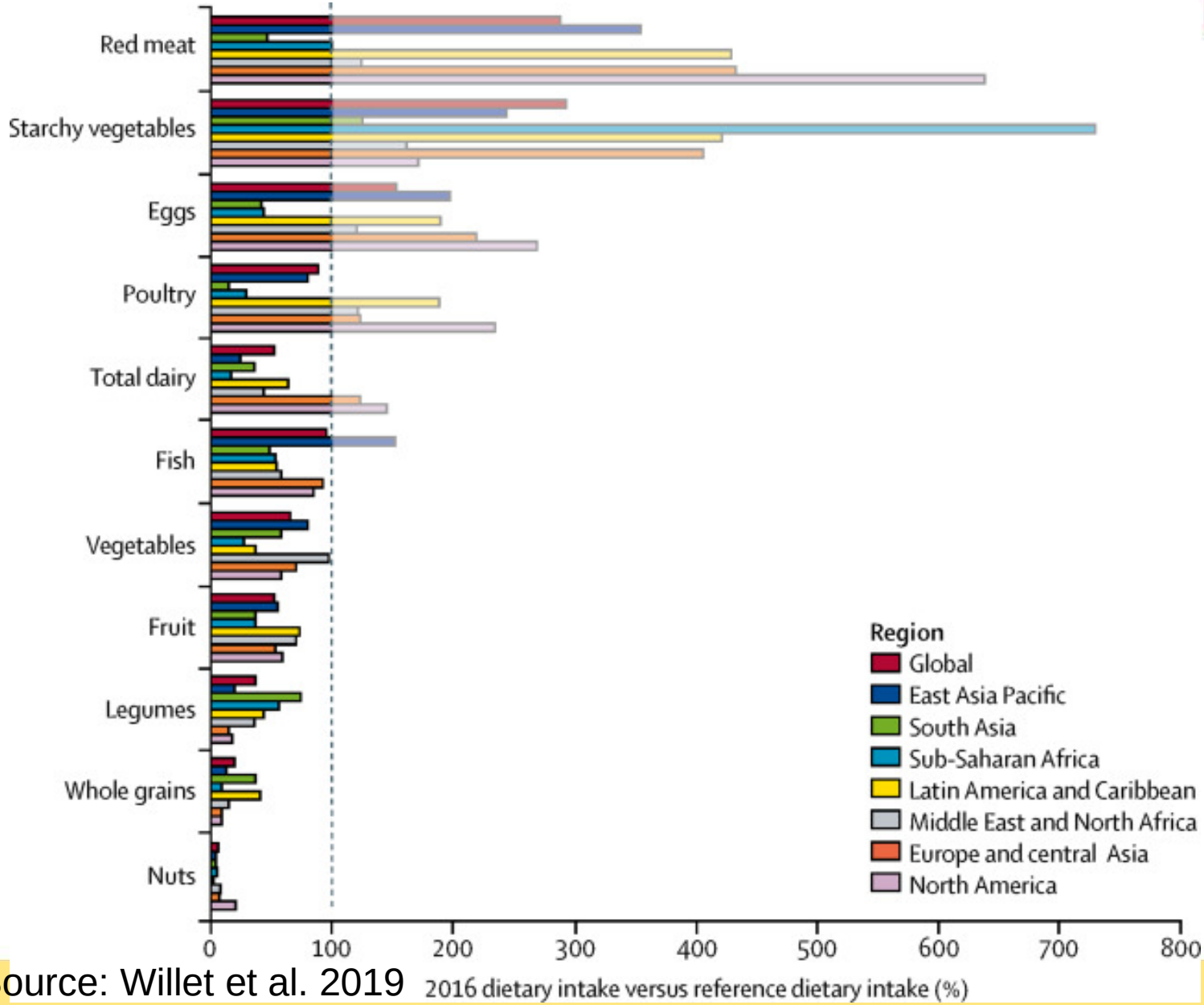
Source: HLPE. 2019.

Secure social equity/responsibility		
8.Co-creation of knowledge. Enhance co-creation and horizontal sharing of knowledge including local and scientific innovation, especially through farmer-to-farmer exchange.	Co-creation and sharing of knowledge	FA, FO
9. Social values and diets. Build food systems based on the culture, identity, tradition, social and gender equity of local communities that provide healthy, diversified, seasonally and culturally appropriate diets.	Parts of human and social values and culture and food traditions	FA, FO
10. Fairness. Support dignified and robust livelihoods for all actors engaged in food systems, especially small-scale food producers, based on fair trade, fair employment and fair treatment of intellectual property rights.		FA, FO
11. Connectivity. Ensure proximity and confidence between producers and consumers through promotion of fair and short distribution networks and by re-embedding food systems into local economies.	Circular and solidarity economy	FA
12. Land and natural resource governance. Strengthen institutional arrangements to improve, including the recognition and support of family farmers, smallholders and peasant food producers as sustainable managers of natural and genetic resources.	Responsible governance	FA, FO
13. Participation. Encourage social organization and greater participation in decision-making by food producers and consumers to support decentralized governance and local adaptive management of agricultural and food systems.		FO

*Scale application: FI = field; FA = farm, agroecosystem; FO = food system
Source: derived from from Nicholls ***et al.***, 2016; CIDSE, 2018; FAO, 2018c.


+
Win-Win-Diet
• Plant-based proteins (beans, lentils, peas)
• Oil with unsaturated fats (sunflower or peanut)in crop rotation
• (Wild caught or sustainable produced) salmon
• Plant-based diet and diverse diet
• Organic tobacco
• Intensively farmed Salmon
Healthy diet
+
-
Lose-lose-Diet
• Red meat (risk for stroke/diabetes)
• Processed food with food miles
• Food with lots of added sugars
• Food with high content of saturated fats, e.g. industrially processed refined palm oil
Environmental sustainability
• Chicken (from factories and processed)
• „Superfoods, e.g. Avocados (high market demand-> water problem Mexico
• Tree nuts such as almonds (1kg almond milk requires more than 6000 l of water) -> water problem California
-

Healthy diet and food diversity is different and not yet too diverse.



Source: Willet et al. 2019

Sustainable food systems and diversification at all levels

…. on the farm

… in the trade/market

… on the plate

… in the transport/ distribution

Diversification

Sustainable food systems to adapt to climate change

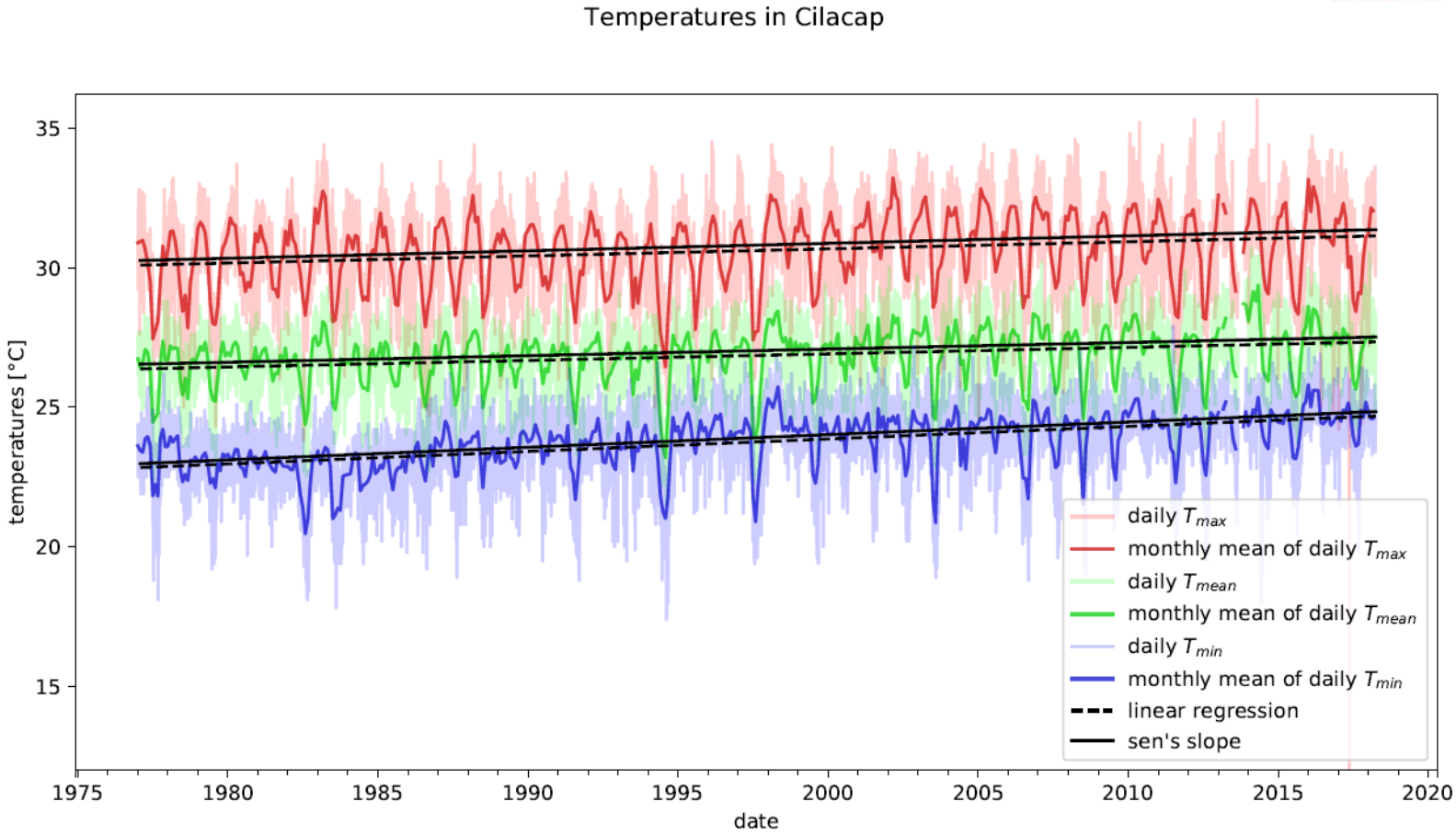
Source: adapted from Cook et al. (2015): 23

Two main messages:

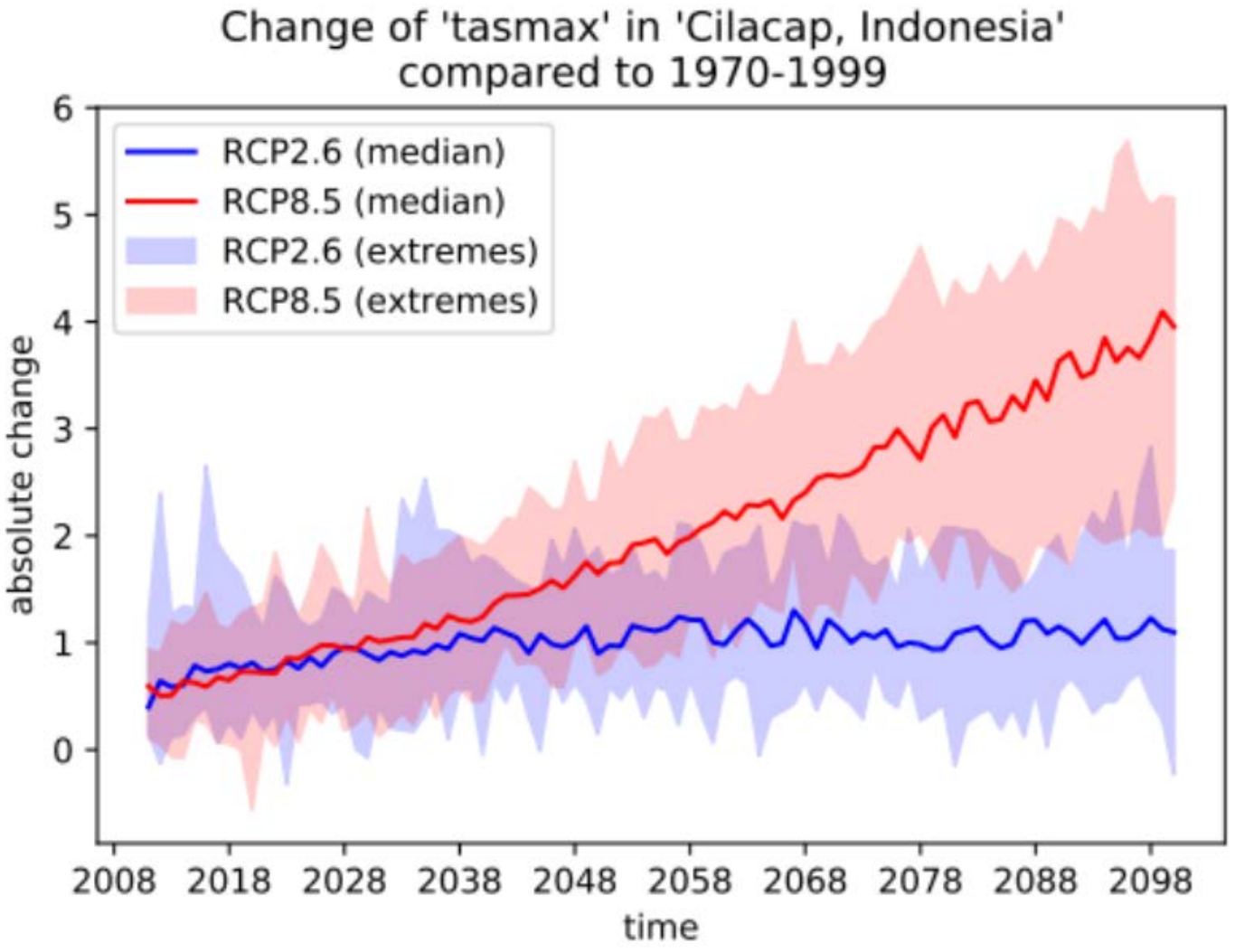
- The annual global temperature keeps rising at 0.3°–0.4°C above the 1981–2010 average
- CO2 concentration keeps rising to 407.4 ppm (2.4%)

- The annual mean temperature of Indonesia was 26.7°C (+0.5°C above normal).
- On 20 May, the Wajo District of South Sulawesi: a record rainfall of 475 mm in 24 hours.
- East Nusa Tenggara experienced its longest number of consecutive dry days (259) from March to November.
- 82% of 92 stations recorded below normal precipitation. Southern Sumatra, Java, Bali, Nusa Tenggara, northern Sulawesi particular.

2. Climate Data Cilacap - **Temperature**



Increasing day and night time temperatures:
Tmin = +0.044 °C per year
Tmax = +0.025 °C per year
Tmean = +0.023 °C per year


Change of 'tasmax' in 'Cilacap, Indonesia'
compared to 1970-1999
RCP2.6 (median)
RCP8.5 (median)
RCP2.6 (extremes)
RCP8.5 (extremes)
absolute change
0
1
2
3
4
5
6
2008
2018
2028
2038
2048
2058
2068
2078
2088
2098
time

		minimum temperature (absolute change [°C])		maximum temperature (absolute change [°C])		precipitation (relative change [%])	
		2030 – 2059	2070 – 2099	2030 – 2059	2070 – 2099	2030 – 2059	2070 – 2099
West/Central Java (Cilacap)	RCP 2.6	0.97 (0.67 – 1.44)	1.00 (0.65 – 1.76)	0.98 (0.72 – 1.57)	1.10 (0.66 – 1.85)	-2.08 (-20.24 – +8.68)	-2.31 (-27.13 – 9.03)
	RCP 8.5	1.45 (1.06 – 2.11)	**3.12** (2.43 – 4.38)	1.51 (0.76 – 2.08)	**3.32** (1.84 – 4.34)	+0.28 (-18.76 – 20.82)	-0.98 (-37.65 – 31.91)
Southern Sulawesi Tana Toraja (Pongtiku)	RCP 2.6	0.99 (0.72 – 1.55)	1.05 (0.66 – 1.87)	0.97 (0.76 – 1.52)	1.04 (0.63 – 1.82)	0.34 (-12.09 – 9.12)	2.17 (-15.09 – 7.99)
	RCP 8.5	1.44 (0.84 – 2.30)	**3.42** (2.13 – 4.63)	1.55 (0.82 – 2.15)	**3.52** (1.95 – 4.63)	2.26 (-14.65 – 15.64)	6.35 (-24.85 – 33.91)

Impact of CC on Agriculture

LAND DEGRADATION

SOIL FERTILITY LOSS

CROP FAILURE AND HARVEST LOSSES

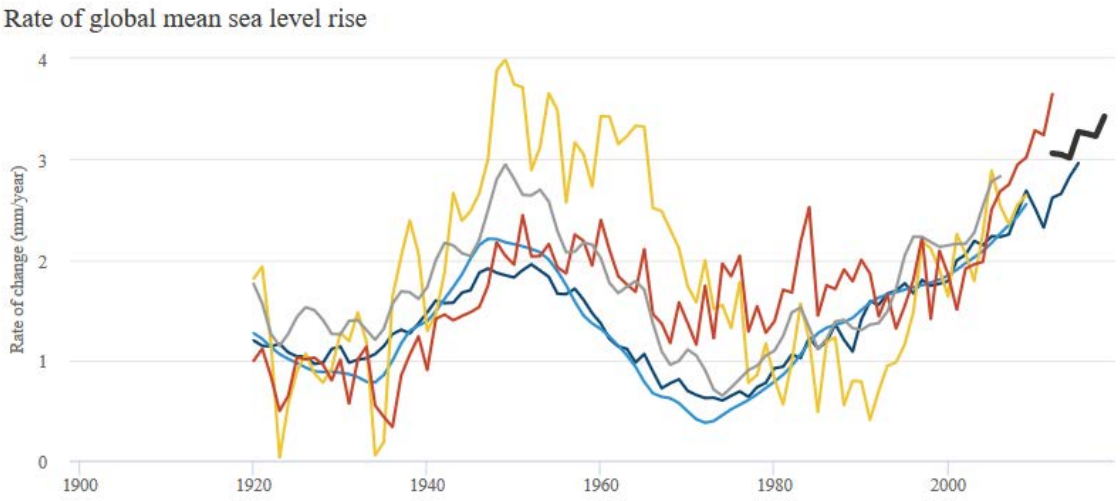
LESS INCOME

Sea Level rise

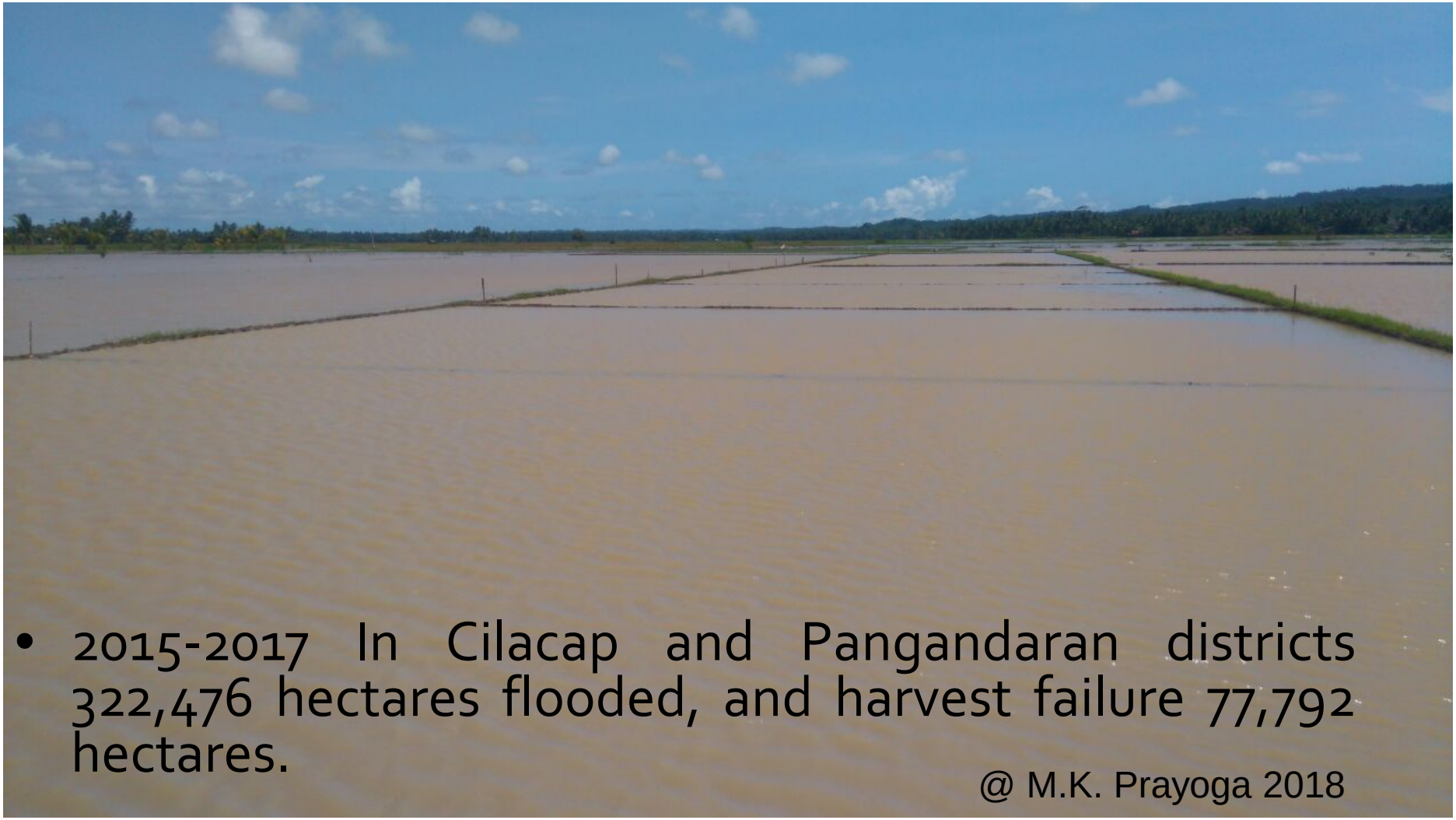
- Global sea levels have risen by between 0.18 and 0.2m (180 to 200mm) since 1900.
- SLR North coast of Java is higher (2.46 ± 0.21 mm/yr) compared to South coast (0.97 ± 0.36 mm/yr). (Wuriatmo et al. 2012)
- In Indonesia, a one-meter rise would inundate more than 13,800 square kilometers and may displace 2.8 million people. (IPCC 2018)

Dangers:

1. land loss from the permanent inundation
2. intensification of inundation from cyclonic storm surges;
3. loss of wetlands, for example mangroves;
4. salinization of soil and water.



January 2018 : Flooding of rice fields



- 2015-2017 In Cilacap and Pangandaran districts 322,476 hectares flooded, and harvest failure 77,792 hectares.

@ M.K. Prayoga 2018

Temperature rise: Arabica Coffee (Läderach et al. 2017)

Coffee adaptation Nicaragua

- Low elevations (500–800 m): coffee will disappear; transformational adaptation is recommended (e.g. replacement of Arabica coffee by Robusta coffee or cocoa);
- Medium elevation (800–1200 m): large negative changes, incremental adaptation is recommended (e.g. new varieties and diversification);
- High elevations (1200–1400 m): little negative changes are projected, incremental adaptation is recommended (e.g. shade and irrigation);
- Very high elevations (1400–1600 asl): positive changes are projected and transformational adaptation is recommended (e.g. expansion into new areas).

Acidity and flavour: quality criteria

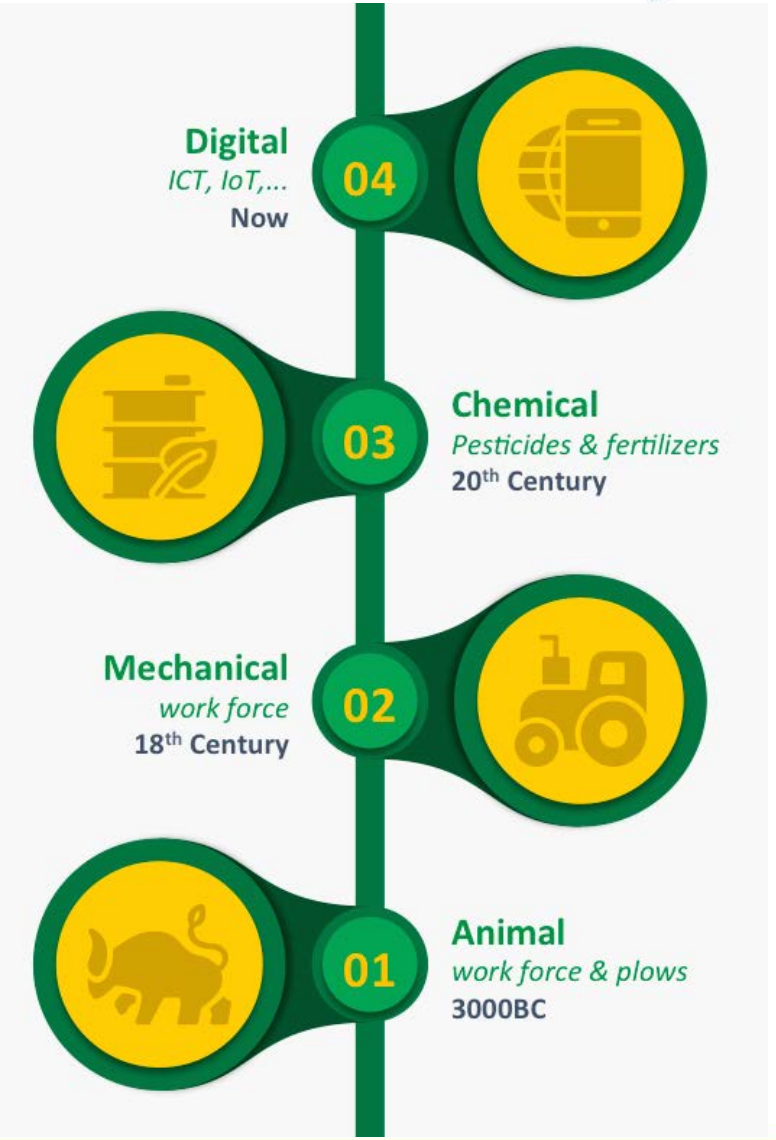
Adaptation to these threats need Innovation in agriculture

- Population growth + resource decline + climate change + urbanisation puts pressure ->

  a chance to develop a sustainable global food system

But!!! diffusion of technologies uneven

Digital = knowledge revolution to capture, measure, analyse, diagnose



Source: slide courtesy J Henze 2018

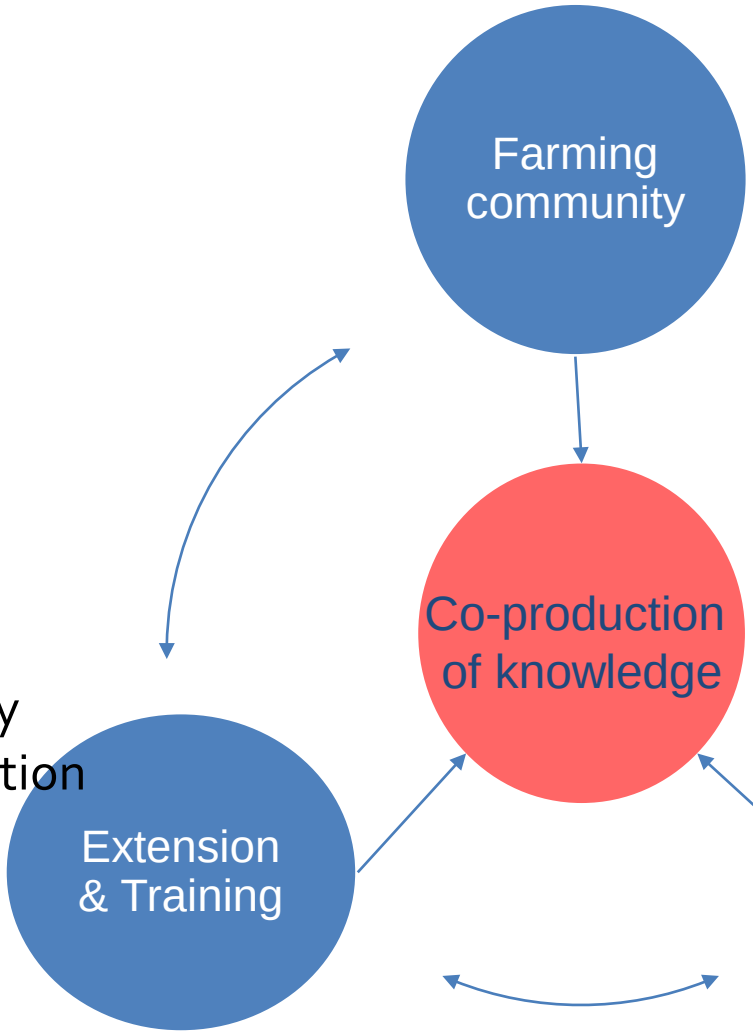
Origin of agriculture **10.000 BC**

Camera

Smartphone

Notebook

Co-production of knowledge approach



- Observation
- Intuitive
- Experience
- Traditional
- Local wisdom

- Facilitation
- Brokerage
- Participatory
- Communication

- International
- Analytical
- Literature
- Methods

Source: SLE 2019

Transfer of Technology Approach

Source: Davis and Sulaiman 2016; GFRA: Lausanne, Switzerland.

Merging knowledge systems

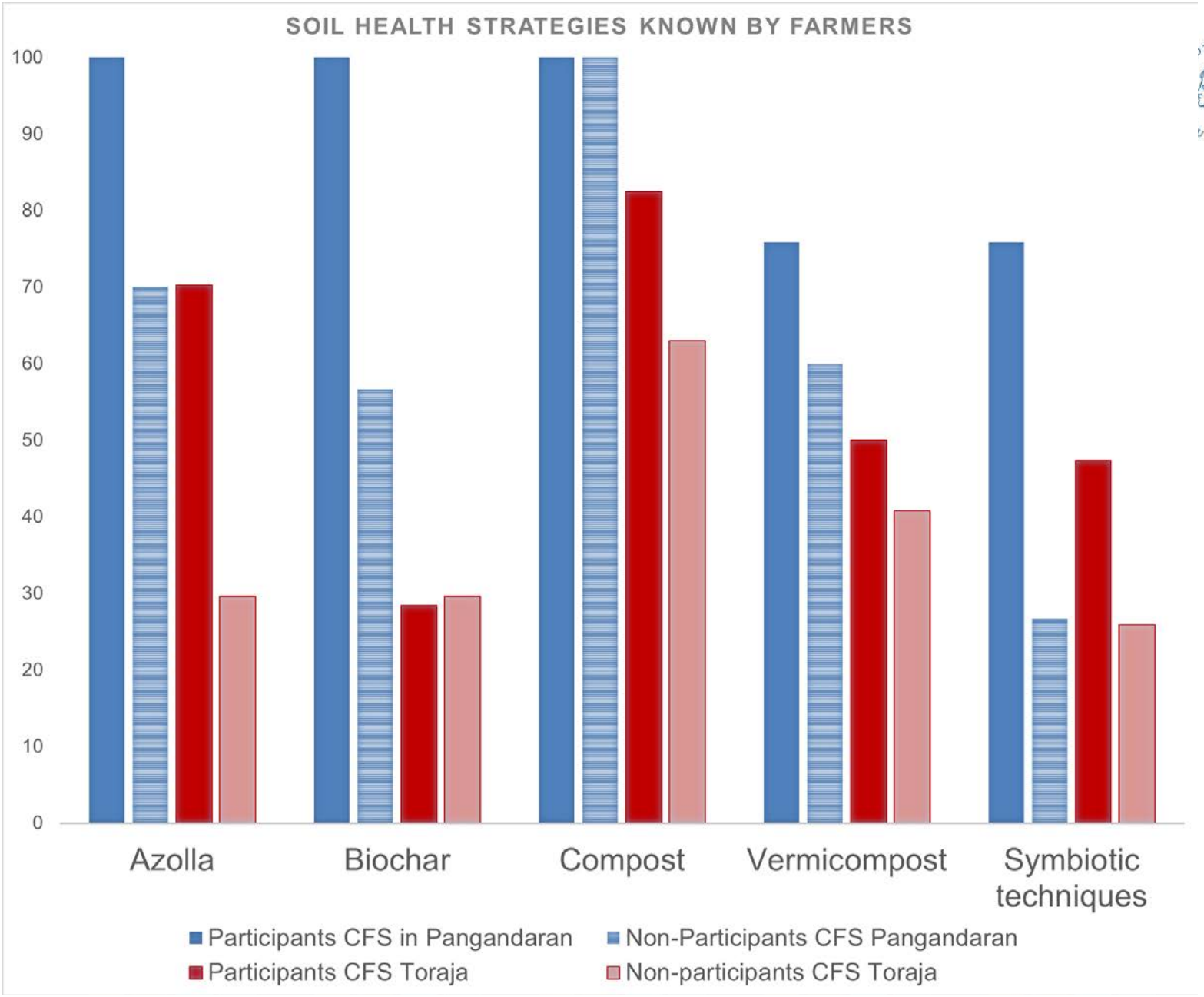
„Many innovations are done by farmers' hands."

„Before I do agriculture like a blind man, now I can see and understand."

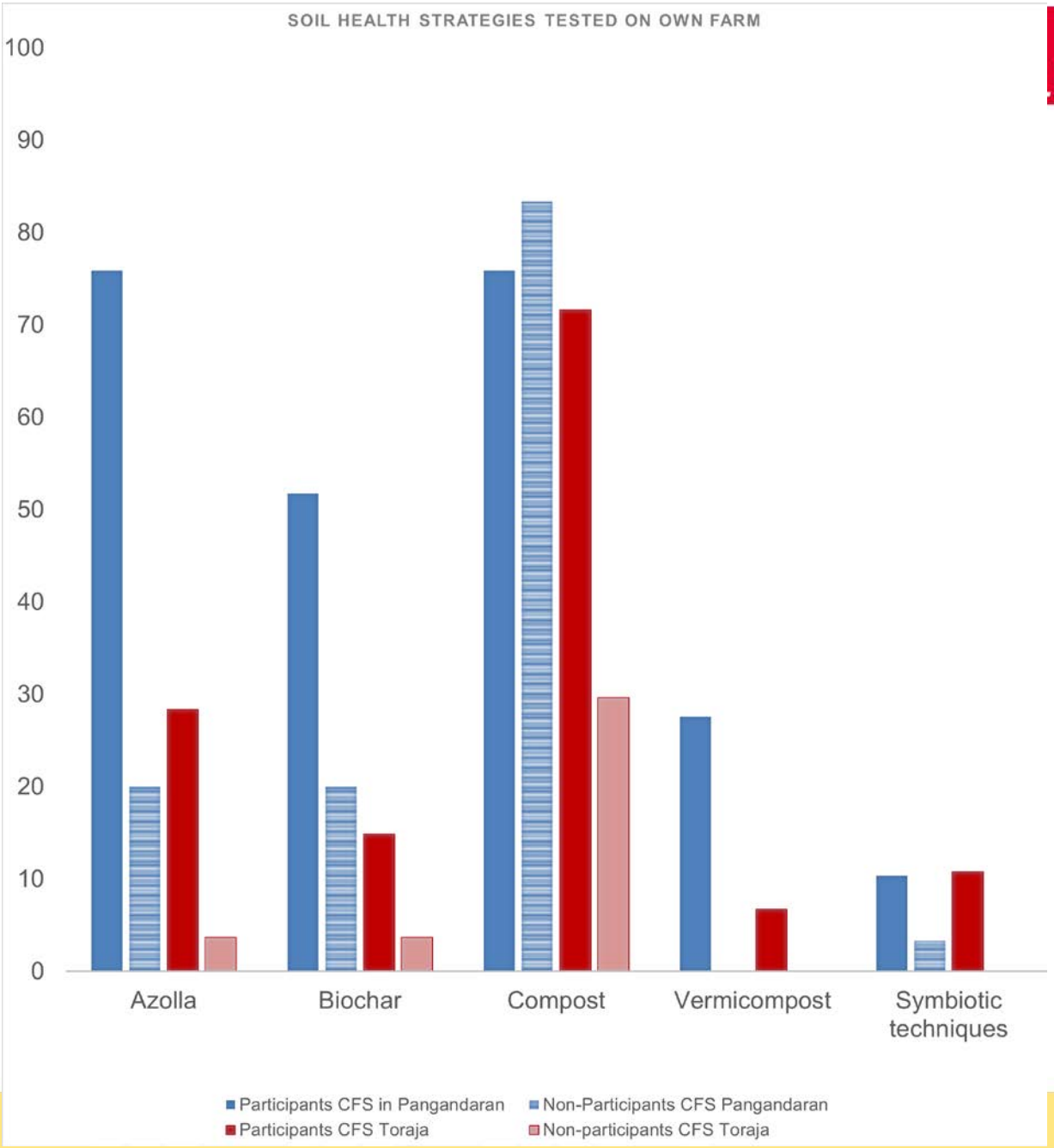
Farmer researcher from Pangandaran, West Java

Academia and farmer in the field

Source: own


SOIL HEALTH STRATEGIES KNOWN BY FARMERS
100
90
80
70
60
50
40
30
20
10
0
Azolla
Biochar
Compost
Vermicompost
Symbiotic techniques
Participants CFS in Pangandaran
Non-Participants CFS Pangandaran
Participants CFS Toraja
Non-participants CFS Toraja

Source: own

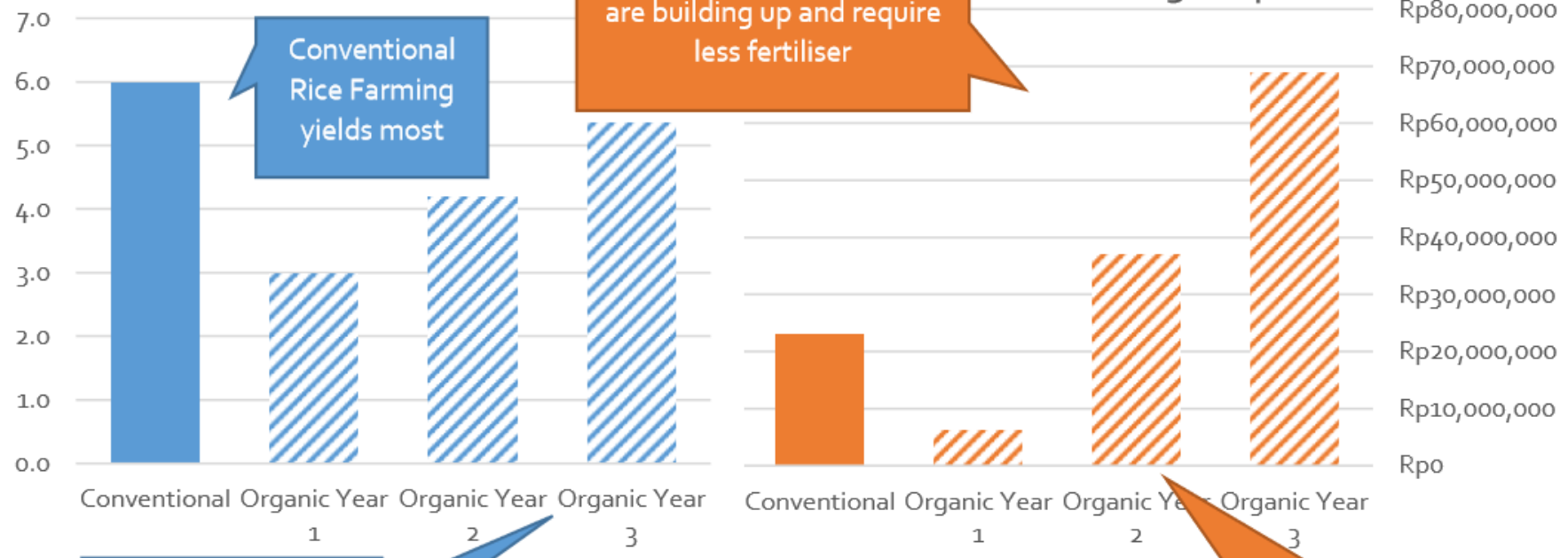

SOIL HEALTH STRATEGIES TESTED ON OWN FARM
100
90
80
70
60
50
40
30
20
10
0
Azolla
Biochar
Compost
Vermicompost
Symbiotic techniques
Participants CFS in Pangandaran
Non-Participants CFS Pangandaran
Participants CFS Toraja
Non-participants CFS Toraja

Source: own

Climate change matters for us, as it impacts agriculture negatively. The temperature is higher than 15 years ago. It becomes difficult to decide on the right time of land preparation, as the onset of the rainy season is unpredictable. There are ***more pests and diseases and also a higher resistance to pesticides****. Lower yields, high chemical inputs and soil with low fertility and water holding capacity are common.*

Pak Endi and Ibu Hera,, picture source: own

Economics of Organic Rice Farming + System of Rice Intensification (SRI)



Conventional Rice Farming yields most

Organic Farming gets more profitable, as yields are building up and require less fertiliser

Organic rice almost reaches conventional yield in third year

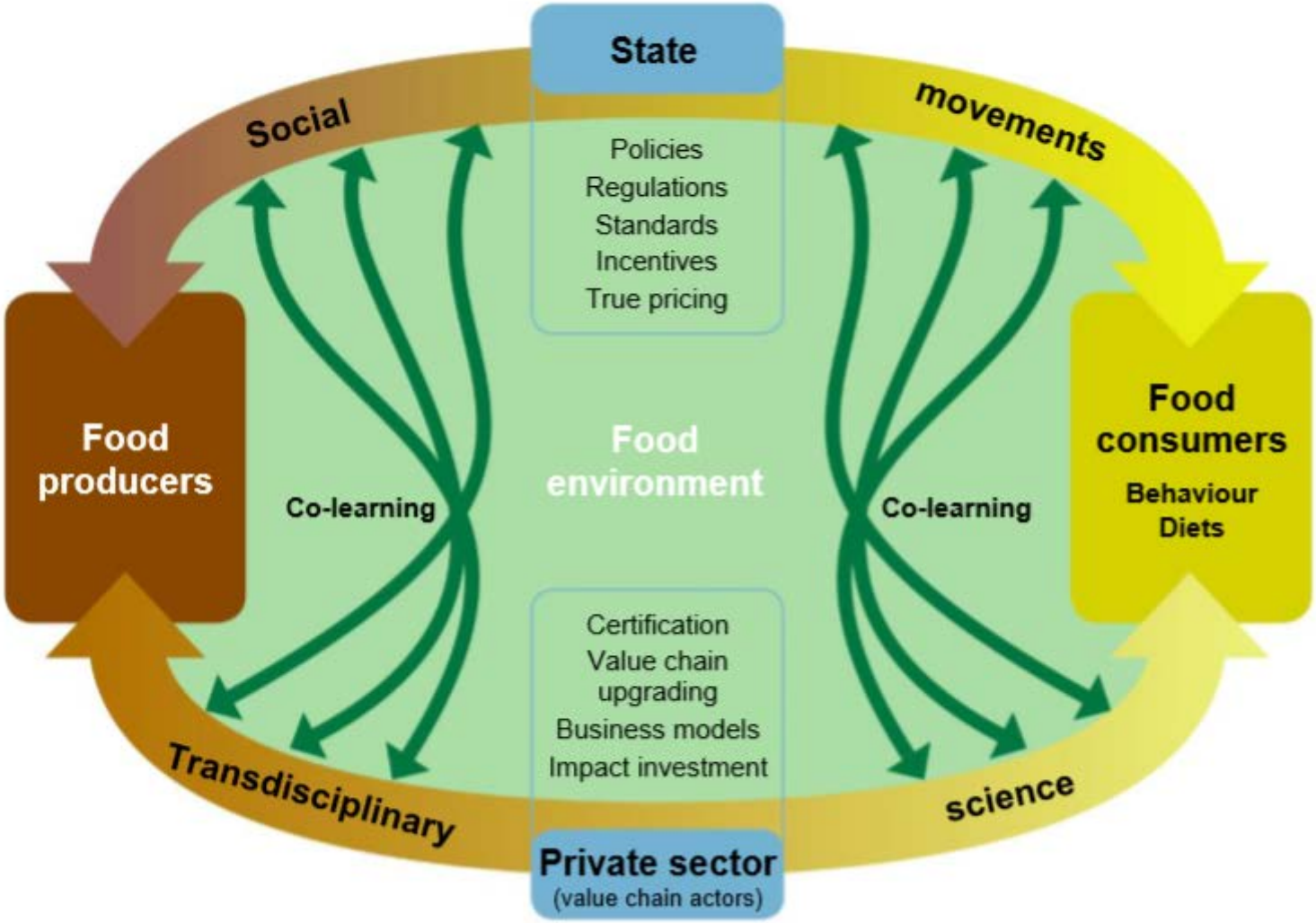
Prices 2018 (Rp/kg)	Conventional	Organic
White rice	12,000	15,000
Red rice	14,000	25,000
Black rice	15,000	31,000

Organic Rice Farming is more profitable from second year onwards:

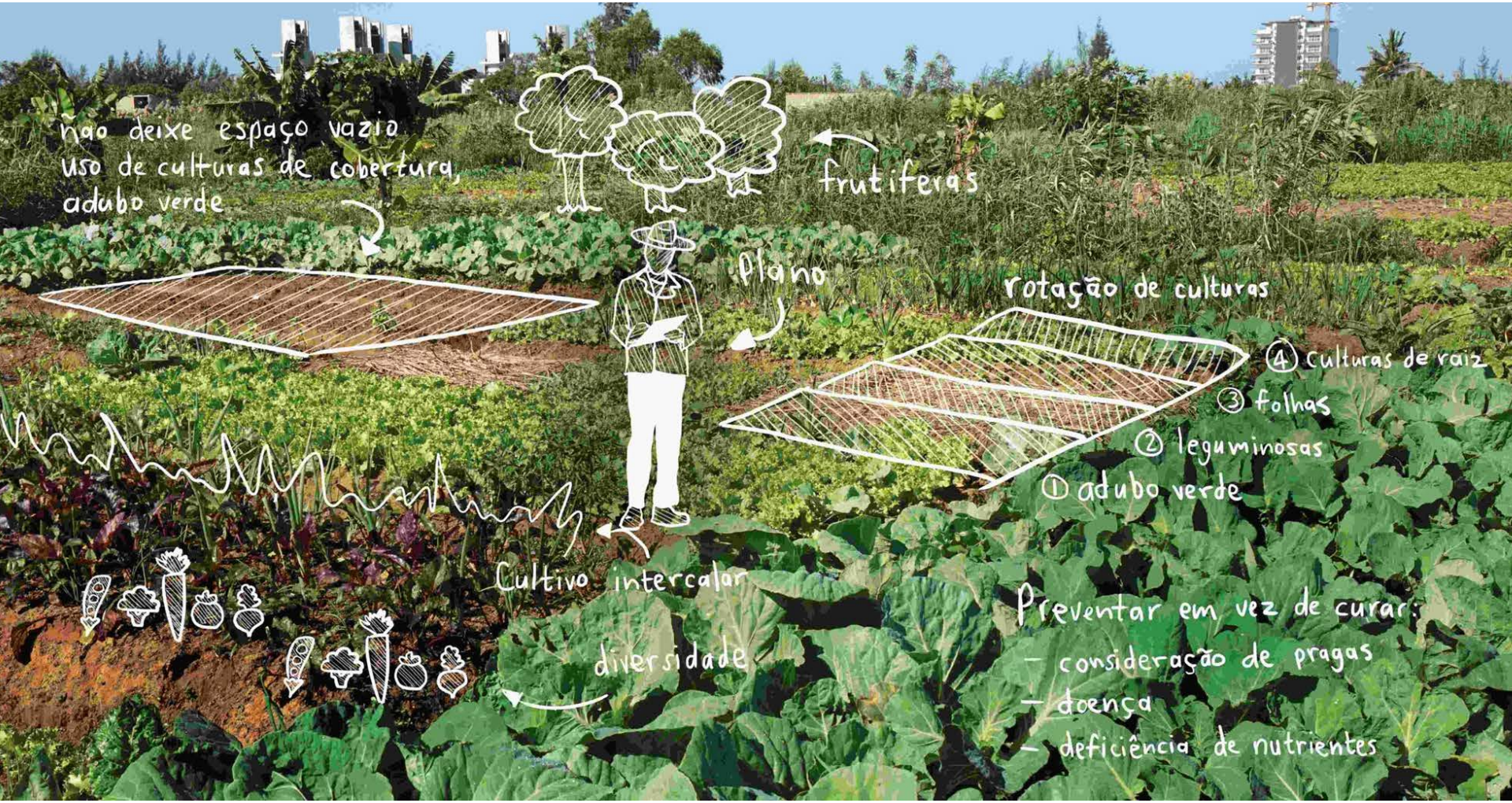
Better prices + lower costs through organic fertilising (only labour costs)

Source: data from JAMTANI/Kustiwa Adinata 2018

Figure 7 Coordination between public and private stakeholders for knowledge generation and co-learning to foster innovation towards SFSs



Source: HLPE 2019



Source: Nicole Paganini 2019

Source: http://www.thefrankstory.com/south-africa.html

Thank you

Terima kasih

Kurre sumanga'

Hatur nuhun

Danke schön

Reference

- Davis and Sulaiman 2016; GFRAS: Lausanne, Switzerland. www.betterextension.org
- HLPE. 2019. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.
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- Wuriatmo et al. 2012

Pangan ditengah Ancaman Perubahan Iklim

KUSTIWA ADINATA

JAMTANI

STRATEGI

DAMPAK PERUBAHAN IKLIM DI WILAYAH PROJECT

Pola Curah hujan yang tidak teratur
mengakibatkan :
Kekeringan, Banjir, Hujan datang lebih awal/lebih lambat, Penyakit Blast, Hama Keong, Meningkat, Topsoil erosion, Keasaman Tanah Meningkat

Suhu Meningkat
mengakibatkan :
Lahan cepat Kering, Hama Meningkat, Lahan pecah dan akar terputus, Nutrisi menurun, Lahan sulit diolah

Muka air Laut Meningkat
mengakibatkan :
Banjir Rob, Lahan terkena air asin meningkat, Abrasi Pantai, Hasil panen menurun bahkan gagal

Angin Puting Beliung
mengakibatkan :
Padi Rebah, Penyebaran Penyakit cepat

Diperlukan treatment untuk memperkuat ketahanan tanaman terutama untuk menghadapi curah hujan tinggi.

- Varitas yang lebih tahan? (*stronger varieties*?)
- Modifikasi sistem/pola tanam? (Modified planting pattern/system?)
- Tambahan input? (Additional input?)
- Simbiosis dengan organisme/microorganisme lain (Mutualistic symbiosis with other organism/microorganism?)
- Solusi Lain? (Other solution?)

Strategi 1: Menigkatkan kapasitas petani dalam mengidentifikasi, menyeleksi **Varietas benih padi yang tolerant** terhadap Dampak **Bencana Iklim**

Strategi 2: Modifikasi teknologi dan perbaikan media tanah melalui Green Manure

Arang sekam, Compost Organik, Azzola Pinata, Sesbania rostrata (Diharapkan tanah mampu menyimpan air lebih lama/tidak keras , tanaman tidak terjadi stres yang berlebihan ketika perubahan musim, akar tidak mudah putus karena tanah retak, tanah menjadi lebih subur dengan unsur hara

Participatory Approach

- ✓ Solusi berdasarkan masalah (*problem based solution*)
- ✓ Aplikasi yang rasional (bagi petani) (applicable by farmers)
- ✓ Efisien dan efektif (efficient and effective)

Dari Analisis Data Cuaca dan Pengalaman Petani

- **Meningkatnya Curah Hujan Tahunan**
- **Pola cuaca yang kurang dapat diandalkan**
- **Kemarau basah/kering yang lebih panjang, curah hujan ekstrim**
- **Meningkatnya Suhu**
- **Naiknya Muka Air Laut**
- **Gelombang/Angin kencang**
- **Hujan Asam**

- **Menurunkan Kesehatan Tanah / Kesuburan**
- **Peningkatan Salinitas Tanah**
- **Musim Berkembang Yang Tidak Diramalkan**
- **Kegagalan panen akibat Banjir/Kekeringan**
- **Baru / Meningkatnya Hama & Penyakit**
- **Penyerbukan berkurang**
- **Erosi Tanah & Tanah Longsor**
- **Kerusakan Fisik Tanaman**

STRATEGI

CRAIIP

Adaptasi

Adaptasi praktek pertanian dan penggunaan lahan yang terancam perubahan iklim

Mitigasi

Mengurangi produksi gas rumah kaca, deforestasi dan degradasi lahan

Farmer Led Research

Kapasitas Petani

Meningkatkan kemampuan petani dalam hal mengembangkan keterampilan di lahan sendiri

Inovasi Teknologi

Merumuskan bersama teknologi baru untuk membantu petani menghadapi tantangan perubahan iklim

Lobby & Advocacy

Mempromosikan penerapan praktik pertanian tahan iklim dalam skala yang lebih luas

Methodologi

- **Pola sekolah lapang/Andragogy** : Design, Pengamatan dan analisa sederhana tetapi ilmiah dilakukan bersama sama (Partisipatif)
- **Petani sebagai Subyek** : Mengidentifikasi, menyeleksi , Melatih dan membentuk pioner petani kritis sebagai Inovator (Seed Breeder, pengamat)
- **Pengujian/Pembuktian Bersama** : ujicoba melalui Demplot **dilahan petani** minimal 1000 Meter persegi.
- **Keputusan :** tindak lanjut di serahkan kepada petani (untuk memilih varietas maupun bentuk uji coba lainnya dengan dibimbing oleh Universitas

METODA

1. **Pelaksanan Riset sederhana**: Pengamatan tidak memakan waktu yang panjang, (contoh: pada pengamatan parameter hama dan musuh alami → tidak dapat diamati dengan baik karena waktu semakin siang); Efisien dan efektif;
2. Pendekatan aksi refleksi dan siklus daur belajar dari pengalaman (Andragogi) PAR (Participatory Action Research)
3. Mengidentifikasi calon peserta petani peneliti, menyeleksi peserta (direct beneficeries), Melatih dan membentuk petani pioneer yang kritis dan Inovator (Seed Breeder, pengamat, menerapkan di lahan sendiri, agen perubahan terkait pertanian ramah iklim, motivator, dinamisator)
4. Design dan Pengamatan melalui metode sekolah lapang (analisa sederhana tetapi ilmiah/ analisis praktis)

5. **Pengamatan berkala**:–Dilakukan pada pagi hari kemudian data dituangkan ke dalam dokumen (Format pengamatan sederhana dan mudah dipahami) dan dipresentasikan kepada peserta ainnya untuk dianalisa serta menghasilkan rekomendasi untuk ditidaklanjuti sesegera mungkin, jika persoalan tidak dapat diselesaikan segera diinformasikan kepada pihak universitas; Pengamatan dilakukan oleh petani peneliti secara terjadwal dan terdokumentasikan sesuai dengan SOP; Menempelkan SOP Pengamatan di Saung Meeting;

6. **Diseminasi hasil**: jenis inovasi yang diesebarkan harus memiliki dampak langsung kepada target terutama aspek ekonomi; Waktu diseminasi disesuaikan dengan kondisi permasalahan yang terjadi di lapangan/target (melakukan survei kebutuhan/ need assessment); menyusun daftar kompetensi setiap petani (meningkatkan kepercaan diri petani--- Bagian dari Integrated Learning); Media diseminasi ditampilkan dalam bentuk sederhana dan mudah dipahami (video, factsheet, brosur, artikel, pamflet, ..); Melibatkan pemerintah terkait untuk mempercepat penyebarluasan dan penyerapan alokasi dana pemerintah;

Prinsip Penelitian

- Adanya Relevansi dengan Perubahan Iklim (Justifikasi)
- Menyepakati aturan dalam pelaksanaan demoplot
- Pemilihan varietas Unggul seperti : Anakan produktif tinggi, rasa enak, Umur genjah, tinggi ideal, tidak mudah rebah
- Varietas toleran terhadap cekaman bencana iklim (Banjir, Kekeringan dan Salinitas)
- Teknologi/Inovasi mudah dikembangkan oleh petani
- Memaksimalkan sumber daya lokal Mudah didapat dan murah (Azolla, Sesbania Rostrata, Compost Hijau, Blue Green Algae,)

Contoh Aksi Penelitian

KONTEKS IKLIM :

- Varietas tahan cekaman Iklim : Inpari 35, 41, Mendawak dll
- Budidaya Hemat Air : SRI
- Nitrogen bersumber dari alam (green Manure) : Azola, Sesbania Rostrata etc
- Menanam varietas hemat emisi : Inpari, Inpara
- Mengolah kotoran ternak : Compost/Fermented
- “Ramah Carbon”:Tidak membakar jerami, menggunakan mulsa organic, Teknologi Solar, kincir Angin dsj

“Setiap peserta adalah narasumber, setiap Narasumber adalah Peserta”

Strengthening Farmers Awareness Through Climate Field School

Climate Field School (Learning from the field) with andragogy approach and learning cycle process

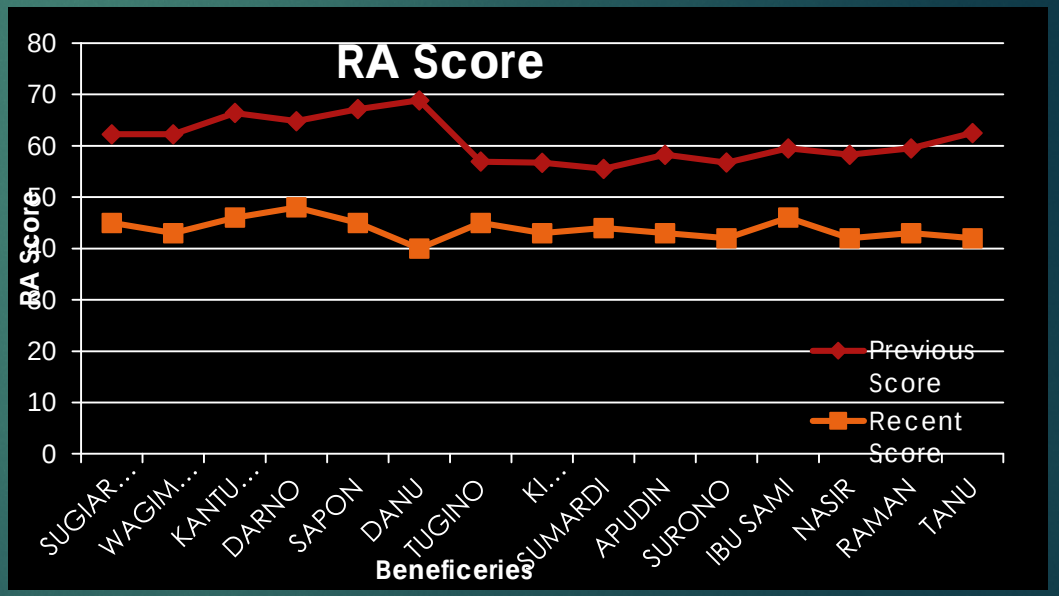
Modify Technology :

- a. Floating Rice
- b. SRI
- c. Stress Tolerant seed
- d. Green Manure

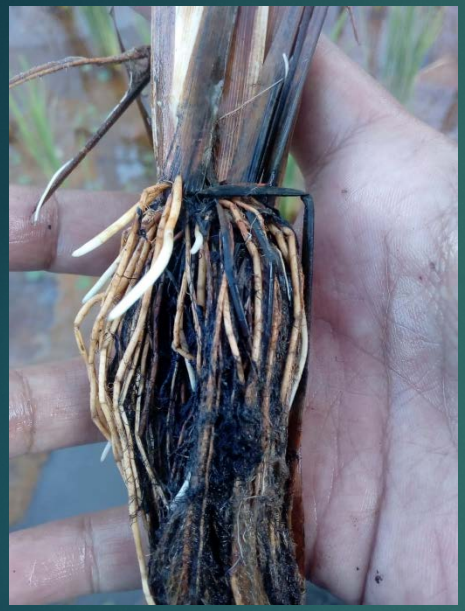
Achievements

Community Roles and Impact

- Increase Capacity to identify, Analyze their problem and alternative solution
- Increase bargaining position to the government and other stake holder, with the experience as Main Actor and involve in program since the beginning with participative process
- Decrease of The Score in base line data (Risk Assessment)
- Paddy yield increased 1,3 Ton/Ha by modified Technology



Salt tolerant Rice Varieties



Komunikasi Tim Iklim

Yield and yield component

Varietas	Number of productive tillers	Number of grain per panicle	Percentage of filled grain per panicle (%)	Yield per hectare (ton)
Inpari 34	17.86[a]	124.54[a]	91.07[a]	3.98[b]
Inpari 41	23.26[a]	118.46[a]	86.93[a]	4.28[a]
Palalawan	17.40[a]	119.96[a]	85.88[a]	2.95[c]
Inpara 02	21.71[a]	82.42[b]	89.26[a]	3.08[bc]
Mendawak	23.71[a]	111.62[ab]	86.02[a]	4.32[a]
Average	**20.79**	**118.65**	**87.83**	**3.72**

Note: number followed by the same letter is non significant ($P<0.05$)

Good taste, hight yield, easy to sell

Source: Rostini et al. 2019

Lessons Learnt

- Climate Field School that Learning from the field with Andragogy approach and learning cycle is very effective for farmers with various back ground (Education, Economic, different age, Social status and income)
- The community and organisation must continuously monitor the climate variables and effectiveness of the adaptation activities in order to determine how far the activities need revision.
- The monitoring and evaluation of the climate change adaptation programme must be more frequent compared to other community development programmes.
- Adaptation programme will be more successful if they answer people's short-term needs (natural disaster, wood-saving stove, and problem of economy) as entry point and followed by long-term activities (mangrove, trees) –win-win solution.
- The involvement of the local community as executive staff will speed up the implementation of the activities, improve the quality of the programme (more effective) and support the programme toward sustainability.

HATURNUHUN

DANKE SCHOEN