Opportunities for agroecological management in fruit & vegetable systems

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Outline

1/ What makes a “sustainable” F&V system?
2/ Approaches to sustainable F&V systems
3/ Agroecological management: theory & practice
4/ 3 success stories
5/ Complementary ecological & nutritional functions
6/ Scaling up agroecological management

Figure 3b. Schmidt et al. 2011. *Nature.*
WHAT MAKES A "SUSTAINABLE" FRUIT & VEGETABLE SYSTEM?

(NAEE)

What makes a “sustainable” fruit and vegetable system? Ecological, social, economic, & nutritional functions

(AGRO) ECOLOGICAL FUNCTIONS

Serves multiple functions simultaneously (“multifunctional”)

Nutrient inputs and outputs balanced over time

Increased capacity for nutrient retention over time

Carbon sink, not source

Crop nutritional quality

Stable yields

Approaches to agricultural sustainability

**PRECISION AGRICULTURE**

**AGROECOLOGICAL MANAGEMENT**

Drinkwater and Snapp 2007; Drinkwater et al. 2008; Photos: Anne Elise Stratton
Approaches to agricultural sustainability

**PRECISION AGRICULTURE**
- Source-sink approach to crop nutrients
- Maximizes nutrient use efficiency from fertilizer applications
- Minimizes growth-limiting factors
- Uncouples biogeochemical cycles (C, N, P)
- Focus: increasing the precision of nutrient delivery

**AGROECOLOGICAL MANAGEMENT**
- Emphasizes internal system nutrient cycling
- Builds soil nutrient pools for plant uptake and microbial immobilization
- Couples C, N, & P cycles
- Focus: retain N and P by maximizing the extent and functional complementarity of living crop biomass in space and time

Drinkwater and Snapp 2007; Drinkwater et al. 2008
Agroecology underlies sustainable F&V systems

**Agroecology (n.)** – short for agricultural ecology, the study and practice of agriculture governed by ecological principles

- Diversified systems
- Biotic interactions replace synthetic inputs to maintain agroecosystem function
- Ecologically increases NUE
- Goals and outcomes are social, ecological, nutritional, and economic

Multifunctionality

Figure modified from Blesh and Wittman 2015, Human Ecology
AGROECOLOGICAL MANAGEMENT SUCCESS STORIES
Cover cropping

FUNCTIONS
C & N SOURCE; SEQUESTERS SOIL C
COMPLEMENTARY NUTRIENT PROVISION & UPTAKE
MAXIMIZE SOIL COVER; MINIMIZE EROSION
ROOT & FUNGAL INPUTS TO SOIL ORGANIC MATTER

Multi-functional vegetable systems

SOUTHEAST MICHIGAN, USA
BLESH AGROECOLOGY LAB
UNIVERSITY OF MICHIGAN
**Functional traits in cover crop mixtures: Biological nitrogen fixation and multifunctionality**

Jennifer Blesh
Intercropping

FUNCTIONS

COMPLEMENTARY NUTRIENT PROVISION & UPTAKE
DIVERSIFIES PLANT COMMUNITY (SPECIES, FUNCTIONS, GENOTYPES)
BUILDS FUNCTIONAL MICROBIAL & INSECT COMMUNITIES
INTER-SPECIES FACILITATION

Wagg et al. 2014; Brooker et al. 2015; Li et al. 2016.
Intercropping patterns widely adopted in Yunnan

Staple & vegetable intercropping adopted on 2.77 million ha (2006-2015)

YUNNAN PROVINCE, SW CHINA
PROF. YOU-YONG ZHU
YUNNAN AGRICULTURAL UNIVERSITY
Perennialization

**FUNCTIONS**

**COMPLEMENTARY NUTRIENT PROVISION & UPTAKE**

**MAXIMIZES SOIL COVER; MINIMIZE DISTURBANCE**

**ROOT & FUNGAL INPUTS TO SOIL ORGANIC MATTER**

**DIVERSIFIES PLANT COMMUNITY (SPECIES, FUNCTIONS, GENOTYPES)**

Crews et al. 2016; King and Blesh 2018.
Agroecological agroforestry systems

SOUTHERN BRAZIL
APPLIED ECOLOGY LAB
FEDERAL UNIV OF SANTA CATARINA

https://www.slideshare.net/Cepagro/rede-safas-trazendo-a-floresta-pra-dentro-da-roa
Ecological & nutritional functional diversity

**Sarstun, Guatemala case study**

Quantified ecological and nutritional functional crop diversity for smallholders (n=60)

Strong positive relationship indicates that as species with diverse ecological functions decline, so will nutritional diversity of production

Remans et al. 2011; Wood et al. 2015; Stratton et al. *In Prep.*
Scaling up agroecological management

Requires policy support & investment

Brazilian example: National School Lunch Program (PNAE)
- Innovative national food procurement program
- 30% local sourcing required at municipal level - fresh fruits, vegetables, whole foods for school lunches (Brazilian Law No. 11.947)
- Explicitly ties family farming, ecological management, local food consumption
- 30% price premiums for organic & agroecological production since 2009
- 6+ month contracts with growers to ensure a stable market
- Participating farmers reduce input use, increase diversity

Thank you!

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Questions?

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References


References


