Sustainable Food Systems: How Better Natural Resources Management Leads to Better Food Security

Speakers:  
Sara Scherr, EcoAgriculture Partners  
Faisal Hossain, University of Washington  
Pete Pearson, World Wildlife Fund

Moderator:  
Julie MacCartee, USAID Bureau for Food Security

Date:  
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Sara Scherr, EcoAgriculture Partners

Dr. Sara J. Scherr, an agricultural and resource economist, is a prominent voice globally in promoting restoration of degraded lands. She founded the non-profit EcoAgriculture Partners in 2002 to promote locally-led transformation of agricultural landscapes for food security, rural livelihoods and ecosystem services. A leading innovator in agricultural landscape analysis, planning, policy, and finance she has supported landscape partnerships in Africa, Latin America, Asia and U.S.; and advised landscape programs world-wide. Her research is widely published in scientific and policy literatures. She previously served as Director of Ecosystem Services at the non-profit Forest Trends, senior researcher at the International Food Policy Research Institute (IFPRI), adjunct professor at Univ. of Maryland, and principal researcher and later Board member of the World Agroforestry Centre (ICRAF). She served on the Millennium Project’s Hunger Task Force to develop strategies to halve the incidence of hunger worldwide.
Pete Pearson, World Wildlife Fund

Pete Pearson is the Senior Director of Food Loss and Waste at World Wildlife Fund (WWF), helping businesses and communities understand agriculture’s impact on wildlife and habitat conservation. Pete has 10 years of technology and grocery retail experience with companies including Hewlett-Packard, Accenture and Albertsons; has worked with public schools and hospitals as a sustainability and zero waste consultant, co-founded a sustainable agriculture non-profit in Idaho, and co-produced a documentary film on local and regenerative agriculture (www.ToLiveLocal.com). Pete currently lives in Washington DC and enjoys fly fishing, sailing, skiing, and exploring the outdoors with his family.
Faisal Hossain received his Ph.D. from The University of Connecticut in 2004, his M.S (1999) and B.S (1996) from The National University of Singapore and Indian Institute of Technology, Varanasi, respectively. His research interests are hydrologic remote sensing, sustainable water resources engineering, transboundary water resources management and engineering education. He is the recipient of awards such as NASA New Investigator Award (2008), American Society of Engineering Education (ASEE) Outstanding Research Award (2009), US Fulbright Faculty Award (2012), G.O.L.D. (Graduate Of the Last Decade) award from University of Connecticut (2012), American Geophysical Union (AGU) Charles Falkenberg Award (2012), American Meteorological Society Editor's Award (2015) and ASCE Walter Huber Award (2015).
Transforming Landscapes to Achieve Food Security and the SDGs

Sara J. Scherr, EcoAgriculture Partners
Sustainable Food Systems: AgriLinks Webinar, January 29, 2020
Food Security depends on achieving all of the Sustainable Development Goals

New Pathways for Sustainable Development

“Leave no one behind…” means in every landscape
A landscape -- interconnecting people, food and nature

A socio-ecological system of natural and human-modified ecosystems, influenced by distinct ecological, historical, economic and socio-cultural processes and activities.
Yet land and resources are being managed today in ‘silos’
Long-term collaboration among different groups of land managers and stakeholders to achieve the full range of goods and services needed from the landscape.

Integrated Landscape Management
Linking food security and resource regeneration in North Coast of Honduras
Adapting to climate change and water risks in the Barind Tract, Bangladesh
Linking land health and food security for vulnerable groups in Laikipia County, Kenya
A global movement for sustainable food security through integrated landscapes is underway

**Continental surveys (428)**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Reported Impacts of Landscape Initiatives</th>
<th>Sub-Saharan Africa (%)</th>
<th>South and SE Asia (%)</th>
<th>Latin America-Caribbean (%)</th>
<th>Impacts - SDG #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Increased yields</td>
<td>40</td>
<td>46</td>
<td>38</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Increased profitability</td>
<td>29</td>
<td>53</td>
<td>37</td>
<td>1</td>
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<tr>
<td></td>
<td>Reduced environmental impacts</td>
<td>39</td>
<td>57</td>
<td>56</td>
<td>6, 12, 15</td>
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<tr>
<td>Ecosystems</td>
<td>Improved biodiversity protection</td>
<td>51</td>
<td>87</td>
<td>66</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Improved water quality and regularity</td>
<td>29</td>
<td>52</td>
<td>42</td>
<td>6</td>
</tr>
<tr>
<td>Institutional</td>
<td>Greater empowerment of women</td>
<td>45</td>
<td>83</td>
<td>55</td>
<td>5, 10, 16</td>
</tr>
<tr>
<td></td>
<td>Preserved/used indigenous and local knowledge</td>
<td>37</td>
<td>88</td>
<td>67</td>
<td>10, 16</td>
</tr>
<tr>
<td>Livelihoods</td>
<td>Improved food security</td>
<td>46</td>
<td>69</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Higher income for low-income households</td>
<td>46</td>
<td>96</td>
<td>52</td>
<td>8</td>
</tr>
</tbody>
</table>
Lots of different approaches....

but five common features......
1) Collaborative, community-engaged processes for landscape dialogue, negotiation, planning and action
2) Shared or agreed landscape objectives that encompass the many benefits from landscapes
3) Field, farm and forest practices that benefit multiple landscape objectives

- Healthy forests for recreation and water retention
- Peri-urban areas are biodiverse, mixed-use food corridors
- Fresh, local food sources
- Biodiverse and economically active coastal areas
- Managed riparian ecosystems

Adapted from: Victoria (Australia) provincial government framework “Building healthy and resilient ecosystems across the landscape”, Chapter 6: 72-73.
4) Land uses across the landscape are managed to achieve synergy & reduce conflict
5) Markets, policies and finance are shaped to align with the integrated landscape strategy
Advancing integrated landscape management
Tools to implement ILM
Scaling up locally-led landscape transformation for food security & the SDGs:
1000 Landscapes for 1 Billion People
Questions and Answers
Our Mission

**WWF PROTECTS THE FUTURE OF NATURE**

- We are a global science-based organization
- We work with companies and communities
- *We strive to meet the needs of both people and nature*
Our Work Is Global

WWF is the Largest multinational conservation organization in the world. We have a presence in 100 countries.
Our Support Is Broad

WWF has built a movement of nearly 6,000,000 people around the globe and 1,100,000 in the U.S.
We Focus on Protecting

1. Sustainable Production
2. Eliminate Waste
3. Sustainable Consumption
60% decrease in populations of mammals, birds, amphibians, fish, and other vertebrates between 1970 and 2014.

Source: WWF 2016 Living Planet Report
70% of biodiversity loss is due to food production

Source: Convention on Biological Diversity, CBD Technical Series No 79, 2014

Photo: earthnewsmedia.com
THE IMPACTS OF FOOD

24% of GHG emissions

Most chemical use

70% of freshwater use

90% of marine stocks fully exploited

50% of topsoil loss

Sources:
• Convention on Biological Diversity, CBD Technical Series No 79, 2014
• http://www.fao.org/3/y4252e/y4252e06.htm
• http://unfccc.int/files/cooperation_and_support/financial_mechanism/application/pdf/blaser.pdf
HOW DO WE ACHIEVE THEM ALL?

SUSTAINABLE DEVELOPMENT GOALS

2 ZERO HUNGER
15 LIFE ON LAND
14 LIFE BELOW WATER
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
Freeze
the footprint of food
Food Loss/Waste Strategy

1. Hospitality and Tourism
2. Restaurants and Food Service
3. Retail Grocery
4. Farms
5. Schools and Universities
Fresh tomatoes are the fourth most popular vegetable in the US after potatoes, lettuce, and onions.

California supplies nearly half of the fresh vegetable crop and more than 93% of processed peaches™.

The value of US lettuce production in 2015 totaled nearly $1.5 billion, making lettuce the leading vegetable crop in terms of value per unit production™.

Peaches are the leading vegetable crop in the US in terms of overall sales, making up 13% of the vegetable market™.

Romaine lettuce is cut, trimmed, and packed whole as hearts or heads. The romaine market is driven by the heads and the leaves and the small market for theRomaine lettuce is cut, trimmed, and packed whole as hearts or heads. The romaine market is driven by the heads and the leaves and the small market for the

The largest fresh tomato-producing states are California and Florida, which together account for the largest commercial supply of fresh tomatoes and the largest production by volume™.

Almost all lettuce is hand-harvested and field-packed for bulk sale or sent to a processing facility.

Peaches in California are harvested by hand; then mechanically by year five. In New Jersey, all peaches are harvested by hand.

Roughly 90% of US potatoes are planted in the spring and harvested mechanically in the fall.

Where do they go?

- About 90% of the domestic tomato market is sent for processing into tomato sauce, paste, and other value-added products while the remaining 10% is eaten fresh at home (70% of market) and at restaurants and other food service outlets (30%).
- About 50% of domestic peach production enters fresh market while the remaining 50% is sent for canning (15% of market), freezing (21%), or dehydration (13%).
- Nearly 60% of potato sales are to processors for French fries, chips, dehydrated potatoes and other potato products.
- All lettuce is marketed as a fresh product.
Fighting Food Waste in Hotels

1 HOSPITALITY / TOURISM
Hospitality Program Strategy

Prevent:
priority #1 is reduction

Donate:
what is not preventable

Divert:
everything that remains

TARGET - MEASURE - ACT
Designing FLW Out of the Food System
Questions and Answers
GROWING MORE WITH LESS: SMART TECHNOLOGY SOLUTIONS TO FEED ASIA

Faisal Hossain
University of Washington
January 29, 2020
AVERAGE WATER USE FOR CEREAL CROPS IN ASIA TODAY

China: 0.82 kg (food)/m³ of water

India: 0.39 kg (food)/m³ of water

Pakistan: 0.13 kg (food)/m³ of water


Foley et al., 2011 Solutions for a Cultivated Planet, Nature.
CAN WE GROW MORE WITH LESS?

Indus Basin Irrigation System – IBIS

- Lowest water use efficiency in Asia = 0.13 kg of food/m$^3$ of water
- The world’s largest surface water irrigation system.
- Operating since the early 1900s
- Centrally planned with large crop zones (~1000 sq km)
CAN WE GROW MORE WITH LESS?

Original design: One crop/year < surface water (=ok for 33.7 million people -1951)

Reality Today: 2.5 crops/year > surface water (=not ok for 198 million people - 2015)

Year-round farming = increased demand on Pakistan's water supply.
LET’S TALK ABOUT RICE FOR EXAMPLE

- 600 mm in Punjab (humid) province  1,400 mm in Sindh (dry) province

- Farmers apply 2,200 mm = tremendous water loss = groundwater decline = costlier pumping each year + loss of crop productivity
SO WHAT IS THE PROBLEM TO SOLVE?

How do we change farmers mindset (that they do not need to ‘irrigate’ that much)?

How do we make the solution **Affordable and Sustainable**?
THE SOLUTION?

ET: Evapotranspiration – crop water demand

Earth Observing Satellites
Observe Current/past Rainfall and Crop ET

Global Numerical Weather Prediction Model
Predict Current/Future Rainfall and Current/Future crop ET

Schematic for Global Atmospheric Model

Horizontal Grid (Latitude-Longitude)
Vertical Grid (Height or Pressure)

Irrigation if Demand > Supply
No irrigation if Demand < Supply

Demand: Crop ET
Supply: Rainfall or recent irrigation
BRINGING THE SOLUTION TO FARMERS

Forecast-based Advisory was added later and it was in highest demand.

Dear farmer friend, we would like to inform you that your wheat crop does not need irrigation due to sufficient rainfall during the past week.

Dear farmer friend, we would like to inform you that the irrigation need for your banana crop was 2 inches during the past week.

<table>
<thead>
<tr>
<th>Year</th>
<th>Farmers</th>
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<tbody>
<tr>
<td>2016</td>
<td>700</td>
</tr>
<tr>
<td>2017</td>
<td>10,000</td>
</tr>
<tr>
<td>2018</td>
<td>100,000</td>
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</tbody>
</table>
QUANTITATIVE IMPACT EVALUATION

2.5 km$^3$ a year (40%) saved per 100,000 farmers

[2.5 km$^3$; A large dam: 10-15 km$^3$]

80% usage rate among farmers

50-100% increase in farmer income
MEANWHILE IN NEIGHBORING INDIA……..

- 140 million farmers in India
- Most (65%) are marginal (plot size < 1 acre)

- Coarse resolution data (~10-25km) from satellites and weather models will not work

- Need finer resolution plot-scale crop/irrigation advisory (~1km-500m)

Image courtesy of Dr. Ryu, University of Melbourne
“Internet of Things” and Low Power Wide Area Network (LPWAN)

IoT compatible water level sensor – *Runs on 2 AA batteries for 2 years*

- Router for LPWAN – *Needs one solar panel*
- Collects data and pushes to cloud

IoT sensors
THE BIRTH OF PANI
Provision for Advisory on Necessary Irrigation
HOW AFFORDABLE IS PANI?

If 100 farmers live in 1 km² (average farmer density in rural India), setup cost per farmer = 5.00 USD/year

Note: Average Farmer income = 1200 USD/year (according to National Sample Survey Office – India)
FARMER FEEDBACK ON PANI

- LARGE Benefit: 26%
- SOME Benefit: 59%
- NO Benefit: 15%

A sample of the farmers during the pilot in 2018-2019 (still running)

- Average Wheat Yield: 4000 kg/ha - 5100 kg/ha with PANI
- Govt reported historical yield at the site: 2867 kg/ha
PANI EXPANSION IN BANGLADESH

PANI portal for Bangladesh (as of 01/27/20) at http://pani.hmrcweb.com
FARMER FEEDBACK OF PANI IN BANGLADESH

As of 12/12/19

Weather forecasts/irrigation advisory were particularly useful during cyclone Bulbul in 2019
TAKE HOME MESSAGES

- Freely available satellite earth observations and numerical weather models are low hanging solutions for growing more with less water in Asia.

- Feeding Asia = Empowering Marginal Farmers

- Technology that has precision and is smart does not have to be expensive.
ACKNOWLEDGEMENTS

- Stakeholder agencies - PCRWR, IITK, Geokno, Kritsnam, Bangladesh Water & Agriculture Ministries, HMRC, BARI, BWDB.
- UW students- Shahryar Ahmad, Nishan Biswas, Hisham Eldardiry, Claire Beveridge, Kensey Daly, Matt Bonnema, Safat Sikder, Indira Bose, Asif Mahmood.
- Collaborators/Volunteers - Ahmed Zeeshan, Naveed Iqbal, Faizan Ul Haque, Muhammad Ashraf, Bharat Lohani, Shivam Tripathi, Harsha Karumanchi, Soham Adla, Sandeep Goyal, Golam Mahboob, Nazmul Ahsan, Raihanul Haque and many more........
Questions and Answers
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Contact: Julie MacCartee
jmaccartee@usaid.gov
www.agrilinks.org

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