What is agriculture?

An answer from 10 years cooperation in Agroecology teaching and research between FAFU-NSAC

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Outline

Opening words:

The ‘Motivating Spring’ in 2004

What is agriculture?

Definitions, Technologies, Ideology and Disciplines

Agroecology paradigm: Toward the Low Carbon Agriculture
Opening words: the ‘Motivating Spring’ in 2004

AGRICULTURE

‘The science, art, politics and sociology of changing sunlight into healthy, happy people’.

---by Claude D. Caldwell, 1996

I met Dr. Caldwell in FAFU in the ‘Motivating Spring’ in 2004
Dr. Caldwell and Dr. Wang in FAFU agroecology Class for “2+2” NSAC-FAFU students in 2004
Transforming Canada-China Educational Cooperation: Significant Legacies and Future Challenges

Entitlements

In 2007, Agroecology was entitled as a Elite course by Fujian provincial government.
Entitlements

In 2009, Agroecology was entitled as a Demonstrating Bilingual Course by Chinese Ministry of Education, MOE.

Agroecology was entitled as a Demonstrating Bilingual Course by the Chinese Ministry of Education, MOE.

Serial number of the official documents from province and state respectively.
Teaching Awards from FAFU and Fujian Provincial Government

- First Prize, Constructing the bilingual teaching system in Agroecology under the Sino-Canada education cooperation, 2007 in FAFU
- First prize, The introduction, reframing and application of course-learning evaluation method for general course of Agronomics, 2009 in FAFU
- Grand prize, Building the bilingual teaching system in Agroecology under the international education cooperation, 2012 in FAFU
- First prize, Building the bilingual teaching system in Agroecology under the international education cooperation, 2013, Fujian Provincial Government
An open class of *Agroecology* was held at the Fujian Agriculture and Forestry University (FAFU) on March 15 by Dr. Claude Caldwell. More than one hundred teachers from 18 colleges attended this class jointly sponsored by the Overseas Education College together with the Registry Office of FAFU.

*Agroecology* is a national model course authorized by the Ministry of Education and Ministry of Finance in China. It is an introductory course with Canadian teaching methods from NSAC for the students of the FAFU-NSAC 2+2 program.

The open class was given by Dr. Claude Caldwell and Dr. Songliang Wang. Every teacher was greatly impressed with how Dr. Caldwell made his class lively and active. Many teachers think the model of the Agroecology course embodies the integration of two different teaching systems; the union of Chinese and Canadian methods is both very novel and attractive.
Textbook published
Opening words:

The ‘Motivating Spring’ in 2004

What is agriculture?

Definitions, Technologies, Ideology and Disciplines

Agroecology paradigm: Toward the Low Carbon Agriculture
Definitions: We are utilitarian…

AGRICULTURE

‘Science or practice of cultivating the soil and rearing animals’

-------Oxford Dictionary

‘The infrastructure of national economy, and main source of living, as well as industrial material for human beings’

----Chinese textbook of agronomy

…..there are more the same definition here and there!
But! WE FAILED TO RECOGNIZE...

- AGRICULTURE

‘As the basic interface between people and their environment’.
---Kenneth Dahlberg, 1979

“Existing at the interface between natural ecosystems and social system”
---Valentine, 2005
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Technologies: history review

- Domestication
- Farming systems
- Water management and mechanization
- New products
- New Genetic breeding
- Green Revolution
- External inputs
- what next? –biotechnologies or GMOs? Information engineering…..

-----more high-tech---more commercial ---more energy input -

--- more natural degradation----more Farmer poverty---more food
security & safety problems---less sustainability…..
Ideology: ‘AGRICULTURE’ HAS BEEN ‘WRONG’?

- Wrong beginnings
- Wrong goals
- Wrong focus
- Wrong time-frame

Green Revolution as a case: was it real green?
Wrong beginnings

- There is a general feeling that despite an important increase in the productivity of some important crops, greater yields and other negative effects could have been avoided if the emphasis had been placed upon the development of livelihood system strategies.
Wrong goals

- The understandable desire to increase grain yield blinded the system to other needs and led scientists to equate yield with nutrition; short-term gains with long-term stability; and yield improvement over farm improvement.
However, presently…

In the world

- About 1.00 billion people lack sufficient daily food ----hunger takes the lives of 2400 people everyday
- Micronutrient deficiencies affect 3 billion people ….
- 350 million people suffered from anemia ,200 millions in iodine deficiency, near 1 million in vitamin A deficiency (FAO)
Wrong focus

- Emphasizing plant genetics over almost everything else, exploiting “wild” species incorrectly for food security. The broader picture of livelihood systems, soil management, landscape, biodiversity are lost from the view and undermined from the start.
Agrobiodiversity loss

- <100 crops provide 95% of all food
- Three (rice, wheat and maize) provide 60%
- Since 1900 >90% of diversity of crops extinct (high of 98% of asparagus and low of 86% of apples)

Made Agroecosystem vulnerable: Irish Potato famine 1845
Diversity is everything!

For living we will lose life!
Wrong time-frame

- The specialization strategy focusing on single commodities and identifiable problems encourages "quick fix" technical solutions from agro-sciences for the short term, undermining in many cases the sustainability in the long term.
Resulting in food safety problems

Food safety dilemma in mainland China

Nothing worse than that!
Because of....

- Polluted soil
- Pesticide spray
- Dust particle precipitation
- Waste water irrigation
- Car emissions
- Synthesized fertilizers
- Trash as soil amendment
Who should be responsible for such wrong “agriculture”?

- Wrong definition
- Wrong Technologies
- Wrong Ideology

Education

- Disciplines
- Sciences
- Curriculum
- Teaching...
Disciplines (majors) in Chinese Agronomy college

- Crop cultivation
- Plant genetics and breeding
- Plant protection (pesticide)
- Soil sciences
- Plant nutrition (agrochemistry, fertilizer)
- Plant biotechnology (GMO)
- ...

“Farmer has problems and university has departments” (Lieblein & Francis, 2002), vice versa!
the Five Blind Men Guessing an Elephant

Where is elephant? Where is agriculture?

The blind men argued heatedly among themselves, but none of them knew what an elephant in reality looked like.
Outline

- Opening words:
  - The ‘Motivating Spring’ in 2004

- What is agriculture?
  - Definitions, Technologies, Ideology and Disciplines

- Agroecology paradigm: Toward the Low Carbon Agriculture
We need a new “AGRICULTURE”

- The science, art, politics and sociology of changing sunlight into happy, healthy people.

- “农业是把太阳光转变成人们健康、幸福生活的科学、艺术、政治学和社会学.”

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May 9-10, 2014, Tsinghua University, Beijing
NEW AGRICULTURE needs NEW paradigm in SCIENCE or DISCIPLINE

The triple bottom line for agricultural sciences
What would happen if there was no soil?

”Humans have been students of ecology as long as we have existed as a species”

(Brewster, 1994)
Agroecology: the marriage of agriculture and ecology
Agroecology: using interdisciplinary approaches
Agroecology: with Systematic (Multi-dimensional) thinking

The niche of agroecology, Wang, Caldwell & Kilyanek, 2005, unpublished data
Agroecology: a paradigm toward the Low Carbon Agriculture

Wang, Caldwell, Kilyannek, 2012
Greenhouse effect and human activities

Incoming solar radiation passes directly through the greenhouse gases.

Previously a balance:
- CO₂ from humans and animals = CO₂ taken in by trees
- O₂ given out by trees = O₂ used by humans and animals

Less heat escapes into space.

Outgoing radiation (heat) passes through greenhouse gases except infrared radiation which is either absorbed by greenhouse gases or 'trapped' beneath them.

Increase in greenhouse gases due to human activity.

More heat is trapped causing global warming.

Surface longwave reflection
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LCA

Agriculture: both Carbon sink and source (emission)
GHG emission from agriculture (Tg CO₂ equiv)

Gordon, 2008
Agriculture contributions to Green House Gas (GHG) emissions

- **Methane (CH₄)**
  - Source: Rice cultivation, livestock production, decay from landfills, mining
  - Average atmospheric residence time: 7-10 years
  - 21 x the warming potential of CO₂
  - Agriculture contributes globally 50%

*Gordon, 2008*
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A hog farm in southern Fujian, China
Whenever keep your soil covered
LCA strategy under agroecology paradigm: integrated farm management (IFM)
Agroecosystem management

Figure 21-5: A conceptual framework of Integrated Farm Management.
ICM: Agroforestry in China

Orchard in mid hill

Mixed forestry at top

Preserved forestry behind village

Animal + fruit

Terrace at bottom

骆世明，2007
IPM: integrated pest management

- Soybean Cyst Nematodes
- Plant Tissue Nutrients
- Pest Insects
- Beneficial Insects
- Plant Pathogens
- Grain Quality
- Weeds
- Economics
- Yields

Soil Quality: Chemical, Biological, Physical
利用紫苏驱虫

骆世明，2007
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骆世明，2007

Rice field ecosystem

+ fish 鱼类

weed and insect 杂草、昆虫

- fish trash 鱼粪

+ rice 水稻

Rice field ecosystem

+
Transforming Canada-China Educational Cooperation: Significant Legacies and Future Challenges

Luo, 2011, Ningxia University

May 9-10, 2014, Tsinghua University, Beijing
Educate consumers: Leading to the Low Carbon Consuming

- Eating the lower food chain: Should we feed grain to beef cattle or should we eat the grain?
Educate consumers: Leading to the Low Carbon Consuming

- Buying local
Transforming Canada-China Educational Cooperation: Significant Legacies and Future Challenges

The 100 meter diet
10,000 kilometre diet

Are they still organic?
Community Supported Agriculture

社区支持农业

Caldwell, 2008
Agreocology and CSA movement in Fuzhou
Dr. Claude Caldwell, Dr. Hanqiang Luo (from Taiwan University), Ms Shannon Kilyanek and Dr. Songliang Wang instruct CSA in Guanyuanli Community College, suburb of Fuzhou in Mar. 19, 2013.
Transforming Canada-China Educational Cooperation: Significant Legacies and Future Challenges

Discussion: Let’s rethink WTO and free trade in agricultural sector

• AGRICULTURE is not only economics but also ecology and politics!

The Economist Has No Clothes
Robert Nadeau,
《Scientific American》, Mar. 27, 2008
Case#1: A 50-years-old tree = 200 $?

Value of forestry
- Water & soil conservation;
- Climate & rainfall regulation;
- Protection of land from wind and desertification;
- Landscape beautification & pollution prevention;
- Living energy supply & source of fertility.

Value of a 50-year-old tree
- $312.00 for producing oxygen,
- $625.00 for preventing atmosphere pollution,
- $312.50 for conserving soil erosion and increasing fertility,
- $312.50 for water nurturance,
- $2500 for producing protein

Ecological: More than 10 thousand dollars

Economic: 200$
### Case#3: the value of China’s biodiversity

<table>
<thead>
<tr>
<th>价值类别</th>
<th>价值/(×10^{12}元)</th>
</tr>
</thead>
<tbody>
<tr>
<td>直接使用价值</td>
<td></td>
</tr>
<tr>
<td>产品及加工品年净价值</td>
<td>1.02</td>
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<tr>
<td>直接服务价值</td>
<td>0.78</td>
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<tr>
<td>小    计</td>
<td>1.80</td>
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<tr>
<td>间接使用价值</td>
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<tr>
<td>有机质生产价值</td>
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<tr>
<td>CO₂ 固定价值</td>
<td>3.27</td>
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<tr>
<td>O₂ 释放价值</td>
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<tr>
<td>营养物质循环和贮存价值</td>
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<tr>
<td>土壤保护价值</td>
<td>6.64</td>
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<td>涵养水源价值</td>
<td>0.27</td>
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<td>净化污染物价值</td>
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<td>小    计</td>
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<td>潜在使用价值</td>
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<td>选择使用价值</td>
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<td>保留使用价值</td>
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<tr>
<td>小    计</td>
<td>0.22</td>
</tr>
</tbody>
</table>

注：引自中国生物多样性国情研究报告，1998。

**Economics**

**Ecology**
Transforming Canada-China Educational Cooperation: Significant Legacies and Future Challenges

May 9-10, 2014, Tsinghua University, Beijing

Case#3: the true value of agroecosystem of Fujian Province of China (Zhu, 2011)

<table>
<thead>
<tr>
<th>Multi-functions</th>
<th>Economic value (× 10^8 Yuan)</th>
<th>In percentages (%)</th>
<th>Values per ha (yuan • hm^{-2})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing product value</td>
<td>1182.7400</td>
<td>5.203</td>
<td>9537.189</td>
</tr>
<tr>
<td>ecotourism</td>
<td>1125.000</td>
<td>4.949</td>
<td>9071.595</td>
</tr>
<tr>
<td>Art, educational and scientific value</td>
<td>331.2136</td>
<td>1.457</td>
<td>2670.787</td>
</tr>
<tr>
<td>Climate Regulating</td>
<td>1263.357</td>
<td>5.558</td>
<td>10187.251</td>
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<tr>
<td>Air Freshening</td>
<td>687.3346</td>
<td>3.024</td>
<td>5542.419</td>
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<tr>
<td>Water cleaning</td>
<td>2219.303</td>
<td>9.763</td>
<td>17895.659</td>
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<tr>
<td>Soil conservation</td>
<td>15862.056</td>
<td>69.779</td>
<td>127905.905</td>
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<tr>
<td>Resisting natural disaster</td>
<td>61.006</td>
<td>0.268</td>
<td>491.929</td>
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<tr>
<td>total</td>
<td>22732.001</td>
<td>100.000</td>
<td>183302.732</td>
</tr>
</tbody>
</table>
Co-published papers and book

Conclusion

Thank you!

- The science, art, politics and sociology of changing sunlight into happy, healthy people (CD Caldwell, 1996)

- 农业是把太阳光转变成人们健康、幸福生活的科学、艺术、政治学和社会学（王松良，2005）．