Jumping into the Future: How Leapfrog Technologies will Change Agriculture

February 19, 2014
Partnering for Innovation Goals

1. Grants for commercialization of proven technology.

2. Mission buy-in for technology or alliances in support of programs.

3. Identify and evaluate effective investment models.

4. Knowledge sharing of best practices and key lessons learned.
Technological Advances
Leapfrogging over landlines
Key Questions

• What is a leapfrog technology?
• What are examples of successful leapfrog technologies and how can we transfer them to agriculture?
• What leapfrog technologies are being prototyped for agriculture and what could the results be?

• What older technologies could have leapfrog potential in developing countries?
Speakers

Bob Rabatsky, Feed the Future Partnering for Innovation, Moderator

Thomas Campbell, Institute for Critical Technology and Applied Science (ICTAS), Virginia Tech

John Magnay, Opportunity International

Samir Ibrahim, SunCulture (K) Ltd
Dr. Thomas A. Campbell is associate director for outreach and research associate professor with the Institute for Critical Technology and Applied Science (ICTAS, http://www.ictas.vt.edu) at Virginia Tech, and a senior fellow (non-resident) with the Atlantic Council (http://www.atlanticcouncil.org). His research specializations are Future Trends—disruptive / emerging / converging technologies, national security, and grand challenges; and Advanced Materials—additive manufacturing / 3D printing, programmable matter, and nanomaterials.
Leapfrog Technologies & Opportunities in Agriculture

Thomas A. Campbell, Ph.D.
Associate Director for Outreach
Research Associate Professor
ICTAS Vision

To be a premier institute to advance transformative, interdisciplinary research for a sustainable future.

www.ictas.vt.edu
Act as a catalyst for transformative interdisciplinary research and an agent of innovation

Engage at the intersection of Engineering & Sciences—physical, life and social—and Humanities

Research modus operandi:

- Multidisciplinary
- Interdisciplinary
- Transdisciplinary
ICTAS Research Thrusts

- Sustainable Energy
- Nano-Bio Interface
- Nanoscale Science and Engineering
- Renewable Materials
- Cognition and Communication
- National Security
- Sustainable Water

Emerging Technologies:
- Innovation-based Manufacturing
- Discovery Analytics
- Humanoid Hospital
- Micro/Nano-Satellite Systems
- Additive Manufacturing (3D Printing)
- Bio-Inspired Science and Technology
- Nuclear Science & Engineering
How does one identify Disruptive Technologies?

- Embrace social media and follow technology leaders – [www.linkedin.com](http://www.linkedin.com), [www.twitter.com](http://www.twitter.com), etc.
- Read constantly and widely outside your original field of education – *Scientific American*, trade magazines, etc.
- Connect the dots between disciplines
- Think disruptively – How can “X” be done better, faster, cheaper, etc.?
- Volunteer to present, organize conferences, write think tank reports – become an influencer yourself
3D Printing

Fused Filament Fabrication

- Uses filament, typically plastic
- Nozzles are heated just above the melting temperature of the filament
- Material hardens immediately and bonds to the layer below

- Could basic items be 3D printed more cost effectively?
- Could 3D printing be a leapfrog technology for manufacturing?
Energy Harvesting - Vortex-Induced Vibration (VIV)

On-demand, robust harvesting of clean, renewable energy from tides and rivers through a unique oscillator-generator system.

- Sustainable power in rural and/or developing regions served by irrigation waterworks.
- Small to moderate power generation for micro-grid systems.
- Reliable reserve power for critical bridge and bridge-tunnel crossings.
Geothermal Energy Applications in Agriculture

Current Agricultural Energy Challenges:
• Grain Drying – low efficiency propane burners
• Greenhouses – low efficiency, fossil fuel-based heating elements

Solution
Conclusions

• Leapfrog technologies have the potential to save money and increase productivity in agriculture.

• Embracing leapfrog technologies requires a holistic approach – farmers must see the value and be provided the resources to implement any new technologies.

• Challenge is to facilitate widespread adoption of leapfrog technologies.
Thomas A. Campbell, Ph.D.
tomca@vt.edu
540-231-8359
John Magnay, Opportunity International’s Head of Agriculture, has spent more than 30 years as an input supplier, processing plant builder, and crop buyer through his agribusinesses. In 2001, he became founder and chairman of Uganda Grain Traders, Ltd, a consortium of grain traders that exported Uganda’s surplus maize to Zambia. Since 2002 he has been involved in establishing the building blocks for formal regional trade, including grain standards, warehouse receipts schemes, market information systems, and commodity exchange to improve the market signals and access to markets. Since 2008, he has been developing Rural Ag Finance with Opportunity with finance programs in five countries including Ghana, Rwanda, Uganda, Malawi, and Mozambique. New programs are starting in Tanzania, Kenya, and the Democratic Republic of the Congo in 2014.
Opportunity International: How Leapfrog Technologies will Change Agriculture
Opportunity International’s Footprint

- 5 million clients
- 45 financial institutions
- 22 countries
- 17,000 employees
- Strategic focus on key value chains
Opportunity International:

• Collaborates with key stakeholders across the value chain.

• Provides farmers with a range of financial services, agricultural training, and market access.

• Equips client farmers to move from subsistence to economically and commercially active farming.
• 5 countries to date
• Tanzania, Kenya & DR Congo
Start 2014
Coordinating with all stakeholders in the value chain is key to the success of the farmer.

Strength of the Rural Model equates to Reduction of Risk for Banks / MFIs
RURAL ACHIEVEMENTS

Opportunity International has:

- Disbursed **164,000** agricultural loans totaling more than **$35 million**
- Provided financing in **20** key crops
- Opened **618,000** rural savings accounts
- Piloted a branchless banking model for agricultural lending in the SAGCOT
AGRICULTURAL FINANCE – The Challenges

- Lack of organized farmer groups receiving technical support

- Project-based support services that disappear with the funding

- Lack of good household & farm data on clients

- High cost of delivery for Financial Services

- Challenges to monitor clients and staff
AGRICULTURAL FINANCE – 2013 Pilot

- Digital Data Capture using Tablets for Account Opening & Loan Processing
- Aggregated Mobile Money platform for Money in & Money Out using multiple telcos
- Village-based Extension Services partnering with Grameen Foundation CKWs
- Exchange of data with Strategic Partners
Branchless Banking in SAGCOT
Loan Disbursement to Clients and Suppliers via Mobile Money
Village-based Loans Officers
Repayment via Mobile Money
Providing Crop Insurance

The Future
- Partners capturing data and monitoring clients
- Coordination of Marketing through CKWs and Buyers
Thank You!
Samir Ibrahim

Samir is Managing Director of SunCulture. He graduated from New York University Stern School of Business’ program with a B.A. in finance and international business. After graduating, he worked in PricewaterhouseCoopers’ Financial Services, Structured Products, and Real Estate Group. He has also worked on a number of international development projects, including creating multi-million dollar budgets for non-profit programs.
83% of Kenyan arable land is unsuitable for rain fed agriculture, thus requiring irrigation systems.

Kenya has 5.4 million hectares of arable land.

83% is unsuitable for rain fed agriculture; this land requires irrigation.

But only 4% is under irrigation.

Source: FAO
SunCulture’s AgroSolar Irrigation Kit combines solar water pumping with drip irrigation.
The AgroSolar Irrigation Kit reduces recurring costs and increases crop yields

### Annual Cost of Production Per Acre (US $)

<table>
<thead>
<tr>
<th>Item</th>
<th>Costs with using a petrol pump and furrow irrigation</th>
<th>Costs with using the AgroSolar Irrigation Kit</th>
<th>Benefits by using the AgroSolar Irrigation Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>(1,035)</td>
<td>(537)</td>
<td>498</td>
</tr>
<tr>
<td>Fuel</td>
<td>(2,640)</td>
<td>0</td>
<td>2,640</td>
</tr>
<tr>
<td>Water pump maintenance</td>
<td>(27)</td>
<td>(9)</td>
<td>18</td>
</tr>
<tr>
<td>Chemicals</td>
<td>(1,260)</td>
<td>(1,116)</td>
<td>144</td>
</tr>
<tr>
<td>Revenue loss due to decreased yields</td>
<td>(10,674)</td>
<td>0</td>
<td>10,674</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>(15,636)</strong></td>
<td><strong>(1,662)</strong></td>
<td><strong>13,974</strong></td>
</tr>
</tbody>
</table>
A farmer using the AgroSolar Irrigation Kit can make up to US $43,680 per year on one acre.

### Annual Revenue Per Acre (US $)

<table>
<thead>
<tr>
<th>Crop Grown</th>
<th>Yield Per Acre (kg)</th>
<th>Maturity (days)</th>
<th>Price Per kg (US $)</th>
<th>Revenue Per Year (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kale</td>
<td>8,000</td>
<td>60</td>
<td>0.29</td>
<td>6,960</td>
</tr>
<tr>
<td>Carrot</td>
<td>22,000</td>
<td>105</td>
<td>0.16</td>
<td>10,560</td>
</tr>
<tr>
<td>Cabbage</td>
<td>20,000</td>
<td>75</td>
<td>0.37</td>
<td>22,200</td>
</tr>
<tr>
<td>Capsicum</td>
<td>20,000</td>
<td>90</td>
<td>0.47</td>
<td>28,200</td>
</tr>
<tr>
<td>Onion</td>
<td>23,000</td>
<td>90</td>
<td>0.52</td>
<td>35,880</td>
</tr>
<tr>
<td>Tomato</td>
<td>56,000</td>
<td>75</td>
<td>0.26</td>
<td>43,680</td>
</tr>
</tbody>
</table>

Source: MFarm
SunCulture improves smallholder farmer livelihoods and environmental sustainability

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>US $586,900</td>
<td>annual farmer cost savings and increased revenues</td>
</tr>
<tr>
<td>2.5 million KGs</td>
<td>fresh fruits and vegetables grown annually</td>
</tr>
<tr>
<td>4.1 million liters</td>
<td>water conserved annually</td>
</tr>
<tr>
<td>38,325 kWh</td>
<td>solar power produced annually</td>
</tr>
</tbody>
</table>
SunCulture streamlines a disconnected value chain for smallholder farmers

Traditional Farmers’ Value Chain
Inefficient and Disconnected

SunCulture Farmers’ Value Chain
Simple and Connected
SunCulture targets the 1 million Kenyan farmers with more than 5 acres of land.

SunCulture targets farmers with more than 5 acres because:

1. They have more disposable income, and are able to use their land as collateral for bank financing.

2. They grow fresh fruits and vegetables (FFV), which have high water requirements and must receive regular irrigation throughout the growing season.

3. FFV have revenue potential 30x greater than low value crops like maize.
SunCulture has the most affordable drip irrigation kits and solar pumping systems in Kenya

<table>
<thead>
<tr>
<th></th>
<th>SunCulture</th>
<th>Competitor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1/8 Acre Drip Irrigation Kit</strong></td>
<td>US $130</td>
<td>US $256</td>
</tr>
<tr>
<td><strong>1/4 Acre Drip Irrigation Kit</strong></td>
<td>US $272</td>
<td>US $430</td>
</tr>
<tr>
<td><strong>1/2 Acre Drip Irrigation Kit</strong></td>
<td>US $555</td>
<td>US $826</td>
</tr>
<tr>
<td><strong>1 Acre Drip Irrigation Kit</strong></td>
<td>US $1,060</td>
<td>US $1,453</td>
</tr>
<tr>
<td><strong>SP-300 Solar Pumping System</strong></td>
<td>US $2,550</td>
<td>N/A*</td>
</tr>
<tr>
<td><strong>SP-700 Solar Pumping System</strong></td>
<td>US $4,060</td>
<td>US $10,586</td>
</tr>
<tr>
<td><strong>SP-1400 Solar Pumping System</strong></td>
<td>US $6,965</td>
<td>US $17,795</td>
</tr>
</tbody>
</table>

*No other company on the market offers a small-scale solar water pumping solution.*
The company has sold 32 AgroSolar Irrigation Kits since May 2013

AgroSolar Irrigation Kits sold: **32**

Average installation size: **1 acre**

Average size of client farm: **5.4 acres**
Contacts

Web: www.SunCulture.com
Email: Team@SunCulture.com
Phone: +254 727 309 780
Mail: PO Box 76501-00508 Nairobi, Kenya

@SunCultureKenya
www.facebook.com/SunCultureKenya
Speakers

Bob Rabatsky, Feed the Future Partnering for Innovation, Moderator

John Magnay, Opportunity International

Thomas Campbell, Institute for Critical Technology and Applied Science (ICTAS), Virginia Tech

Samir Ibrahim, SunCulture (K) Ltd
Join our Online Community

• Check us out on LinkedIn, Facebook, and Twitter @FTF_PI

• Visit our web site for models, case studies, blogs, and other resources.

• Email us at: innovation@fintrac.com

www.partneringforinnovation.org