Computing and the Developing World
CSEP 590B, Spring 2008
Lecture 5 – ICT and Agriculture
Richard Anderson

Administration

• LUMS Holiday, May 1
• Schedule Shuffle
  – Apr 30, Agriculture
  – May 7, Handheld devices and Medicine
  – Brian DeRenzi
  – May 12, Open Source software
  – Neal Lesh
  – May 21, Education
  – May 28, Data Collection
  – Tapan Parikh
  – June 4, Non-literate UIs

Highlights from Lecture 4

• Umar Saif
  – umar@lums.edu.pk, umar@mit.edu
  – dritte.org
• Internet realities
  – Many considerations very different from US
• Content distribution problem
• Offline internet browsing
• Inverse multiplexing on cellular networks
• Teleputer

Tonight

• Agricultural Markets
  – Robert Jensen
• SMS Applications
  – Warana Unwired
  – Survey of other agricultural projects
• Digital Green

Warana Unwired

• High profile kiosk project to support agriculture
• After 7 years, the project had only achieved a fraction of its goals and had very high maintenance cost
• Main application was replaced by a cell phone/SMS application
Warana Sugar Cooperative

• At harvest, farmers send sugar cane to cooperative for processing
• Farmers receive reports of the amount of sugar cane processed by factory
• Before kiosk project:
  – Farmers visit central processing office
• After kiosk project:
  – Farmers visit kiosk office
  – Kiosk operator places request
  – After one or two days, farmer gets report

Warana: Cell Phone Solution

• Low cost mobile phone at the kiosk
• Smart phone running server at processing plant
  – Messages translated into DB query
  – "TON 123456 0807"
  – Answer sent back to calling phone
• Farmers would have kiosk operator place the text message
• Set up as experiment to evaluate cell phone against the PC

SMS Applications (Homework 3)

<table>
<thead>
<tr>
<th>Country</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain</td>
<td>Domain</td>
</tr>
<tr>
<td>Problem</td>
<td>Problem</td>
</tr>
</tbody>
</table>

Key ideas for SMS Applications

1. 

2. 

3. 

Markets and Development

• The key for solving rural poverty is greater agricultural income
• Improved markets are necessary for increasing income

Market Price Info

• Agricultural wholesale markets can have large price swings during the day
• Transportation costs and perishability limit producer options
• Advance notice of price information
  – Decision which market to use
  – Decision whether to bring goods to market
  – Decision whether to harvest
• Is there any evidence that this information actually is of value?
Robert Jensen

- Study of wholesale prices of fish markets in Kerala
- Data covered the time period when cellular coverage was introduced

Main result

Why did prices stabilize?

Importance of Agricultural Output Markets

- Significant portion of the worlds poor are in agriculture, fisheries, forestry
- Functioning of Markets important for well being of the poor
- Markets
  - coordinate dispersed consumers and producers
  - price coordinates allocation of goods
- Fundamental theorem of welfare economics
  - “Law of one price”

Information and Market Functioning

- Sigler, Economics of Information
  - Costly search for information leads to price dispersion
  - Especially if infrastructure is poor and markets are dispersed
- Without information, no reason to assume markets are efficient
  - Consumers, Producers, Intermediaries don't adjust to scarcity
- Price dispersion reflects inefficiency. Improved information might improve efficiency and help the poor.

Information for Fishermen
Welfare Economics

- Welfare theory argues for a net gain for producers and consumers
- Gains depend on the shape of the curve
  - Price elasticities
- Reduction in waste potentially benefits both groups
- Impact of reduced price variability on consumers not clear

Mackerel Economics

Economics

- Beach Market Survey (N=15, 15 km apart)
  - Every Tuesday, 7-8 am, 1996-2001
  - All transactions
- Fisherman Survey (weekly, N=15*20)
- Fishing village survey (monthly, N = 15)
- Consumer price survey (weekly, N = 15)

Study

Cell phone adoption

- Fishermen quickly adopted cell phones as they became available
- Fishermen would contact a large number of buyers while at sea
- Other benefits of cell phones for fishermen documented by Abraham (ICTD 2006)

Conclusions (Jensen)

- Poor information limits functioning of markets
- Information makes markets work, and markets help the poor
  - It’s the I, not the T
- Fishing in Kerala probably not a special case
- This was not a development project
  - People figured it out on their own
SMS (Short Message Service)

- Protocol for text messages on GSM phones
  - 1120 bit messages
    - 160 7-bit, 140 8-bit, 70 16-bit characters

SMS Costs worldwide

<table>
<thead>
<tr>
<th>Country</th>
<th>SMS Cost, Local</th>
<th>SMS Cost USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>$0.10</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>50 paisa</td>
<td>$0.008</td>
</tr>
<tr>
<td>India</td>
<td>10 paisa</td>
<td>$0.0025</td>
</tr>
<tr>
<td>China</td>
<td>0.15 yuan</td>
<td>$0.02</td>
</tr>
<tr>
<td>South Korea</td>
<td>10 won</td>
<td>$0.01</td>
</tr>
<tr>
<td>Namibia</td>
<td>0.40 NAD</td>
<td>$0.05</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1 taka</td>
<td>$0.015</td>
</tr>
<tr>
<td>Philippines</td>
<td>1 peso</td>
<td>$0.02</td>
</tr>
<tr>
<td>Cambodia</td>
<td>150 riel</td>
<td>$0.03</td>
</tr>
<tr>
<td>Bhutan</td>
<td>1 nu</td>
<td>$0.025</td>
</tr>
<tr>
<td>Botswana</td>
<td>0.40 pula</td>
<td>$0.06</td>
</tr>
</tbody>
</table>

Smart phone vs. Dumb Phone

- Should ICTD work target "Smart Phones" or "Dumb Phones".
- Why?

Warana Wired Village (1998)

- Case study of a failed kiosk project
- Very ambitious goals
- Funding split:
  - Central: 50%, State: 40%, 10% Cooperative
- 54 to 70 Village Kiosks
- Setup
  - Concrete building
  - PC (Pentium, Win95), UPS, Printer
  - Landline, 10 kbps connection

Planned applications

- Warana on the Internet
- Database of farmer statistics
- GIS of 70 villages
- Local language interface
- Land record computerization
- Intranet site about crop pests
- Agricultural price info
- Personalized sugarcane information
- Internet connectivity

Warana Experiment

- Question: can the Kiosk functions be replaced by SMS.
- Method: have Kiosk operators use cell phones instead of the PC. Other operations remained the same.
- Issues:
  - Physical space: kiosks and computers left in place
  - Printouts: handwritten and stamped receipts given by kiosk operator
  - Security and privacy: not a worry for the farmers. Access restricted to registered phones
Warana Results: Cost Savings

• Compared to what?
  – Existing PC System
  – New PC System
  – Mobile SMS with Kiosk
  – Mobile SMS without Kiosk
  – GPRS with Kiosk
  – GPRS without Kiosk

Study results

• 7 village pilot
• Training of kiosk operators on SMS system
• Usage comparable to kiosk
• Query time: 2 minutes
• Favorable response from farmers
  – Requests to expand the pilot
  – Use from phones outside of kiosks

Other SMS based projects

Zambian National Farmers Union

• ZNFU
• http://www.farmprices.co.zm/prices.php

Market Price Queries

tradenet.biz

• Agricultural trading in West Africa
• Primarily web based, but supports SMS notifications
www.dam.gov.bd

- Web portal with price information for agricultural commodities in Bangladesh

Why things fail literature

- Richard Heeks
  - Information systems and developing countries: Failure, Success, and Local Improvisation

Failures

- What percentage of startup companies fail?
- Leading cause of failure ____________________________

- What percentage of IT projects fail?
- Leading cause of failure ____________________________

Design-Actuality Gaps

- Components from the designers’ own context
- Conceived assumptions about the situation of the user

- “Information systems per se have a tendency to be designed according to models of rationality”

Hard vs. Soft Models

<table>
<thead>
<tr>
<th>Dimension</th>
<th>“Hard” rational design</th>
<th>“Soft” political actuality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>Standardized, formal, quantitative information</td>
<td>Contingent, informal, qualitative</td>
</tr>
<tr>
<td>Technology</td>
<td>Simple enabling mechanism</td>
<td>Complex, value-laden, status-symbol</td>
</tr>
<tr>
<td>Process</td>
<td>Stable, formal; outcomes as optimal solutions</td>
<td>Flexible, complex, constrained, informal</td>
</tr>
<tr>
<td>Objectives and values</td>
<td>Formal organizational objectives</td>
<td>Multiple, informal, personal objectives</td>
</tr>
<tr>
<td>Staffing and management</td>
<td>Staff viewed as rational beings</td>
<td>Staff viewed as political beings</td>
</tr>
<tr>
<td>Management systems and structures</td>
<td>Formal, objective processes</td>
<td>Informal, subjective processes</td>
</tr>
<tr>
<td>Other resources: time and money</td>
<td>Used to achieve organizational ends</td>
<td>Used to achieve personal ends</td>
</tr>
</tbody>
</table>

KACE: Kenya Agricultural Commodity Exchange

- Private sector firm collecting and distributing market information to smallholder farmers
- Market information to help small holder farmers
  - Reduce power of middleman
  - Marketplace arbitrage
- Exchange of goods through offers to buy and sell
KACE MIS

- Rural market based Market Information Points (MIPs)
- District-level Market Information Centers (MICs)
- Mobile Phone Short Messaging Service (SMS)
- Interactive voice Response (IVR) service
- Internet based database system
- Mass media (radio)

Mobile Phone

- Branded service with Safaricom
  - 7 Ksh per message ($0.10)
- Simple SMS interface
- Prices updated daily
- Separate voicemail system
  - Pre-recorded in English and Kiswahili
  - Menu based
  - 20 Ksh

Status

- 2004 – 2 MICs, 11 MIPs
- Support from foundations
  - USAID, Rockefeller, etc.
  - Long term model – user fees, revenue sharing with phone companies
- Moderate SMS, and website use
  - End of study an upswing in Voice use
- Possible improvements in market conditions

Mobile phone based market information systems

- How important do you expect these to be?

<table>
<thead>
<tr>
<th>Importance</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worse than useless</td>
<td>Minor niche applications</td>
</tr>
<tr>
<td>No impact</td>
<td>Moderate: multiple locales and crops</td>
</tr>
<tr>
<td>Significant widespread use</td>
<td>Revolutionary: Will change agriculture</td>
</tr>
</tbody>
</table>

Digital Green

- Microsoft Research India Project
- Mediated Video to promote agricultural practices
  - Locally produced video
  - Mediated by villagers

Small holder farmers

- Vast majority of rural poor are farmers
- Farms are generally very small
  - Total production limits possible income
- Many farmers have limited access to inputs
  - Seed
  - Fertilizer
  - Water
- Farmers squeezed by debt and reduced land
Agricultural Productivity

- Underlying assumption
  - Farm productivity (and sustainability) can be improved through introduction of new agricultural practices
- Traditional agricultural extension
  - Training & Visit
  - 100,000 extension offers in India
  - Extension office salary: Rs. 4,000 per month

Extension Problem

- Disseminate agricultural knowledge
- Promote practices that increase yields and preserve environment

<table>
<thead>
<tr>
<th>Main source of Agricultural Information</th>
<th>% farm households (n = 51,770)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other farmers</td>
<td>17%</td>
</tr>
<tr>
<td>Salesmen</td>
<td>14%</td>
</tr>
<tr>
<td>Radio</td>
<td>14%</td>
</tr>
<tr>
<td>Television</td>
<td>9%</td>
</tr>
<tr>
<td>Newspaper</td>
<td>7%</td>
</tr>
<tr>
<td>Extension worker</td>
<td>6%</td>
</tr>
<tr>
<td>Cooperative</td>
<td>3%</td>
</tr>
<tr>
<td>Buyer</td>
<td>2%</td>
</tr>
<tr>
<td>Government</td>
<td>2%</td>
</tr>
<tr>
<td>Other</td>
<td>8%</td>
</tr>
</tbody>
</table>

Digital Green Project

- **Green**: NGO Promoting sustainable agricultural practices
- **Digital Green**: Collaboration between MSRI and Green using facilitated Video
- Phase I
  - Figure it out
- Phase II
  - Evaluation
- Phase III
  - Scale and spin out

Basic Ideas

- Video record farmers implementing practices
- Extension worker appears in video with local farmers
- Video replay done in public setting with a mediator
- Pay close attention to costs
- Build archive of agricultural video material
  - digitalgreen.org
- Digital video is the enabling technology

Example topic: Azolla cultivation

Azolla: Aquatic fern that can be used to augment animal feed

1. Dig a hole in the ground
2. Line with plastic tarp
3. Secure tarp
4. Add some cow dung and cow urine
5. Add some Azolla
6. Wait a few weeks
7. Harvest

Parameters

- Mediated vs. non-mediated
- Mediator skill level
- Video participants
  - Facilitator
  - Farmer
- Themes
- Screening locations
Evaluation

• Experimental study
  – 9 month study
  – 8 villages (Digital Green)
  – 8 control villages (Green extension workers)
• Digital Green
  – TV + DVD Player per village (USD $225)
  – Mediator: 3 sessions per week
    • USD $38 per month honorarium
  – 150 local language videos
  – 500 screenings
  – 1000 farmers participated

Results

• Participation
• Surveys
• Adoption
  – 280 farmers per month attended a screening
  – Approximately half expressed interest in adopting practices
  – Between 9% and 26% implemented a practice
• Main result: four month study
  – In Control 8% adopted at least one practice
  – In DSH 55% adopted at least one practice

Key aspects of Digital Green

• Sustained local presence
• Mediation
• Repetition (and novelty)
• Integration into existing extension operations
• Social homophily between mediator, actor, and farmer
• Desire to be “on TV”
• Trust built from identities of farmers and villages in videos

Poster Green

• Same as Digital Green, with local mediator, but no TV/DVD
• Mediator makes posters and holds regular group sessions

Cost per adoption

<table>
<thead>
<tr>
<th>System</th>
<th>Cost (USD) / village / year</th>
<th>Adoption (%) Village/Year</th>
<th>Cost / Adoption (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classical Green</td>
<td>$840</td>
<td>11%</td>
<td>$38.18</td>
</tr>
<tr>
<td>Digital Green</td>
<td>$630</td>
<td>85%</td>
<td>$3.70</td>
</tr>
<tr>
<td>Poster Green</td>
<td>$490</td>
<td>59%</td>
<td>$4.14</td>
</tr>
</tbody>
</table>

DigitalStar

• List two other potential applications of the DigitalGreen methodology
  •
  •
Lecture summary

- Importance of Markets
  - Jensen, Sardine fishing in Kerala
- SMS based applications
  - Agricultural queries for sugar processing
- Other agricultural deployments unclear
- Digital Green: Mediated Video