Cross-Cutting Initiatives:

Watershed Modeling and Assessment

C. Heatwole, Virginia Tech

Linking Knowledge and Action

E. Mwangi, Harvard/CIFOR

Assessing and Managing Soil Quality

P. Motavalli, Univ. of Missouri

Gendered Access to Markets

M. E. Christie, Virginia Tech

Soil Metagenomics

K. Garrett, Kansas State

SANREM CRSP

CENTER for WATERSHED STUDIES at VIRGINIA TECH

SANREM CRSP

SANREM-CRSP 2009 Annual Meeting

Falls Church, Virginia

Watershed Modeling and Assessment

Conrad Heatwole

Center for Watershed Studies

Biological Systems Engineering

Virginia Tech, Blacksburg

VirginiaTech

USAID FROM THE AMERICAN PEOPLE

Objectives

1. Support natural resource management at a watershed and regional scale using geospatial imagery and analysis.
2. Assess the impacts of climate variation and land use practices on agricultural sustainability and natural resource management at a watershed scale.
3. Evaluate the accuracy and value of low-cost community-based monitoring of watershed hydrology.

Summary of activities

Watersheds (9) in Bolivia, Ecuador, Zambia, Philippines

- Base satellite imagery acquired for 8 project areas
- 22 stream gauging stations (pressure sensors and staff gauge) installed
- 8 weather stations, 17 recording rain gauges
- Water samples for sediment analysis
- Plot study in Bolivia – runoff / erosion / nutrients
- Training on flow monitoring using the salinity tracer method and flow meter for project teams
- Watershed modeling workshops (LTRA-2,3)
- Imagery and modeling analysis of watersheds
- Model development and testing (Zambia, Bolivia)

Watershed Modeling and Assessment
Lessons learned

1. Low-cost monitoring can work
   - Provides valuable data
   - Opportunity for community education
2. Community involvement is important
   - Supports the research / assessment needs
   - Instills understanding and ownership of NR
3. Analysis tools (imagery, models) have wide application and value
4. We have more to learn

Watershed Modeling and Assessment
Lessons learned

1. Low-cost monitoring can provide valuable data
   - Stream flow
   - Weather
   - Sediment analysis

Weather and Rainfall

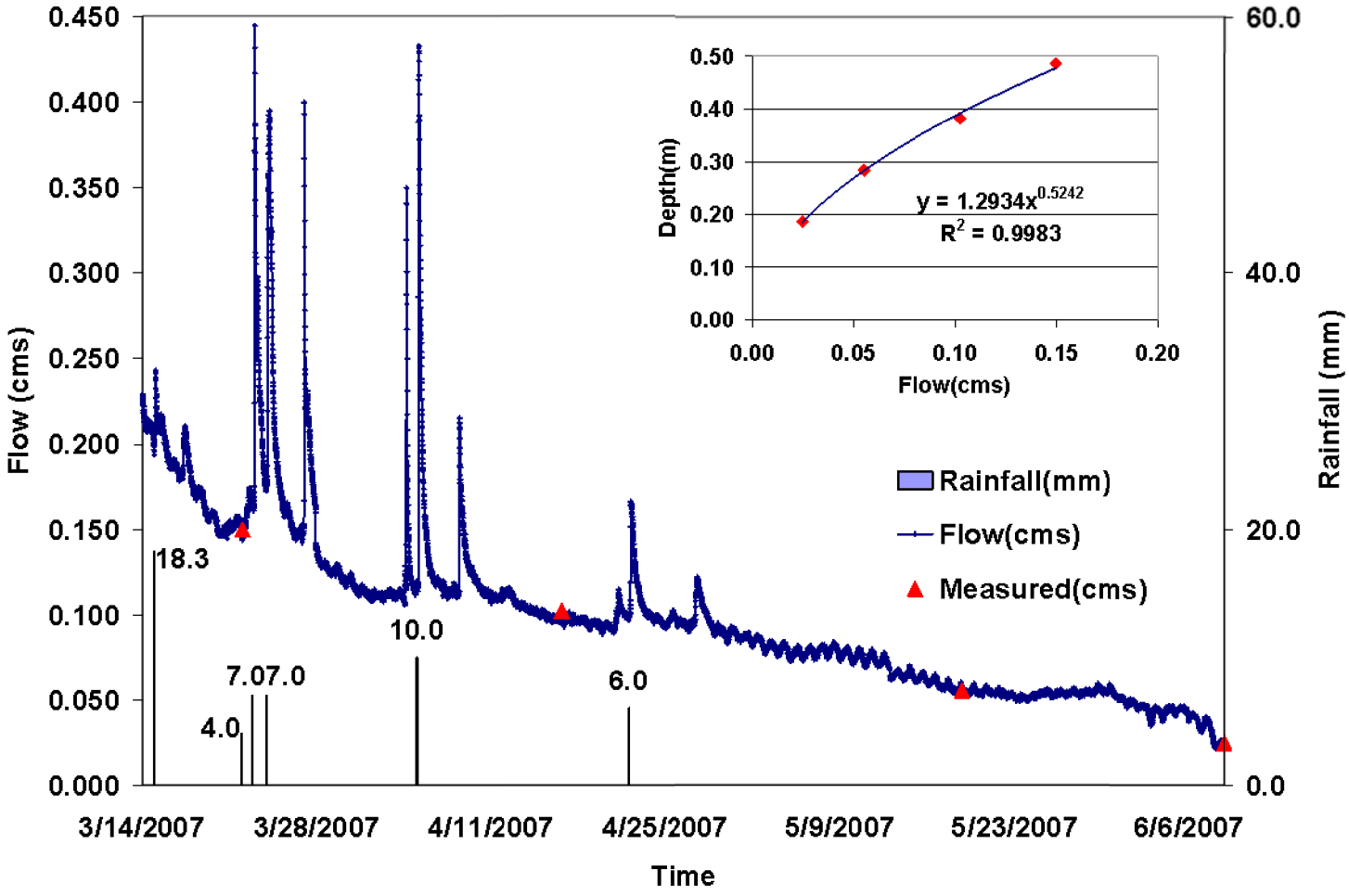
- Rainfall is spatially variable so a dense raingage network needed
- Weather stations & recording raingages
- Manual observations by farmers, and community collaborators

Stream Flow Measurement

- Water depth
  - Staff gage readings (daily) by local observer
  - Pressure sensor records depth eve 15 min
- Flow rate for stage/discharge relationship
  - Cross-section and velocity using flow meter
  - Velocity using float and stopwatch

Kamwamphula River

(preliminary data)



Sediment analysis of water samples

Watershed Modeling and Assessment Lessons learned

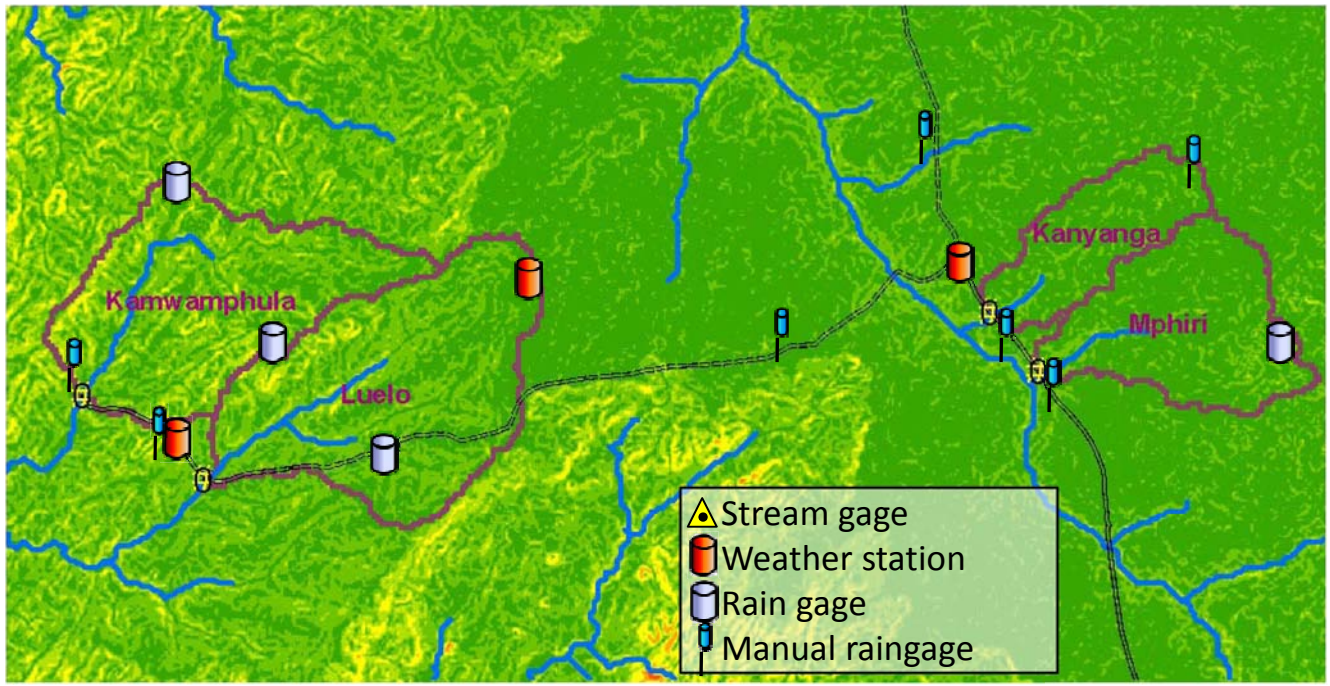
2a. Involvement instills understanding and ownership of community NR

Watershed Modeling and Assessment Lessons learned

2b. Community involvement benefits research

- Data to verify instrument readings
- Supplement and extend density of data network

- Reduces loss/destruction of instruments



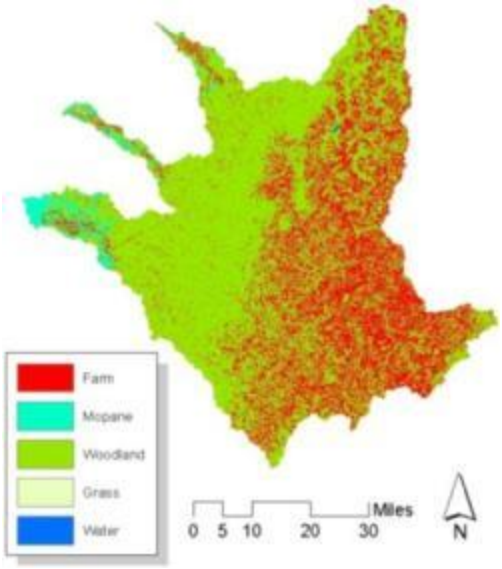
Watershed Modeling and Assessment Lessons learned

3. Analysis tools (imagery, models) have wide application and value

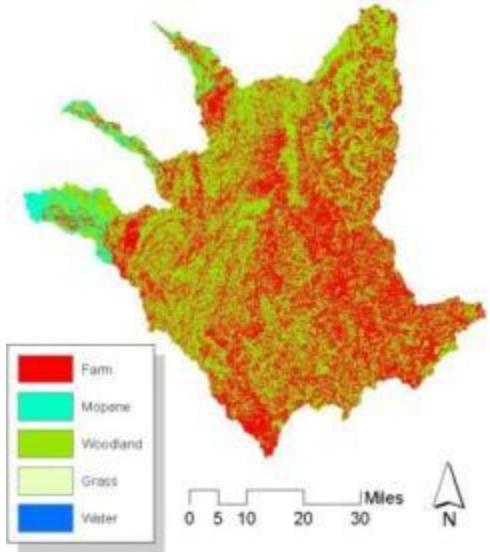
- Model for field-scale analysis of nutrient management in potato production systems in Bolivian Andes
  - Application: evaluate nutrient and management alternatives to improve productivity and economics
- Evaluating models of hydrology of dambo-influenced watersheds in Zambia
  - Application: how can dambos be used while protecting the hydrologic function in the landscape

Modeling Analysis – 3 Scenarios

- Current (2002) land use
- Scenario1 – “Native” – all forest (no cropland)
- Scenario2 – Expanded cropland in forest area
  - Assumes hill region with slopes < 4% are cleared for crops

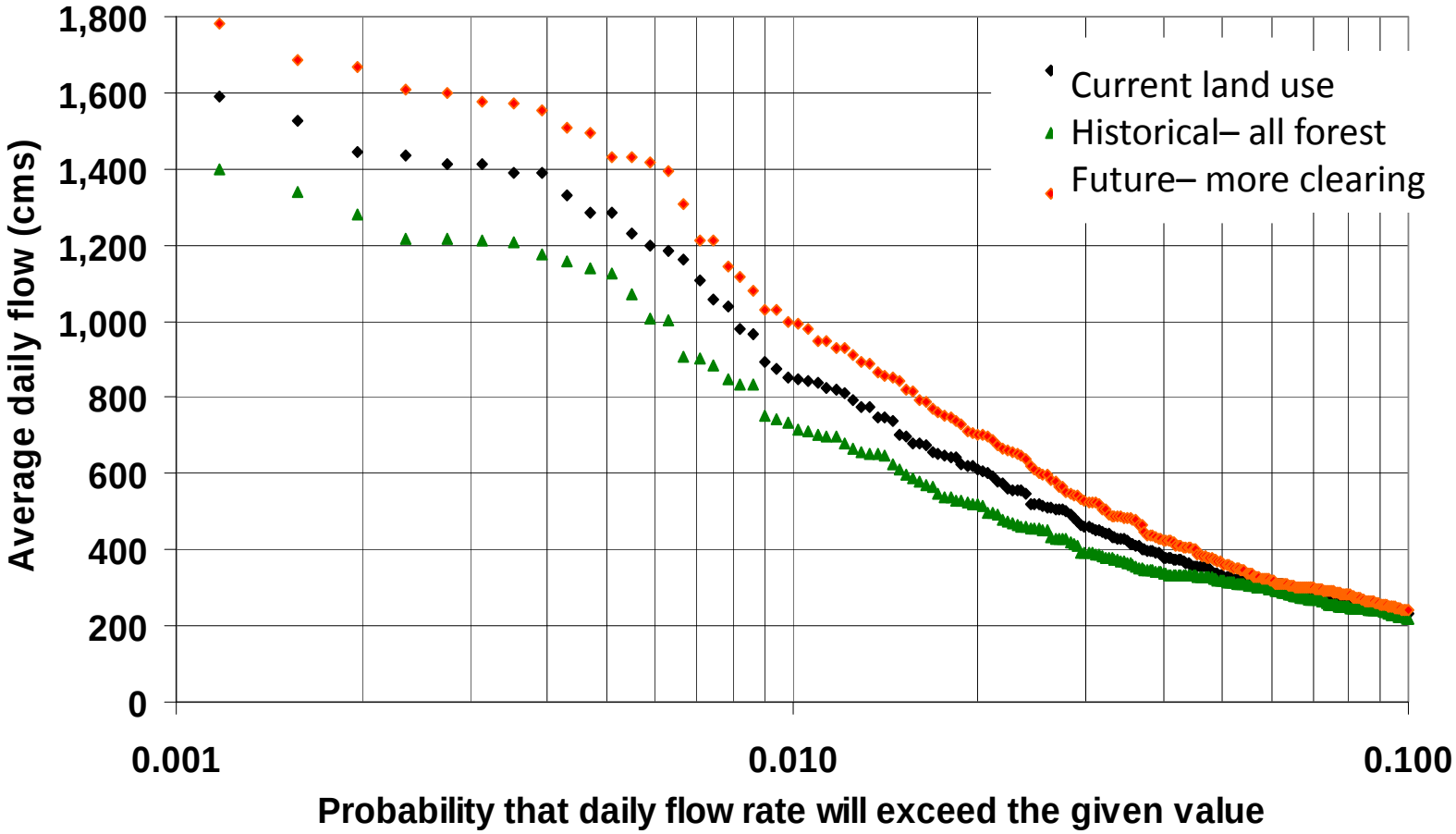


Current (2002)



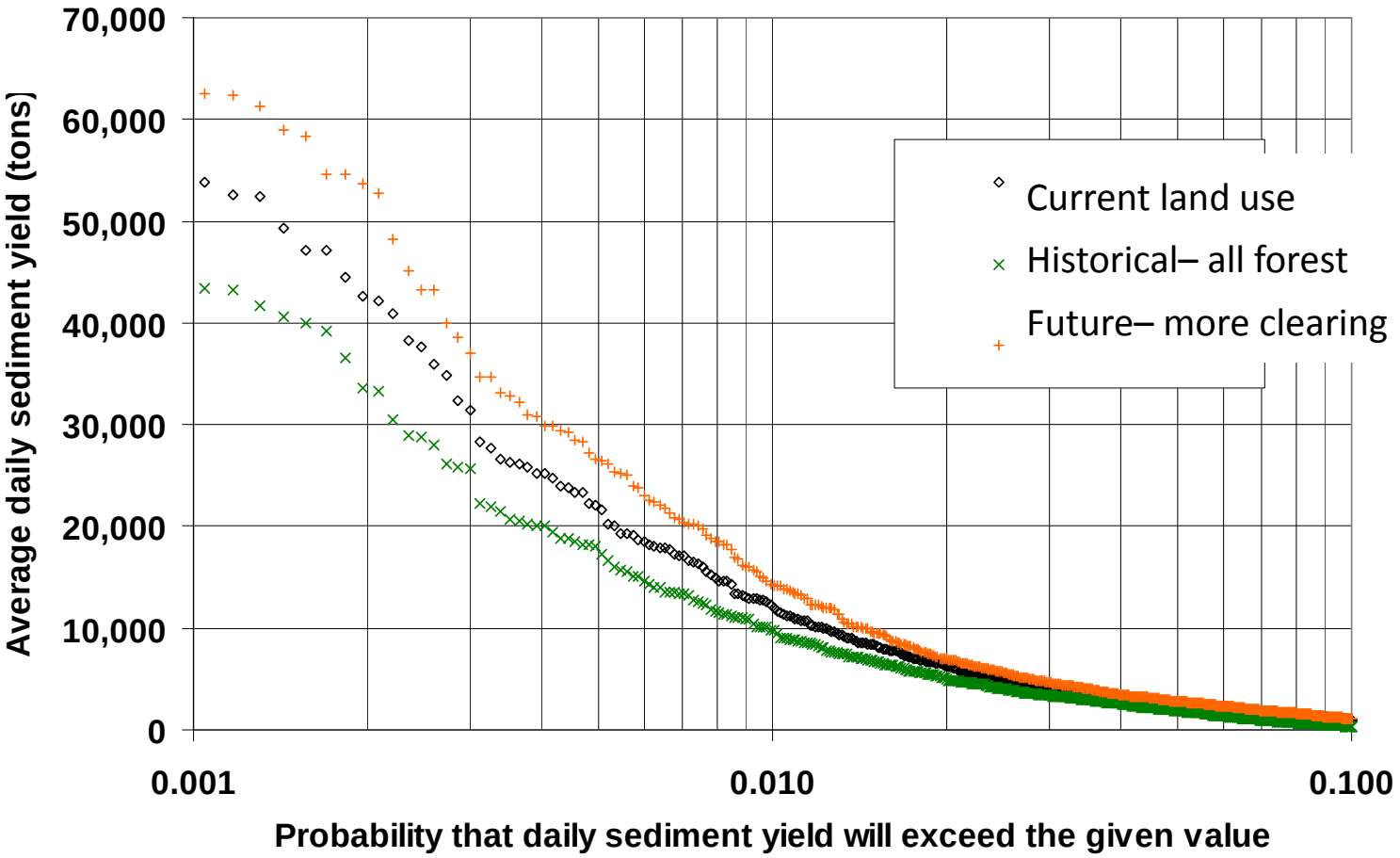
Future (Scenario 2)

Modeling Results – High Flows



- *Key points….*
  - *High flows (flooding) occurs for any land use, but*
  - *Flooding is more frequent and higher with increased clearing of forest*

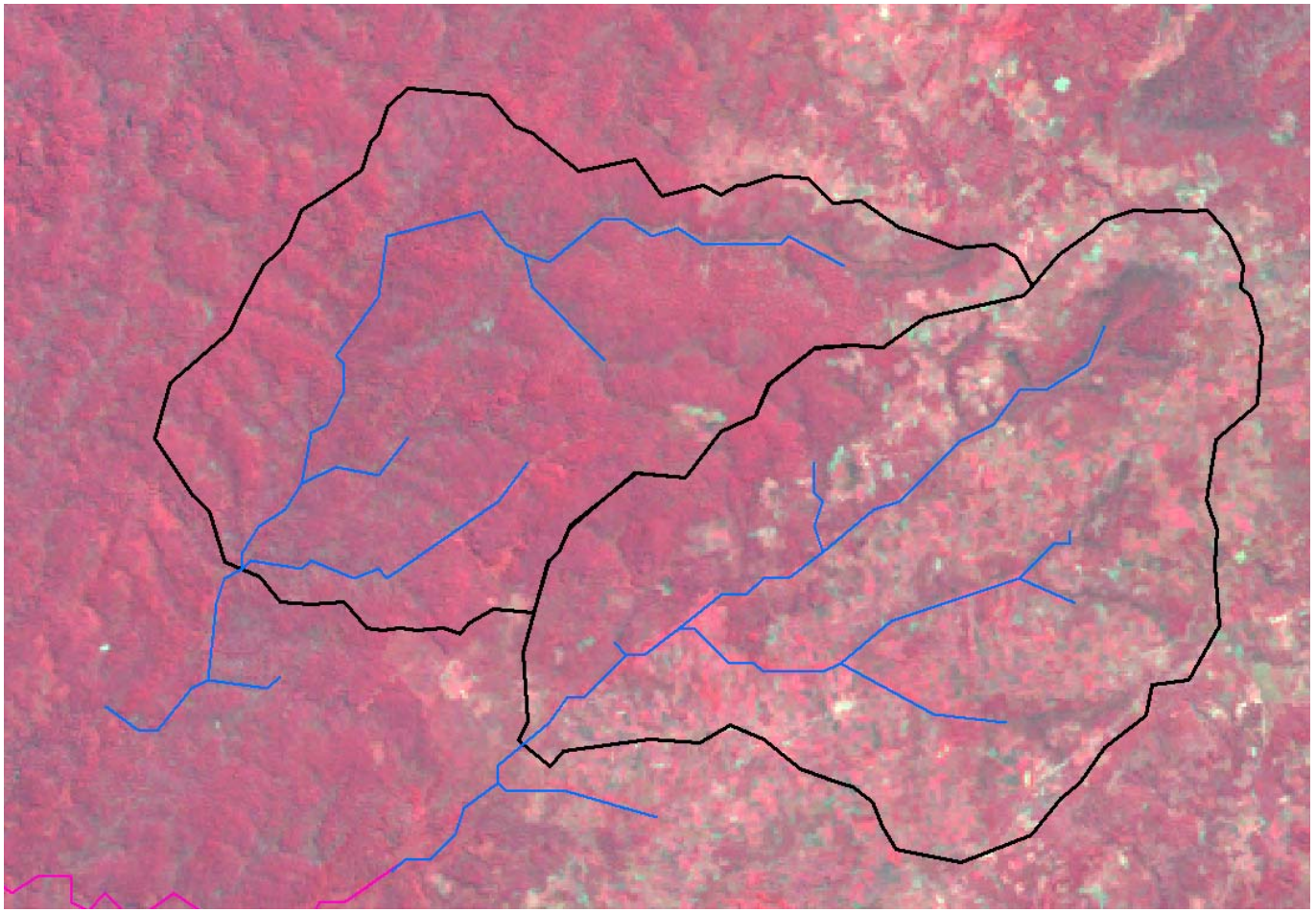
Modeling Analysis - Sediment



- *Key point….As with high flows, sediment loads will be higher and occur more frequently as clearing of forest increases.*

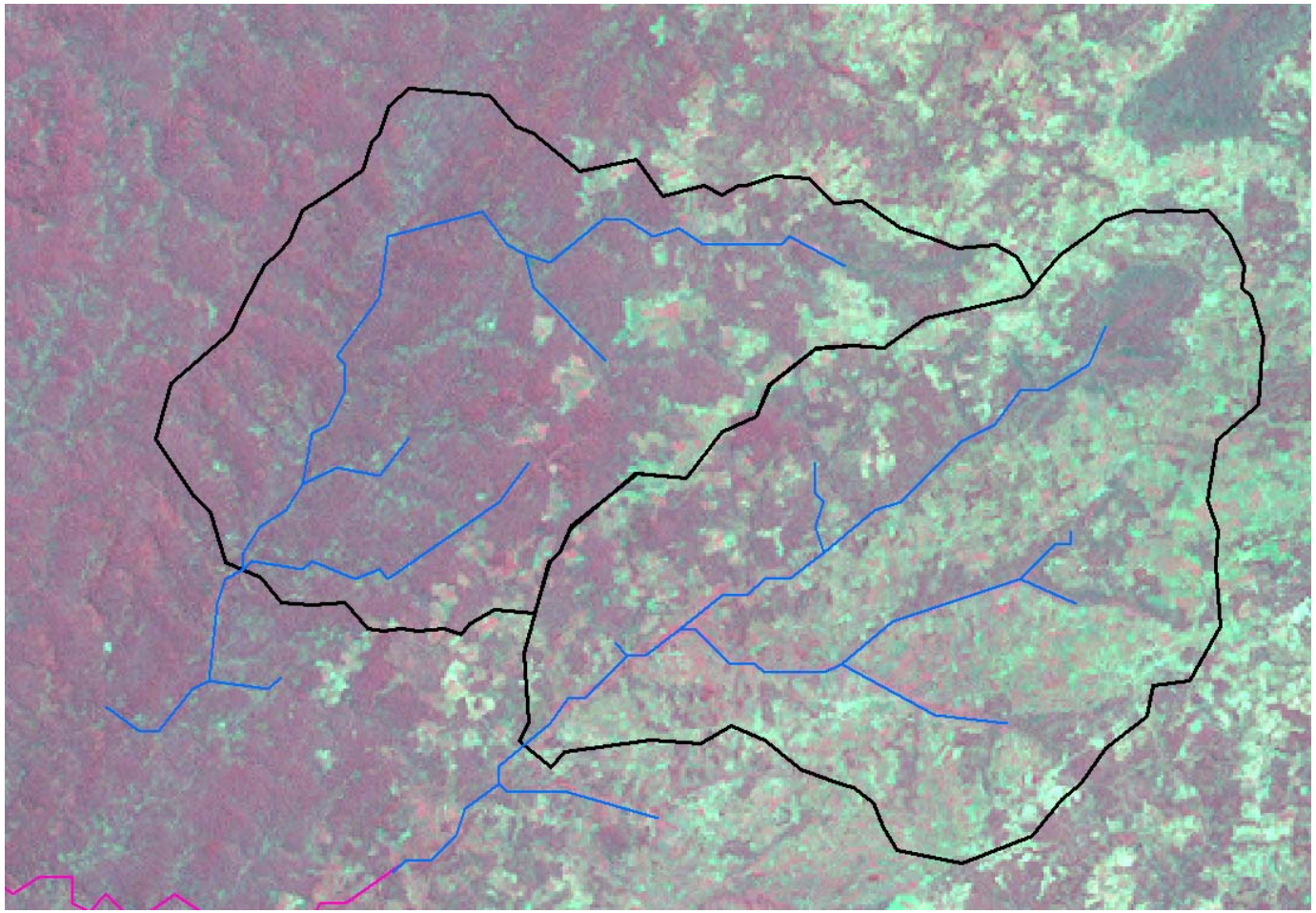
Cropland expansion 1989-2007

1989
Landsat



Cropland expansion 1989-2007

2002
Landsat



Watershed Modeling and Assessment
Lessons learned

4. We have a lot to learn … more research needed
   - Assumptions and 'common sense' are sometime wrong
     - Bolivia plot study - highlands
       - higher runoff from native range vs. tilled/fallow
     - Watershed observations in Zambia
       - higher runoff from forest than expected
     - Watershed observations – Zambia, Philippines, Brazil
       - Is runoff and erosion / sediment from agriculture?

- Roads are a significant source of runoff and sediment
- Road contribution is poorly quantified and not regularly considered in watershed analysis

Watershed Modeling and Assessment Lessons learned

1. Low-cost monitoring can work
2. Community involvement is important
3. Analysis tools (imagery, models) have wide application and value
4. We have more to learn

Thank you !

Conrad Heatwole – Virginia Tech

Thanks

Cross-Cutting Initiative:

Linking Knowledge and Action

Esther Mwangi, Harvard University/Center for International Forestry Research

Long-term Research Activity Partners

Decentralization Reforms and Property Rights – E. Ostrom

Watershed-based Natural Resource Management for Small-scale Agriculture – J. Alwang

Practices and Strategies for Vulnerable Agro-ecosystems – C. Valdivia

Agroforestry and Sustainable Vegetable Production – M. Reyes

Research questions

1. **What strategies** have the research projects used to try and link their research to policy makers and resource users? Have those strategies been effective? Why/why not?

2. **Who are the participants/actors** in the research-action arena? Who is included/excluded and why? How might who participates influence outcomes?

3. How do participants in the research-action arena think about research? **Do they value research**, for what purposes? How do they envisage it may help or hinder them in their daily work?

4. **What factors influence learning** by participants in the resource action arena? What constraints do they face? What factors influence their actions and priorities?

SANREM CRSP

Research questions

5. How **have resource users and policy makers used research** findings from these projects in their daily lives and strategic planning. What institutional and other constraints have they faced?

6. What **kinds of knowledge systems** lead to more action and policy responses? Under what conditions can successful knowledge-action efforts be promoted?

7. What can be done to **improve the knowledge-action link**? Specifically, what kinds of insights can the SANREM experience provide to researchers regarding elements sequencing, timing and delivery of their knowledge to action strategies to ensure maximum impact?

Institutional Analysis

Philippines	Vietnam
Poor inter-service communication	National programs are often irrelevant and wasteful at local level
no coordination between research and extension	A set model is compulsory for all – no room for feedback
	Consequently, trainees (attendance paid) are uninterested
Weak links between the government agencies and the private sector	
Research generated knowledge not linked to extension dissemination programs	Technical solutions not addressing the problems which farmers need to solve
Career advance for extension staff is based on seniority, not knowledge or competence in job	Need better technical knowledge/training for local officials communicating with mass organizations

Implementing Participatory Processes

Uganda	Kenya
Research findings are slow to be translated into policy recommendations	Research/extension liaison was non-existent – uptake of technologies was low
Implementation of policy requires community acquiescence and participation of the relevant sectors	Technologies and practices often not adapted to local conditions
Joint implementation among policy makers and end-users increases impact	Low involvement of local officials and local institutions
Publications written in English is only available to a special few – Feedback workshops were most effective	Research publications not useful for communicating with end-users – simple briefs are needed
Limited resources constrain implementation of approved plans	Projects were designed with inadequate timeframes and unrealistic expectations

ASSESSING AND MANAGING SOIL QUALITY FOR SUSTAINABLE AGRICULTURAL SYSTEMS

SANREM-CRSP
Cross-Cutting Initiative

OBJECTIVES

- **Assess community perceptions and indicators of soil quality, including differences in perceptions of soil quality due to differences in gender, environment and socio-economic factors.**
- **Evaluate the use of spectroscopic-based (near-infrared, mid-infrared, and visible range) analytical methods to assess soil organic matter fractions and soil quality in degraded and non-degraded soils [in Bolivia (Cochabamba and Umala), Indonesia, and Philippines].**
- **Collaborate in the evaluation of soil metagenomic methods as an indicator of soil degradation.**

SOIL QUALITY SURVEY

- One survey for male and female community members and one for agricultural professionals who work in community.
- Questions asked about perceptions of soil quality and desired characteristics of a soil quality test.
- Farmers primarily use soil physical properties (i.e., soil color, texture and structure, water retention/drainage) and plant growth as criteria for assessing soil quality.
- Agricultural professionals indicate that the soil quality test needs to be convenient, low-cost and be accompanied by sufficient training for its use.

SIGNIFICANT FINDINGS

SANREM CRSP

- **Laboratory and field-based tests (e.g., $KMnO_4$ test) that measure more biologically-available forms of soil organic matter can be indicators of changes in management practices and are relatively rapid and inexpensive tests of soil quality and soil degradation.**

- **Near infrared spectroscopy (NIR) is a rapid and nondestructive field method for evaluating changes in soil organic matter fractions, but its current cost may make it less favorable for developing countries.**

- **Development of an inexpensive NIR field instrument may have some promise for use in soil quality assessment.**

Gendered Access to Markets: Gendered Networks and Livelihood Alternatives

Cross-cutting gender initiative

Impacts of SANREM Phase III

Maria Elisa Christie

August 31, 2009
USAID

1. Background

- Budget: $12,000 over two years (FY4 and FY5) per LTRA

- Partners: LTRAs 2, 3, 4, and 5
  - (Cornell, VA Tech, University of Missouri, North Carolina A & T)

- 7 Countries:
  - Zambia (Africa)
  - Bolivia, Peru and Ecuador (South America)
  - Indonesia, Vietnam and The Philippines (Southeast Asia)

- 8 Gender case studies across 4 LTRAs

1. Background

- Objectives:
  - ME role
    - Provide ongoing guidance and support to individual LTRAs
    - Coordination through annual meetings and electronic communication
  - LTRA role: Data gathering, analysis and comparison, and writing of case studies
- Overarching research question:

How does the gendered nature of networks linking women to markets impact the quality of information they receive and their bargaining power (in the household, market, etc.)?

2.1 Sample case studies: Southeast Asia

- Product introduced by SANREM in Indonesia
  - Katuk production and marketing
  - Adoption of vermicomposting reduces dependence on chemical inputs
- Gendered social networks controlled by women
- Affects household bargaining decision-making power
- Organizational development among women
- Participation of more than 100 farmers (i.e. over 75,000 katuk cutting)
- Vietnam: Characterization of network (Farmers Union Women's Union, Trader's Network, traditional network (ho/hui)

2.2 Sample case studies: Bolivia

- Most farmers have access to market information through:
  - Radio programs (in Quechua)
  - 1 or 2 cell phones (in 50% of households)
- Initial findings suggest that the probability for a farmer who owns a cell phone to go to an urban market is 24% higher than a farmer who does not
- 80% of wholesalers are women; all have cell phones
- Location of towers (watershed) benefit some, disadvantage others
- Texting of market information not an option

3. Capacity building

- Students involved in the research cross-cutting (partial funding for research):
  - Zambia (1 PhD)
  - Bolivia (1 MSc and 4 undergraduate)
  - Peru (2 MSc)
  - Indonesia (1 MSc and 2 undergraduate)
  - Vietnam (3 undergraduate)

Fields: Agricultural Economics, Agronomy, Development Sociology, Sociology

4. Recommendations

- Set up a gender team from the beginning
- Take advantage of women's networks during development of programs (even knitting circles; nutrition workshops)
- Dissemination of findings by publishing case studies at regional level
- Efforts to improve incomes of producers should recognize gendered roles of different actors within the respective chain
- Gender approaches:
  - Invest in crops for which women have control
  - Social networks and cell phones opens new possibilities
  - Help to improve and/or develop production and marketing organizations
  - Address nutritional issues

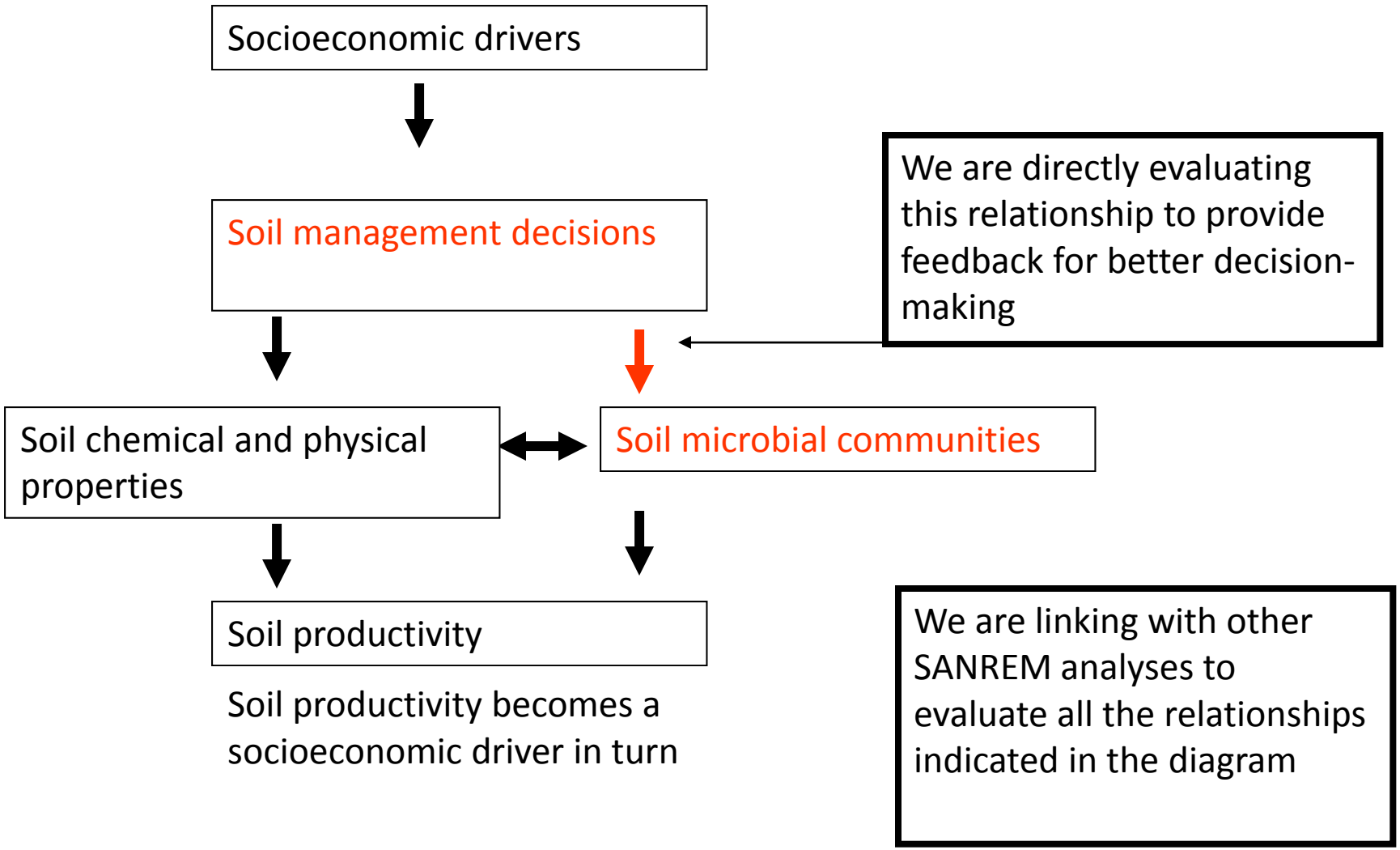
Soil metagenomics and tropical soil productivity

Motavalli

- To manage agricultural natural resources, we need to know what these resources are!
- Microbes that are difficult to culture are barely understood and make up a huge part of soil – sequencing techniques allow us to study them
- We need translational research to put new metagenomic tools to work for developing regions

Soil metagenomics and tropical soil productivity

- Soil productivity is an important limiting factor in many tropical systems
- Soil microbes such as mycorrhizal fungi and rhizobia are particularly important to support productivity in low-input systems
- Pathogens often increase in importance under reduced tillage systems such as Conservation Agriculture systems
- New DNA sequencing approaches make it much easier to study soil microbial communities in productive and degraded soils
- We are doing translational research to apply these tools for the benefit of agriculture in developing countries


Socioeconomic drivers
Soil management decisions
We are directly evaluating this relationship to provide feedback for better decision-making
Soil chemical and physical properties
Soil microbial communities
Soil productivity
Soil productivity becomes a socioeconomic driver in turn
We are linking with other SANREM analyses to evaluate all the relationships indicated in the diagram

SANREM activities

http://www.soilfoodweb.com.au

Soil sample

DNA extraction

Fragments of DNA from all the microbes

- In our SANREM cross-cutting project, students Lorena Gomez and Neshmi Salaues are evaluating microbial communities in the experimental contexts developed in these three LTRA projects
- They will have complete sequencing results for these experiments in the next few months

Treatments being evaluated for effects on microbial communities

- Valdivia LTRA: Effects of fallow period and plant cover
- Alwang LTRA: Effects of elevation and level of degradation
- Travis LTRA: Effects of soil management and amendments

Benefits of this new type of knowledge

- We anticipate that knowledge of the effects of soil management decision-making on microbial communities will allow us to
  - evaluate the effects of decisions on microbes known to have positive or negative effects on productivity
  - identify microbes that are indicators for higher and lower productivity
  - ultimately, identify microbes important to productivity whose role was not understood in the past