Using Prize Rewards to Stimulate Innovation and Adoption in African Agriculture

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Prize rewards: the story ahead

• African agriculture needs new innovation incentives
• We propose a new system of “prize rewards”:
  – a fixed sum, paid proportionally to measured value,
  – to reward innovators for value they create but cannot capture
  – to recognize successful approaches and attract other funding
• These slides detail our motivation and proposal
  – published in 3 refereed journal articles
  – discussed at >17 conferences and workshops
  – funded so far by Adelson Family Foundation and IFPRI
  – supported by 8-member advisory board
  – endorsed by NEPAD, for implementation through FARA
The problem:
Africa’s ag technology is far behind

Average cereal yields by region, 1961-2004

There are diminishing returns to inputs, e.g. simply adding more fertilizer

Fertilizer Use (N+P+K), 1961-2002

Sustaining growth requires new technologies, e.g. new varieties

Adoption of new varieties (pct. of cropped area)


Africa has had remarkably low public investment in crop improvement

Public agricultural R&D per capita, 1971-2000

Note: Sample varies from n=13 to 26 for SSA countries, and n=9 to 15 for OECD countries. Source: Agricultural R&D is from IFPRI (2003), available online at www.astc.cgiar.org; total population is from FAOStat (2004), available online at apps.fao.org.
Private R&D builds on public investment

Notes: Calculated from IFPRI (2003), available online at www.asti.cgiar.org. Data refer to various years from 1971 through 2000, and exclude the chemical and machinery sectors.

R&D has varied but high payoffs in all regions, including Africa

Estimated return to agricultural research and extension (%/year)

…but sustaining foreign aid for agricultural R&D has been difficult!

**Figure 5: Real expenditures of the CGIAR, 1966-2000**

**USAID Funding for Research and Extension in Africa, FY1961-2001**

Source: Gary Alex (2003), unpublished file data.

Prize rewards can jump-start innovation

- Agricultural innovation faces a severe market failure
  - value creation is measurable but dispersed among the poor
  - private investment is limited by cost of value capture
  - public investment is limited difficulty of predicting success

- Innovation can be accelerated with prize payments
  - to reward successful innovators
  - to recognize successful strategies:
    - attract private investment for marketable innovations
    - attract public funding to proven approaches
Prize initiatives are important but short-lived

• Prize programs are often needed
  – Rewards for personal accomplishment are widespread
  – Rewards for specific technologies arise as needed:
    • 1714-1773 British reward for computing longitude at sea
    • 1802-1809 French reward for food preservation
    • 1901-1940 Various rewards for civil aviation
    • 1995-2005 Ansari X-prize for civilian spaceflight

• Technology prizes are a temporary instrument
  – by revealing what works best, they are replaced by
    • private investment when the innovation is marketable
    • public grants and contracts when it is a public service

How prize rewards can help jump-start African agriculture

• Pre-specifying a traditional prize won’t work
  – farmers need a changing portfolio of new techniques
  – success requires location-specific knowledge

• but we can measure value with verifiable data
  – controlled experiments for output/input change
  – farm surveys for extent of adoption;
  – input and output prices

• so donors can reward social value like a market sale
  – announce funding, eligibility and measurement rules
  – assist innovators to compile data after adoption
  – verify data and pay out in proportion to measured gains
  – visibility of rewards leads others to imitate success
New technologies often involve multiple innovations

Genetic improvement
(by researchers, using controlled trials)

Agronomic improvement
(by farmers, using land & labor)

Successful innovations are often surprising

traditional “flat” planting

labor-intensive “Zai” microcatchments

For these fields, the workers are:
Prize rewards can stimulate any kind of innovation whose value is measurable.

Improved fish-drying in Senegal using hermetic bags to store crops.

**Implementing Prizes:**

*Schematic overview*

**Step 1:**
donors specify lines of credit for target domains (e.g. $1 m. for food crops)

**Step 2:**
innovators submit data on gains from new techniques after adoption (e.g. $36 m. over 7 submissions)

Prizes would be a small fraction of total activity, but a key market-like signal of value

**Impact:**
other donors, investors and innovators imitate successes

**Step 3:**
secretariat verifies data and computes reward payments (e.g. 1/36th of measured gains)
Implementing Prizes:  
An example using case study data

<table>
<thead>
<tr>
<th>Example technology</th>
<th>Measured Social Gains (NPV in US$)</th>
<th>Measured Social Gains (Pct. of total)</th>
<th>Reward Payment (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cotton in Senegal</td>
<td>14,109,528</td>
<td>39.2%</td>
<td>392,087</td>
</tr>
<tr>
<td>2. Cotton in Chad</td>
<td>6,676,421</td>
<td>18.6%</td>
<td>185,530</td>
</tr>
<tr>
<td>3. Rice in Sierra Leone</td>
<td>6,564,255</td>
<td>18.2%</td>
<td>182,413</td>
</tr>
<tr>
<td>4. Rice in Guinea Bissau</td>
<td>4,399,644</td>
<td>12.2%</td>
<td>122,261</td>
</tr>
<tr>
<td>5. “Zai” in Burkina Faso</td>
<td>2,695,489</td>
<td>7.5%</td>
<td>74,904</td>
</tr>
<tr>
<td>6. Cowpea storage in Benin</td>
<td>1,308,558</td>
<td>3.6%</td>
<td>36,363</td>
</tr>
<tr>
<td>7. Fish processing in Senegal</td>
<td>231,810</td>
<td>0.6%</td>
<td>6,442</td>
</tr>
<tr>
<td>Total</td>
<td>$35.99 m.</td>
<td>100%</td>
<td>$1 m.</td>
</tr>
</tbody>
</table>

Note: With payment of $1 m. for measured gains of about $36 m., the implied royalty rate is approximately $1/36 = 2.78% of measured gains.

Implementing Prizes:  
Data requirements

Data needed to compute each year’s economic gain from technology adoption

Variables and data sources

- **Market data**
  - $P, Q$ National ag. stats.

- **Field data**
  - $J$ Yield change × adoption rate
  - $I$ Input change per unit

- **Economic parameters**
  - $K$ Supply elasticity (≈1 to omit)
  - $\Delta Q$ Demand elasticity (≈0 to omit)
Implementing Prizes: 
*Data requirements*

Data needed to estimate adoption rates across years

Implementing Prizes:
*Data requirements*

Computation of cumulative economic gains
Implementing prizes:  
What’s done, what’s next

• Refinement and endorsement of the proposal
  – many meetings, publications and citations since 2003
  – formal Advisory Board formed October 2004
  – formal FARA commitment September 2005

• Funding for project development
  – Adelson Family Foundation (New York), 2004-06
  – IFPRI (Addis Ababa), 2006-08

• Funding for prize rewards
  – significant interest from various donors
  – could be funded directly through FARA

For more information…

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Advisory Board
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Robert Evenson (Yale)
Richard Nelson (Columbia)
Phil Pardey (Minnesota)
Carl Pray (Rutgers)
Jock Anderson (World Bank)
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Prabhu Pingali (FAO)
Per Pinstrip-Andersen (Cornell)
Jim Ryan (Australia, former DG of ICRISAT)
Eugene Terry (former DG of WARDA)

Other endorsements to date
Walter Alhassan (Ghana, former DG of CSIR)
Julian Alston (UC Davis)
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