Is the Share of Agricultural Maintenance Research Rising?

John Adam Sparger*, Paul Heisey[±], Jeffrey Alwang*, George Norton*

**Department of Agricultural and Applied Economics,*
Virginia Polytechnic Institute and State University
208 Hutcheson Hall (0401), Blacksburg, Va, 24061
jasparg@vt.edu

[±]USDA, Economic Research Service, 1800 M St. NW
Washington, DC 20036-5831

Poster prepared for presentation at the Agricultural & Applied Economics Association 2010
AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

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Contact author: jasparg@vt.edu

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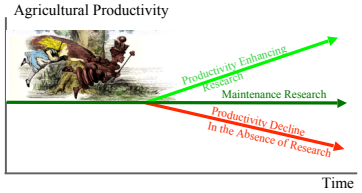
What is maintenance research?

- Maintenance research replaces existing research results that have deteriorated due to changes in the base conditions resulting in a loss of productivity, efficiency, or other realized past gains. This is in contrast to productivity enhancing research which increases theoretical yield boundaries.
- The elimination of maintenance research could result in as much as a 25% reduction in productivity in as little as five years and up to 40% over fifteen years[1]. As overall agricultural productivity grows, a growing proportion of research must be devoted to maintenance research so that the productivity gains realized will not be lost to deterioration[2].
- Adusei and Norton[3] found that 34.8% of agricultural research on commodities was devoted to maintenance research in 1986.
- Research benefits cannot be measured purely in terms of output gains, but must also be measured in terms of losses avoided. Failure to do so will undervalue the returns to research.



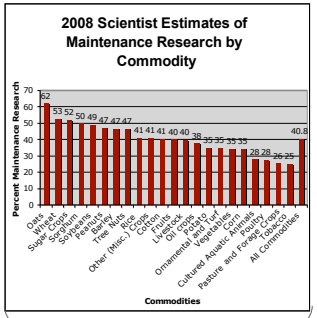
Objectives

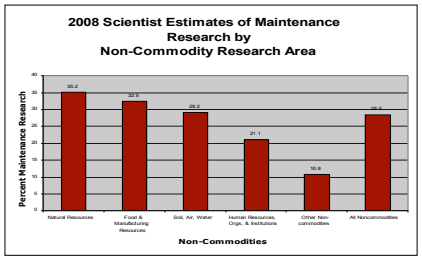
1. Measure the current amount of agricultural research for commodities involved in maintenance research and compare this to the 1986 estimate.
2. Measure the current amount of agricultural research for non-commodity areas involved in maintenance research.
3. Develop an empirical model to explain what factors are responsible for maintenance research expenditures.

Methods

- **National survey of agricultural research scientists in 2008:**
  - Surveyed percentage of research devoted to maintenance research by commodity or non-commodity area and discipline.
  - Assessed examples of factors causing research deterioration, necessitating maintenance research.
- **For the empirical model, survey results were used to define:**
  - Specific Research Knowledge Areas within USDA's Current Research Information System as maintenance research for the dependent variable.
  - Explanatory variables chosen from categories of research funding, climatic conditions, pest and pathogen control, and agricultural production.

How much maintenance research is there today?





Empirical Model

$$(MainteanceResearch)_{it} = \beta_1\left(\frac{Livestock}{Crops}\right)_{it} + \beta_2(TotalResearch)_{it} + \beta_3\left(\frac{Federal + Private}{State}\right)_{it} + \beta_4(Temperature)_{it} + \beta_5(PrecipitationChanges)_{it}$$

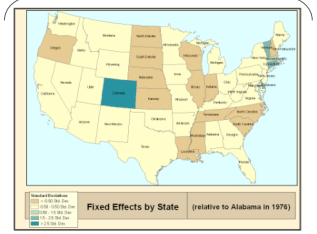
$$+ \beta_6(PesticideResistance)_{it} + \mu_i + \lambda_t + \upsilon_{it}$$

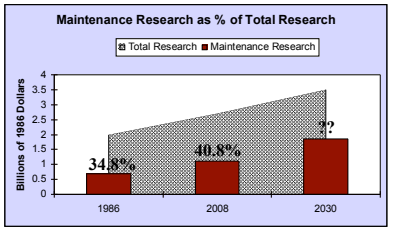
CRIS Knowledge Areas representing Maintenance Research

- plant protection from weeds, insects, pathogens, and other pests
- animal protection from parasites, diseases, and toxins
- protection of food and humans from pathogens, parasites, and toxins
- conservation and protection of soil, nutrient, water, and air resources
- climate, weather, and pollution research
- economic and market research

Examples of Research Deterioration from Survey (response rate)

- antibiotic resistance and diseases in animals and crops (27%)
- changes in temperature, climate, environmental factors, and pollution (17%)
- control of weeds and invasive species (15%)
- changes in regulatory restrictions, input prices, or other market forces (11%)
- changes in nutrient requirements due to genetic modifications/selective breeding in crops and livestock (10%)
- changes arising from reduced tillage practices (5%)
- replacement of insecticides due to regulatory elimination, evolving pests, and changing pest complexes (4%)





Empirical Results

Panel data from 1976-2006 for Maintenance Research Expenditures by State revealed:

- Different commodity mixtures have different maintenance research requirements. A higher livestock to crop ratio requires less maintenance research, for example.
- A higher ratio of private and federal funding relative to state funding of agricultural research leads to decreased expenditures on maintenance research.
- Higher temperatures, both spatially and across time, are correlated with higher levels of maintenance research.
- Changes in weather patterns as measured by both positive and negative trends in precipitation lead to increased spending on maintenance research.
- As pests adapt and gain increased resistance to pesticides, maintenance research is increased in the attempt to develop more effective pesticides.

Conclusions

1. Maintenance Research influenced over long run by:
   - accrual of small climatic changes
   - pressure buildup from evolving pest and pathogen populations
2. Influenced in short run by:
   - funding sources
   - size of the agricultural research budget
   - commodity production choices
3. Higher temperatures have largest effect through:
   - growing conditions
   - geographical domain of invasive species
   - rate of pest reproduction and, thus, pest resistance
4. Maintenance research has increased over past 20 years from 34.8% in 1986 to 40.8% in 2008 in commodities and stands at 28.5% for non-commodity research.
5. Same research budget today buys less productivity enhancing research than it once did.
6. Increases in maintenance research could signal diminishing marginal returns to research as funding is directed away from productivity enhancing research and towards combating productivity declines.

"Now, here, you see, it takes all the running you can do just to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that.

-the Red Queen to Alice
in Lewis Carroll's *Through the Looking Glass*

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