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Does Modern Technology Increase Agricultural Productivity? Revisiting the Evidence from Loevinsohn et al.

SPIA TECHNICAL NOTE

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Summary

We reexamined the 214 papers identified by Loevinsohn and colleagues in their 2013 report to the UK Department for International Development (DFID) on the circumstances and conditions under which technology adoption results in increased agricultural productivity. That report produced no clear evidence-based guidance on such circumstances and conditions. Using criteria slightly less restrictive than theirs, we identified 30 of the 214 studies that reported a relationship between technology and agricultural productivity: 21 of the 23 with yield data showed a positive relationship between use of technology and yield, and 2 showed no increase; 24 of 26 examining income showed a positive relationship between technology use and income, and the other 2 showed no increase.

Background

The use of modern technology in agriculture has been controversial since the mid-1970s, when the Green Revolution spread rapidly through irrigated wheat- and rice-producing areas of Asia (Dalrymple 1978). Some expressed fear that adoption of semi-dwarf seeds and fertilizer would be dominated by wealthy, powerful farmers, who would force out smaller family farmers; others argued that farmers would find the new technologies only a short-term benefit and would soon revert to traditional practices (see, e.g., Anderson et al., 1982). Careful examination of empirical evidence on adoption, however, showed that by 1980 farmers across the entire size and wealth spectrum were adopting in roughly the same proportions (Herdt and Capule, 1983); the use of such technologies continued to expand through the beginning of the 21st century (Evenson and Gollin, 2003).

Research centers continue to produce ever-newer crop varieties and related technologies. Even leaving aside consideration of genetically engineered seeds, which have been subject to intense scrutiny, the question of whether other newer technologies generate benefits is of continuing interest. In a report to the UK Department for International Development (DFID), the authors of one recent review designed to gain insight into when agricultural technology leads to increased productivity reported that they were unable to uncover clear, evidence-based guidance on the conditions and circumstances under which farmers achieve productivity gains when they adopt innovative technology (Loevinsohn, Sumberg, Diagne, and Whitfield, 2013; henceforth LSDW).

LSDW focused on gains in food crop production of farmers in low- and lower-middle-income countries that might have been achieved through improved crop cultivars, biotechnology and the management of water, soil fertility and pests. They assembled a list of more than 20,000 papers by using several academic databases, “snowballing,” and searching published and “gray” literature with help from library professionals. These were screened to exclude papers that were not written in English or French, based on primary data, concerning family farms, focused on lower- or lower-middle-income countries, or about adopting crop or livestock-related technology. These criteria excluded all but 214 of the initial list. The 214 were then screened to exclude those for which the technology was not clearly described, it was not possible to determine a functional definition of adoption, no clear definition and measure of productivity were provided, no relevant condition or circumstance was described, or it was not evident how a non-productivity benefit was measured, if one was claimed. Of the 214 that passed the first stage of screening, only five passed the second stage!

Because five studies constitute too small a sample from which to generalize, the effort to identify the conditions under which technology is associated with productivity gains[1] was unsuccessful and LSDW concluded that little insight to support more effective policy and program management was generated and, it would appear, a good deal of research time and money was wasted.

This finding is a clear indictment of agricultural research and implies that the technology generated by research and evaluated in the 214 studies does not lead to productivity gains. This conclusion is a huge disappointment to funders of agricultural research and stands in stark contrast to the large body of analytical work that has examined the costs and benefits of agricultural research and found generally high rates of return (Alston et al., 2000). The contrast prompted the CGIAR's Standing Panel on Impact Assessment (SPIA) to wonder what might be learned by applying a slightly modified set of criteria to the literature. To that end, SPIA requested the list of 214 papers, and the authors and sponsors of the original review graciously agreed to share them. We then examined these papers to see what insights could generated by modified criteria.

LSDW Criteria for Screening Papers

LSDW were careful to define their criteria, especially technology "adoption"—they required a satisfactory "functional definition of adoption" to specify three "dimensions of use." That is, a study had to state how long farmers had known of or used the technology, on what area or proportion of their fields farmers were using the technology, and what proportion or which elements of a complex technology, such as conservation agriculture, farmers were using. For technologies like fertilizers and pesticides, the relevant dimension was the intensity with which they were applied, typically measured in the number of applications or the quantity applied. They focused on agricultural technologies involving the major food crops of low- and lower-middle-income countries: maize, rice, wheat, millet, sorghum, cassava, banana, and bean.

We read through as many of the 214 papers as we could locate. LSDW did not specify which criteria each paper failed to meet, but in our reading, we found, in agreement with them, that most studies failed to define the three specified dimensions of adoption. In general, the studies passed over the matter of adoption rather casually, generally accepting a farmer's response that he or she had or had

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[1] LSDW showed a particular interest in evidence of how "conditions and circumstances" in low- and middle-income countries articulate the relationship between technology use and productivity outcomes. This interest seems to follow in the spirit of work on the effectiveness of development aid, one line of which hypothesizes that development aid has had a positive impact on economic growth in countries with sound fiscal, monetary, and trade policies (Burnside and Dollar 2000; Boone 1996), although the hypothesis has been contested by others (Roodman 2004; Kanbur 2003; Easterly et al. 2003)

not used a named technology. At first blush this approach might seem adequate—adoption seems to be a simple yes/no issue. However, adoption is generally an incremental process. For example, take the case of a crop variety. The answer to the question “Did you grow variety X?” would seem to be clear, but farmers generally grow several varieties of a given crop in any planting season and change their mix of varieties over time. “Adoption” connotes more than simply experimenting—it implies that the variety is used in several different seasons, so the time dimension enters. A more appropriate question is “What proportion of your crop did you plant to variety X in season Y?” Even variety adoption is a matter of degree, and it changes over time. Although there may be practical reasons for treating adoption as a binary variable—e.g., to facilitate statistical analysis—for most studies it is impossible to tell whether or not such simplification is intentional.

If, in addition, one is seeking to differentiate the relationship of inputs to outputs with old and new technology, then one must identify the inputs and outputs devoted to each variety grown each season. Most of the studies fail on this count as well, which is another reason they would not have passed LSDW’s second-stage screening.

Still, it seemed to us that one might learn something from the assembled papers, so we read all we could find. While doing so, we found that some seemed to fail to meet even LSDW’s *first* set of criteria—i.e., they focused on adoption rather than impact of agricultural technology, they were not based on primary data, or they failed in other ways. Our first reading led us to place each of the 214 papers into one of the 7 categories summarized in Table 1.

We could not locate copies of 25 of the papers, and 3 studies were listed twice. In addition, we discovered some anomalies in LSDW’s initial screening: 2 papers were studies of cotton, and 1 looked at soybeans in the United States. This review left us with 31 papers in category 1.

Table 1. Initial classification of studies cited by LSDW

Category	Type of study	Number of studies
1	Studies we could not locate, duplicates, and anomalies	31
2	Literature reviews, case studies, or ex ante analyses	54
3	On-farm agronomic or extension trials (researcher- or farmer-controlled)	49
4	Analyses of determinants of adoption of technology, not impact analysis	35
5	Evaluations examining economic surplus; modeling or productivity analyses	13
6	Tabular or OLS regression of before versus after or adopters versus non-adopters	19
7	Regression analysis with instrumental variables or propensity score matching	11

Fifty-four of the studies were literature reviews, case studies, or ex ante analyses, rather than studies using primary data as LSDW had stated. Forty-nine studies reported on on-farm agronomic trials in which researchers either directed farmers in the application of the technology or applied technology in farmers' fields themselves. Such studies are useful for understanding how technology might perform in farmers' fields but clearly do not meet the adoption criterion. Thirty-five of the studies examined determinants of adoption but did not have the productivity information needed to answer our question. Thirteen of the studies were either evaluations using economic surplus concepts rather than farm-level productivity, or analyses of productivity variability that did not clearly identify adoption.

The remaining 30 studies—in categories 6 and 7—examined data of farmers who reported using a technology of interest and reported productivity measures such as yield or income associated with the technology used. We closely examined these papers, which we believed satisfactorily met LSDW's first set of criteria and also applied an appropriate statistical approach to answering the question of whether new technology increases productivity and income—together, we refer to these two conditions as the Herdt-Mine criteria.

In this paper, we examine the significance of these studies' findings in two steps, first characterizing each study according to a key set of descriptors, then reviewing each study's findings.

Characteristics of Papers Screened according to Herdt-Mine Criteria

In the first step, overall, we were struck by the diversity of methods applied and the heterogeneity of analytical approaches. Two-thirds of the 30 compared either the mean productivity values of "adopters" and "non-adopters" or used regression analysis to compare the two groups. The remaining studies used more sophisticated analytical methods intended to estimate causal relationships.

Analysts have come to put greater emphasis on the distinction between observing an *association* of technology use and productivity and attempting to identify a *causal* effect of the first on the second. As early observers recognized, farmers who adopt a new technology often differ in many ways from farmers who do not adopt, although the differences are often more complex than simply farm size or tenure. The essential difference is that some farmers *choose* to use a new technology whereas others choose not to use it. This problem of self-selection is a major challenge to those who wish to attribute productivity change to a technological, policy, personal, or social innovation.

Another major challenge to understanding the impact of technology is the difficulty of obtaining data from adopters and non-adopters. Most countries have no systematic reporting of farmer yields by technology so all such information comes from samples of farmers. A few of the 30, qualified studies were based on nationally representative samples, but in most cases samples consisted of small groups, perhaps from areas where the technology was expected to have been preferentially adopted. Table 2 summarizes some key features of the 30 studies.

There were nearly equal numbers of papers from Africa and Asia, and nearly equal numbers of genetic and management innovations. In Africa, most of the studies were conducted in areas where the innovation being considered had been promoted or where it seemed especially well suited, with two studies based on nationally representative samples of farmers. In those two cases an effort was made to measure the extent of adoption of the technology among farmers as well as its productivity effect. In Asia about half of cases represented areas where the crop was important and half where the innovation of interest had been promoted.

Table 2. Number of LSDW-identified studies by their characteristics, among the 30 that meet Herdt-Mine criteria[a]

Region	Analytical approach		Innovation		Sample represents:		
	Tabular or OLS	IV, PSM	Crop, soil, nutrient	Genetic	Nation	Area where crop is important	Area where innovation was promoted
Africa	9	7	6	11	2	3	11
Asia	10	3	11	4	0	6	7
Other	1	1	1	1	1	1	0

[a] Some studies included both types of analysis and innovation.

Table 3 summarizes the impacts reported in studies meeting our criteria. Some studies analyzed only yield impacts, some only income. The majority (19) examined both. Additionally, 15 of the studies assessed outcomes too diverse to generalize, including food security, poverty, inequality, nutrition, health, consumption expenditure, efficiency, risk, and environmental impact.

Findings of Papers Screened according to Herdt-Mine Criteria

Findings on yield and income effects were largely positive. Of the 23 studies analyzing yield, 21 provided evidence that technology adoption had a positive impact and 2 found no gain. No studies reported a yield decrease from technology adoption. Twenty-four of the 26 studies addressing income effects provided evidence that technology adopters had higher incomes than non-adopters, and 2 studies showed no impact. One study provided evidence that the impact on income could be negative under certain conditions.

Table 3. Findings of LSDW-identified studies that meet Herdt-Mine criteria

Citation	Country	Innovation	Average yield effect	Average income effect
Adekambi et al. 2009	Benin	Genetic, rice	N/A	Positive, significant
Akinola et al. 2009	Nigeria	Management, nutrient	Increase > 200%	Doubled
Asfaw et al. 2012	Tanzania	Genetic, pigeonpea	Significant increase	Significant increase
Barret et al. 2004	Madagascar	Management, SRI	85% increase	N/A
Bennett et al. 2005	India	Genetic, cotton	45–63% increase	49–74% increase
Bravo-Ureta et al. 2006	El Salvador, Honduras	Management, diversification	N/A	US$311/ha increase
David et al. 2000	Uganda	Genetic, bush bean	35–79% increase	88% of adopters gained
Deffo et al. 2003	Cameroon	Genetic, potato	94% increase	44% of adopters gained
Dibba et al. 2012	Gambia	Genetic, rice	157 kg/ha increase	US$148 annual increase
Erenstein et al. 2008	India and Pakistan	Management, zero tillage (rice-wheat)	4% increase in India	US$69/ha increase in India
Gebregziabher et al. 2009	Ethiopia	Management, irrigation	N/A	4,000–4,500 birr increase
Inaizumi et al. 1999	Nigeria	Genetic, cowpea	N/A	44% increase in profit in dry season
Kabamba and Muimba-Kankolongo 2009	Zambia	Management, conservation farming	66% reported higher yields	N/A
Kasem and Thapa 2011	Thailand	Management, crop diversification	N/A	Net income per ha increased
Kijima et al. 2008	Uganda	Genetic, rice	N/A	US$20/ha increase
Mangisoni 2008	Madagascar	Management, irrigation	N/A	Higher net farm incomes per ha
Matuschke et al. 2007	India	Genetic, wheat	351 kg/acre increase	1,852 rupees/acre increase
Morris et al. 1999	Ghana	Genetic, maize	88–102% increase	56% reported increase
Moya et al. 2004	China	Management, alternate wetting and drying	No effect	No effect
Namara et al. 2007	India	Management, irrigation	Significant increase	N/A
Narayanamoorthy 2004	India	Management, irrigation	23% increase for sugarcane	74% increase in profit
Nguezet et al. 2011	Nigeria	Genetic, rice	Significant increase	Significant increase
Noltze et al. 2013	Timor Leste	Management, SRI	46% increase	Small but significant increase
Qaim and Javry 2003	Argentina	Genetic, cotton	Over 500 kg/ha gain	$39/ha increase
Quinion et al. 2010	Malawi	Management, agroforestry	24% to 31% had higher yield	Significant increase
Ramasamy et al. 2000	India	Genetic, pearl millet	720–998 kg/ha increase	399–1,972 rupees/ha increase
Rejesus et al. 2011	Philippines	Management, alternate wetting and drying	No effect	No effect
Sarwar and Goheer 2007	Pakistan	Management, zero tillage (rice-wheat)	Almost 300 kg/ha increase	3,352 Rs/ha increase
Stone 2011	India	Genetic, cotton	18% increase	N/A
Xiaoyun et al. 2005	China	Management, SRI	70% reported increase	9% increase

Note: N/A means the effect was not reported in the paper.

Conclusion

Loevinsohn et al. (2013) clearly highlighted the weakness of much of the impact analysis in the area of agricultural research and technology. Loevinsohn et al. selected from their initial list of 20,000 studies, first 214 and finally only 5 that they said offered qualified evidence-based guidance on the conditions under which agricultural research and technology could lead to productivity improvements for farmers. When we applied slightly different criteria to the 214 studies on the LDSW list, we still eliminated 184. There is clearly room for improvement in impact analysis. Still, we found the remaining 30 studies provided useful evidence. Moreover, what these studies tell us about new technology and productivity is largely positive. Clearly more rigorous research—meeting the criteria laid out either in LDSW or here—is needed to produced evidence that will enable investments in agricultural research and technology to be used in ways that actually improve farmers' lives and livelihoods.

References

Adekambi, S. A., Diagne, A., Simtowe, F., & Biaou, G. (2009). The impact of agricultural technology adoption on poverty: The case of NERICA rice varieties in Benin. Paper prepared for the International Association of Agricultural Economists conference, Beijing, China, August 16–22.

Akinola, A. A., Alene, A. D., Adeyemo, R., Sanogo, D., & Olanrewaju, A. S. (2009). Impacts of balanced nutrient management systems technologies in the northern Guinea savanna of Nigeria. Ibadan, Nigeria: International Institute of Tropical Agriculture (IITA).

Alston, J. M., Marra, M. C., Pardey, P. G., & Watt, T. J. (2000). Research returns redux: A meta-analysis of the returns to agricultural research. *Australian Journal of Agricultural Economics 44*(2), 185–215.

Anderson, R. S., Brass, P. R., Levy, E., and Morrison, B. M., eds. 1982. *Science, politics, and the agricultural revolution in Asia.* Boulder, CO: Westview Press.

Asfaw, S., Kassie, M., Simtowe, F., & Lipper, L. (2012). Poverty reduction effects of agricultural technology adoption: A micro-evidence from rural Tanzania. *Journal of Development Studies 48*(9), 1288–1305.

Barrett, C. B., Moser, C. M., McHugh, O. V., & Barison, J. (2004). Better technology, better plots, or better farmers? Identifying changes in productivity and risk among Malagasy rice farmers. *American Journal of Agricultural Economics* 86(4), 869–888.

Bennett, R. M., Ismael, Y., Kambhampati, U., & Morse, S. (2004). Economic impact of genetically modified cotton in India. *AgBioForum 7*(3), 96–100.

Boone, P. 1996. Politics and the effectiveness of foreign aid. *European Economic Review* 40: 289-329.

Bravo-Ureta, B. E., Solis, D., Cocchi, H., & Quiroga, R. E. (2006). The impact of soil conservation and output diversification on farm income in Central American hillside farming. *Agricultural Economics 35*(3), 267–276.

Bullock, D. S., & Nitsi, E. I. (2001). Roundup Ready soybean technology and farm production costs: Measuring the incentive to adopt genetically modified seeds. *American Behavioral Scientist* 44(8), 1283–1301.

Burnside and Dollar 2000. "Aid, policies and growth." *American Economic Review* 90: 847-868.

Dalrymple, D. G. (1978). *Development and spread of high-yielding varieties of wheat and rice in less developed nations*. USDA Foreign Agricultural Economic Report No. 95. Washington, DC: US Department of Agriculture.

David, S., Kirkby, R., & Kasozi, S. (2000). *Assessing the impact of bush bean varieties on poverty reduction in sub-Saharan Africa: Evidence from Uganda*. Occasional Publications Series, No. 31. Kampala, Uganda: International Center for Tropical Agriculture (CIAT), Network on Bean Research in Africa.

Deffo, V., Njualem, D., Koi, J., & Demo, P. (2003). Socioeconomic impact of two potato varieties (Cipira and Tubira) released in Cameroon. *American Journal of Potato Research 80*(3), 151–158.

Dibba, L., Fialor, S. C., Diagne, A., & Nimoh, F. (2012). The impact of NERICA adoption on productivity and poverty of the small-scale rice farmers in the Gambia. *Food Security* 4(2), 253–265.

Easterly, W. et al., 2003 New Data, New Doubts: Revisiting Aid, Policies, and Growth. Washington, D.C., Center for Global Development.

Erenstein, O., Farooq, U., Malik, R. K., & Sharif, M. (2008). On-farm impacts of zero tillage wheat in South Asia's rice-wheat systems. *Field Crops Research 105*(3), 240–252.

Evenson, R. E., & Gollin, D. (2003). *Crop variety improvement and its effect on productivity.* Wallingford, UK: CABI Publishing.

Gebregziabher, G., Namara, R. E., & Holden, S. (2009). Poverty reduction with irrigation investment: An empirical case study from Tigray, Ethiopia. *Agricultural Water Management* 96(12), 1837–1843.

Herdt, R. W., and Capule, C. (1983). *Adoption, spread and production impact of modern rice varieties in Asia*. Los Baños, Philippines: International Rice Research Institute (IRRI).

Inaizumi, H., Singh, B. B., Sanginga, P. C., Manyong, V. M., Adesina, A. A., & Tarawali, S. A. (1999). *Adoption and impact of dry-season dual-purpose cowpea in the semiarid zone of Nigeria.* Ibadan, Nigeria: International Institute of Tropical Agriculture (IITA).

Kabamba, H., & Muimba-Kankolongo, A. (2009). Adoption and impact of conservation farming on crop productivity among smallholder farmers in Kapiri Mposhi District of Zambia. *Journal of Animal and Plant Sciences* 3(2), 205–214.

Kanbur, R. (ed.) 2003 Q-Squared: Combining Qualitative and Quantitative Methods in Poverty Analysis. Permanent Black (Delhi).

Kasem, S., & Thapa, G. B. (2011). Crop diversification in Thailand: Status, determinants, and effects on income and use of inputs. *Land Use Policy* 28(3), 618–628.

Kijima, Y., Otsuka, K., & Sserunkuuma, D. (2008). Assessing the impact of NERICA on income and poverty in central and western Uganda. *Agricultural Economics 38*(3), 327–337.

Loevinsohn, M., Sumberg, J., Diagne, A., & Whitfield, S. (2013). *Under what circumstances and conditions does adoption of technology result in increased agricultural productivity?* A systematic review prepared for the UK Department for International Development. Brighton, UK: Institute of Development Studies.

Mangisoni, J. H. (2008). Impact of treadle pump irrigation technology on smallholder poverty and food security in Malawi: A case study of Blantyre and Mchinji Districts. *International Journal of Agricultural Sustainability 6*(4), 248–266.

Matuschke, I., Mishra, R. R., & Qaim, M. (2007). Adoption and impact of hybrid wheat in India. *World Development* 35(8), 1422–1435.

Morris, M. L., Tripp, R., & Dankyi, A. A. (1999). *Adoption and impacts of improved maize production technology*: *A case study of the Ghana Grains Development Project*. Economic Programme paper, 99–101. Mexico City: International Maize and Wheat Improvement Center (CIMMYT).

Moya, P., Hong, L., Dawe, D., & Chongde, C. (2004). The impact of on-farm water saving irrigation techniques on rice productivity and profitability in Zhanghe Irrigation System, Hubei, China. *Paddy and Water Environment* 2(4), 207–215.

Namara, R. E., Nagar, R. K., & Upadhyay, B. (2007). Economics, adoption determinants, and impacts of micro-irrigation technologies: Empirical results from India. *Irrigation Science* 25(3), 283–297.

Narayanamoorthy, A. (2004). Impact assessment of drip irrigation in India: The case of sugarcane. *Development Policy Review* 22(4), 443–462.

Nguezet, P. M. D., Diagne, A., Olusegun Okoruwa, V., & Ojehomon, V. (2011). Impact of improved rice technology (NERICA varieties) on income and poverty among rice farming households in Nigeria: A Local Average Treatment Effect (LATE) approach. *Quarterly Journal of International Agriculture* 50(3), 267–291.

Noltze, M., Schwarze, S., & Qaim, M. (2013). Impacts of natural resource management technologies on agricultural yield and household income: The system of rice intensification in Timor Leste. *Ecological Economics* 85, 59–68.

Qaim, M., & De Janvry, A. (2003). Genetically modified crops, corporate pricing strategies, and farmers' adoption: The case of Bt cotton in Argentina. *American Journal of Agricultural Economics* 85(4), 814–828.

Quinion, A., Chirwa, P. W., Akinnifesi, F. K., & Ajayi, O. C. (2010). Do agroforestry technologies improve the livelihoods of resource poor farmers? Evidence from Kasungu and Machinga districts of Malawi. *Agroforestry Systems* 80(3), 457–465.

Ramasamy, C., Bantilan, C. S., Elangovan, S., & Asokan, M. (2000). *Improved cultivars of pearl millet in Tamil Nadu: Adoption, impact, and returns to research investment.* Hyderabad , International Crops Research Institute for the Semi-arid Tropics, (ICRISAT).

Rejesus, R. M., Palis, F. G., Rodriguez, D. G. P., Lampayan, R. M., & Bouman, B. A. (2011). Impact of the alternate wetting and drying (AWD) water-saving irrigation technique: Evidence from rice producers in the Philippines. *Food Policy* 36(2), 280–288.

Roodman, D. 2004 The anarchy of numbers: Aid, development and cross-country empirics. Washington, D.C., Center for Global Development.

Sarwar, M. N., & Goheer, M. A. (2007). Adoption and impact of zero tillage technology for wheat in rice-wheat system: Water and cost saving technology: A case study from Pakistan (Punjab). Prepared for the International Forum on Water Environmental Governance in Asia, Bangkok, March 14–15.

Stone, G. D. (2011). Field versus farm in Warangal: Bt cotton, higher yields, and larger questions. *World Development,* 39(3), 387–398.

Xiaoyun, L., Xiuli, X., & He, L. (2005). *A socio-economic assessment of the System of Rice Intensification (SRI): A case study of Xinsheng Village, Jianyang County, Sichuan Province*. Report for College of Humanities and Development, China Agricultural University, Beijing.

Zeng, D., Alwang, J., Norton, G. W., Shiferaw, B., Jaleta, M., & Yirga, C. (2015). Ex post impacts of improved maize varieties on poverty in rural Ethiopia. *Agricultural Economics* 46(4), 515–526.

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