



The Agricultural Resource Management Survey

An information system for production agriculture

The ARMS

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Abstract

Purpose – The purpose of this article is to offer an introduction of the Agricultural Resource Management Survey (ARMS) for applied research in agricultural finance and farm management.

Design/methodology/approach – This article provides a brief overview of the history, design, use, and accessibility of the ARMS in government reporting and applied research.

Findings – The ARMS provides a number of unique advantages for addressing critical issues of the agricultural sector.

Originality/value – The paper provides an access point for researchers who are unfamiliar with the basic features of ARMS.

Keywords Agricultural Resource Management Survey, Research, Agriculture, Resource management

Paper type General review

The Agricultural Resource Management Study (ARMS) is the annual survey of farm and ranch operators conducted by USDA to obtain information about the status of farmer's finances, resource use, and household economic well being. The ARMS is uniquely positioned as the only annual national source of data collected by the Federal Government that enables the financial status of farm businesses to be related to the economic health of farm families and to the use of the nation's natural resource endowment. The uniqueness of ARMS is further enhanced by its ability to provide information about the diverse mix of businesses and families that make up the farming sector of the national economy, ranging from small part-time or limited-resource operations to farms with sales and assets of many millions of dollars.

Since 1996, ARMS data have provided a direct link between the financial status of farms and its operators' household and the farms' commodity production practices. It serves as the primary source of information for a wide range of USDA analyses, programs, and research, and it also plays an important role in academic research related to the financial conditions of the agricultural sector.

A brief history of ARMS

The ARMS had been in use as USDA's farmer finance-resource survey since 1996. The ARMS survey instrument was created by fully integrating survey instruments that had collected data on farmer's cropping practices with a survey focused on collection of farm production and business-related structure and finance data. These predecessor surveys to the ARMS (Farm Costs and Returns Survey (FCRS) and the Production



Practices and Use Survey) had been in use by USDA since the mid-1980s. This history provides a context both for assessing annual results and for interpreting how specific weather, market, or policy events, including changes in rural labor markets, may have affected a farm or household's economic status in the survey year (USDA, n.d.).

The genesis of the current ARMS survey is the 1974 legislation that required USDA to:

[...] conduct a study of the costs of producing wheat, feed grains, cotton, and milk and to produce annual estimates of costs that were representative of the sizes and types of farms engaged in production, and the range of technologies in use.

This led to the development of the Costs of Production surveys for each commodity and the Economic Research Service (ERS) and NASS joint Farm Production Expenditure Survey (FPES). FPES contained detailed questions about production practices and input use in crop and livestock production, and about expenditures for the business as an establishment. However, information for sales, inventories, assets, or liabilities of the business was either incomplete or non-existent in surveys conducted during the late 1970s and into the early 1980s.

The incomplete information of the existing (enterprise and establishment) surveys proved costly during the 1980s farm crisis as ERS and NASS were charged with measuring the extent of the financial difficulty in US farming, rural communities, and financial institutions. In addition, it was increasingly obvious that the traditional "one farm, one farmer, and one household" concept was inadequate for describing the modern farm sector. Thus, there was an apparent need for survey data which more accurately reflected the structural realities of the farm business and the relationship of households to their farm business establishments.

The solution for the 1984 calendar year survey was to merge the independent Costs of Production surveys and FPES, called the FCRS. Figure 1 shows the timeline of the development of the current ARMS design in reference to the 1984 FCRS. The survey methodology used in collecting the FCRS was updated to a probability-based, stratified, multiple frame survey. It consisted of a sample drawn from a list frame of medium to large farms and a complimentary area frame for completeness that covered new entrants and smaller farms. Content developed for the initial 1984 survey was insufficient to develop an estimate of an accrual-based net income, so analyses of financial status and performance were constrained to cash based measures.

In addition to improving measurement of financial indicators for farms and farm households, FCRS also changed the design of the Cost of Production surveys. The redesigned Cost of Production questionnaires now included farm and household-level data that provided a direct link to the detailed expenditure version of the survey.

Recognizing that cash based measures of financial indicators were incomplete, ERS staff revised survey questionnaires in the 1980s to enable more complete specification of the income statement and balance sheet for farm businesses. New questions measured depreciation and changes in inventory value, providing the basis to move from cash based measures of income to an accrual basis. Three other important data improvements also occurred during the mid-1980s. First, the survey explicitly accounted for contract arrangements in commodity production. This was important because it allowed assignment of income and expenses to the appropriate entity. For example, under contract production arrangements the farm typically does not own the commodity

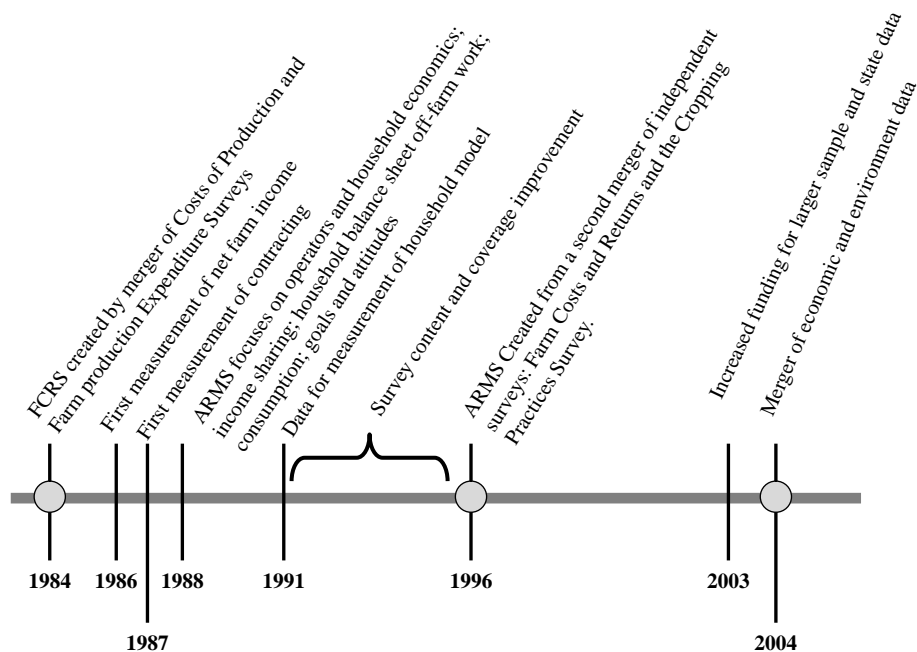


Figure 1.
Time path to the
development of ARMS

being produced. Rather, the producer receives a payment for services provided under the contract. Retaining the total value of contract production in farm operator financial statements would overstate performance by the amount of return that belonged to the contracting party.

The second major data improvement occurred in the 1987 survey. Farm operator income was calculated properly after separately measuring the output and income that belonged to both contract firms and landlords. This was a benchmark achievement in the production of financial statements for farms. We could say that both the income statement and balance sheet produced for a farm not only reflected economic and accounting standards and concepts, but that their components were cleanly partitioned among farms, landlords, and contractors.

Third, surveys conducted for 1986 and 1987 were the first attempts to collect farm operator household information. Information was collected for four components of off-farm income: non-farm-related business income, wages and salaries, interest and dividends, and all other non-farm sources of income. Demographic and other information, such as primary occupation, operator age, and education level, which put farm and household income into a broader context that extended beyond the association with a business, were also collected. Off-farm income data collected during this period provided the first opportunity to develop a perspective about the ability of households to service debt out of total income.

In 1996, ERS and NASS agreed to a second merger of independent survey activities. This merger combined the FCRS and Cropping Practices surveys conducted by USDA. The Cropping Practices survey focused on collection of yield, production practices, and input use data at the field-level. Advantages of this merger were to link household

and farm economic data to field level chemical use and production practice data and to expand information available for assessing cost distributions and technology and practice adoption. As part of the merger, the sample design was reexamined to make sure that it adequately represented the population of farms as monitored and reported by NASS. New summary and estimation procedures were devised for use with the revised sample design. An outcome of this merger was a survey that combined multiple survey activities into an integrated survey conducted in phases at different times of the calendar year and that featured a highly flexible modular design.

Merger of independent surveys into the ARMS also set the stage for further integration of the ARMS into NASS' on-going Census and national survey programs. Integration with the Census of Agriculture was accomplished in 1997 by including questions in the ARMS survey instrument that were needed to complete a Census questionnaire. Potential sampling problems (duplication) were solved by not mailing Census questionnaires to anyone on both the Census list and the ARMS sample list. The practical result of the Census-ARMS integration was to strengthen the ARMS sample, edit, and summary programs and procedures by drawing from routines created for the Census. Even beyond this, the integration of ARMS and Census provides a direct link from the ARMS to the Census. Thus, if the ARMS sample design was robust, aggregate expansions from the ARMS should reproduce, after allowing for sample and non-sampling error, official USDA estimates produced from Census and other survey activities.

ARMS design characteristics

ARMS data are collected in an information system framework where agricultural issues, economic theory, and basic accounting concepts guide survey design and data collection. Farm businesses are the primary sampling unit and include all establishments that sold, or normally would have sold, at least \$1,000 of agricultural products during the year (NASS, 2011). For the purpose of conducting the Census of Agriculture, NASS maintains a list of farm and ranch operators. The list is obtained from official USDA records, as well as outside sources. A profile of each farm is maintained which indicates what the farm has produced historically and a general indication of the size of the operation. The ARMS sample population is selected using a dual sampling frame approach to provide complete coverage of the target population. A list frame is used to identify all relevant farm operations, and an area frame is used to ensure that the sample accurately depicts the population geographically. The area frame is also designed to compensate for farms not on the list frame and is particularly effective in capturing farms with small expenses and income.

The ARMS utilizes a modular design in order to reflect complex farm production, organization, and financial structures. The ARMS design and data collection calendar are shown in Figure 2. The first phase of the survey includes a screening of respondents and is conducted in July through August of the reference year. The second phase of the survey is designed to collect field level information on agricultural practices and resource use and is conducted in the fall of the reference year. The second phase also collects information on crop enterprise Costs of Production, enterprise management practices, and technology adoption. The third phase of ARMS collects information for farm business and household finance and structure; whole-farm management practices and technology adoption; and household labor and financial asset allocation decisions. The information for ARMS Phase III is collected in the spring following the reference year.

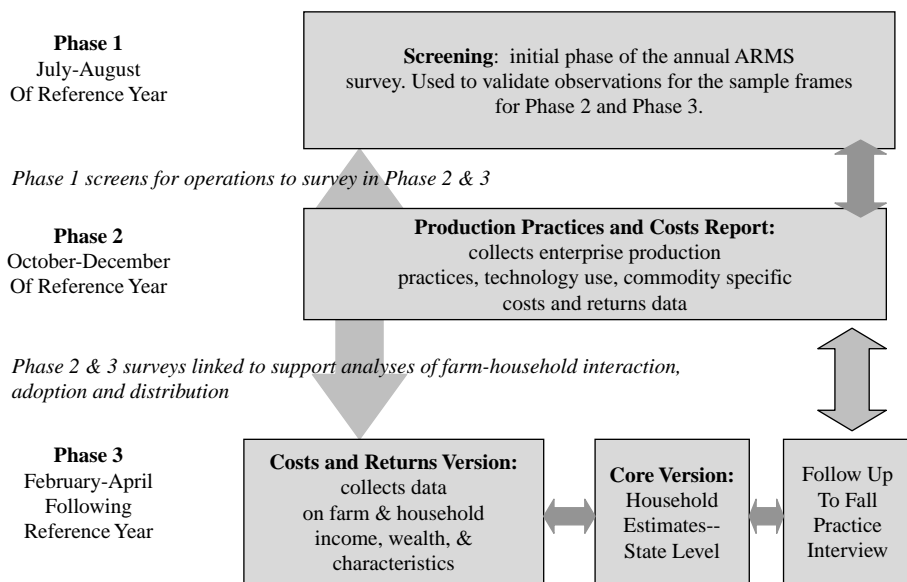


Figure 2. ARMS has a modular design to reflect complex farm-household production, financial structure, and organization

Phases II and III of the survey can be linked because the operation associated with the field surveyed in Phase II is part of Phase III. Therefore, specific production practices and other environmental issues can be assessed based on the financial performance of the business or household.

The total sample size for ARMS is approximately 35,000 farms. A set of 16,500 farms are allocated to the mail-interview. The information for the remaining 18,500 farms is collected by personal interview. As shown in Figure 2, the mail-interview version of the survey is called the “core version”, and the personal interview version is called the “cost and returns version”. The core version is an abbreviated version of the survey questionnaire. All of the questions of the core version are included in the cost and returns version, but the cost and returns version includes additional questions. The core version is used to increase the total sample size and ensure the reliability of state-level estimates of key indicators. Of the 18,500 farms, as many as 3,000 enterprises are selected for the Phase II survey.

Phase II surveys focus on a particular commodity or set of commodities which rotate across reference years. The Phase II survey for reference year 2007 included tailored surveys for apples, cotton, and rice, and in 2009 the commodities included winter, spring, and durum wheat. The information collected in Phase II is designed to measure field level production practices and costs. Questions involve acreage, seed, field characteristics, crop insurance, fertilizer, pesticide, pest management practices, specific field operations, drying, and irrigation. For the major inputs, application rates, costs, and type of product are identified. In addition to specific practices, field operations focus on types of equipment used, labor, and custom hire services.

Content of Phase III questionnaires is guided by information required to conduct financial analysis of the farm business and principal farm operator household. For farm businesses, specific components of farm income and expenses

(including capital purchases) are collected. This information forms the basis for cash and accrual estimates of farm business income. Farm business financial structure is measured by asking about specific components of farm business assets and liabilities. Farm household finances involve capturing farm operator sources of off-farm earnings in addition to the share of income from the farm business for the principal operator's household. Farm operator household wealth represents the combination of non-farm assets and liabilities and the operator's share of farm business net worth.

ARMS data in economic research

The ARMS supports five key uses of enterprise, farm, and household data within USDA. These uses correspond with mandated activities required by the US Congress, government wide responsibilities delegated to USDA, assessment of USDA policies and programs, and enabling research to inform public and private decision makers on agricultural and farm issues. The ARMS is the source of primary data to help satisfy four requirements that the Congress has established. These mandated activities include:

- (1) to develop and report estimates of commodity costs and returns for selected commodities (wheat, feed grains, cotton, milk);
- (2) report estimates of net farm income for commercial producers of selected farm types (producers of program crops, other crop commodities and livestock);
- (3) produce an index of prices paid by farmers (ARMS provide weights for computing the index); and
- (4) generate a report providing current demographic and structural information and trends for family farms.

The Congress was specific in stating what it wanted included in the required estimates and reports. For example, costs and return estimates must include all typical variable costs, interest, a return on fixed costs and return for management along with the various production practices used by farmers in a weighted national average estimate. To meet the reporting requirement for incomes of commercial business establishments and the costs and returns for major commodity groups, the ARMS sample design has to be representative of all farm types and sizes. Requirements to produce and report estimates also lend support to the need to collect sufficient data to establish income estimates for households, including income from both farm and non-farm sources.

In addition to Congressional estimation and reporting requirements, USDA holds farm sector income estimation responsibilities along with internally initiated reporting requirements for household income. In 1956, the US Office of Management and Budget tasked USDA with the responsibility to produce annual estimates of sector-wide net farm income. These estimates are transmitted to the US Department of Commerce for inclusion in the National Economic Account estimates of gross domestic product and personal income. The ARMS is a key resource used to produce the sector-wide estimates of income, especially production expenses and farm-related income components of the account where ARMS is the only annual source of data. Supporting the National Economic Accounts had an influence on sample design and survey content much like the congressionally required data series. Fortunately, the data uses are complementary, basically requiring that the sample be representative of all US agriculture. However, support for the National Accounts does have an effect on questionnaire content.

For example, we make an extra effort to ask about dwelling values so that implicit rents can be calculated and we ask about capital expenditures for use in estimating what it would cost to replace capital used in production.

Rounding out ARMS as a complete information system, the data enable a wide range of research by both USDA staff and staff located at universities and other institutions that conduct research in the public interest. ARMS is the only source of national survey data to underpin research on farmers' decisions to adopt new and emerging technologies and to relate those decisions to the economic performance and structural attributes of farms and farm families. Key technology adoption decisions being tracked in the ARMS includes the choice of bio-engineered seed, the selection of waste management practices by livestock producers, and the use of information management technologies, ranging from precision farming in crop production to using the internet to sell commodities and to purchase inputs. The annual assessment of the financial performance of farm businesses is conducted using these data. The economics of farm operator households and comparisons with non-farm households are based on ARMS. ARMS data facilitate measurement of the economics of various environmental practices. These data also form the basis for research conducted by the ERS and other government agencies. In addition to basic research, ARMS data are the core of economic intelligence for production agriculture necessary for policy analysis and evaluation of current programs. ARMS data are also used as input in a variety of forecasting and farm economy models.

Throughout its history, agricultural economics has addressed important issues at the farm-level, including management decisions, technology adoption, and the impacts of farm policy. In an effort to address these important issues, a large volume of literature relied on evidence provided by state or regional level data. ARMS data have been widely adopted in a number of studies across the discipline and within *Agricultural Finance Review* specifically because they offer insights at a larger scale. Mishra and El-Osta (2009, p. 248) argue the value of ARMS to provide "national farm-level data with the unique feature of a larger sample than previously reported" and that the data allow for the comparison of farms "of different economic sizes and in different regions of the USA".

ARMS data have been widely adopted throughout agricultural and applied economics. To date, over 150 published journal articles have employed ARMS microdata or ARMS-based aggregate estimates. These studies have had a high impact on the literature with over 1,800 total citations (according to Google Scholar citations listed on August 8, 2011). The average citations per paper measure 11.7 or 2.4 per year. Over 180 authors have contributed to these studies which appear in more than 50 journals. ARMS related research has appeared in almost all agricultural economics journals; examples include *American Journal of Agricultural Economics* (Goodwin, *et al.*, 2003), *Food Policy* (Tauer and Mishra, 2006), *Journal of Agricultural and Resource Economics* (Key and Kaplan, 2007), and *Journal of Agricultural and Applied Economics* (Fernandez-Cornejo *et al.*, 2002). In addition, ARMS-based research appears in several general audience economics journals, including *Journal of Political Economy* (Kirwan, 2009), *Journal of Econometrics* (Morrison-Paul and Nehring, 2005), and *Economic Policy* (Hertel, *et al.*, 2007).

Articles drawing on ARMS in *Agricultural Finance Review* include studies of both the farm business and the farm household. The 1996 ARMS was used in a study of the profitability of limited-resource and small farms by Mishra *et al.* (1999) and in a study of off-farm investments of farm households by Mishra and Morehart (2001).

Goodwin and Mishra (2000) examine farm financial risk based on the interest rates charged on agricultural loans in the 1997 ARMS survey, and the variation in interest rates reported by farm operators was also explored by Kropp and Whitaker (2011) who estimate the impact of direct payments on the interest rate on short-term operating loans using 2007 ARMS data. Mishra and Goodwin (2003) examine the adoption of crop and revenue insurance based on evidence from the 2001 ARMS survey.

Examples of farm household research include Mishra and El-Osta (2009), who study the factors that influence farm household wealth accumulation using the 2001 survey. Mishra and El-Osta (2001) examine the variability of farm household income related to net farm income and off-farm income sources in 1995 and 1999. El-Osta (2010) estimates expenditure elasticities among farm households based on the 1997 survey.

ARMS accessibility

ARMS data may be made available to researchers and other government agencies that have collaborative projects with ERS or NASS, which contribute to the public sector mission of USDA. These must be formally administered through a contract, cooperative agreement, or memorandum of understanding. Entities and individuals outside USDA with access to confidential survey data are subject to the same Federal statutes that apply to USDA and its employees. Under these statutes, individuals who unlawfully disclose confidential data are subject to fines and other penalties. All reports, publications and releases based on survey data must pass strict non-disclosure reviews.

To expand external researcher access, ERS and NASS developed dynamic, technologically advanced, and easy to use web-based data delivery tools that are readily available through the ERS web site (www.ers.usda.gov). Researchers now have instant access to tailored information about agricultural production technology, farm business viability, and the structure of US agriculture. Since its launch in November 2004, the customized data summary tool has averaged 936 unique visits per month (Figure 3). It has become a main feature of the ERS web site data page and has been widely accepted and used by our customer base. Online access makes analyzing natural resource, technology adoption, farm business, and farm household issues less costly and more efficient.

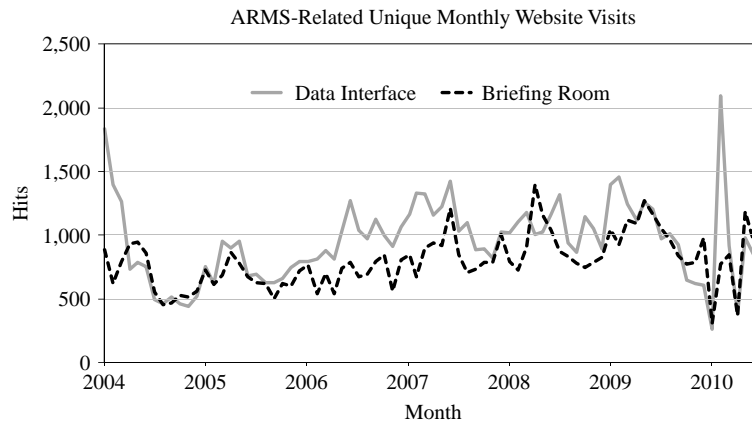


Figure 3.
ARMS related unique
monthly web site visits

In 2006, ERS initiated a pilot project with the National Opinion Research Center (NORC) to investigate developing secure, remote access to ARMS data. The NORC data enclave provides a confidential, protected environment within which authorized researchers can access sensitive microdata remotely from their offices, an approach that combines good researcher access with researcher training and administrative support. The enclave uses Citrix technology to prevent outsiders from reading data transmitted between the researcher's computer and NORC's network and to prevent the user from transferring data from the data enclave to a local computer. Output is disclosure reviewed before results are removed. Currently 13 researchers from ten states representing 11 academic institutions are using the data enclave to accomplish their research, increasing the value added of the ARMS data collection through high quality analysis, deeper insights into key issues and by tapping into a broader analytic community. They are also able to address questions at a more local level than can be done directly at ERS. Participants have achieved greater efficiency and lower costs by not having to undertake the time and expense of travel to USDA offices, and the support burden on these offices has been reduced.

An evolving survey

The ARMS has an extensive record of innovation and adjustment that stretches through its predecessors to the 1970s. This course has enabled ARMS to avoid obsolescence in design and implementation, in content, and in interview schedules established to provide key commodity and issue coverage. As a result, ARMS has been at the forefront of data collection activities in informing the department, the farm community, and the public about the performance, financial status, and changes on-going in US farming.

The farm sector and farm communities are continuing to undergo major changes, as a result of new production and information technologies, changes in markets, and changes in commodity, environmental, and a wide variety of other policies, programs and regulations. The "leading edge" of farming continues to adopt new practices, governance structures, and ownership strategies. In an effort to stay abreast of changes across the agricultural sector, ARMS features an evolving set of specialized questions that address specific policy needs or public concerns. For example, the 2004 survey included a set of questions related to computer use and internet adoption, and the emerging use of bioenergy has been addressed in surveys starting in 2008. To reflect these adjustments in farming and rural economies, ARMS has to remain a flexible, adaptive program going forward.

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