Agricultural Extension: The Precursor To Today's Technology Transfer

By Mojdeh Bahar and Robert Griesbach

Abstract

Agricultural extension and technical services are important and unique features of the U.S. agricultural system. Extension outreach and technology transfer to stakeholders enable and empower the U.S. agricultural sector. Extension legislation and policies have also been mirrored in many of the technology transfer legislation and policies. One could argue that extension was the first form of technology transfer in the United States. Moreover, extension's principles have been integrated in many U.S. technical assistance programs outside the United States. This paper examines the genesis of the extension program, its relation to dissemination of scientific information, and its effect on subsequent laws and policies.

Introduction

The United States was founded on an agricultural economy. In 1800, approximately 75 percent of the nation's exports were agricultural products.[1, 2] It was apparent to our first four presidents, all farmers, that a strong economy depended on an innovative agricultural sector.

The U.S. Department of Agriculture (USDA) has over 150 years of experience in delivering science-based knowledge and solutions to stakeholders. Agricultural extension and technical services are important and unique features of the U.S. agricultural system that support the demonstration and diffusion of agricultural products, information, and technologies. Agricultural extension outreach and technology transfer to stakeholders enable and empower the U.S. agricultural sector. Interestingly, this paper will show that extension legislation and policies are mirrored in many of the current technology transfer statutes and policies. In fact, one could argue that agricultural extension was the first form of technology transfer in the United States. Additionally, the same extension principles are integrated in many U.S. technical assistance programs administered outside the United States. This paper examines the genesis of the extension program, its relation to dissemination of scientific information, and its effect on subsequent laws and policies.

Technology transfer in the United States originates in the U.S. Constitution. The framers of the Constitution valued the promotion of innovation. Article 1, Section 8, Clause 8 states: "Congress shall have power… to promote the progress of Science and useful Arts by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." This clause serves as the genesis and authority for both copyrights and patents. Approximately a year after the Constitution was ratified, Congress passed the Patent Act of 1790 "to promote the progress of useful Arts." From the very beginning, patenting played a role in promoting the adoption of new and innovative agricultural technologies. On July 31, 1790, Samuel Hopkins received the first U.S. patent for a process of making potash, an ingredient for use in fertilizer. This patent was signed by President George Washington.[3]

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Communicating Innovation in Agriculture

The ideas set forth in the Constitution were promoted in part by a Congressional charter in 1816 to create the Columbian Institute for the Promotion of Arts and Sciences ("Institute"). With an economy fueled by agriculture, there was a need for the systematic collection and distribution of the latest information on new farming practices, as well as the introduction and marketing of new and improved plant cultivars to all U.S. farmers. In theory, the Institute provided a perfect means of knowledge transfer, functioning as a clearing house to make new innovations available for wider distribution and adoption. In 1839, a year after the expiration of the Institute's charter, Congress established the Agricultural Division within the United States Patent Office (Patent Office) which later became the USDA. This Division gained importance and visibility over time. In fact, in 1849, the Agricultural section of the annual report of the Patent Office was published for the first time as a separate, stand-alone volume with numerous scientific and practical papers written in common language. In 1860, Superintendent of the Agricultural

Division, Thomas Clemson stated:

*"It is the duty of the government to care for this immense property, and to prevent exhaustion of the soil and depopulation. This can be done by **diffusing** [emphasis added] agricultural knowledge … The publication of a Report on the subject of Agriculture, in which information could be authoritatively presented and diffused, would be of the greatest value. In the yearly Report it is important to give a summary of the advancement of this science [chemistry] connected with agriculture."*[4]

The concept of "diffusion" of agricultural knowledge became the foundation of agricultural extension—a distillation of innovations communicated to farmers by intermediaries who understood the scientific language and could translate to farmers—arguably technology transfer as it is understood today.

Innovation and the Civil War

The Civil War created a farm labor shortage with approximately 75 percent of the 2.75 million soldiers being farmers. In order to meet food demands, there was an urgency to couple mechanized production with improved cultivars for more efficient production systems. Recognizing the urgency, President Abraham Lincoln and Congress in 1862 established the USDA:

"There shall be at the seat of government a Department of Agriculture, the general design and duties of which shall be to acquire and to diffuse among the people of the United States useful information on subjects connected with agriculture, rural development, aquaculture, and human nutrition, in the most general and comprehensive sense of those terms, and to procure, propagate, and distribute among the people new and valuable seeds and plants." (7 U.S.C. § 2201).

In 1890, Edwin Willets, Assistant Secretary of Agriculture, established the policy that all research conducted by the Department would be "mission-oriented to a *practical objective*"[5] [emphasis added]. To date, this principle is the driver of agricultural research in the USDA. In fact, the mission of the Agricultural Research Service ("ARS"), the current principle research agency of the USDA, states: "ARS delivers scientific solutions to national and global agricultural challenges."

Morrill Land-Grant Act: Creation of Land Grant Universities

In addition to establishing the Department of Agriculture, Congress in 1862 passed the Morrill Land-Grant Act (7 U.S.C. § 301 *et seq.*). Under this act, the government granted federal land to individual states to support:

"the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

The land-grant college model was expanded in 1890 by the second Morrill Act (ch. 841, 26 Stat. 417, 7 U.S.C. §322 et seq.). This act contained a provision that resulted in the creation of separate land-grant schools for students of color, *i.e.,* historically black colleges and universities ("HBCUs"). Today, 19 institutions in 18 states are officially recognized as 1890 Schools.[6] Not only did the government provide land and resources to the states for colleges, it also provided human and intellectual capital. The creation of land-grant universities and the experiment stations they house helped fortify the infrastructure for agricultural extension.

The Hatch Act: Creation of Agricultural Experiment Stations

In 1887, the passage of the Hatch Act (7 U.S.C. § 361a *et seq.*) gave each land-grant college funds to establish an Agricultural Experiment Station. The stations were to be used:

"to promote scientific investigation and experiments … bearing directly on the agricultural industry of the U.S. … due regard to the varying conditions and needs of the respective states…"

The land-grant Agricultural Experiment Stations served as demonstration farms for the state in which the respective colleges were located. Yearly field days for farmers were held to demonstrate cultivar comparison trials, new production practices, and new equipment. This practice continues and field days are still being held at these stations. These experiment stations served as pioneers to be emulated by what today would be perceived as "proof of concept" centers and demonstration/education centers in other sectors.

The Smith-Lever Act: Creation of Cooperative Extension Services

In 1914, the Smith Lever Act (7 U.S.C. § 341 *et seq.*) established a system of Cooperative Extension Services connected to the land-grant colleges to:

"aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture."

Among other things, this act recognized that many citizens did not have the time or funds to attend formal college classes. This act created an early form of the cost-sharing model requiring matching funds from federal, state and local sources where the state is the dominant funding source. This not only recognizes the

existence of different stakeholders in agriculture, but also helps bring together funding and resources from stakeholders at different levels. This concept underlies many of today's collaborative projects between government entities and universities, and eventually other third parties.

Elsewhere, the Smith Lever Act describes:

"Cooperative agricultural extension work shall consist of the development of practical applications of research knowledge and giving of instruction and practical demonstrations…"

Much like the experiment stations, knowledge dissemination and demonstration of new methods and machinery were essential functions of cooperative extension services.

Cooperative extension was not only a means of dissemination of scientific and technological information, but it was also integrated in everyday life and culture. In 1948, Norman Rockwell captured the "The County Agent" for a *Saturday Evening Post* cover. This well-known painting typified the Cooperative Extension Service. Each county in the United States had an extension office with an extension agent that visited farms and families. The extension agent provided research-based advice on a wide range of subjects, such as what crops to grow, livestock feed, food safety, human nutrition, or consumer finance. Extension agents were not only represented in period art pieces but were depicted as characters in popular television shows.

The Bankhead-Jones Act: Funding Research and Extension

In 1935, the Bankhead Jones Act (7 U.S.C. § 427a-h), commonly known as the Agricultural Research Act, provided funds to the Secretary of Agriculture:

"to conduct research into the laws and principles underlying the basic problems of agriculture in its broadest aspects ... and to disseminate information relative thereto."

The basic research authorized under this act was initially conducted within the USDA. The state agricultural experiment stations and federal and state extension services would be responsible for the dissemination of information related to the research.

The Bankhead-Jones Act also established the framework for collaborative research with federal laboratories and other organizations in the public and private sectors. Collaboration agreements were required to either place the resulting research in the public domain or assign it to the federal government. The USDA would seek patent protection to technologies assigned to the federal government but license those technologies non-exclusively without cost or royalties.

The Bankhead-Jones Act appropriated funds for the purchase and/or rental of land, construction of and maintenance of laboratory buildings, and purchase of scientific equipment. The 1938 Agricultural Adjustment Act (P.L. 75-430) further defines the construction of new facilities that were to be both research laboratories and pilot plant facilities for the commercial scale-up of USDA laboratory research. Many of the research projects had commercial partners that worked with the USDA scientists in the pilot plants. Pringles™ potato chips, lactose-free milk, permanent press cotton and xanthan used in foods, toothpastes and medicines are some of the commercialized products based on the research outcomes of the pilot plants.[7]

During the 1970s, the USDA reorganized to more closely focus on research and technology transfer. At this juncture, non-research activities were removed from ARS.[8] For example, animal and plant health regulatory functions were moved to a newly created Animal and Plant Health and Inspection Service (APHIS). In order to facilitate the adoption of research outcomes, the ARS mission statement was amended to read:

"To conduct research to develop & transfer solutions to agricultural problems of high national priority and provide information access and dissemination."

Recently ARS's mission statement was simplified to read:

"ARS delivers scientific solutions to national and global agricultural challenges."

Technology Transfer Legislation: Bayh-Dole and Stevenson-Wydler

With the passage of major technology transfer legislation in 1980 and 1986, every ARS researcher was responsible not only for conducting research but also to ensure that research results were transferred to appropriate stakeholder(s). The extension service shifted focus to the transfer of academic research results because all intramural research programs at ARS now had a technology transfer or "extension"component.

Many decades after the implementation of agricultural extension, specific technology transfer legislation was enacted with language that broadened concepts found in extension legislation to all federally owned research and technologies. For example, the Bayh-Dole Act, (35 U.S.C. §§200-212) defines the term "practical application," previously used in the Smith-Lever Act:

"(f) The term "practical application" means to manufacture in the case of a composition or product, to practice in the case of a process or method, or to operate in the case of a machine or system; and, in each case, under such conditions as to establish that the invention is being utilized and that its benefits are to the extent permitted by law or Government regulations available to the public on reasonable terms."

Section 209, authorizing the licensing of federally owned inventions, further underlines the importance of "practical application" of an invention, which enables the public to benefit from the results of federal research and development efforts. Section 210 specifically states that the Bayh-Dole Act will take precedence over the provisions in the Bankhead-Jones Act that relate to the disposition of rights in inventions derived from collaborative research agreements with private or public sector organizations.

The Stevenson-Wydler Innovation Act of 1980 ("Stevenson-Wydler") (15 U.S.C. §§ 3701-3709) refers to "application of this new knowledge." Stevenson-Wydler was amended in 1998 by the Technology Transfer Commercialization Act that refers to "practical utilization" and "practical application" of an invention.

The Federal Technology Transfer Act of 1986 (15 U.S.C. § 3710) established Offices of Research and Technology Applications and charged them with assessing potential commercial applications of inventions, yet again underlining the importance of a technology's application and the practical use of federal research and development.

The notion of information dissemination in the Hatch and Smith-Lever Acts also permeates these more recent technology transfer statutes. The Federal Technology Transfer Act designates the National Technical Information Service as the clearinghouse for "the collection, dissemination and transfer of information on federally owned or originated technologies…"[11] Similarly, Stevenson-Wydler emphasized the importance of accessibility of research results by the public:

"The Federal laboratories and other performers of federally funded research and development frequently provide scientific and technological developments of potential use to State and local governments and private industry. These developments, which include inventions, computer software, and training technologies, should be made accessible to those governments and industry…."[9]

Similar to the Hatch, Smith-Lever, and Bankhead-Jones Acts, Stevenson-Wydler also recognized the need for collaboration between academia, industry, and federal labs and enables such collaboration between and among these players. The statute provides:

"Cooperation among academia, Federal laboratories, labor, and industry, in such forms as technology transfer, personnel exchange, joint research projects, and others, should be renewed, expanded, and strengthened."[10]

These laws emphasize the need for exchange of information and knowledge among government, academia, and industry, and establish public-private partnerships as the cornerstone of today's scientific endeavors. However, the USDA has focused on the concept of collaboration and information dissemination since its inception. In his 1864 State of the Union address, President Abraham Lincoln coined the phrase the "People's Department," acknowledging the role of the USDA in solving problems for the benefit of all. The ARS is, and began as, a problem-solving agency. Before "technology transfer" became a modern-day phrase, it was the culture of USDA to solve problems and deliver solutions. Over the last century, USDA research and extension has adapted to the changing country. While only two percent of Americans live on a farm today,[11] the USDA is still the "People's Department," and its research and extension now address a wider array of both urban and rural needs in our modern society.

Extension and U.S. Programs

In today's lexicon, extension is a function that can be applied to various areas such as education, health and rural development.[12] While the cornerstone of extension remains education and communication, the word has been translated to lighting the path, promotion, guidance, advising, or popularization. The principles of agricultural extension and advisory services later became the cornerstone of some of the federal government's national, as well as international technical assistance programs. The Manufacturing Extension Program at the National Institute of Standards and Technology (NIST) serves as an example of such a domestic program. Point Four, a program initiated under President Truman shortly after the end of World War II, serves as an illustration. In the fourth point of his inaugural address, President Truman states:

"…we should make available to peace-loving peoples the benefits of our store of technical knowledge…. Our aim should be to help the free people of the world, through their own efforts, to produce more food, more clothing, more materials for housing and more mechanical power to lighten their burdens."[13]

The Point Four Program was the federal government's first international technical assistance and economic development program established within the Department of State. The program was subsequently renamed the Technical Assistance Program. While the home agency that implemented the program has changed multiple times, today the United States Agency for International Development and the Foreign Agricultural Service administer similar programs in developing countries.

Conclusion

At the USDA, technology transfer has evolved over the past 150 years. Not only have the delivery methods changed, but policies and legislation were developed to improve the transfer and translation of science-based knowledge and solutions to stakeholders. Tracing the different pieces of legislation over the last

200 years underlines the importance of communicating research results and enabling the adoption of research outcomes. These congressional acts emphasize not only the importance of information and knowledge dissemination, but also cooperation among federal, state, local, and foreign governments, industry, and academia to achieve practical application of research results, concepts that are the basis of technology transfer today. ■

Available at Social Science Research Network (SSRN): *https://ssrn.com/abstract=3658636*

Notes:

1. O. P. Auston, "Statistical Record of the Progress of the United States, 1800-1913." *United States, Bureau of Foreign and Domestic Commerce Bulletin* 370 (1913).

2. Even though only nine percent of the nation's exports were agricultural products in 2018, the United States is the top agricultural exporting country in the world. Kimberly Amadea, "US Imports and Exports with Components and Statistics." *The Balance* (2019), *https://www.thebalance.com/u-s-imports-and-exports-components-and-statistics-3306270*. Stephen Simpson, "Top Agricultural Producing Countries." *Investopia* (2012), *https://www.investopedia.com/financial-edge/0712/top-agricultural-producing-countries.aspx.*

3. *https://www.uspto.gov/about-us/news-updates/first-us-patent-issued-today-1790.*

4. "Report Commissioner of Patents for the year 1860, Part II: Agriculture." *Office of Printers to House of Reps*, 1861, p. 6-36.

5. Edwin Willits, "Special Report of the Assistant Secretary," in: Report of the Secretary of Agriculture for 1890, (Washington, DC: G.P.O., 1891), pp. 59-73.

6. 1890 schools: Alabama A&M University (AL), Alcorn State University (MS), Central State University (OH), Delaware State University (DE), Florida A&M University (FL), Fort Valley State University (GA), Kentucky State University (KY), Langston University (OK), Lincoln University (PA), North Carolina A&T State University (NC), Prairie View A&M University (TX), South Carolina State University (SC), Southern University System (LA), Tennessee State University (TN), Tuskegee University (AL), University of Arkansas Pine Bluff (AK), University of Maryland Eastern Shore (MD), Virginia State University (VA), and West Virginia State University (WV).

7. "ARS Utilization Centers' 75th Anniversary." *AgResearch Magazine* 63(10).

8. 15 U.S.C. § 3710 (d)(1)

9. 15 U.S.C. § 3701 (10) 15 U.S.C. § 3701 (3), Stevenson-Wydler Technology Innovation Act of 1980, Public Law 96–480; approved October 21, 1980, as amended through P.L. 114–329, enacted January 6, 2017.

10. 15 U.S.C. § 3701 (3), Stevenson-Wydler Technology Innovation Act of 1980, Public Law 96–480; approved October 21, 1980, as amended through P.L. 114–329, enacted January 6, 2017.

11. American Farm Bureau Federation. Fast facts about agriculture. *https://www.fb.org/newsroom/fast-facts.*

12. Agriculture and rural extension: definitions, FAO.

13. President Truman's Inaugural address, Jan 20, 1949, *www.trumanlibrary.gov.*