Journal homepage
www.ajas.uoanbar.edu.iq
Anbar Journal of Agricultural Sciences
(University of Anbar – Agriculture College)

ROLE OF AGRICULTURAL EXTENSION IN ADOPTION OF SUSTAINABLE AGRICULTURE PRACTICES

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Article info

Received: 2023-01-16
Accepted: 2023-04-07
Published: 2023-06-30

DOI-Crossref:
10.32649/ajas.2023.179947

Cite as:
Hameed, T. S., and B. Sawicka. (2023). Role of agricultural extension in adoption of sustainable agriculture practices. Anbar Journal of Agricultural Sciences, 21(1): 250-260.

Review Article

Abstract

Agricultural extension activities can facilitate the introduction of agricultural innovations to farmers and their adoption because agricultural extension services are the primary conduit through which many agricultural innovations are disseminated. Additionally, agricultural extension studies play a crucial role in boosting agricultural productivity and advancing the sector. It can be challenging to convince farmers to implement the suggestions made through extension programs. There is a recursive, mutually supportive cycle at work between the generation of new knowledge and its dissemination to farmers in a form they can understand through extension.

The adoption of technologies over the long term is linked to extension policies. Contact with extension and attendance at training courses have been shown to be influential in the successful implementation of SAPs, according to a number of studies. This is not a positive sign for innovation adoption and transfer. Due to the low number of farmers who rely on the extension agents, it would appear that the extension service and agents are not performing their duties to promote sustainable agriculture in the region. Whether or not farmers adopt new technologies is contingent on the knowledge and expertise of extension workers and the quality of the information they receive. For instance, this could be because of limitations such as a lack of guidance for agricultural extension workers, which reduced farmers'

access to information sources, or because the extension workers' methods of disseminating that information were insufficient or inappropriate for farmers' needs.

Keywords: Agricultural Extension, Training courses, Information sources.

دور الإرشاد الزراعي في تبني الممارسات الزراعية المستدامة

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الخلاصة

يمكن تقديم الابتكارات الزراعية للمزارعين واعتمادها من خلال أنشطة الإرشاد الزراعي لأن خدمات الإرشاد الزراعي هي المصدر الرئيسي الذي يتم من خلاله توجيه العديد من الابتكارات الزراعية. بالإضافة إلى ذلك، تلعب الدراسات الإرشادية دورًا مهمًا في زيادة الإنتاجية الزراعية وتطوير القطاع. ليس من السهل إقناع المزارعين بتبني وممارسة المقترحات المقدمة لهم من خلال الأنشطة الإرشادية. إن إنتاج المعرفة، ونقلها إلى شكل مفهوم من قبل المزارعين، والإرشاد، وتصور المزارعين لها واستخدامها، يتم في دورة تكمل بعضها البعض. ترتبط سياسات الإرشاد بالتبني التكنولوجي المستدام. كشفت العديد من الدراسات أن الاتصال مع الإرشاد والمشاركة في الدورات التدريبية هي عوامل فعالة في اعتماد برامج التكيف الهيكلي. هذا لا يبشر بالخير لتبني الابتكار ونقله. تشير النسبة المنخفضة للمزارعين الذين يعتمدون على المرشدين إلى أن خدمات الإرشاد / الوكلاء لا يلعبون دورهم في تعزيز الزراعة المستدامة في المنطقة. قد لا يكون للوصول إلى خدمات الإرشاد في حد ذاته تأثير إيجابي على تبني التكنولوجيا، لأن هذا يعتمد على مهارة العاملين في الإرشاد ونوعية المعلومات المقدمة للمزارعين على سبيل المثال، قد يكون ذلك بسبب بعض القيود مثل نقص التوجيه بالنسبة للعاملين في مجال الإرشاد الزراعي، مما أدى إلى صعوبة وصول المزارعين إلى مصادر المعلومات، أو نُهج النشر التي يستخدمها المرشدون، والتي لم تكن مناسبة تمامًا أو لا تتناسب مع ظروف المزارعين.

كلمات مفتاحية: الارشاد الزراعي، الدورات التدريبية، مصادر المعلومات.

Introduction

The history of the society, ecological systems, and economic and technical endeavors necessary for sustainable development make it an ethical imperative to pursue these methods of progress. It highlights the need for an integrated, cross-sectoral approach to problem solving and the importance of promoting economic growth without adding to environmental pressure (coupling). It places an emphasis on the societal

side of health and food safety, participating in the implementation of sustainable development at all levels of management in extensive social circles. Boosting the economy's competitiveness is crucial because, in a free market economy, it is what ultimately ensures the expansion of the economy. (12, 26, 44 and 45).

The European Union's (EU) strategy for sustainable development aims to balance economic growth, social justice, and environmental preservation. (12, 26, 44 and 45). Since this topic has been debated for over 30 years, many different definitions of sustainability have emerged. (41 and 44). Research is needed to define sustainable development in agriculture. The issue of agricultural production has expanded beyond its purely technical roots to include social, cultural, political, and economic factors. (1, 11 and 26).

Sustainable development strategy in agriculture: The idea of maintaining a farm's ability to function for future generations is not new to farming, agricultural science, or agricultural policy. (27, 34 and 44). The productivity of arable land can be maintained in some measure through the use of a variety of agricultural practices. As of late, the idea of sustainability has been making its way into policy-making arenas at all different levels, which has resulted in the dominance of ecological sustainability issues becoming somewhat diminished. (18). Despite its ambiguity and the many ways it can be interpreted, the concept of sustainability is helpful because it captures a number of issues related to agriculture, which is seen as the product of the interaction between human society and the natural environment. (8). There is no sustainable farm or mode of production in general, but each agro-ecosystem is characterized by different threshold of sustainability, which can be met by different technologies and production structures. In the industrial model, the basic entity is managing entity. It is assumed that other entities follow " leading " entity in terms of economic efficiency. In the sustainable model, there is a structure in which all stakeholders play their role including resource providers. Holistic and integral approach to the farm gain in importance including interoperability of plant and animal production.

Sustainable agriculture produces plenty of food without polluting or depleting resources. Nature-based agriculture creates self-sustaining crop and livestock systems. Sustainable agriculture is the agriculture of social values, whose success is linked to vibrant rural communities, rich farm family lives, and healthy food for all. (10). In its definition of "sustainable agriculture and rural development" presented at the 1992 Earth Summit in Rio de Janeiro, the United Nations Food and Agriculture Organization (FAO) stated, "Sustainable development is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations." (36). Such sustainable development (in the agriculture, forestry, and fishery sectors) is non-detrimental to the environment, technically appropriate, economically viable, and socially acceptable because it conserves land, water, plant and animal genetic resources. In 1995, FAO elaborated its definition of sustainable agriculture and rural development to include the following steps:

1. Provide a variety of agricultural products while guaranteeing the quality and quantity of food needed to meet the nutritional needs of current and future generations.
2. Give everyone involved in farming a secure job with benefits, a fair wage, and safe working conditions.
3. keep and improve the productive capacity of the natural resource base as a whole, as well as the regenerative capacity of renewable resources, without interfering with the proper operation of fundamental ecological cycles and natural balances, eradicating the unique characteristics of rural communities, or polluting the environment.,
4. Strengthen agricultural sector independence and resilience to natural, social, economic, and other risks. (36).

The measurement of the sustainability of agriculture has special characteristics, which limit the choice of measurement and testing methods used to determine it. This is due to the nature of the impact of agricultural production on the environment, on the one hand it can degrade, on the other hand, protect the natural environment, and due to the close relationship between the sustainability and local conditions. The characteristics largely depend on the decision of the farmer, type of business production intensity as well as local environmental conditions. The local agro-system should be the determinant of the action of man, due to the fact that the ecological effects of farming methods can only be assessed at the regional level. Because the conditions of agriculture in other countries or regions are often insufficient for the realities of Polish agriculture, this greatly restricts the practical use of results, including sustainability measures applied in other countries and international organization. Sustainable farms have environmental, social, and economic benefits, and a full evaluation of the farm needs to use a variety of indicators that account for the full spectrum of possible outcomes from the agricultural practices that were implemented. (40 and 40). The measurement of the sustainability of farms is a complex task that faces difficulties of both methodological and methodical nature and the difficulties in access to the relevant data (12, 25, 27 and 44).

Adoption of Sustainable Agriculture Practices: Sustainable agriculture is An integrated farming system that will, over the long term, satisfy food and fiber needs, enhance environmental quality, make the most efficient use of resources, sustain the economic viability of farm operations and enhance the quality of life" (19). Despite the fact that There are sustainable agricultural practices, but they are not standard. Farmers use many sustainable agriculture methods. The literature frequently mentions crop rotation, cover crops, no-till and low-till farming, soil conservation, diversity, nutrient management, integrated pest management, rotational grazing, water quality/wetlands, agro-forestry, and alternative marketing. (28). Improving agricultural sustainability is dependent on widespread implementation of sustainable agricultural practices (SAPs). (31 and 39). Improve the long-term viability of agricultural systems by adopting sustainable agriculture practices (SAPs), which have received widespread support in recent years. The purpose of promoting SAPs is to encourage their voluntary adoption. Conservation tillage, legume intercropping, and

legume crop rotations are all examples of SAPs, but there has been little empirical research into the factors that encourage or discourage their adoption and spread. (2). According to (30), It is generally agreed that many countries have seen low adoption rates for them. (33). According to (30) global survey, only 3% of all farmland in Africa, Asia, and Latin America is used for sustainable agriculture at the present time. The United States has only widely adopted a small number of sustainable practices.

Agricultural extension models in adoption of sustainable agricultural technologies: An ever-evolving suite of environmentally responsible farming methods is at the heart of sustainable agriculture (SAPs). Conservation tillage, contour farming, intercropping, cover cropping, organic fertilizers, and integrated pest management are just a few of the most widely used SAPs (IPM). Appropriate SAPs in one region may not be applicable in another due to fundamental differences in the conditions. (46). Thus, sustainable agriculture is not a single practice. (28) However, the current state of progress in sustainable agriculture is poorly understood. One approach that might lead to such understanding is to gain insight into the adoption rate of SAPs. As defined in (33), adoption is the implementation and continued use of a practice. It is different from trial or experiment. Many studies have asserted a limited adoption of SAPs (3 and 21). However, most countries have not officially published this data because it has not been systematically collected through an agricultural census. (39) Thus, we lack knowledge of sectoral, national, and regional SAP adoption. (33). Over the past few years, researchers have steadily broadened the static and dynamic dimensions of the technology adoption theory to encompass a wider range of technology adoption behaviors. (9 and 16). Multiple technology adoption is an important but under-researched aspect of technology diffusion. (38 and 43). The reasons for adopting multiple technologies are an intriguing part of the phenomenon of multi-technology adoption. (13). Many farming systems employ multiple technologies at once to combat issues like weeds, pests, diseases, and poor soil fertility. (14 and 20). (14) emphasized that obtaining reliable impact estimates of technology adoption requires taking into account the interdependencies between technologies being considered. Therefore, it is crucial to model the processes, determinants, and impacts of technology options in a multiple technology choice framework for analysis of adoption and impact the impact of different intensification practices on farm income and agrochemical demand needs to be better understood so that sustainable agricultural intensification policies can be developed. (13).

Transfer of Technology (TOT) Model: In the 1950s, agricultural research primarily followed the pure transfer of technology model. In this model, innovation is generated in developed countries and then spread to developing ones via a chain of intermediaries, including research stations, extension officers, and farmers. (23). The underlying assumptions were: (Poor-country farmers are stuck in the past and require a radical change if they are ever going to join the modern world. The frontier of global scientific knowledge is in one place. Agricultural technology can be used anywhere in the world, regardless of the climate.) (24). The farmer is viewed as a recipient of new technology in the transfer of technology model; if the farmer chooses to adopt the technology, the farmer is seen as progressive. Failure of

adoption is attributed mainly to psychological factors: irrationality, conservatism and traditionalism. In this model, researcher break-through is transferred to extension for delivery to end-users Farmers in the model are categorized as adopters or non-adopters of technology; they are not seen as the creators of new techniques or methods. (5 and 42). It assumes a linear process of technology transfer, in which farmers are merely the recipients of new innovations. Psychological factors like conservatism, traditionalism, or irrationality are typically blamed when people don't adopt. Only progressive farmers are usually the recipients of this technology (34).

Adaptive Technology Transfer (ATT) Model: This model acknowledged that the location-dependent tech needs and the farmers' habits are no longer taken as seriously as a barrier to adoption. Farmers' ability to adopt new technology is hindered by factors such as a lack of access to credit, so efforts are being made to adapt technology to local conditions and eliminate these factorsIn the 1970s and 1980s, this style was widely used. This model does not incorporate much input from the farmers, so the process of creating and spreading innovations remains primarily linear. It is on this model that the Training and Visit (T & V) extension system operates. For farmers with few resources working in complex ecosystems with limited access to input markets and dangerous weather, the model was a dismal failure (6).

Farming Systems Research (FSR) Model: It was in the 1980s that the FSR model, which aimed to help the world's poorest farmers adopt new technologies, really took off. FSR has significantly impacted the pace of innovation and adoption of new technologies in the agricultural sector. The establishment of a two-way feedback loop between farmers and scientists, along with an emphasis on farmer-made discoveries, on-farm trail goals and constraints, and farmer involvement in the evaluation of experimental crop varieties and agricultural practices, all contributed to this end result. The FSR ethos takes into account the challenges faced by small-scale farmers and approaches the possibility of resolving those challenges with caution. Rather than the other way around, constraints should be used to direct technological development. (23).

Farmer-First Research (FFR) Model: In response to criticisms of the FSR approach to ensuring that research priorities are aligned with farmer needs, FFR was developed. The model does not put enough emphasis on farmers' experience and ability to experiment. The data collected from farmers, the layout of on-farm trials, and the type of technology ultimately recommended for widespread adoption are all under the strict control of the research station's expected staff of agric specialized scientists, social scientists, and their assistants. In contrast to the traditional linear model where scientists are at the beginning of the process and farmers are at the end, the farmer-first model named after (7) but based on the 'farmer-back-to-farmer' model of (32) sees the supply and demand for innovations as a cyclical process where farmers are at the beginning and the end. Since the process is ongoing and built on a foundation of collaboration between experts in the field and farmers in the field, the circle's beginning point is arbitrary. (23).

Farmer-Back to-Farmer (FBT) Model: This is used to develop agricultural technologies that are acceptable to farmers. The model outlines an alternative strategy for addressing technological issues at the farm level. It was designed to increase food production in developing world by emphasizing multidisciplinary teams in the identification, generation, and transfer of appropriate farming technologies. (32). The central idea behind the model is that farmers should be involved at every stage of the research and development process. Researchers think farmers will be more open to new ideas if they have a hand in shaping the conclusions of the research as shown in (Figure 9). Additionally, farmers are seen as co-researchers, developers, and extensionists in the FBF model for the purpose of creating models for the transfer of technology.

Farmer-First-Farmer-Last (FFFL) Model: The Farmer-First-Farmer-Last is a model proposed by (5). It requires reversing learning and research methods. Instead of the scientist's professional preferences, farm families' needs and opportunities determine research problems and priorities. This model gives farmers options to diversify their farming system. It highlights resource-poor farmers' ability to experiment, adapt, and innovate. It views development as a partnership between researchers, extensionists, and rural people. (7). To most, the outsiders play the role of catalysts or facilitators, encouraging the free flow of ideas between partners who can offer critical insights into the problems to be solved and the best ways to do so. (7). The method reflects the growing influence of social scientists and shifts the focus from the recipients to the contributors who receive the information, as was common in early agricultural communication models. (23).and information between various interest groups. This model advocates incorporating rural people's knowledge into scientific knowledge. This is based on the idea that on-farm conditions should be given more attention and that farmers should be more involved in agricultural experimentation. The authors believe that farmer participation in on-farm research will improve technology development to local conditions and properties. Thus, conventional on-farm research largely designed and managed by external researchers was transformed into Farmers Participatory Research (FPR), where farmers are the central actors in research and experimentation. (23).

Beyond Farmer First (BFF) Model: The BFF model was developed by (7). It shows where the farmer-first approach lacks analytical depth and proposes more radical programs that incorporate socio-politically differentiated development views. The model emphasizes gender, ethnicity, class, age, and relationship's impact on research and extension. It emphasizes that local and non-local people have many different, sometimes conflicting, interests and goals and different access to vital resources. Diffuse and piecemeal knowledge emerges as a result of the sporadic and unequal interactions among the actors, who include researchers, extension agents, and farmers. (8). This framework elevates the value of farmers' own empirical inquiry and research. According to this model, farmers' own agricultural performances include a constant risk of injury due to the practice of experimentation.

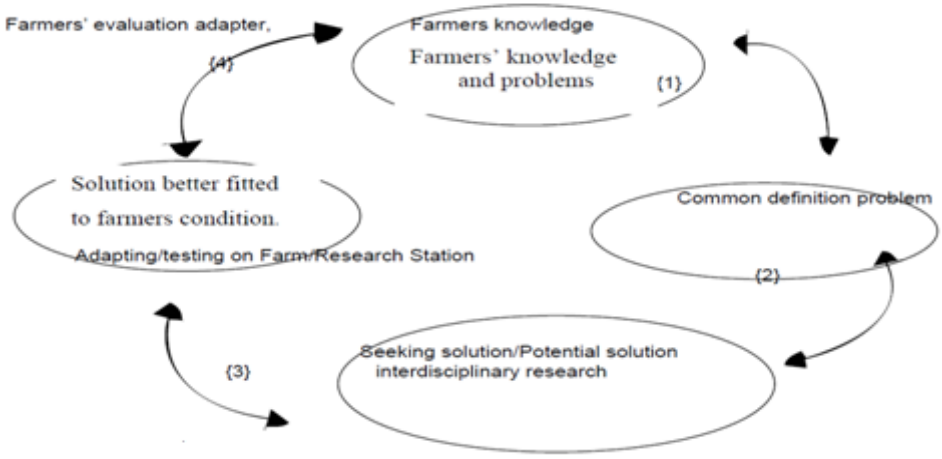

Figure 1 The Farmer-to-Farmer Business Model Source: Adapted from (7).

Barriers to Adoption of Sustainable Agriculture Practices: Most studies on sustainable agriculture adoption have found several obstacles (15). (4) point out that there is a range of constraints that discourage adoption of natural resources management programs. (21) noted that sustainable agriculture practices are management-intensive and require a lot of learning. (37) claim that insufficient managerial abilities and the lack of farmers' information are contributing factors to the failure to adopt. Adoption of sustainable agriculture practices is often cited as being hampered by a lack of information. (21). (22) explains that lack of knowledge about the technical or economic implications of these technologies is one of the reasons farmers are unable to adopt residue management techniques. One major obstacle to widespread use is the general public's ignorance about how and whether these methods can be put into practice. (21 and 29). Insufficient Background Knowledge and Data among Influencers of Change. Adoption is stymied, according to reports, because change agents don't have the information necessary to assist farmers in putting practices into action. (22 and 40). Because of their ignorance, change agents are skeptical of sustainable agriculture and less likely to advocate for it. This may be a significant obstacle to the widespread implementation of environmentally friendly policies. The extension service is crucial to widespread uptake because of the large number of people who can consistently reach farmers through the service. (44 and 45).

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