A Vision to Develop the Effectiveness of the Dissemination of Innovations to Rationalize the Use of Irrigation Water in Iraqi Agriculture

Hussain Khadair Al-Taye 1, Saad Obaid Fayyadh 1 and Ihsan Radhi Hassooni 1

1Department of Agricultural Extension & Technologies Transfer, College of Agricultural Engineering Sciences, University of Baghdad, Iraq.
Email: hussain.khudair@coagri.uobaghdad.edu.iq

Abstract

Iraqi agriculture faces a major water problem, affecting cultivated areas, agricultural production, farmers' incomes and food security. However, the results achieved in rationalizing the use of irrigation water are still limited and do not match what they should be in order to meet this serious challenge. The study aimed to provide a vision for the development of the effectiveness of the dissemination of innovations to rationalize the use of irrigation water in Iraqi agriculture. In light of the framework of the dissemination of agricultural innovations, factors related to their effectiveness, and the summary of the Iraqi experience in the field of dissemination of modern irrigation technologies and the factors related to its limited effectiveness, the vision was prepared to develop the effectiveness of the dissemination of these innovations. The vision consists of eight integrated elements, which are distributed to the internal and external environment for the dissemination of agricultural innovations, which are defined as follows: 1. Enhancing national responsibility and institutionalized partnership. 2. Development of planning. 3. Updating the approach of disseminating innovations. 4. Capacity development. 5. Active supplying. 6. Develop an enabling environment. 7. Establishment and development of infrastructure. 8. Monitoring, evaluation and continuous improvement.

Key word: Vision, Development, Effectiveness, Dissemination, Innovations, Rationalize, Irrigation water.

1. Introduction

According to the National Development Plan for 2013-2017, the country's water deficit will reach about 43% in 2015 from the overall average of its water revenues of 77 billion cubic meters, which will increase in subsequent years [1]. Iraq’s water resources will decline by one billion cubic meters annually, and the amount of these revenues will amount to 28.5 billion cubic meters in 2035 compared to 43.7 billion cubic meters in 2015 [2] while the needs of agriculture alone are estimated at more than 50 billion cubic meters [1].

Although the dangers of water scarcity and scarcity plague everyone in Iraq - human, animal and plant - and all sectors, the risks in the agricultural sector and food security is the biggest and most dangerous, because agriculture is the largest consumer of water, as it consumes about 75% or more of water supplies [3]. At the forefront of this effect are the limited cultivated areas and the resulting agricultural production. The area planted annually in Iraq and in the best conditions is of no more than 14.5 million donums (3.6 million hectares) constitute 52% of the total arable land estimated at 28 million donums [2] as well as the decrease of cultivated area in some years, and inability of expand through it and the severe decrease during summer season in which rice is planted as a main product. This is reflected negatively on the amount of agricultural production and its returns to farmers and their families, who make up one third of the population, as well as its impact on food security as the country is forced to import millions of tons of agricultural and animal products to fill the deficit in the agricultural production which costs billions of dollars. Moreover, the shortage of one billion cubic meters of water will lead to the departure of 62,500 hectares (quarter of a million donums) of arable land [1, 4]. The risks of water scarcity are increasing as a result of climate change. Food security depends entirely on water security. Fragile water security means fragile food security.

Therefore, the need for effective and rational management of water security in Iraq and the need to speed up the completion of the necessary infrastructure development is considered in the forefront of the major challenges of the government. It is a
national task and a high necessity of life, economic, social, environmental, political and security at this stage and the coming decades.

Rationalizing the use of irrigation water is an important strategy in water security, mitigating the risk of water scarcity, ensuring the sustainability of agricultural activity and providing the opportunity to expand the cultivated areas to contribute in achieving sustainable food security [5]. Iraq is required to achieve sustainable increases in its agricultural and animal production by more than 50% in some crops and up to more than 100% in other agricultural products to meet the growing demand for agricultural products and food resulting from the continuous increases in population, estimated at 51.5 million in 2025 [6] and doubling in 2050. Moreover, rationalization constitutes an important remedy for the problem of waste and misuse of irrigation water, especially as Iraqi agriculture suffers from water losses that have weakened the efficiency of field irrigation to less than 50% [2]. The problem of irrigation water in Iraq is complex - scarcity, waste, misuse and quality degradation. Rationalization of irrigation water also contributes to halting the degradation of agricultural land - waterlogged and salted - which covers millions of donums, especially in the central and southern regions. Saving, protection and enhancement of natural resources is a fundamental principle for the sustainability of food and agriculture [7].

Despite the importance and necessity of rationalizing water uses for agriculture, and emphasizing it in the first and second national development plans, and more than one national project in this field has been implemented in the country during the past two decades, the results achieved, although important in some areas, but generally do not amount to the level of effective contribution to the effective response to the water threat in the country, and little has been achieved in irrigation water conservation. The general assessment, which was published by the National Development Plan 2018-2022 on the achievement of the objectives of the agricultural sector during the development plan 2013-2017 is an important indicator and evidence of the weak achievements in this sector in all its fields and projects. Enters into this (agricultural) sector " [2]. The situation is no better with regard to the achievements of the first national development plan 2010-2014.

Therefore, in the context of facing the threat of fragile water security in the country, Iraqi agriculture imposes the necessity of achieving a rapid and large-scale rationalization covering all rural areas and all types of agricultural activity by activating the diffusion of innovations to rationalize the use of irrigation water, and this requires: a. Leaving traditional publishing work; traditional work is not an appropriate option to meet challenges [8, 9], b. Meeting farmers' needs of appropriate practices and technologies to rationalize irrigation water by improving the performance and effectiveness of the diffusion process and providing them with appropriate support. This is what FAO [10] called for. The aim of the research is to provide a vision to develop the effectiveness of the diffusion of innovations to rationalize the use of irrigation water in Iraqi agriculture.

2. Materials and methods

The current research comes within the qualitative research that does not use quantitative, statistical or experimental methods in studying the phenomenon, but rather uses various methods, including literature, previous studies, documents, and an analysis of them to draw conclusions that help in dealing with the problem or phenomenon. Accordingly, the procedures are defined as follows: First. Preparing a conceptual framework that includes related concepts, components and factors. Second. Conclusions drawn from a number of scientific studies on the Iraqi experience in the field of disseminating of innovations for rationalizing irrigation water over the past two decades.

2.1 Conceptual framework of innovation dissemination

1. Innovations of rationalize irrigation water. According to the World Bank [11], innovation means new technologies and practices for a society, which are not entirely new, but are being disseminated in that economy or society. In this light, innovations to rationalize the use of irrigation water are technologies (irrigation systems, suitable varieties or hybrids, etc.) and agricultural practices that are not applied in certain agricultural systems and are intended to be disseminated in order to rationalize the use of irrigation water.

2. Diffusion of innovations for rationalize irrigation water. Rogers [12] defined the diffusion of innovations as the process by which innovations were delivered through certain channels over time between members of the social system. Accordingly, the diffusion of irrigation water use innovations is a planned process involving actors (scientific research, industrialization, propagation, supply, processing, extension, financing and lending, other supporting services) and stakeholders (farmers and their organizations) to introduce appropriate technologies and practices in water conservation. Irrigation to an agricultural society that is not applied or is not widespread in order to achieve its spread in the community, and achieve the desired objectives, namely: To achieve efficient use of available water, and to meet the need of farmers to exercise their agricultural
activities, and to preserve them, and to minimize the effects of risk of continuous water scarcity, conservation of agricultural land, increased productivity and agricultural production.

3. The diffusion of agricultural innovations consists of a series of interrelated and integrated activities - scientific research, supply (manufacture or supply, propagation and provision), extension, and other supporting services within the framework of an agricultural policy, implemented by the network of the publishing system, which are all actors with the participation of farmers and their organizations, to identify the basic problems and needs of farmers in the field of irrigation in each region or agricultural activity, and to find appropriate solutions (practices and technologies) for agricultural systems in them, and promote them, and to convince farmers of their advantages, and acquire the knowledge and skills necessary to apply them, and equip them with it and with what may be required from lending to get them or other services, and follow up their implementation have access to the installation of the decision adopted and incorporate them into their practices and their systems of farm, calendar results [5].

4. Effectiveness is a term relates to objectives, and is considered one of important indicators to measure the extent to which an organization / program achieves its objectives according to its adaptation to the environment in which it operates, in light of the use of its available resources [13]. Accordingly, effective diffusion of water conservation innovations means rapid and widespread deployment of farmers' fields with appropriate practices and technologies to achieve efficient irrigation, satisfy farmers' water needs for their agricultural activities in a sustainable manner, and to preserve the water that is described as diminishing and scarce, as well as to preserve arable, and achieve the desired agricultural productivity.

5. The effectiveness of the diffusion of irrigation water use innovations is influenced by a variety of interrelated factors, first and foremost the characteristics of deployment management - planning, organization, leadership, control, capacity characteristics of actors and stakeholders, the level of performance and implementation of their activities and programs, and the characteristics of the enabling environment and infrastructure [14].

2.2 Summary of the Iraqi experience in the diffusion of modern irrigation technologies during the last two decades:
During the last two decades, the Iraqi Ministry of Agriculture has implemented two projects in the field of water conservation:

1. The National Project for the Development of Modern Irrigation Technologies was implemented in 1999, the objectives of which are: a. Rationalizing the use of water for agriculture, b. Addressing the low productivity of some strategic and industrial crops [15]. The project supplied (imported) large mobile irrigation systems 60 donums, 120 donums (30 hectares), and encouraged and motivated farmers to adopt them. The project was halted in 2003 as a result of the conditions followed the invasion by the United States.

2. The project of spreading the use of modern irrigation techniques (later became the project of using irrigation technologies and modern mechanization), was implemented in 2011, the objectives of which were defined in: a. Achieving the coverage of 3 million donums (750,000 hectares) with modern irrigation technologies and 15,000 fixed irrigation technologies, by supplying these technologies and equipping farmers with them over 6-8 years. b. Achieving wheat production in the target area covering 15 governorates to 1000 kg / donums (4 tons / hectare). The implementation of this project coincided with the project of development of wheat planting. Thus, the goal of the two projects is to achieve the production of 3 million tons of wheat at the end of the two projects in an agricultural area of 3 million acres (750 thousand hectares). c. Providing 3.6 billion cubic meters of water that can be used to irrigate new areas, increase agricultural density, or wash and reclaim salted lands in central and southern Iraq [16].

3. The most important results of the two projects mentioned above are that significant positive results have been achieved in the field of diffusion of significant numbers of modern irrigation technologies, and achieving high production of wheat crop exceeding one ton / donum in some areas in some governorates [17, 18, 19, 20]. However, neither project has achieved its objectives, nor the results achieved are few compared to the larger objectives of each. The number of systems that the farmers who were equipped for the first four years 2011-2014 of the life of the second project - the first half of the life of the project - 2720 systems of all kinds [16], which constitutes a very small proportion of 7.7% of the total systems diffused during the eight years of the lifetime of the program and this is reflected negatively on the expected water savings achieved from the project, and the situation was not better in the second half of the life of the project.

3. Results and Discussion

Based on the theoretical framework for disseminating of innovations for rationalizing irrigation water and conclusions drawn from a number of scientific studies on the Iraqi experience in this field over the past two decades. Identified elements of a vision to develop the effectiveness of the diffusion of these innovations with eight interrelated and complementary elements related to the internal and external environments. The process of disseminating these innovations is:

1. Enhancing national responsibility and institutional partnership. 2. Development planning (quality application). 3. Updating the methodology for the diffusion of innovations. 4. Capability development. 5. Effective processing (quality application). 6. Developing the enabling environment. 7. Construction and development of infrastructure. 8. Continuous follow-up, evaluation and improvement.

1. strengthen national responsibility and institutional partnership

Effectively addressing the challenges of water security vulnerability in the country is a national task, and accordingly rationalizing the use of irrigation water in agriculture is a national responsibility that requires: a. Develop a sense of collective national responsibility to effectively address this challenge at the level of governmental and non-governmental organizations, their workers and target groups, including farmers, their families and organizations. b. Active participation of all parties (organizations and companies) in the system of diffusion of innovations to rationalize the use of irrigation water, and the commitment of each to fulfill its role and responsibility in the form of interaction, integration, coordination and joint work with other parties and at all local levels, including the development of appropriate mechanisms to achieve the implementation of all practical activities Integrated and effective diffusion.

2. Development of planning

Diffusion of agricultural innovations is a planned process, which includes a set of coherent and integrated plans, each focusing on a particular activity of the diffusion process - research plan, technology production, multiplication or supply plan, processing plan, extension plan, lending plan, follow-up plan and evaluation plan . . Etc. [14]. The effectiveness of the deployment is greatly influenced by the characteristics of its planning process, especially the participation, integration and appropriateness from the characteristics of the planning team, the operational procedures of the process and the characteristics of the plans [21]. To achieve this: a. Applying quality in the planning process, by achieving conformity which means the availability of criteria that should be met in the planning process, and to achieve the appropriate characteristics of the target systems and to meet the needs of the target and achieve their satisfaction [22]. By identifying innovations based on the needs of farmers and the characteristics of their farming systems in each region. c. To promote decentralization in planning activities and programs for the diffusion of innovations at the local level. d. Emphasis on the qualified integrated planning
team(s) in which representatives of parties as well as farmers and their representatives participate. e. Achieving the integration and objectivity of the plans, including the necessary financial allocations required for the plans correction and making the required modifications.

3. Updating the approach of disseminating innovations

The field of extension work and the transfer of agricultural innovations at the global level is of great interest in the development of diffusion approaches as a vital factor in accelerating and expanding the diffusion process. Therefore, a shift from the traditional approach that has been in place for more than 60 years to one or more modern participatory approaches is vital in developing the effectiveness of water-use innovations diffusion. In this regard, the Farmer Field Schools curriculum, which achieves a paradigm shift in the roles of the two sides of the advising currency, is proposed as a participatory approach in which farmers learn from and with each other facilitated by extension agents and specialists [23], which harmonizes with the trends of the strategic plan of the ministry of agriculture for the years 2015-2025 - the expansion in the Farmer Field Schools [24]. In addition, FAO supports approach and its diffusion [10].

4. Capabilities development

The capability simply means the ability of people, organizations and society as a whole to manage their affairs successfully [25]. In general, the capability is seen as the ability of individuals, organizations or society as a whole to set and implement development goals, as well as to identify and address sustainable development challenges [26]. In the field of diffusion of agricultural innovations, capability development is a dynamic and continuous process at all levels - individuals, organizations, and the diffusion system as a whole - focusing on learning, developing knowledge, skills, attitudes and performance, as well as developing technical capabilities to achieve harmony and complementarity of efforts and activities and develop their results through the use of Appropriate strategies and methods, first and foremost, develop interaction, coordination and joint action among all parties, within and with all stakeholders, to ensure proper and effective management of the diffusion of these innovations. It is important that development begins at the level of each of the parties.

5. Effective supplying

The provision of technologies in quantities and qualities appropriate to the needs of farmers and the characteristics of their agricultural systems in each region and at the appropriate time, high quality, at subsidized prices and consistent with the economic capabilities of farmers, especially the poor who are the majority, and equipping the farmers according to mechanisms that achieve speed and simplicity in processing and ensure that all farmers have access to technologies is considered a vital factor in the effectiveness of the process of diffusing agricultural technologies [21, 27], especially one of the reasons of the weakness of the effectiveness of the new irrigation technologies diffusion during the previous period is the weakness exporting those technologies.

The provision of technologies in the required quantities as well as the implementation of other activities required in the deployment process requires the provision of necessary financial allocations and good use, and control.

6. Development of enabling environment

Enabling environment is a broad term, and the most important part of this term is legislation, rules and policies [28]. The enabling environment is an essential factor influencing the effectiveness of the diffusion of agricultural innovations in general, including innovations to rationalize the use of water for irrigation. It provides the requirements for the protection of water and its sources, and supports and encourages and motivates farmers and enables them to adopt these innovations, as well as support, stimulate and develop the capacities of parties in the diffusion process. The enabling environment is embodied in a variety of terms, including: a. Activating and developing legislation related to the protection of water and its sources as national wealth and public property, as well as the protection of the local product and effective control over ports.

b. Continuing to support the prices of irrigation systems, increasing the percentage of subsidies, and emphasizing the priority of poor farmers in obtaining innovations.

c. Continuity of granting loans to farmers to buy modern irrigation systems.

d. Encourage investment to establish factories to produce irrigation technologies and other technologies and their application requirements and maintenance workshops.

7. Establishment and development of infrastructure

The development of effective national infrastructure is an essential element in the development and sustainable development of the agricultural sector, which is lacking in Iraqi agriculture. The third national development plan 2018-2022 clearly pointed to this fact, considering the dependence of the agricultural sector on imported inputs as one of the challenges of agricultural development in Iraq [2]. The lack or weakness of this vital component is one of the main reasons for the weak effectiveness of projects and programs to spread modern technologies, including projects to spread irrigation technologies. Therefore, the rapid and widespread diffusion of water conservation innovations in Iraqi agriculture requires the building of a national government industry and a private sector for modern irrigation technologies and their application requirements and the development of production of other relevant technologies. The third national development plan 2018-2022 considered manufacturing of agricultural machinery and equipment, including modern irrigation technologies, one of the means to achieve the objectives of sustainable agricultural development in Iraq [2].

8. Monitoring, evaluation and continuous improvement
Monitoring and evaluation are fundamental processes in the good management of projects and programs [29], and they form a sub-system in the agriculture diffusion system [30], and two elements in the development of capabilities of the agricultural system innovation in general including the innovations diffusion [25], and an effective administrative decision-making service to develop that process and its activities and programs. They achieve an orderly and objective flow of data and information on activities, their relevance, implementation and results. Continuous improvement means the constant search for new methods that improve the current level of performance [31], and it is one of the principles of total quality management which philosophy is based on the belief that all aspects of operations can be improved [32]. Continuous diffusion of innovations to rationalize the use of irrigation water requires: a. Organize follow-up and evaluation (formation of more units at the national and local levels), and related matters to determine their relevance, tasks, staff, duties and qualifications. b. Adopting objective indicators, methods and tools in data collection and analysis. c. Use the results of follow-up and evaluation in making decisions about the development of the diffusion of these innovations. d. Maintaining the continuous improvement and enhancement throughout the work.

Conclusion

That policy-makers and decision-makers in the agricultural sector in Iraq pay attention to the elements that came in this vision to improve the effectiveness of dissemination innovations for rationalizing irrigation water in farmers’ fields, in a way that contributes to the sustainability of their agricultural activities.

References

[1] Ministry of Planning 2013 National Development Plan 2013-2017. Baghdad, Iraq.
[2] Ministry of Planning 2018 National Development Plan 2018-2022. Baghdad, Iraq.
[3] The World Bank 2012 Agricultural Innovation Systems. an Investment Source Book, Washington, D.C.
[4] Abd Al-Haniz JA 2017 The Use of Rice Husk for Graywater Treatment in Irrigation and for Improving the Properties of Leaching Saline Soil. Al-Qadisiyah Journal For Agriculture Sciences. 7(2): 184 - 191.
[5] Ati AS, Shaima SD and Inas AA 2013 Effect of Pulverization Tools and Deficit Irrigation Treatments on Water Use Efficiency and Yield of Barley. Al-Qadisiyah Journal For Agriculture Sciences. 3(1): 135-142.
[6] Al-Hakim AHN 2013 Studies in Iraqi agriculture - Part I. Future farming. Baghdad, Iraq. 317-318.
[7] FAO 2014 Building a Common Vision for Sustainable Food. Rome.
[8] FAO 2017 The Future of Food and Agriculture. Trends and Challenges. Rome.
[9] Prior RM 2013 Developing an Agricultural Innovation System to Meet the Needs of Smallholder Farmers in Developing Countries. Extension Farming Systems Journal, 9(1):258-263.
[10] Food and Agriculture Organization of the United Nations 2011 Conservation and Expansion. A Guide for Policymakers on Sustainable Intensification of Crop Production for Small Owners, Rome.
[11] The World Bank 2010 Agricultural Innovation Systems. an Investment Source Book, Washington, D.C.
[12] Rogers EM 2003 Diffusion of Innovations. 5th ed. Free press, New York : 11.
[13] Al-Anzi SA 2015 Organization Theory (Concepts, Approaches, Operations). Al-Saysaban Library for Publishing and Distribution, Baghdad, Iraq.
[14] Al-Taye HK 2009 Improving the Management of Agricultural Technology Diffusion Programs in Iraq. Al-Furat Journal for Agricultural Sciences, 1(2).
[15] Mohammed, M.A., Abdulridha, W.M., Abd, A.N. (2018). Thickness effect on some physical properties of the Ag thin films prepared by thermal evaporation technique. Journal of Global Pharma Technology, 10(3), 613-619.
[16] Al-Abboodi HNK 2015 Complementarity between the Agricultural Initiative and the Modern Irrigation Technologies Project in Sustaining Natural Resources and Increasing Productivity in Holy Karbala and Wasiti Governorates. Unpublished Master Thesis, Department of Agricultural Extension and Transport, College of Agriculture, University of Baghdad.
[17] Hashim AN and Al-Taye HK 2015 The level of prevalence of agricultural developments in the field of sustainability of agricultural natural resources and increase the productivity of wheat crop in the Nahrawan region. Journal of Iraqi Research, 21(2).
[18] Al-Gharawzi F and Jawad M 2016 Some of the reasons related to the gap between the realized and potential productivity of the two wheat cultivars. Ibaa 99 and Abu Ghrabi 3 - in the fields of farmers in Wasit province and ways to bring them. Master Thesis, Department of Extension and Transport of Agricultural Tanat, College of Agriculture, University of Baghdad.
[19] Najim YS and Al-Taye HK 2016 The Role of the National Wheat Crop Development Program in Diffusion of Agricultural Developments and Increasing Yield in Wasit Governorate. Al-Furat Journal for Agricultural Sciences, 8(4).
[20] Al-Hakim AHN, Abdul KHH, Al-Quat SB, Abbas DF and Numan SM 2017 Evaluation of the program for the development of wheat cultivation in Iraq for the seasons 2011/2012 - 2015/2016. Journal of Iraqi Research Agriculture (special issue), 22(11): 100-112.
[21] Al-Taye HK 2013 Introduction to Improving the Quality of Agricultural Technology Diffusion in Iraq. Hewar Al-Fikr Journal, Issues 25-26.
[22] Najim AN 2013 Introduction to Project Management. 1st edition, Al-Warraq for Publishing & Distribution, Amman-Jordan.
[23] Al-Badri AAR 2005 Evaluation of some economic and social changes resulting from the National Program for the Development of Irrigation Technologies. Unpublished doctoral thesis. Department of Agricultural Extension and Education, College of Agriculture, University of Baghdad.

[24] Ministry of Agriculture 2015 Strategic Plan of the Ministry of Agriculture for the years 2015-2025. Baghdad, Iraq.

[25] Dania Mohmed Danish Aladdin Sajadi, Akram Othman Esmail. (2020). Comparison Between Groundwater Quality at North East and South West of Erbil Governorate for Irrigation Using Some Global Systems and Principal Component Analysis. Al-Qadisiyah Journal For Agriculture Sciences, 10(2), 308-324.

[26] Land A 2000 Implementing Institutional and Capacity Development: Conceptual and Operational I Ministry of Planning 2009. National Development Plan 2010-2014, Baghdad, Iraq.

[27] Al-Taye HK and Manhal MAK 2010 An Integrated Management Model of the Program to Meet the Needs of the Agriculture Producers From the Production Requirements. Tikrit University Journal for Agricultural Sciences. 10(1): 290-299.

[28] Tropical Agriculture Platform (TAP) 2016a Common Framework on Capacity Development for Agricultural Innovation Systems. Conceptual Background, Rome.

[29] Drebee, H.A. (2017). The Impact of Cultivated Area and Price on Production of Rice in AL-Qadisiyah -Iraq During the Period (1990-2014) by Using VECM. Al-Qadisiyah Journal for agriculture science, Vol.7, No.1,123-135.

[30] Al-Taye HK 2016 Improving the Quality of Diffusion of Agricultural Technologies in Arab Countries. Journal of the Arab Organization for Agricultural Development, the third periodic meeting of officials and experts of research and transfer of technologies in the field of plant production held by the Arab Organization for Agricultural Development for the period 27-29/12/2015, Khartoum, Sudan.

[31] Al-Ameri SMM and Al-Ghalbi TMM 2011 Business and Management, third edition. Wael Publishing House, Jordan, Amman.

[32] Al-Najjar SM and Maha KJ 2014 Quality and Environment Management - Principles and Applications - Saysaban Library, Baghdad, Iraq.