Risk Management and Its Connection to Technical Innovation Adoption Decisions Among Field Crop Farmers in Rainfed Regions: A Case Research of Nineveh Governorate

Rayan Rayadh Kadhum[1*], Mohammed Talal Ahmed [2*]Ahmed Salem Taha [3*]

[1]Department of Agricultural Extension and Technology Transfer, College of Agriculture and Forestry, University of Mosul, Mosul, Iraq

[2]Department of Field Crop Sciences, College of Agriculture and Forestry, University of Mosul, Mosul, Iraq

[3]Department of Field Crop Sciences, College of Agriculture and Forestry, University of Mosul, Mosul, Iraq 3

Corresponding authors email: rayan.rayadh@uomosul.edu.iq

[2]mohammed.ramo@uomosul.edu.iq

[3]ahmad.Salim@uomosul.edu.iq

Abstract

The research addressed measuring the levels of adoption of technological innovations among field crop farmers in rainfed agriculture areas and assessing their methods of managing agriculture risks in addition to determining the correlation between adoption levels and personality variables (age, agriculture experience, land area, ability to innovate) , while identifying the main obstacles that hinder the adoption.

The research sample included all field crop farmers in the research area a sample random sample was selected to accurately represent the population and the research objectives , a three-part questionnaire was designed: the first part addressed personal characteristics the second part measured the level of innovation adoption and the third part focused on perceptions of risk management and existing constraints , data were collected through personal interviews and SPSS software was used for statistical analysis to describe data.

The results showed that the highest category of farmers were in the medium category in adopting technological innovations this indicates a delicate balance between the desire to increase production and the need to mitigate climate-related risks, the results showed a strong positive correlation between adoption level agricultural experience land size and degree of innovation suggesting that financial stability and accumulated knowledge enhance farmers ability to manage risk and integrate technology within existing constraints, climate risks and rainfall fluctuation also ranked first a barrier to adoption followed by high financial.

The research recommended the need to establish specialized guidance programs that focus on how to manage risks in order to reduce the knowledge for farmers in addition to providing them with sufficient support to transition from traditional rain-fed agriculture.

Keywords: Technical Adoption, Risk Management, Rainfed Agriculture, Agricultural Extension, Field Crops.

Introduction

Agricultural development is the basic of the general framework of economic and social development especially in developing societies dependent on agricultural production, especially with the increasing food ga[which has led the need to increase production and compensate for the shortage by adopting modern agricultural technologies [19],by adopting and applying modern methods of agricultural transportation production , the element of risk emerges as a key variable as the absence of water resources and rainfall fluctuations represent major obstacles that threaten food security and reduce agricultural yields , lack of water security and reduce agricultural crop productivity [20],agriculture in rainfed regions remains the cornerstone for securing strategic crops and traditional methods to adopting technical innovations (such as drought-tolerant varieties and conservation agriculture) is an urgent necessity for achieving food security.

ISSN 2072-3857

In rainfed areas the issue is no longer simply about adopting technologies but has evolved into building resilient agricultural systems capable of withstanding successive climatic and economic shocks [2],in the current situation due to climate change water scarcity and low rainfall farmers are struggling to secure freshwater sources, the necessitates protecting them from risks by having agricultural extension agents focus on the importance of modern irrigation technologies and their correct scientific and practical application to overcome these challenges [4].

farmers in rain-fed areas are considered the cornerstone of the food security system as they constitute a group with socio economic and behavioral characteristics that make the process of adopting technical innovations a difficult path [13. While irrigated crop farmers may rely on the stability of water resources, rainfed farmers link their innovative decisions to climatic variables beyond their control thus in technological innovation becomes an ultimately to full adoption [3].

Extension studies indicates that the farmers behavior is greatly by the nature of strategic field crops grown on areas this means that any decision to adopt a new seed variety or modern technology involves a large capital investment and high risk [16]. The comparative advantage of innovation plays a key role as farmers in these areas tend to adopt technologies that ensure the safety of production and reduce waste rather than those that aim only to achieve the highest production therefore the rain-fed farmer is described as a rational adopter who carefully balances the cost of innovation with the probability of failure associated with rainfall fluctuations, social media and communication networks play a key role in shaping these farmers' attitudes toward agricultural innovations [18],social influence is stronger in rain-dependent communities and farmers often observe the results of innovations among pioneer farmers or neighbors before taking the risk themselves [14]. Field crop farmers resort to reducing the risks face through limited trials with the innovator from the perspective of agricultural extension , the success alone but rather on it is compatibility with the system of values and accumulated experience of farmers as well as it is ability to provide practical solutions to environmental challenges such as drought and soil degradation [15].

Understanding the innovative behavior of field crop farmers requires a comprehensive view that links their personal characteristics with their economic reality, when discussing the adoption of innovations in field crops, we are addressing a long-term

ISSN 2072-3857

investment aimed at achieving integrated agricultural development this transformation seeks to move from traditional production methods that barely meet basic needs to modern systems that improve resource efficiency and boost productivity [12].farmers whether the land is owned or leased, the farmer seeking to increase productivity always attempts to owned or rented always strive to increase productivity and maximize profits and minimize losses through the correct use of inputs and technologies [1], however this ambition may sometimes be hampered by a lack of confidence resulting from insufficient financial and moral support from official bodies, such as the Ministry of Agriculture and supply companies lading to adopting levels remaining at an average level.

The process of moving from traditional to advanced agriculture is not just replacing one machine or variety with another, but a radical change in the farmer's mindset by replacing old patterns with modern ones in a fundamental factor for the continuity of life and the development of livelihoods which necessitates reducing waste and promoting agricultural development by using modern irrigation methods [6]. furthermore, this progress is hindered by the reality of rainfed areas which suffer from a productivity gap and declining water security due to overexploitation and traditional methods, as well as weak infrastructure [8], here adopting technology becomes an urgent necessity that requires farmers to take responsibility for correct and to achieve the desired economic strategies however the decision to adopt is not made in isolation from the surrounding environment [10],in these regions Farmers live in a constant state of risk management balancing the benefits of technology with their fears of production failure or rising costs which keeps their levels of use mostly within the average given the growing gap between our actual food production and our needs [7], through scientific research vertical expansion becomes the only refuge to confront the limited arable land and water remains the most important element in this equation [11], farmers in rain-fed areas face global and local challenges most notably the scarcity of fresh water which represents only 3% of the planet's water this problem is exacerbated by overconsumption and reliance on outdated traditional methods leading to enormous water losses through evaporation which negatively impacting food security and increasing poverty [5].

The essential and pivotal role of agricultural extension lies in transferring knowledge and modern methods, field crop farmers in rain-dependent areas often face a real conflict between the desire for

ISSN 2072-3857

development and the fear of production and financial risks associated with the work environment [17]. The absence of risk management strategies leads to hesitation in implementing technological innovations keeping production within the framework of traditional agriculture that barely meets needs [9].

The core of the research problem is defined in the following main question, what is the nature of the relationship between farmers perception of risk management methods and their decision regarding the adoption of technical innovations in rainfed agricultural areas? The research aims to provide guidance to support in making informed extension vision that assists farmers in making informed technological decisions taking into account the challenges associated with climate and economic uncertainty.

Research Objectives

The researchers presented this research with a set of challenges the most prominent of which was assessing the extent to which farmers in the agricultural fields of the research area have adopted technological innovation.

Evaluate the farmers' perception levels regarding agricultural risk management methods.

Identify the correlational relationship between adoption levels and specific independent variables, including:

Age.

Farming experience.

Landholding size.

Attitude toward farming (Agricultural orientation).

Identify the primary constraints hindering the adoption of modern technologies in rainfed agriculture.

Materials and Methods

Research Methodology: The research adopted a descriptive-analytical approach, as it is the most suitable method for achieving the research objectives and analyzing the relationships between variables.

Research Sample: Due to the vast extent of the research population in the southern and western regions of Nineveh, a simple random sample was selected. The sample consisted of 180 farmers, representing 25% of the total field crop farmers in the research area.

Research Instrument: A three-part questionnaire was developed as the primary data collection tool:

Part I: Independent variables, including age, farming experience, landholding size, and attitude toward farming.

Part II: A scale to measure the level of technical innovation adoption, utilizing a four-point Likert-type scale (High adoption, medium adoption, Low adoption, No adoption).

Part III: A risk management scale, comprising items related to climatic, financial, and technical risks.

Validity and Reliability

The questionnaire was presented to a group of experts in agricultural guidance and field crops to ensure the validity of the scale, the stability of the scale was confirmed using Cronbach’s alpha law as it is value was (0.84) which indicates the validity of the scale for application.

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Results and Discussion

Objective 1

Assessing farmers awareness of agricultural risk management methods.

Based on the achieved results the respondents were divide into three categories based on the range law, the highest value obtained by the respondents was (260) and the lowest value was (100) while the value of the arithmetic mean reached (180) as shown in table (1)

Table (1): respondents were divided into three categories based on farmers level of awareness of agricultural risk management methods.

Category (Score Range)	Frequency	Percentage (%)	Mean
Low (100-153)	31	17.2%	126.5
Medium (154-207)	102	65.7%	180.5
High (208-260)	47	26.1%	234.2
Total 180	180	100%	____

The table shows that the medium category with a percentage of (56.7%) is the dominant category among crop farmers who depend on dime farming in the research area while the percentage of the high and low category respectively reached (26.1%) (17.2%).

This pattern suggests a generally favorable inclination toward embracing modern agricultural technologies, even under the constraints imposed by rainfed farming conditions, these results are attributed to a variety of factors.

The prevalence of the medium class reflects a state of actionality as rain fed farmers typically avoid sudden and wholesale adoption of modern technologies for of capital losses when rainfall fluctuates and opt for gradual adoption.

The fact that most respondents tended towards the middle to upper classes suggests a belief among that innovative technologies as drought resistant varieties or modern mechanization are most successful methods for mitigating production risks in arid regions

The accumulation of knowledge highlights the disparity between the upper and lower levels which is in favor of the first category indicating the success of agricultural guidance paths in conveying the special advantage of technological innovation and overcoming the usual agricultural obstacles.

Objective 2: the result showed that the highest score achieved by participants on the risk perception scale was (120) while the lowest score (60) with an overall mean score of (90), based on the overall score range participants were

ISSN 2072-3857

divided into levels as detailed below Table (2):

Table (2): ranking of respondents according to their agricultural risk management style.

Category (Score Range)	Frequency	Percentage (%)	Mean
Low Perception (60-80)	38	21.1%	71.3*
Medium Perception (81-101)	108	60.0%	91.0*
High Perception (102-122)	34	18.9%	112.0*
Total	180	100%	______

Objective 3: Analyzing the Correlation Between Independent Variables and Technical Innovation Adoption Levels

Correlation was analyzed for quotative variables using person, while spearman method was used quotative variables

Table (3): ranking of respondents according to personal variables and correlation.

Independent Variable Categories Statistical Significance	Frequency	Percentage (%)	Correlation (r)
Age Young (24-39)	42	23.2	-0.24* Inverse (Negative)
Middle-aged (40-55)	105	58.3	
Older (56+)	33	18.4	
Farming Experience Low (4-17 years)	35	19.4	0.28* Positive
Medium (18-31 years)	108	60.0	
High (32+ years)	37	20.6	
Landholding Size Small (10-105 units)	48	26.7	0.35* Positive
Medium (106-202 units)	96	53.3	
Large (203+ units)	36	20.0	
Innovativeness Negative (10-23)	30	16.7	0.72* Strong Positive
(Attitude toward Change) Neutral (24-37)	115	63.9	
Positive (38-50)	35	19.4	

From the table it is clear that the decision-making process by farmers to modern technologies is not an easy random process but rather a complex process resulting from the interaction between personal economic and social factors as shown below

ISSN 2072-3857

1. experience and academic achievement

It is noted that there is a correlation between experience and academic achievement as its value reached (0.28) when interpreting this relationship, it becomes clear that academic achievement is paves the way for individuals that helps them absorb modern, this is reflected in the fact that adopting technologies requires a good level of education and experience to understand technologies and reduce fears of failure.

2. the gap between the age variable and acceptance of change (Age: -0.24)

By analyzing the results, it became clear that there is an inverse correlation between the age variable and adoption it is concluded from this that older farmers are more cautious in adopting modern technologies and leaning towards traditional methods while younger farmers are more inclined to adopt technologies and bear risks, this makes them an effective factor in spreading modern technologies.

3.land size and adoption

Although the correlation coefficient in dictates a limited effect land size does influence the decision to adopt and apply modern technologies as farmers who own a large area have the audacity to allocate part of their land for experimentation without fear for their livelihood.

4. trend towards change (0.72) **

The results show the psychological role that determines the actual application and adoption of technologies as a farmer who has an open mind for change and leadership has a smoother application of technologies.

Objective 4: Identifying Constraints to Modern Technology Adoption in Rainfed Agriculture

The obstacles were ranking according to percentage weight from the farmers point of view.

Table (4): ranking obstacles by Importance.

Rank	Constraint	Mean	Weighted Percentage (%)
1	Rainfall fluctuations and climate risks	2.88	96%
2	High initial costs of modern technology	2.75	92%
3	Lack of maintenance services and spare parts	2.55	85%
4	Insufficient government funding and soft loans	2.40	80%
5	Adherence to traditional farming	2.25	75%

ISSN 2072-3857

	practices (Heritage)		
6	Weak extension services regarding risk management	2.10	70%
7	Small farm landholding size	1.95	65%
8	Lack of technical information on technology use	1.80	60%
9	Incompatibility of technology with local topography	1.65	55%

Analysis of Constraints:

The major obstacles (90%) are environmental and physical constraints, and the variability of rainfall (96%) and high initial costs (92%) reflect a high level of uncertainty, for rain-dependent farmers these external factors represent driver risk.

The category of medium impact (70-85%) includes logistical and organizational issues such as maintenance (85%) lack of official support (80%) and weak agricultural guidance services (70%), this is evidence of a gap in support where farmers experience a lack of technical and logistical protection necessary for the application of modern technologies.

The category of obstacles with a low impact (65%) included problems such land space (65%) scarcity of data (60%) and surface suitability (55%), this is a positive indication that farmers do not suffer from a fundamental lack of knowledge a

Conclusions

1.The results of the research show that essence of the extension process dose not revolve around merely transferring knowledge or technical tools as much as it is based on stimulating a profound psychological transformation that pushes farmers to wards change and reshaping the professional identity of the farmer internal motivation acts as a key driver that transcends challenges associated with knowledge or material capabilities accordingly any guiding endeavor that ignores the psychological and constructivist dimensions of the target audience collides with walls of negative resistance there fore investing in farming and strengthening psychological is a basic guarantee for achieving success in adopting new.

2.The concept of adoption in rain-fed agricultural environments goes beyond its technical boundaries to take on the character of an existential gamble whose results can not be predicted which justifies limiting innovation to specific groups such as the rural elite who are distinguished by their possession of material resources and educational skills that help them take risks, the research indicates that what is known as the application gap dose not

ISSN 2072-3857

reflect a lack of awareness as is believed but rather is linked to a state of executive paralysis, this places farmers in a state of acute alienation between what they perceive cognitively and what they can achieve in practice

3.The research reflects the focus on youth as the most important gate way to achieving successful modernization of the agricultural sector youth are characterized by cognitive flexibility and an innate ability to deal with risks compared to older generations whose practices are based on the legacy of traditional safety as a means of protection against the fluctuation and conditions of the natural environment, this inverse relation ship between age and willingness to adopt suggests the need to review counseling strategies moving it from the traditional comprehensive approach to the more specialized option

Recommendations

1. Given the limited impact of traditional education in promoting the adoption of technologies and innovation it is preferable to adopt non-formal agricultural education by designing field training programs and learning by doing which contributes to bridging the gap by decreasing the educational level of the researchers and providing them with the skills that enable them to overcome obstacles when applying modern technologies.
2. Launching peer mentoring programs to address the age that hinders the adoption of innovation this involves attracting older farmers who have achieved notable technical successes to act as local mentors to their peers of the same age group this method enhances mutual persuasion within a single generation and reduces resistance to change due to adherence to traditional methods.
3. Encouraging the establishment of cooperative agricultural clusters or collective holdings the approach allows small farmers to share the risks related to new experiments and jointly bear the costs of modern technologies transforming weak individual capabilities into a collective force that enhances the adoption rates of innovative agricultural solutions.

ISSN 2072-3857

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ISSN 2072-3857