

**ADOPTION OF WATER AND SOIL CONSERVATION
PRACTICES: THEORETICAL FRAMEWORKS AND
ATTITUDINAL COMPONENTS**

Amirali FARIDI¹, Mohammad KAVOOSI KALASHAMI^{1*}, Hamid EL
BILALI²

¹Department of Agricultural Economics, Faculty of Agricultural Sciences, University of
Guilan, Rasht, Iran

²International Centre for Advanced Mediterranean Agronomic Studies of Bari (CIHEAM-
Bari), Valenzano (Bari), Italy

*Corresponding author: mkavoosi@guilan.ac.ir

ABSTRACT

Agricultural production requires two main resources; water, as a source of life, and soil, as a living environment. Water and soil conservation is a critical issue in areas facing water and soil resource constraints. The purpose of this review paper is to provide an overview on the theoretical frameworks used in the analysis of the adoption of water and soil conservation practices. Different models and frameworks have been used in the analysis of the acceptance and/or adoption of new technologies and practices; these include Technology acceptance model, Motivational model, Theory of reasoned action, theory of planned behavior, Innovation diffusion theory and the Unified theory of acceptance and use of technology. The Icek Ajzen's Theory of Planned Behavior (TPB) has been used as a conceptual framework in many studies on the factors affecting the adoption of water and soil conservation practices. The TPB allows examining the impact of individual factors (i.e. attitude), social norms (cf. subjective norms) and situational factors (i.e. perceived behavioral control) on the adoption of practices. It posits that if a person assesses the suggested behavior as positive (cf. attitude) and if he/she thinks that others want them to perform the behavior (cf. subjective norm), these result in a higher intention and motivation to do so. However, the TPB has some limitations such as not considering environmental/contextual and economic factors that may affect the individual's intention to perform a behavior. Therefore, despite the widespread use of the TPB model, the paper concludes that the UTAUT seems a better model in understanding the dynamics of acceptance and adoption of water and soil conservation practices.

Keywords: *Theory of Planned Behavior, Unified Theory of Acceptance and Use of Technology, Technology Adoption, Water conservation, Soil conservation.*

INTRODUCTION

The destruction of agricultural land leads to the loss of soil quality and, consequently, its productivity. Erosion is a major driver of agricultural land degradation and can be very important because it is often irreversible and, in cases of severe degradation, causes complete loss of soil (Hugo, 2006). Soil erosion is a challenging issue not only because it reduces productivity, but also because it is strongly linked to desertification and rural poverty (Barbier & Bishop, 1995). The causes of agricultural land degradation are varied and complex and can be classified into three main categories (Muchena et al., 2005): (1) climate (such as rainfall, drought); (2) bio-geophysics (such as slope, soil type); and (3) Management (such as farmers' education, experience, access to development services). These three groups of variables are crucial in determining the probability and rate of soil erosion (Muchena et al., 2005).

Irrigation water plays an important role in agricultural productivity and food security, but it is becoming a resource whose scarcity is increasing (Bruinsma, 2009). In areas where rainfall is falling, the agricultural sector is facing increased competition with other uses (e.g. houses, industry, power plants). Therefore, the agricultural sector needs to produce more food with less water.

In view of the above-mentioned factors, it is important to consider soil and water conservation practices. In this regard, understanding the challenges surrounding the adoption of these practices by farmers and determining the contribution of economic, social, financial, human and user characteristics to the acceptance process is crucial. Also, understanding the factors affecting the acceptance of conservation practices by farmers can provide insights for appropriate policy and long-term planning. In other words, identifying the factors affecting the adoption of conservation practices is a path for policymakers and planners to reach the micro and macro goals in all social, economic, and so forth fields. Many conceptual models have been used in the study of the adoption or acceptance of new technologies and practices and this study introduces and compares them.

ADOPTION THEORETICAL FRAMEWORKS

Technology acceptance model (TAM)

The Technology Acceptance Model, first proposed by Davis (1985), comprises the core variables of user motivation (i.e., perceived ease of use, perceived usefulness, and attitudes toward technology) and outcome variables (i.e., behavioral intentions, technology use). Of these variables, perceived usefulness (PU) and perceived ease of use (PEU) are considered key variables that directly or indirectly explain the outcomes (Marangunić & Granić, 2015). These variables are often accompanied by external variables explaining variation in perceived usefulness and ease of use; among others, subjective norms (SN), self-efficacy (CSE), and facilitating conditions (FC) were significantly related to the TAM core variables—however, to different degrees (Abdullah & Ward, 2016; Schepers & Wetzels, 2007). These external variables represent personal capabilities next to contextual factors and their conceptualizations vary across studies. Overall, perceived ease of use and

perceived usefulness, the most important factors in the TAM, refer to the degrees to which a person believes that using a technology would be free from effort (cf. PEU) and that using a technology would enhance their job or task performance (cf. PU). Since many technology adoption studies have used this model, it can also be used to study the adoption of soil and water conservation measures.

Motivational Model (MM)

Since 1940's, many theories have been developed from motivation research. Self-Determination Theory (SDT) developed by Deci & Ryan (1985) is one of them. SDT proposed that self-determination is a human quality that involves the experience of choice, having choices and making choices (Deci & Ryan, 1985). Deci et al. (1991) mentioned that the regulatory process is choice when behavior is self-determined, but when it is controlled, the regulatory process is compliance or defiance in some cases. The motivation theory has supported the researches in psychology as an explanation for behavior. These researches showed that the motivational theory contains two major factors of motivations: extrinsic motivation and intrinsic motivation. SDT represents the extrinsic motivation and consists of four types of self-determinations (external, interjected, identified and integrated form of regulation), while the intrinsic motivation refers to intrinsic regulation. It also represents how the social environment influences on motivated behaviors. In addition to that, the amotivation behavior must be considered to understand human behavior fully (Deci & Ryan, 1985). Amotivation behavior is non-regulation and not extrinsically or intrinsically motivated.

Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) is one of the earliest technology acceptance theories. It was developed in the field of social psychology by Ajzen and Fishbein in 1975. Its history returns to the period from 1910's to 1960s. This period was the beginning of studying the individuals' behavior through the impact of attitude. Attitude has either a direct or an indirect effect on behavior, and it is either one-dimensional or multidimensional factor. Ajzen and Fishbein (1980) mentioned that TRA was designed to explain virtually any human behavior. TRA is a general model, not designed for a specific behavior or technology but one of the most fundamental theories of human behavior. Ajzen and Fishbein's model was a result of a research program that started in the late of 1950s on the Persuasion Models of Psychology. Their aim was to develop a theory that could predict, explain, and influence human behavior (Ajzen and Fishbein, 1980). They considered that this theory is moderated by two main constructs; attitude toward behavior and subjective norm.

Theory of Planned Behavior (TPB)

An alternative approach to understanding consumer decision making is provided by the Theory of Planned Behavior (Ajzen, 1991, 2005, 2012). Instead of relying on the overall evaluation or utility of a product or service, this theory focuses on the

specific consumer behavior of interest. The goal of the TPB is to provide a comprehensive framework for understanding the determinants of such behaviors. First described in 1985 (Ajzen, 1985), the TPB is today one of the most popular social psychological models for understanding and predicting human behavior. Briefly, in the TPB, the immediate antecedent of a particular behavior is the “intention” to perform the behavior in question. This intention is assumed to be determined by three kinds of considerations or beliefs. The first is termed “behavioral beliefs” and refers to the perceived positive or negative consequences of performing the behavior and the subjective values or evaluations of these consequences. In their aggregate, behavioral beliefs that are readily accessible in memory lead to the formation of a positive or negative “attitude toward the behavior”. A second kind of consideration has to do with the perceived expectations and behaviors of important referent individuals or groups, combined with the person’s motivation to comply with the referents in question. These considerations are termed ‘normative beliefs’, and the normative beliefs that are readily accessible in memory combine to produce a perceived social pressure or ‘subjective norm’ with respect to performing the behavior. The third type of consideration, ‘control beliefs’, is concerned with the perceived presence of factors that can influence a person’s ability to perform the behavior. The third type of consideration, control beliefs, is concerned with the perceived presence of factors that can influence a person’s ability to perform the behavior. Together with the perceived power of these factors to facilitate or interfere with behavioral performance, readily accessible control beliefs produce a certain level of perceived behavioral control (or self-efficacy—cf. Bandura, 1977) in relation to the behavior. Wauters et al. (2010) used the TPB in their research on the adoption of soil conservation practices in Belgium. Kumar Chaudhary et al. (2017) used this model too.

Theory of Diffusion of Innovation (TDI)

Diffusion of innovations is a theory by Everett Rogers that seeks to explain how, why, and at what rate new ideas and technologies spread. Rogers argues that diffusion is the process by which an innovation is communicated over time among the participants in a social system. For Rogers (2003), adoption is the decision of “full use of an innovation as the best course of action available” and rejection is the decision of “not to adopt an innovation”. Rogers defines diffusion as “the process in which an innovation is communicated through certain channels over time among the members of a social system”. As expressed in this definition, innovation, communication channels, time, and social system are the four key components of the diffusion of innovations. Innovation diffusion research has attempted to explain the variables that influence how and why users adopt a new technology such as the Internet; opinion leaders exert influence on audience behavior via their personal contact, but additional intermediaries, called change agents and gatekeepers, are also included in the process of diffusion. Mango et al. (2017) used the theory of diffusion of innovation in a study about awareness and adoption of soil and water conservation practices in the Chinyanja Triangle (Southern Africa).

Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh et al. (2003) developed a unified model that brings together alternative views on user and innovation acceptance viz. the Unified Theory of Acceptance and Use of Technology (UTAUT). The UTAUT suggests that four core constructs (viz. performance expectancy, effort expectancy, social influence and facilitating conditions) are direct determinants of behavioral intention and ultimately behavior, and that these constructs are, in turn, moderated by gender, age, experience and voluntariness of use (Venkatesh et al., 2003). It is argued that by examining the presence of each of these constructs in a 'real world' environment, researchers and practitioners will be able to assess an individual's intention to use a specific technology/system, thus allowing for the identification of the key influences on acceptance in any given context. In the years since its introduction, UTAUT has been widely employed in technology adoption and diffusion research as a theoretical lens by researchers conducting empirical studies of user intention and behavior. Since the original article by Venkatesh et al. (2003), UTAUT has been discussed with reference to a range of technologies (e.g. information and communication technologies) with different control factors (e.g. age, gender, experience, voluntariness to use, income, and education), and focusing upon a variety of user groups.

DISCUSSION

Each of the presented models has its strengths but also limitations and shortcomings. One of the limitations of the Technology Acceptance Model (TAM) concerns the variable that pertains to the behavior of users, which is inevitably evaluated through subjective means such as behavioral intention (BI) and interpersonal influence. Nevertheless, interpersonal influence, as a subjective norm, means when a person is influenced by words of mouth from a colleague, or a friend. While a superior can influence subordinate employee by directing him/her to perform a specific task with the use of a specific technology, based on the company's policy, a friend has no directive influence over staff who is subject to the line manager. Another limitation is that behavior cannot be reliably quantified in an empirical investigation, owing to a number of different subjective factors such as the norms and values of societies, personal attributes and personality traits. Hence, the argument that a relative or friends could influence the use of a technology through exerting social pressure (Ang et al., 2015; Shan & King, 2015) is highly falsifiable.

The Motivational Model (MM) has many applications on the motivational studies, learning, and health care. But its application on technology usage and acceptance is not effective (Deci & Ryan, 2008; Ryan & Deci, 2000). It still needs to include many factors to become more suitable to study technology usage (Parijat & Bagga, 2014; Gagné & Deci, 2005).

The Theory of Reasoned Action (TRA) is a very general model and not designed for a specific behavior or technology (Davis et al., 1989). Correspondence is the main limitation for it (Ajzen, 1985); it predicts a specific behavior, attitude, and

intention to be in agreement with action, target, context, and time frame (Sheppard et al., 1988; Silva & Dias, 2007). TRA is still limited with no mention to other variables that affect behavioral intention like fear, threat, mood or previous experiences.

The Theory of Planned Behavior (TPB) is an extension to the limited TRA model. It suggests that the behaviors are already planned by adding a new construct that is the perceived behavioral control (Sheppard et al., 1988). However, it does not show the planning mechanism of individuals and how it relates to TPB, with no mention to other variables that affect behavioral intention and motivation, such as fear, threat, mood or past experience. Furthermore, it does not take into account the environmental or economic factors that may influence the individuals' intention to perform a behavior (Truong, 2008).

The Theory of Diffusion of Innovation (TDI) explains the decision of innovation and predicts the rates of its adoption (Askarany et al., 2012; Hameed et al., 2012). But it does not mention how the attitude affects accepting or rejecting a technology (Karahanna et al., 1999; Oliveira & Martins, 2011). In addition, this theory doesn't care about individual's resources or social support to adopt the new behavior.

The Theory of Acceptance and Use of Technology (UTAUT) has been praised for its capability to inform the understanding of factors that determine the acceptance of an impending new technology. Although the model is quite new, its growth and popularity are high as compared to the preceding versions (Al-Hakim, 2006). Moreover, its stability, validity and viability in technology adoption surveys within several contexts have already been ascertained and practically confirmed. For instance, the study of Alshehri et al (2012) on TAM, TRA and TPB ascertained that UTAUT model enlightens the understanding of factors that influence the acceptance of new technologies (Jaeger & Matteson, 2009; Mayer-Schönberger & Lazer, 2007). UTAUT model explains over 70% of all the technology acceptance behavior, unlike other models that explain as little as 40% of the entire technology acceptance behavior. Therefore, UTAUT exposes more factors influencing the intention of the observed behavior (Grant, 2011). Actually, it intends to counter the deficiencies of prior models and theories by combining them together for a common good. For that reason, it has emerged as one of the most encompassing adoption theories (Grant, 2011). Even though this model has attained an adequate reception from most researchers, a number of shortcomings exist. Although the integrated models utilize several terminologies within their phraseology of acceptance, these aspects are often similar in nature. Subsequently, every model has its own shortcomings, which also influences the ultimate viability of UTUAT model as a whole (Cetron, 2007). In particular, UTAUT has limitations mainly in its relationship between the intention and use behavior. Nevertheless, the benefits obtained from this model are far more significant than the shortcomings listed above (Mayer-Schönberger & Lazer, 2007; Grant, 2011).

CONCLUSION

This paper provides an overview on the main conceptual models and theories used in the studies on the adoption of new technologies and practices, namely the Technology Acceptance Model (TAM), the Motivational Model (MM), the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), the Theory of Diffusion of Innovation (TDI) and the Unified Theory of Acceptance and Use of Technology (UTAUT). It also discusses the main limitations and shortcomings of each model. Since the TAM model focuses primarily on the impact of friends on technology adoption, it cannot be used as a reliable model to study the adoption of water and soil conservation practices. The MM also loses its qualification for use due to the lack of required components and its incompleteness. The TRA is a general model and can be used to analyze the acceptance of water and soil conservation practices and the attitudinal factors that affect it, but it ignores external factors that may be effective. Therefore, despite the relative competence of this model, it cannot be effectively applied. Although TPB is an expanded model of TRA and has been applied in a wide range of studies related to acceptance of soil and water conservation practices, it has some limitations (e.g. lack of relationship between behavioral intention and motivation, not considering environmental and economic factors) that makes it ineffective in predicting use behavior. While the primary focus is on attitudinal factors, the TDI model does not cover how attitudes affect individual decisions regarding the acceptance of protection practices. Therefore, this model also cannot play a significant role in the research on the adoption of soil and water conservation practices. While the UTAUT is a newer, it is more complete and more applicable than the other models, its advantages are far more than its disadvantages and weaknesses, and its competence for application is far greater than the other models that were introduced in this study. Therefore, despite the widespread use of the TPB model, we suggest that researchers studying the adoption of new practices and technologies in agriculture use the UTAUT model.

REFERENCES

- Abdullah, F. & Ward, R. (2016). Developing a General Extended Technology Acceptance Model for E-Learning (GETAMEL) by analysing commonly used external factors. *Computers in Human Behavior*, 56, 238-256. doi:10.1016/j.chb.2015.11.036
- Ajzen I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2): 179-211. DOI: 10.1016/0749-5978(91)90020-T
- Ajzen I. (2005). *Attitudes, personality, and behavior*. Maidenhead, UK: Open University Press.
- Ajzen I. (2012). The theory of planned behavior. In, Lange P.A.M., Kruglanski A.W. & Higgins E.T. (Eds.), *Handbook of theories of social psychology*. London, UK: Sage. pp. 438-459.
- Ajzen, I. & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour*. Englewood Cliffs, N.J.: Prentice-Hall.

- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. *Action control*. Berlin, Heidelberg: Springer. pp. 11-39.
- Al-Hakim, L. (2006). *Global E-Government: Theory, Applications and Benchmarking: Theory, Applications and Benchmarking*. University of Southern Queensland, Australia. DOI: 10.4018/978-1-59904-027-1
- Alshehri, M., Drew, S., Alhussain, T. & Alghamdi, R. (2012). The Effects of Website Quality on Adoption of E-Government Service: An Empirical Study Applying UTAUT Model Using SEM. 23rd Australasian Conference on Information Systems, Melbourne, Australia.
- Ang, M. C., Ramayah, T. & Amin, H. (2015). A theory of planned behavior perspective on hiring Malaysians with disabilities. *Equality, Diversity and Inclusion: An International Journal*, 34(3), 186-200.
- Askarany, D., Brierley, J. A. & Yazdifar, H. (2012). The effect of innovation characteristics on activity-based costing adoption. *Int. J. Managerial and Financial Accounting*, 4(3): 291–313.
- Barbier, E. B. and Bishop, J. T. (1995). Economic values and incentives affecting soil and water conservation in developing countries. *Journal of soil and water conservation* 50(2): 133-137.
- Bruinsma, J. (2009). The resource outlook to 2050: by how much do land, water and crop yields need to increase by 2050. Paper Prepared for the Expert Meeting on How to Feed the World in 2050, Food and Agriculture Organization (FAO), Rome.
- Cetron, J. F. (2007). *Wireless acceptance in a University setting using the Unified Theory of Acceptance and Use of Technology*. University of Delaware: New York.
- Davis, F. D. (1985). A technology acceptance model for empirically testing new end-user information systems: Theory and results. PhD, Massachusetts Institute of Technology, Cambridge, MA. Retrieved from <https://dspace.mit.edu/bitstream/handle/1721.1/15192/14927137-MIT.pdf?sequence=2>
- Davis, F. D., Bagozzi, R. P. & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, 35(8), 982-1003.
- Deci E. L. and Ryan R. M., (2008). Self-Determination Theory: A macrotheory of Human Motivation, Development, and Health. *Can. Psychol. J.*, 49(3), 182–185.
- Deci, E. L. & Ryan, R. (1985). *Motivation and self-determination in human behavior*. New York: Plenum Publishing Co.
- Deci, E. L., Vallerand, R. J., Pelletier, L. G. & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational psychologist*, 26(3&4): 325–346.
- Fishbein M. and Ajzen I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison-Wesley, Libraries Australia.

- Gagné, M. & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational behavior*, 26(4), 331-362.
- Hameed, M. A., Counsell, S. & Swift, S. (2012). A conceptual model for the process of IT innovation adoption in organizations. *Journal of Engineering and Technology Management*, 29(3), 358-390.
- Hugo, G. (2006). Trends in land degradation in South America. Workshop of Agricultural Meteorology Programme (AgMP). World Meteorological Organization (WMO): Portland, Oregon, pp. 127-146.
- Grant, K., (2011). Proceedings of the 2nd International Conference on Information Management and Evaluation. Ryerson University, Toronto (Canada), 27-28 April 2011. Reading: Academic Pub. International Ltd.
- Jaeger, P. & Matteson, M. (2009). e-Government and Technology Acceptance: The Case of the Implementation of Section 508 Guidelines for Websites. *Electronic Journal of E-Government*, 7(1), 87-98.
- Karahanna, E., Straub, D. W. & Chervany, N. L. (1999). Information technology adoption across time: a cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS quarterly*, 23(2), 183-213.
- Kumar Chaudhary, A., Warner, L. A., Lamm, A. J., Israel, G. D., Rumble, J. N., & Cantrell, R. A. (2017). Using the Theory of Planned Behavior to Encourage Water Conservation among Extension Clients. *Journal of Agricultural Education*, 58(3), 185-202.
- Mango, N., Makate, C., Tamene, L., Mponela, P., & Ndengu, G. (2017). Awareness and adoption of land, soil and water conservation practices in the Chinyanja Triangle, Southern Africa. *International Soil and Water Conservation Research*, 5(2), 122-129.
- Marangunić, N. & Granić, A. (2015). Technology acceptance model: a literature review from 1986 to 2013. *Universal Access in the Information Society*, 14(1), 81-95. DOI:10.1007/s10209-014-0348-1
- Mayer-Schönberger, V. & Lazer, D. (2007). *From e-government to i-government: Governance and information technology in the 21st century*. MIT Press, Belfer Center for Science and International Affairs John F. Kennedy School of Government, Cambridge, Massachusetts.
- Muchena, F., Onduru, D., Gachini, G. & De Jager, A. (2005). Turning the tides of soil degradation in Africa: capturing the reality and exploring opportunities. *Land Use Policy*, 22(1), 23-31.
- Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at firm level. *Electronic Journal of Information Systems Evaluation*, 14(1), 110-121.
- Orr, G. (2003). Diffusion of innovations, by Everett Rogers (1995). Retrieved from <http://www.stanford.edu>
- Parijat, P., & Bagga, S. (2014). Victor Vroom's expectancy theory of motivation—An evaluation. *International Research Journal of Business and Management*, 7(9), 1-8.

- Schepers, J. & Wetzels, M. (2007). A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects. *Information & Management*, 44(1), 90-103. doi:10.1016/j.im.2006.10.007
- Shan, Y. & King, K. W. (2015). The effects of interpersonal tie strength and subjective norms on consumers' brand-related eWOM referral intentions. *Journal of Interactive Advertising*, 15(1), 16-27.
- Silva, P. M. & Dias, G. A. (2007). Theories about technology acceptance: why the users accept or reject the information technology? *Brazilian Journal of Information Science: Research Trends*, 1(2), 69-86.
- Truong, Y. (2008). An evaluation of the theory of planned behaviour in consumer acceptance of online video and television services. *The Electronic Journal Information Systems Evaluation*, 12(2), 177-186.
- Venkatesh, V., Morris, M. G., Davis, G. B. & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 27, 425-478.
- Wauters, E., Biielders, C., Poesen, J., Govers, G., & Mathijs, E. (2010). Adoption of soil conservation practices in Belgium: an examination of the theory of planned behaviour in the agri-environmental domain. *Land Use Policy*, 27(1), 86-94.