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Drivers of Forecasting the Behavioral Intention and Acceptance Behavior of the Hail Canon Technology (HCT): Using Logistic and System Dynamics Modeling

ABADI Bijan, HAGHANINIA Mohammad

(*Faculty of Agriculture*, *University of Maragheh*, *Golshahr Town* 55181-83111, *Iran*)

Abstract: Globally known about the drivers through which farmers are instigated to uphold and use Hail Canon Technology (HCT) is lacking. Therefore, this article intended to examine the drivers of forecasting the behavioral intention and acceptance behavior of the HCT, 249 apple farmers from northwestern Iran were recruited, including adopters (n_1 = 114) and non-adopters (n_2 = 135). The conceptual foundation included demographic theory, resource-based theory, theory of planned behavior, innovation diffusion model, and institutional support model. We also used the system dynamics model (SDM) in the Netlogo to assess the results of the conventional statistical approach (i.e., the logistic model). Authenticated the fitness of conceptual model with the data, logistic model manifests that the most outstanding determinants of the acceptance of HCT entail age, experience, total land size, income, attitude, compatibility, visibility, relative advantage, and financial support. Using the SDM, it was also shown that the results of the logistic model are confirmed by the SDM. In conclusion, management implications are available for the university extension to eliminate the adoption obstacles and stir up farmers to join in applying HCT, furthermore, researchers would avail themselves of remarks for future research.

Keywords: climate change; resilience; Hail Canon Technology (HCT); system dynamics; Iran

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1 Introduction

Hail is one of the atmospheric hazards and threats that causes great damage to the environment, living organisms, industries, urban human settlements, and the quantity and quality of tree and crop production in the agricultural sector (Stigter et al., 2010; Khoshakhlagh et al., 2013; Mirmousavi et al., 2013). Being as large as coffee grain to an orange fruit, the hail is grown out of spring thunderstorms and is produced instantly by cumulonimbus clouds, and their precipitation expansion is about 100 m (Khoshakhlagh et al., 2013; Saneei et al., 2013). Hailstorms with grain sizes as large as a coffee grain to an orange fruit (Stigter et al., 2010) may be behind the dominant clouds in the sky that create turbulence, which is mainly associated with a cold and unstable troposphere (Steiner, 1988). Currently, Hail Canon Technology (HCT) is used in the townships of Mahabad, Ardabil, Alborz, Maragheh, Aras Free Zone, and regions situated in the western Azerbaijan. The HCT affects the clouds in a radius of about 500 m, being able to cover more than one hundred ha of peripheral lands.

The history of using HCT coincides with issuing the scientific perspective of using manipulating technologiestomakeadjustmentsinweatherandclimate(Changnon- and Ivens, 1981). Deliberate climate change (DCC) is

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Corresponding author: ABADI Bijan. E-mail: abadi.bijan@gmail.com

the conscious manipulation or modification of the environment that leads to climate change. The DCC is used to enrich clouds by spraying silver iodide crystals on clouds, leading to deposited vapor on the crystals and agglomerated rain droplets, which regulate local water scarcity, agricultural production, and ecosystem conservation (de Wilde, 2016; Chien et al., 2017). Chien et al. (2017) argue that there are two political dimensions to understanding rainfall control and the use of water in the clouds 1) a new ideological policy of changing human-nature relationships from climate adaptation to taming and 2) volumetric policy that offers the unique characteristics of water from cloud fertility, compared to ground and groundwater resources. In general, there are several active or inactive methods to challenge frostbite, which may be performed to combat hail (Fig. 1).

Risk management scientists call attention to the use of sustainable technologies, for example, anti-hail nets (AHNs) that are well-suited to manage hail damage (Stigter et al., 2010), providing a shield to prevent damage to fruits and damage to leaves and tree branches (i.e., defoliation). These nets are light, hard, and durable and have high resistance to the sun's UV rays (Bhavani et al., 2017). Rogers (2003) argues that innovation is defined as an idea, activity, object that is perceived from the perspective of an individual or a set of new adopters. The installation of HCT in the regions exposed to hail is a useful initiative to annihilate damages to the agricultural sector.

By reviewing the research literature, witnesses bring into consideration the previous body of knowledge about the use of intentional weather modification technologies (Frenzen, 1970; Buller et al., 1981; Changnon and Ivens, 1981; Changnon, 1983; 1992; Chien et al., 2017), as well as the use and adoption of technologies that are directly adapted to climatic conditions, for ex-

Thaw Mats (https://digready.com/tech-specs/)

Hole-cut steel barrels to thaw the ground quickly. Photo: Heather Smith Thomas (https://www.grainews.ca/2015/02/17/thawing-oven-speeds-digging-post-holes-in-frozen-ground/)

Hail netting protecting (or shade nets, anti-hail nets) (http://anahitabroadway.com/anti-hail-net)

Hail Canon Technology (https://www.amusingplanet.com/2015/10/hail-cannon-gun-that-allegedly-controls.html)

Workers and wine growers light heaters early in the morning, to protect vineyards from frost damage outside Christian Hartmann, Reuters (https://www.cnbc.com/2017/04/29/in-pictures-french-farmers-use-fire-to-try-to-save-their-vineyards.html)

Orchard furnaces (http://betteroffread.com/2013/04/08/blossoms-of-life/smudgepots/)

Fig. 1 Methods of handling frostbite ample, cloud seeding (Chien et al., 2017) or indirectly, the use of ICT systems, such as the use of Internet databases (IDBs) for weather forecasting technologies (Moran et al., 2016), the adoption and application of climate-smart agricultural technologies (SATs) (Nakabugo et al., 2019), and the use of climate-related information tools (i.e., satellites, software, computing, sensors). There is very little knowledge on the matter of the adoption of HCT, further research need to reduce the knowledge gap by calling attention to attitude-intention-adoption. This study identifies the factors affecting the acceptance of HCT, also addressing the following objectives:

(1) To identify the behavioral intentions of farmers to accept the HCT;

(2) To examine the drivers of forecasting the behavioral intention and acceptance behavior of the HCT;

(3) To make policy and management implications to develop more farmers' acceptance of the HCT.

2 Integrated Theoretical Foundation

The main underlying assumption taken into account in this study is the regions with a low and high risk of hail diversify anti-hail policy initiatives and the decisions made by farmers. This issue makes farmers to reap the benefits of HCT more or less urgent. Porsch et al. (2018) declare that, for instance, for orchards with a low risk of hail and low yield potential, lack of using hail risk mitigation is more effective, and the use of HCT is a safe solution for gardens with a high risk of hail and high yields. Therefore, a social motivation to prevent losses resulting from hail and investing in HCT is determined by relying on the severity of hail damage (Farhar et al., 1977; Stigter et al., 2010).

2.1 Demographic theory: adoption of HCT based on demographic characteristics

Gained insight into upholding and using climate-friendly electric vehicles (EVs), Egbue and Long (2012) have indicated that people of different ages possess different attitudes towards EVs. Older farmers are less inclined to become involved in innovative activities and new types of production technologies (Al-Karablieh et al., 2009). Using a hybrid method of interviewing and surveying 32 Irish farmers, Das et al. (2019) found that the rate tied in with the adoption of SATs like cloud computing technology is higher for younger farmers than older ones. Odhiambo (2018) provides evidence that age influences farmers' decision to adopt Internet of Things (IoT) sensing technologies in agriculture.

Connected to the impact of educational attainment on taking an interest in climate technologies, Nakabugo et al. (2019) in Uganda and Das et al. (2019) in Ireland declare that farmers with higher educational attainment are likely to adopt SATs and cloud computing. As witnessed, the level of educational attainment is positively correlated with the chances of taking in production technologies (Agwu, 2004; Al-Karablieh et al., 2009).

The number of family members working on farms and ownership of land and its assets also impinge upon adopting the technologies, such as SATs, PHEVs, and taking environmentally-friendly behaviors (Akman and Mishra, 2015; Rahimi et al., 2017; Nakabugo et al., 2019).

As documented by Oyekale and Idjesa (2009), the likelihood of upholding the agricultural technologies increases when farmers' farming experience increases. Surveyed 543 rice farmers in northern Ghana, Zakaria et al. (2020) make clear that the rate of farmers' acceptance of climate SATs is positively affected by farmers' cultivation experience of rice.

Associated with the climate health impressed by clean energy, Rahimi et al. (2017) examine beliefs about the clean energy consumption of 200 households in Tehran City, Iran, findings disclose that households' income is an effective driver of forecasting the process by which people make a decision about applying clean energy use behavior (i.e., electricity). Revenues that are gained from job returns are impressive in covering the initial costs of purchasing the technologies. For example, Divilly (2018) concludes that one of the primary barriers to uphold Agri-IoT technology in Irish farming systems is the initial cost of purchasing and maintaining the technology, showing a negative relationship between the cost and staying on the technology use. The compliance and acceptance of the HCT in comparison with other alternatives depends on the monetary value of the agricultural products (Stigter et al., 2010) and returns gained from the sale of the products. As witnessed in the literature, membership in the organization of farmers like co-operatives and unions (Bonabana-Wabbi et al., 2016), access to credits (Makate, 2019; Nakabugo et al., 2019), and access to extension or contact to extension (Tufa et al., 2019) are other variables that shape the adoption of improved technologies and climate SATs. Hence, the following hypotheses were established.

Hypothesis 1: Age influences the adoption (–H1a) and intention to adopt HCT (–H1b);

Hypothesis 2: Educational attainment influences the adoption (+ H2a) and intention to adopt HCT (+ H2b);

Hypothesis 3: Family size influences the adoption (+ H3a) and intention to adopt HCT (+ H3b);

Hypothesis 4: Experience influences the adoption (+ H4a) and intention to adopt HCT (+ H4b);

Hypothesis 5: Income influences the adoption (+ H5a) and intention to adopt HCT (+ H5b);

Hypothesis 6: Land ownership influences the adoption (+ H6a) and intention to adopt HCT (+ H6b);

Hypothesis 7: Cooperative membership influences the adoption (+ H7a) and intention to adopt HCT (+ H7b);

Hypothesis 8: Access to extension influences the adoption (+ H8a) and intention to adopt HCT (+ H8b);

Hypothesis 9: Access to credit influences the adoption (+ H9a) and intention to adopt HCT (+ H9b).

2.2 Resource-based theory: adoption of HCT based on the resources of farmlands

Land size is one of the remarkable resource-based factors measured when modeling the processes of decision-making about the acceptance of technologies and innovations. By examining a sample of 1172 small farmers in Malawi and Zimbabwe, Makate (2019) provides evidence that land size has a positive influence on the adoption of climate SATs. In order to determine the drivers of the acceptance of cloud computing in the manufacturing and services sector, Oliveira et al. (2014) conclude that company size affects the acceptance of respective innovations. Furthermore, farm size accounts for the acceptance of Agri-IoT technologies (Divilly, 2018) and cropping technologies (Agwu, 2004). Thus, the following hypothesis was formulated.

Hypothesis 10: Land size influences the adoption (+ H10a) and intention to adopt HCT (+ H10b).

2.3 Theory of planned behavior (TPB)

Attitude towards technologies like Smart Metering Technology (SMT) and SATs is a major driver of predicting intention to use the technologies, which leads to an increase in knowledge about climate change issues (Kranz and Picot, 2012; Netravathi and Chauhan, 2018). Farhar et al. (1977) gain an impression of why farmers in Illinois state, US, are reluctant to adopt the anti-hail systems, as they are not familiar with the technology; despite the hail damage and having a view that hail is a serious problem. In this case, if insurance agencies do not make reparation for the losses of agricultural products caused by hail, farmers are forced to find other alternatives to deal with natural disasters. Nevertheless, farmers' attitudes towards SATs are based on a coherent understanding of changing climate conditions that include changes in the length and intensity of rainfall patterns, unpredictability, drying up of river flows, increased flood incidence; higher temperatures, and stronger winds, as these changes cause low productivity and increased uncertainty (Schaller et al., 2017). To diminish air pollution using Green House Gas mitigation technologies in urban transportation, research shows that attitudes are influential drivers in fomenting people to use PHEVs and alternative fuel vehicles (AFVs) (Akman and Mishra, 2015; Chen et al., 2016).

The literature has documented the effect of SNs on the acceptance of technologies like Agri-IoT technologies (Divilly, 2018), AFVs (Chen et al., 2016), SMT (Kranz and Picot, 2012), and Internet of Things sensors (Sensing) (Odhiambo, 2018), it is concluded that provoker and inspirer people have an influence on the decisions made by target persons about adopting the technologies. Chen et al. (2016) and Akman and Mishra (2015) conclude that perceived behavioral control (PBC) influences the intention to use and adopt AFVs and PHEVs. Therefore, the following hypotheses were developed.

Hypothesis11: Attitude influences the adoption (+ H11a) and intention to adopt HCT (+ H11b);

Hypothesis 12: SNs influence the adoption (+ H12a) and intention to adopt HCT (+ H12b);

Hypothesis 13: PBC influences the adoption (+ H13a) and intention to adopt HCT (+ H13b).

2.4 Innovation diffusion model

Compatibility is defined as the extent to which an innovation is consistent with the values, activities and needs of individuals (Rogers and Shoemaker, 1971). Climate manipulation requires high technologies and large databases analyzed by computer calculations, might be with no consistency with targeted individuals' values, past experiences, backgrounds, needs, and norms, if so, technologies are unlikely to be accepted by target community. Associated with adopting of the cultivation technologies, Asimeh and Nooripoor (2017) provide evidence that farmers' perception of compatibility of innovation is in a high situation, paving the way for the adoption of farming technologies. As evidenced by Powelson (2011), it is disclosed that compatibility has an influence on the tendency to adopt and use Cloud-computing Innovation.

Visibility means the degree to which the results of a disseminated innovation are visible or observable to others (Rogers and Shoemaker, 1971), playing a substantial role in predicting the tendency to accept and use innovations (Powelson, 2011). To study 346 Iranian farmers' behavioral intention to ratify and use drip irrigation technology (DIT), Haji et al. (2020) extended the TAM and concluded that visibility of DIT has the potential to have a positive and indirect influence on the adoption behavior, as medicated by perceived ease of use.

The advantages of the use of technologies are understood by weighing the perceived benefits and the costs of using the technologies and paying attention to economic (Swanson et al., 1972; Buller et al., 1981), social (e.g., reduced poverty and enhanced food security) (Mittal and Hariharan, 2018), environmental (Wieringa and Holleman, 2006), political, legal, educational aspects (Borland, 1977; Farhar et al., 1977). Changnon (1983) argues that the study of the social and environmental aspects of planned climate manipulation raises the question of whether the use of relevant technologies makes a meaningful way to benefit to the society. As an economic point of view, Swanson et al. (1972) believe that if the net profit from the use of climate change technologies is higher than the costs, especially leading to a decrease in food production costs, if technologies are economically viable, they are likely to be embraced by farmers. Buller et al. (1981) explicate that the application of artificial rain technology may increase the total income of farmers because the percentage of increase in production is greater than the percentage of decrease in price of the products. Therefore, comparative advantage has an impact on the adoption of, for instance, cloud computing technologies and Big Data Technology (BDT) (Oliveira et al., 2014; Chowdhury, 2018). Kranz and Picot (2012) show that perceived usefulness of SMT has an impact on the attitudes towards SMT, which leads to the formation of the effect on the intention. Wieringa and Holleman (2006) argue that hail suppression is an unreliable meteorological issue in the agricultural sector. In this regard, the development of scientific and governmental policies requires the identification of an old axiom principle that is evident in the study of climate change resulting from regional climate change and its behavioral consequences, think globally, but take action locally.

In accepting technologies that use energy more efficiently, Kranz and Picot (2012) show that perceived ease of use of SMT influences attitudes towards SMT. With an insight into the discussion of accepting cloud computing, Powelson (2011) states that complexity is an effective variable in explaining the tendency to accept and use cloud computing, therefore, the more complex these innovations are, the less they are ratified and used by people.

Hypothesis 14: Compatibility influences on the adoption (+ H14a) and intention to adopt HCT (+ H14b);

Hypothesis 15: Visibility influences the adoption (+ H15a) and intention to adopt HCT (+ H15b);

Hypothesis 16: Ease of use influences the adoption (+ H16a) and intention to adopt HCT (+ H16b);

Hypothesis 17: Perceived advantage influences the adoption (+ H18a) and intention to adopt HCT (+ H18b).

2.5 Institutional support theory

The political orientation of the constitution and strategic plans towards investing and disseminating technologies enhances the likelihood of the adoption of the HCT (Farhar et al., 1977). For example, the challenge of low adoption of climate SATs emanates from prudential policies and institutional efforts to find ways to apply climate-smart agriculture practices (CSA) on a large scale (Makate, 2019). However, due to limited financial resources, high prices, and expenses of technologies, farmers may not be willing to adopt the technologies, if they receive financial support to meet the costs, their volitional control will increase (Abadi et al., 2020).

Given the role of non-formal educational institutions that play in enhancing the rate of acceptance of climate innovations, for example, Nambiza (2014) takes a look at the adoption of climate information and SATs in agriculture and highlights the use of climate information services to adapt to climate conditions. The access to education and information delivered by institutions and media contributes to increasing the adoption of the technologies (Makate, 2019; Nakabugo et al., 2019), an increase in awareness, knowledge, and information of people establishes attitudes, normative beliefs, and the intention to adopt technologies (Ashworth et al., 2012; Kranz and Picot, 2012; Chen et al., 2016). When farmers become unified in associations and coalitions and are supported by the government's institutional aids, making easy for them to accept innovations and technologies due to the coverage of costs of technologies and reduced vulnerabilities that threaten individual people. The hypotheses are the following.

Hypothesis 18: Financial support influences the adoption (+ H18a) and intention to adopt HCT (+ H18b);

Hypothesis 19: Educational support influences the adoption (+ H19a) and intention to adopt HCT (+ H19b);

Hypothesis 20: Institutional support influences the adoption (+ H20a) and intention to adopt HCT (+ H20b).

Fig. 2 displays the theoretical model of the study.

3 Materials and Methods

3.1 Research site

Maragheh township, with 21 000 ha of orchards, is the center of fruit production in eastern Azerbaijan. The local government of Maragheh township with the collaboration of the department of agriculture has implemented the HCT project in the villages of Nova, Divrazm, Saeed Abad, and suburbs of the township, which cover 300 ha of orchards in the township, 8 HCTs also will be installed and put into operation in future. In the province of eastern Azerbaijan, 47 active HCTs have covered 4700 ha of orchards, as 700 million Rials have been allocated to cover the cost.

3.2 Sample and sampling

Table 1 displays the distribution of rural areas where the survey was done (n = 249), as farmers were randomly selected. The criteria for grouping respondents into low-risk and high-risk areas was based on the experience of

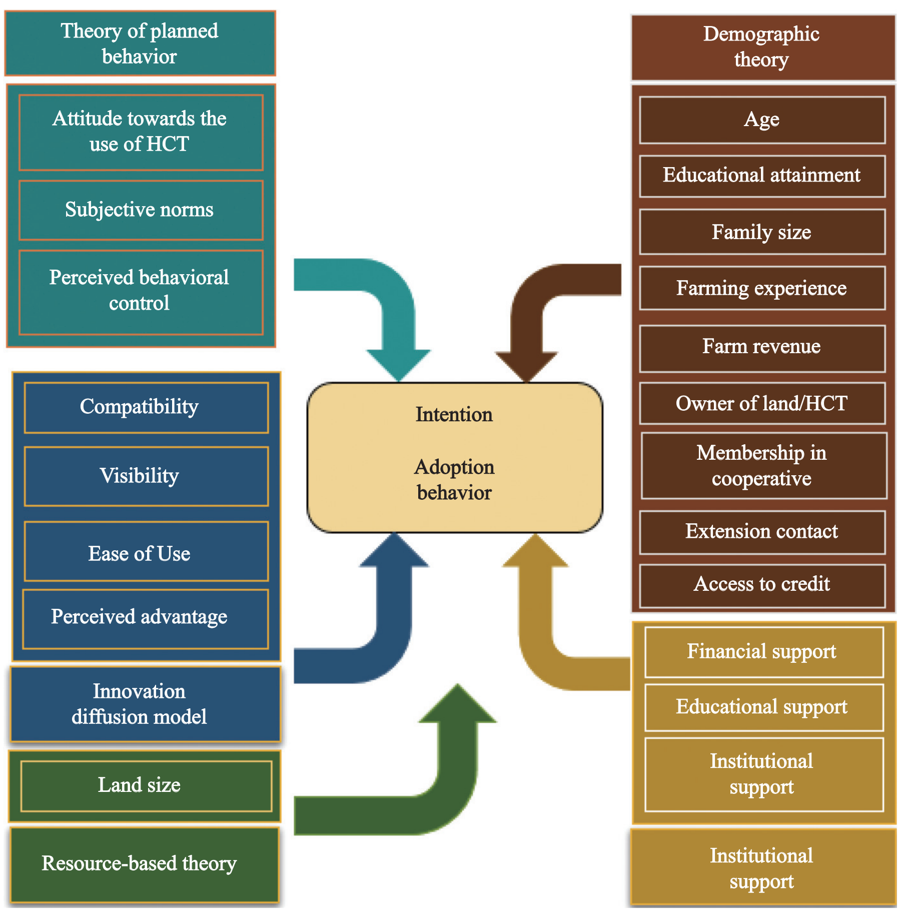

Fig. 2 Theoretical model. HCT, Hail Canon Technology

Table 1 Frequency distribution of selected rural areas

Rural areas	Frequency	Percentage / %
Nova	43	17.3
Saeid-Abad	26	10.4
Divrazm	31	12.4
Aghajeri	35	14.1
Taleb-Khan	20	8.0
Haji-Kord	26	10.4
Chekan	13	5.2
Alavian	22	8.8
Tazeh-Kand Sofla	18	7.2
Tazeh-Kand Olya	15	6.0
Total	249	100.0

these areas being encountered with risk of hail, as officially reported, and also, being under the cover of anti-hail devices installed in the high-risk regions.

3.3 Reliability and measurement scale of constructs

To make sure the sufficient value of internal consistency of constructs has been achieved, we benefited from Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE), the cutoff measures of these indices were met (Cronbach's Alpha > 0.70; CR > 0.70, AVE > 0.50; and CR > AVE). To measure CR and AVE, the following formulas (1) and (2) (Abadi et al., 2020) were used:

$$\mathrm{CR}=\frac{\sum(\lambda_{\mathrm{i}})^2}{\sum(\lambda_{\mathrm{i}})^2+\sum(\sigma_{\mathrm{i}})^2} \tag{1}$$

$$\mathrm{AVE}=\frac{\sum(\lambda_{\mathrm{i}})^2}{\sum(\lambda_{\mathrm{i}})^2+\sum(\sigma_{\mathrm{i}})} \tag{2}$$

where λ represents the standardized factor loading, *i* is the frequency of the items of latent variables, and (σ) is the error variance of items.The constructs were assessed by a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree).

3.4 Assumptions of linear and logistic regression models

We met the assumptions of linear regression as follows, as stated by Hahs-Vaughn (2016).

• *Independence:* The assumption pertains to the independence of observations, resulted from the randomly selected respondents and randomly collected data.

• *Collinearity:* The assumption indicates that high correlations between independent variables collapse the power of the model in predicting the variance of the dependent variable.

• *Linearity:* In logistic analysis, the assumption of linearity is realized when there are linear relationships between all pairs of independent variables in each group of dependent variables.

• *Outlier:* Out-of-bounds or out-of-range data are data that, due to the strong impact on the mean, lead to inaccuracies in inference and interfere with the inference of results.

• *The scale of independent variables:* In logistics analysis, the type of scale used to measure independent variables should be cumulative response scale, interval, or ratio scale, although two-category variables can also be entered into the logistic regression function.

• *Sample size:* There is no consensus among statisticians on the exact value of sample size relevant us logistics analysis; larger samples might be sufficient for logistic regression.

As believed by Pampel (2000), the benefit of logistic regression is no requirement of the method to the assumptions obliged to be fulfilled in the linear regression like linearity, additivity, normality, and homoscedasticity.

4 Results

4.1 Descriptive statistics

Table 2 displays the items of the questionnaire, mean, standard deviation, and internal consistency of constructs, as assessed by Cronbach's alpha, CR, and AVE.

4.2 Inferential statistics

4.2.1 Linear regression model of intention

To find out the drivers of the behavioral intention to accept the HCT, we took the measure of the hypotheses using the linear regression model.

4.2.2 Logistic regression model of behavior

The nonlinear linkage of the dependent variable with the independent variables is converted into a linear relationship by turning probability changes into the log odds changes (Hahs-Vaughn, 2016). A unique coefficient of Exp (B) is accordingly obtained.

4.2.3 The criteria of goodness of fit

As maintained by Hahs-Vaughn (2016), there is a group

Table 2 Items of questionnaire, mean, standard deviation, and reliability of research constructs measured by composite reliability (CR), average variance extracted (AVE)

Indices and items	Code in SPSS	Mean ±SD	Composite reliability (CR)	Average variance extracted (AVE)	Skewness/ (Kurtosis)
1. Attitude towards the use of HCT (α = 0.97)					
The use of HCT is a useful career	ATT1	3.33±1.44	0.74	0.52	–0.38(–1.21)
The use of HCT makes sense	ATT2	3.51±1.45			–0.61 (–.99)
The use of HCT is a good career	ATT3	3.42±1.42			–0.50(–1.06)
The use of HCT is a wise thing to do	ATT4	3.42±1.45			–0.50(–1.11)
2. Social Norms (α = 0.96)					
People who are important to me think that I should use an HCT	SN1	3.10±1.26			0.1(–1.07)
If I use an HCT, people who are important to me will approve of it	SN2	3.15±1.29	0.85	0.56	–0.02(–1.13)
People who are important to me think that using an HCT is appropriate and useful	SN3	3.08±1.32			0.009 (–1.16)
3. Perceived Behavioral Control (α = 0.64)					
If I want, I can easily use the HCT	PBC1	2.33±1.21			0.48(–0.88)
I have the time and skills to use an HCT	PBC2	2.63±1.24			0.17(–1.12)
I have the necessary financial resources to use the HCT	PBC3	1.96±1.09	0.78	0.66	0.92 (–0.05)
I can decide on everything that happens on the farm	PBC4	3.51±1.29			–0.54(–0.86)
4. Intention (α = 0.77)					
I plan to buy and use an HCT in the next year	INT1	2.61±1.46			0.30(–1.35)
I intend to encourage other farmers to buy and use HCT	INT2	2.97±1.51	0.86	0.66	0.05(–1.42)
I plan to attend HCT training classes	INT3	2.51±1.38			0.37(–1.22)
5. Compatibility (α = 0.84)					
Buying an HCT fits my life needs	Comp1	3.08±1.22			–0.16(–1.06)
Buying an HCT is harmless to the nature and climate of the region	Comp2	2.91±1.45			0.07(–1.35)
Purchasing an HCT is commensurate with improving the welfare of farmers	Comp3	3.17±1.25	0.81	0.63	–0.24(–0.96)
Purchasing an HCT is commensurate with improving the financial situation of farmers	Comp4	3.08±1.37			–0.11(–1.23)
6. Visibility (α = 0.93)					
The results of using an HCT are easily visible to me	Obs1	3.04±1.31	0.88	0.67	0.02(–1.15)
I can easily explain the results of using an HCT to others	Obs2	3.20±1.30			–0.17(–1.10)
The results of using an HCT are clear to me	Obs3	3.02±1.32			–0.05(–1.14)
7. Relative Advantage (RA) (α = 0.95)					
Use of HCT					
Reduces damage to facilities, tools, farm buildings, and gardens	RA1	3.38±1.17			–0.88(–0.13)
Reduces damage to crops and fruit trees	RA2	3.91±1.15			–1.01 (0.18)
It turns hail into the rain and reduces the impact on crops and orchards	RA3	3.61±1.36	0.79	0.63	–0.57(–0.93)

Continued Table 2

Indices and items	Code in SPSS	Mean ± SD	Composite reliability (CR)	Average variance extracted (AVE)	Skewness/ (Kurtosis)
Prevents stress on farmers and gardeners during the seasons with the possibility of hail	RA4	3.62±1.38			–0.64(–0.82)
It reduces financial losses to farmers	RA5	3.72±1.38			–0.72(–0.78)
It reduces food crisis food shortages	RA6	3.38±1.48			–0.53(–1.14)
8. Ease of use (α = 0.82)					
Working with HCT is easy for me	Ease1	2.63±1.09			0.19(–0.90)
I have enough knowledge to work with HCT	Ease2	2.30±1.03	0.89	0.56	0.50(–0.55)
I have enough skills to work with HCT	Ease3	2.56±1.13			0.31(–.76)
I think it is easy for me to learn how to work with an HCT	Ease4	3.22±1.32			–0.17(–1.07)
9. Financial support (FS) (α = 0.93)					
Government subsidies encourage farmers to adopt HCT	FS1	4.12±1.13	0.71	0.54	–1.20(0.47)
The provision of credit facilities (loans) by the government to farmers increases the acceptance of HCT	FS2	4.17±1.09			–1.27(0.77)
10. Educational support (ES) (α = 0.93)					
Training programs on how to use an HCT encourage farmers to adopt it	ES1	3.48±1.16			–0.59(–0.64)
Government education support encourages farmers to adopt HCT	ES2	3.60±1.17			–0.66(–0.51)
The training support of consulting services organizations encourages farmers to adopt HCT	ES3	3.33±1.19	0.85	0.54	–0.29(–0.89)
NGO training support encourages farmers to adopt HCT	ES4	3.25±1.23			–0.33(–0.93)
11. Institutional support (IS) (α = 0.95)					
Organizing farmers' unions and associations, coalitions make it easier for farmers to buy and use HCT	IS1	3.46±1.28			–0.55(–0.76)
Organizing farmers' cooperatives make it easier for farmers to buy and use HCT	IS2	3.36±1.25	0.78	0.57	–0.37(–0.85)
Organizing NGOs makes it easier for farmers to buy and use HCT	IS3	3.24±1.30			–0.26(–0.99)

Notes: Skewness and kurtosis are at the range of –2 and + 2, SNs: Subjective Norms, PBC: Perceived Behavioral Control

of tests in logistic regression, called the omnibus tests of model coefficients. The obtained results of this type of test show that the value –2LL for the constant only model calculate by the summation of the chi-square value and –2LL of the model for Model 2 (high-risk condition), and the measure of 343.415 for Model 3. A point necessary to remember is that the properly fitted model is attained when the value –2LL for the whole model is less than the value –2LL of the constant model, as achieved in the study. These tests inquire about the appropriateness and qualification of the independent variables entered into the logistic regression function. In this case, a significance level of less than 5% indicates that the null hypothesis is not accepted and the independent variables are tailored that improve the predictability of the model. The chi-square value and the critical value demonstrate that the null hypothesis is rejected, as it assumes that the best prediction model is the only constant model. To better understand, the full model with predictors has the best performance in predicting the adoption behavior of the HCT.

The Cox & Snell and Nagelkerk multiple correlation coefficients are pseudo-multiple correlation coefficients and function as the same R^2, also interpreted as similarly as multiple R^2. These coefficients serve as effect size for logistic regression, and the Cohen correlation interpretation is used for interpretation. The measures of the Cox & Snell R square are 0.29, 0.35, and 0.25 for the three models. These values indicate that independent variables predict 25%–35% of changes in the logistics function.

The Hassmer-Lemshoff test is also used to check the accuracy of the classification of the variables. The statistical non-significance of the test is an indication of the appropriateness of the model. In other words, for a significance level greater than 5%, the Hassemmer-Lemshoff fitness test is not rejected, therefore, expressing that the classification is consistent with the observations. It is worth noting that this test is affected by the small size of the sample and if the sample size is less than 50, the interpretation of the results should be used with caution.

4.2.4 Model 1: Adopters and non-adopters under the low-risk conditions

For the respondents that come under the category of low-risk of hail, as being pertinent to Model 1, the significance level of less than 5% for the land size (B = 0.59, Wald_{BHV} = 4.314, Exp(B) = 1.181, P < 0.05) and less than 1% for the educational support (B = –0.87, Wald_{BHV} = 6.785, Exp(B) = 0.417, P < 0.01) signify that these two variables are suited for predicting the variation of the acceptance of HCT. The value of B for the land size variable is equal to 0.59, which indicates that per a one-unit increase in land size, a 0.59-unit increase would occur in the acceptance of HCT. The Exp(B) values represent odds ratios, the odds ratio of 1.181 for the land size variable makes manifest that per a one-unit increase in the land size variable, the chance of accepting the HCT would become 1.181 times. Notwithstanding, the variables of attitude (B = 0.29, P < 0.05), compatibility (B = 0.38, P < 0.001), financial support (B = 0.18, P < 0.01) are the predictors of behavioral intention to accept the HCT.

4.2.5 Model 2: Adopters and non-adopters under the high-risk conditions

Model 2 bears upon the respondents who are at high risk of hail, for these cases, the variables, such as compatibility (B = –0.71, Wald_{BHV} = 4.185, Exp(B) = 0.489, P < 0.05), visibility (B = 0.50, Wald_{BHV} = 4.210, Exp(B) = 1.659, P < 0.05), and educational support (B = 0.63, Wald_{BHV} = 3.952, Exp(B) = 1.895, P < 0.5) contribute to explaining the variation of the acceptance behavior of the HCT. The value of B for the visibility is 0.50, indicating that for a one-unit increase in visibility, a 0.50-unit increase would occur in the acceptance of the HCT and the odds ratio of 1.659 for this variable shows that for one-unit increase in the visibility variable, the chance of accepting the HCT would become 1.659 times. For the educational support variable, the odds ratio is 1.859, showing that for one-unit increase in the educational support variable, the chance of accepting the HCT would be 1.859 times. Additionally, age (B = –0.25, P < 0.05), experience (B = 0.34, P < 0. 01), land size (B = 0.29, P < 0.01), compatibility (B = 0.22, P < 0.05), visibility (B = 0.16, P < 0.05) are determinants of behavioral intention to accept the HCT (Table 3).

4.2.6 Model 3: Adopters and non-adopters

As displayed in Table 4, the results of running of Model 3 manifests that land size (B = 0.34, Wald_{BHV} = 5.319, Exp(B) = 1.410, P < 0.05), compatibility (B = –0.49, Wald_{BHV} = 4.304, Exp(B) = 0.612, P < 0.05), and visibility (B = 0.38, Wald_{BHV} = 4.508, Exp(B) = 1.465, P < 0.05) are the drivers of predicting the acceptance behavior of the HCT. In this group, the highest value of B has a bearing on visibility, showing that per a one-unit increase in visibility, a 0.38-unit increase would occur in the acceptance of HCT. The odds ratio of 1.465 relating to the visibility variable refers to a one-unit increase in the visibility, the chance of accepting the HCT would become 1.465 times. Furthermore, the variables of age (B = –0.18, P < 0.05), experience (B = 0.26, P < 0. 01), land size (B = 0.18, P < 0.01), income (B = –0.16, P < 0.05), attitude (B = 0.16, P < 0.05), compatibility (B = 0.32, P < 0.001), visibility (B = 0.13, P < 0.05), relative advantage (B = 0.16, P < 0.05), and financial support (B = 0.10, P < 0.05) account for the variation of the behavioral intention to take an interest in the HCT.

The Cox and Snell pseudo R^2 serves as an index to estimate the value of the adoption behavior, the measures of Cox & Snell pseudo R^2 referring to two conditions of low and high risk and without low-high risk conditions are illustrated in Table 5, also the results of adjusted R^2 of two conditions of low and high risk as well as without low-high risk conditions are seen in Table 6.

4.3 System dynamics model

In order to find out about the interactions of the components of the conceptual model, we run a system dy-

Table 3 Results of the estimation of the model for BHV and INT, under low risk condition, non-adopter (n_1 = 43) and adopter (n_2= 61), under high risk, non-adopter (n_1 = 71) and adopter (n_2 = 74)

Variables	Low risk (n_1 = 43, n_2 = 61)				High risk (n_1 = 71, n_2 = 74)			
	Wald coefficient ($Wald_{BHV}$)	Regression coefficient (β_{INT})	–2LL	Cox & Snell R^2	Wald coefficient ($Wald_{BHV}$)	Regression coefficient (β_{INT})	–2LL	Cox & Snell R^2
Owner of system	0.001				0.001			
Age (yr)	0.704	–0.16			1.551	–0.25*		
Educational attainment	0.005				1.008			
Family size	2.653	0.12			0.261	–0.07		
Experience (yr)	0.045	0.28			4.992*	0.34**		
Owner of land	0.043				0.023			
Total land (ha)	4.314*	0.14			0.839	0.29**		
Membership in Cooperative	0.722				0.943			
Extension contact	0.001				0.401			
Access to credit	0.024				0.691			
Income (US $)	0.856	–0.21	105.90	0.29	0.000		137.53	0.35
Attitude	0.016	0.286*			0.000	0.08		
Subjective Norms	0.252	–0.108			0.576	0.05		
Perceived Behavioral Control	2.626	0.070			0.392	0.02		
Behavioral Intention	0.110	–			1.325			
Compatibility	1.718	0.380***			4.185*	0.22*		
Visibility	1.061	0.099			4.210*	0.16*		
Relative advantage	0.229	0.163			0.270	0.12		
Ease of use	1.209	0.039			0.037	0.02		
Financial support	1.041	0.183**			0.094	–0.01		
Educational support	6.785**	0.066			3.952*	0.11		
Institutional support	1.557	–0.024			2.732	0.13		

Notes: Regression coefficient β is related to the estimation of intention, and –2LL pertains to the estimation of behavior. * significant at $P < 0.05$, ** significant at $P < 0.01$, *** significant at $P < 0.001$, R^2 of Model 1 is 0.579, R^2 of Model 2 is 0.472

namics model in the interface of Netlogo software, simulated the hypothesized interactions to visualize the interactions of farm-level and natural environments. A system dynamics model is a mathematical representation and realization of the developed interactions among system variables over time (Rehan et al., 2013).

In this section, we show the results of a system dynamics model of adoption intention, as three predictors of attitude, compatibility, and visibility were constant at the real range, and other variables were minimized by at least value. The best value for intention obtained as the interactions of the components of the model was tested by three variables of attitude, visibility, and compatibility.

5 Discussion

As resulted in the earlier section, the finding manifests that the rate of taking in the HCT is 45.78%; almost being ready of the respondents to apply the HCT because of having a well-prepared intention and mental tendency. As obtained, land size and educational support are the drivers that make a difference between adopter and non-adopter farmers in the low-risk regions. This finding shows that the larger the land is, the greater the ac-

Table 4 Results of the estimation of the model for behavior and intention (I), for two groups of the adopter (n_1 = 114) and non-adopter (n_2 = 135)

Variables	Adopters (n_1 = 114) & Non-Adopters (n_2 = 135)			
	Wald coefficient ($Wald_{BHV}$)	Regression coefficient (β_{INT})	–2LL	Cox and Snell R^2
Owner of system	0.001			
Age (yr)	0.205	–0.18*		
Educational attainment	0.947			
Family size	1.790	–0.01		
Experience (yr)	2.844	0.26**		
Owner of land	0.059			
Total land (ha)	5.319*	0.18**		
Membership in Cooperative	1.534			
Extension contact	0.090			
Access to credit	0.428			
Income (US $)	0.135	–0.16*	268.60	0.25
ATT	0.056	0.16*		
SNs	0.009	–0.004		
PBC	0.112	0.06		
INT	1.797	–		
Compatibility	4.304*	0.32***		
Visibility	4.508*	0.13*		
Relative advantage	0.015	0.16*		
Ease of use	0.700	0.02		
Financial support	1.530	0.10*		
Educational support	0.163	0.07		
Institutional support	0.073	0.03		

Notes: Regression coefficient β is related to the estimation of intention, and –2LL pertains to the estimation of behavior. * significant at $P < 0.05$, ** significant at $P < 0.01$, *** significant at $P < 0.001$. R^2 of model 3 is 0.61. ATT: Attitude, SNs: Subjective Norms, PBC: Perceived Behavioral Control, INT: Intention

Table 5 Cox and Snell pseudo R^2 for the two conditions of low and high risk and without low-high risk conditions, three logistic regression models

Models	Low risk$_{\text{Adopter and Non-Adopter}}$		High risk$_{\text{Adopter and Non-Adopter}}$		Adopter and Non-Adopter	
	–2LL	Cox & Snell R^2	–2LL	Cox & Snell R^2	–2LL	Cox & Snell R^2
Model 1	105.90	0.29				
Model 2			137.53	0.35		
Model 3					268.60	0.25

Note: Adopter and Non-Adopter indicated adopters and non-adopters of HCT

Table 6 Adjusted R^2 of two conditions of low and high risk and without low-high risk conditions, three linear regression models

Models	Low risk$_{\text{Adopter and Non-Adopter}}$		High risk$_{\text{Adopter and Non-Adopter}}$		Adopter and Non-Adopter	
	R	R^2	R	R^2	R	R^2
Model 1	0.800	0.579				
Model 2			0.726	0.472		
Model 3					0.784	0.590

Note: Adopter and Non-Adopter indicated adopters and non-adopters of HCT

ceptance generated by the adopter farmers. This finding is because when land size increases, the scale of farmland being faced with hail increases, thus the exposure of crops to the risk increases. Since these farmers operate on a commercial scale, they are more likely to adopt the HCT. The reason for the negative impact of educational support is that farmers in this group may not become conscious of the significant role of education yet, being of service to facilitate working with the technology. In addition, the low-quality educational services and lack of trust in educational resources may also be influential and inhibiting drivers. This finding is in harmony with the previous research findings, for example, Agwu (2004), Divilly (2018), Makate (2019).

The findings reveal that for a group of low-risk farmers, attitude, compatibility, and financial support plays a substantial role in predicting behavioral intention. The financial support would increase the ability of farmers to become involved in purchasing and applying the HCT and thus establishing a positive mentality and making ready farmers accept the system.

The determinants of adoption of the HCT in the group of farmers with a high risk are inclusive of compatibility, visibility, and educational support. Additionally, the variables, such as age (with negative impact), experience, compatibility, and visibility serve as the determinants of behavioral intention to embrace the HCT. The negative effect of age on acceptance illustrates that younger people have more acceptance, being pertinent to the risk-taking nature of younger people rather than adult persons, these farmers accept the dangers of the farm environment, also being more prepared to take enterprise actions, accept the unknown environmental conditions and bear the technical, economic, psychological and social costs of cultivation. Furthermore, taking risks to achieve the goal leads farmers to take more significant risks. Similarly, the habit of taking more risks urges farmers to make decisions more systematically and take more significant risks in farming activities (Abadi et al., 2021). This finding conforms to investigations carried out by Al-Karablieh et al. (2009) and Das et al. (2019).

Additionally, the compatibility of using the HCT with different economic, social, and environmental aspects gives rise to the acceptance, therefore, more compatible technologies curtail the time occupied by farmers to evaluate and tradeoff the technology, and accordingly, reduce their resistance time. The more visibility of the results of using the system, the more farmers become inclined to adopt the HCT. This finding is because of the internal characteristics of adults, as they want to feel immediately the results of an action. This group of farmers pays more attention to educational support and probably feels more in need of training to use the system. In essence, sufficient knowledge assures farmers that this knowledge has the potential to become observable behavioral measures. It debates that scientific policies for the development of suitable education have an essential role in the acceptance of technology. For example, Farhar et al. (1977) argue that the lower the level of scientific consensus on the technological capability and the potential exclusion of opponents from the decision-making process, frequent disputes about groups interested in technology revolves around anti-hail technology, resulting in polarization in society and making controversial events that further hinder public acceptance and support for the continued development of the HCT.

In general, the internalization of knowledge by farmers will probably form the mentality and behavioral intention necessary for acceptance, as a result, farmers' doubts and ambiguities about field actions will decrease and farmers' technical abilities will increase (Abadi et al., 2021). This finding is in step with the inquires done by Powelson (2011) and Haji et al. (2020). Given the analysis of whole respondents, the results show that land size, compatibility, and visibility play a substantial role in predicting the acceptance behavior of the HCT, also, age, land size, income, attitude, visibility, relative advantage, and financial support are drivers in forecasting the behavioral intentions. The impact of financial support is because farmers in developing countries usually pay a lot of attention to government financial support (Abadi et al., 2021). Most farmers in developing countries belong to the small and poor; therefore, when they receive various forms of financial support, they get the impression that supportive financial resources help them to expand farm activities. In general, there are other anti-hail technologies in the markets, for example, fabric anti-hail nets (FAHNs). A point kept in mind is that HCTs are cheaper than other technologies like FAHNs. Therefore, although their sufferance, farmers prefer HCT relative to other technologies, in other words, following the principle of micro-economic, they substitute FAHNs with the HCT. No patronage from the government may give rise to not convenient adoption of HCT by farmers. Nevertheless, cumulative adoption is an issue in innovation research, their researches need to find how farmers embrace HCT. This issue grows more intense as the amount of compensation and indemnity paid to farmers by the insurance funds is low and limited, for example, inclusive of only orchards with damage above 70%.

6 Conclusions, Management Implications and Remarks

The study intends to investigate the determinants of farmers' intention to take in the HCT, as respondents were polarized into two groups of the adopter and non-adopter farmers. As seen, the determinants of behavior were examined in three sub-groups, including: 1) low-risk cases, 2) high-risk cases, and 3) total cases of farmers regardless of the stratification of being exposed to low and high risk.

In the first group, the results showed that land size and educational support, with a negative impact, have a significant influence on the distinction of the adopter and non-adopter farmers. Hence, the agricultural extension (AE) is obliged to pay primary attention to farmers with larger lands, because they make a show of having more inclined to look at and adopt the HCT. However, this must be done with great care and caution, because it can lead to class divisions in rural communities in the long run. The AE needs to have more connections, in various communication forms, with these communities to prepare their mentality about education and its importance. Additionally, this group of farmers showed that attitude, compatibility, financial support shaped the basis for the formation of positive behavioral intention.

In the second group with a high level of risk, adoption is affected by compatibility, visibility, and educational support. In addition, age, experience, compatibility, and visibility forecast behavioral intention to adopt HCT. The negative effect of age on acceptance shows that younger people have more tendency to adopt the system, which can be related to the risk-taking nature of young groups in rural communities. Therefore, the AE is needed to start the diffusion and development of the system with younger groups of rural communities who are more prepared to accept risky actions, so that the results of diffusion are gradually transpired to other groups of rural communities like the early majority and late majority. Giving attention to compatibility in the dissemination of innovations is also an important issue that should be considered by the AE. Various aspects of compatibility include the adaptation and appropriateness of HCT to economic, social, and environmental conditions. Paying attention to these issues will not lead to biased innovation, in other words, it will not lead to an unbridled tendency towards a certain group, or it will not have high opportunities for losses and costs.

In the third group, which includes all respondents, regardless of the nature of the risk—low risk and high risk—the results showed that land size, compatibility, and visibility play a role in predicting the acceptance behavior of the HCT. Also, the variables of age, land size, income, attitude, compatibility and visibility, relative advantage, and financial support affect the behavioral intention of accepting the HCT. Therefore, concerning AE, it is necessary to provide orientation training to farmers regarding the comparative advantage of using the system. In this regard, the negative effect of income on the intention to accept shows that the lower the income, the more behavioral intention of acceptance will be formed. Therefore, it is necessary to pay special attention to the promotion of the lower-income groups of farmers and to strengthen their knowledge, skills, abilities, and financial strength.

One of the limitations of the research is that it is assumed that the HCT has benefits to reduce the risks and damage to crops, although there are more sustainable ways to overcome hail damage. For the future, it is recommended to assess the impact of adopting HCT on different aspects of economic, social, equity, and environmental features.

References

Abadi B, Yadollahi A, Bybordi A et al., 2020. The contribution of diverse motivations for adhering to soil conservation initiatives and the role of conservation agriculture features in decision-making. *Agricultural Systems*, 182: 102849. doi: 10.1016/j.agsy.2020.102849

Abadi B, Azizi-Khalkheili T, Morshedloo M R, 2021. Analysis of adopter and non-adopter farmers' behavior to cultivate medicinal plants in Sari Township. *Iranian Agricultural Extension and Education Journal*, 17: 49–59.

Agwu A E, 2004. Factors influencing adoption of improved cowpea production technologies in Nigeria. *Journal of International Agricultural and Extension Education*, 11(1): 81–88. doi: 10.5191/jiaee.2004.11109

Akman I, Mishra A, 2015. Sector diversity in green information technology practices: technology acceptance model perspective. *Computers in Human Behavior*, 49: 477–486. doi: 10.1016/j.chb.2015.03.009

Al-Karablieh E K, Al-Rimawi A S, Hunaiti D A, 2009. Logit models for identifying the factors that influence the adoption of barley production technologies in low rainfall areas. *Jordan Journal of Agricultural Sciences*, 5(3): 251–265.

Ashworth P, Jeanneret T, Romanach L et al., 2012. *Understanding Stakeholder Attitudes to Carbon Capture and Storage (CCS) in Victoria*. EP125331. Pullenvale: CSIRO.

Asimeh M, Nooripoor M, 2017. Factors affecting the adoption of innovations: the case of safflower in Bandamir district. *Journal of Agricultural Extension and Education Research*, 10(3): 63–72.

Bhavani K, Mallikarjun N, Sunilkumar N M, 2017. Agro textiles - Their applications in agriculture and scope for utilizing natural fibers in agro tech sector. *International Journal of Applied Home Science*, 4(7–8): 653–662.

Bonabana-Wabbi J, Mogoka H, Semalulu O et al., 2016. Adoption of integrated soil fertility management by groundnut farmers in Eastern Uganda. *Journal of Development and Agricultural Economics*, 8(4): 86–94. doi: 10.5897/JDAE2014-0627

Borland S W, 1977. Hail suppression: progress in assessing its costs and benefits. In: Foote G B, Knight C A (eds). *Hail: A Review of Hail Science and Hail Suppression*, Boston, MA: American Meteorological Society: 155–179. doi: 10.1007/978-1-935704-30-0_8

Buller O, Bark L D, Vanderlip R, 1981. Effect of weather modification on supply and total revenue of a region. *Western Journal of Agricultural Economics*, 6(1): 57–67.

Changnon S A Jr, Ivens J L, 1981. History repeated: the forgotten hail cannons of Europe. *Bulletin of the American Meteorological Society*, 62(3): 368–375. doi: 10.1175/1520-0477(1981)062<0368:HRTFHC>2.0.CO;2

Changnon S A Jr, 1983. Society's involvement in planned weather modification. *Developments in Agricultural and Managed Forest Ecology*, 12: 15–21. doi: 10.1016/B978-0-444-42214-9.50007-7

Changnon S A, 1992. Inadvertent weather modification in urban areas: lessons for global climate change. *Bulletin of the American Meteorological Society*, 73(5): 619–627. doi: 10.1175/1520-0477(1992)073<0619:IWMIUA>2.0.CO;2

Chen C F, Xu X J, Frey S, 2016. Who wants solar water heaters and alternative fuel vehicles? Assessing social–psychological predictors of adoption intention and policy support in China. *Energy Research & Social Science*, 15: 1–11. doi: 10.1016/j.erss.2016.02.006

Chien S S, Hong D L, Lin P H, 2017. Ideological and volume politics behind cloud water resource governance –Weather modification in China. *Geoforum*, 85: 225–233. doi: 10.1016/j.geoforum.2017.08.003

Chowdhury N, 2018. *Factors Influencing the Adoption of Cloud Computing Driven by Big Data Technology: A Quantitative Study*. Minnesota: Capella University.

Das V J, Sharma S, Kaushik A, 2019. Views of Irish farmers on smart farming technologies: an observational study. *AgriEngineering*, 1(2): 164–187. doi: 10.3390/agriengineering1020013

de Wilde S, 2016. *The Future of Technology in Agriculture*. The Hague: Stichting Toekomstbeeld der Techniek.

Divilly J, 2018. *Factors affecting the adoption of Agri-IoT*. MSc thesis in Management of information Systems. University of Dublin, Ireland. Available at: https://www.scss.tcd.ie/publications/theses/diss/2018/TCD-SCSS-DISSERTATION-2018-045.pdf

Egbue O, Long S, 2012. Barriers to widespread adoption of electric vehicles: an analysis of consumer attitudes and perceptions. *Energy Policy*, 48: 717–729. doi: 10.1016/j.enpol.2012.06.009

Farhar B C, Changnon S A, Swanson E R et al., 1977. Hail suppression and society. Illinois State Water Survey. https://core.ac.uk/download/pdf/29158187.pdf

Frenzen D, 1970. Weather modification: law and policy. *Boston College Industrial and Commercial Law Review*, 12(4): 503–540.

Hahs-Vaughn D L, 2016. *Applied Multivariate Statistical Concepts*. New York: Routledge.

Haji L, Valizadeh N, Rezaei-Moghaddam K et al., 2020. Analyzing Iranian farmers' behavioral intention towards acceptance of drip irrigation using extended technology acceptance model. *Journal of Agricultural Science and Technology*, 22(5): 1177–1190.

Khoshakhlagh F, Mohammadi H, Shamsipour A et al., 2013. The statistical and synoptic analysis on widespread hailstorm events in northwest of Iran. *Journal of Geography and Environmental Hazards*, 2: 55–69. doi: 10.22067/GEO.V1I2.16264

Kranz J, Picot A, 2012. Is it money or the environment? An empirical analysis of factors influencing consumers' intention to adopt the smart metering technology. AMCIS 2012 Proceedings. 3. Available at: https://aisel.aisnet.org/amcis2012/proceedings/GreenIS/3

Makate C, 2019. Effective scaling of climate smart agriculture innovations in African smallholder agriculture: a review of approaches, policy and institutional strategy needs. *Environmental Science & Policy*, 96: 37–51. doi: 10.1016/j.envsci.2019.01.014

Mirmousavi S H, Jalali M, Keiani H, 2013. Tempo-spatial analysis of hail precipitation occurrence probability in Kermanshah Province. *Geographic Space*, 13(43): 83–98.

Mittal S, Hariharan V K, 2018. Mobile-based climate services impact on farmers risk management ability in India. *Climate Risk Management*, 22: 42–51. doi: 10.1016/j.crm.2018.08.003

Moran K R, Fairchild G, Generous N et al., 2016. Epidemic forecasting is messier than weather forecasting: the role of human behavior and internet data streams in epidemic forecast. *The Journal of Infectious Diseases*, 214(S4): S404–S408. doi: 10.1093/infdis/jiw375

Nakabugo R, Mukwaya I P, Geoffrey S, 2019. Adoption of climate smart agricultural technologies and practices in Drylands in Uganda: evidence from a Microlevel study in Nakasongola District. In: Bamutaze Y, Kyamanywa S, Singh B R et al. (eds). *Agriculture and Ecosystem Resilience in Sub Saharan Africa*, Switzerland: Springer: 541–568. doi: 10.1007/978-3-030-12974-3_24

Nambiza W, 2014. Understandings of climate change, climate-smart small scale agriculture and practices of climate-smart small scale agriculture as climate change adaptation in two Tanzanian districts: a case study of Kilosa and Chamwino districts. http://41.73.194.134:8080/xmlui/handle/123456789/448.

Netravathi G, Chauhan N B, 2018. Knowledge towards Climate Change (CC) among postgraduate women research scholars in State Agriculture Universities (SAUs) of Gujarat. *International Journal of Pure & Applied Bioscience*, 6(5): 1095–1102.

Odhiambo P L, 2018. *Factors that Influence Farmers Decision to Adopt IOT Sensing and Monitoring Greenhouse Farming Solutions in Kenya: A Case Study of Illuminum Green House*. Nairobi: University of Nairobi.

Oliveira T, Thomas M, Espadanal M, 2014. Assessing the determinants of cloud computing adoption: an analysis of the manufacturing and services sectors. *Information & Management*, 51(5): 497–510. doi: 10.1016/j.im.2014.03.006

Oyekale A S, Idjesa E, 2009. Adoption of improved maize seeds and production efficiency in Rivers State, Nigeria. *Academic Journal of Plant Sciences*, 2(1): 44–50.

Pampel F C, 2000. *Logistic Regression: A Primer. Series: Quantitative Applications in the social Sciences*. Thousand Oaks, CA: Sage.

Porsch A, Gandorfer M, Bitsch V, 2018. Strategies to manage hail risk in apple production. *Agricultural Finance Review*, 78(5): 532–550. doi: 10.1108/AFR-07-2017-0062

Powelson S E, 2011. *An Examination of Small Businesses' Propensity to Adopt Cloud-Computing Innovation*. Minneapolis, MN: Walden University.

Rahimi A, Morovat H, Faridzad A, 2017. The role of attitudes and beliefs on the electrical energy consumption of households in Iran. *Iranian Energy Economics*, 6(21): 129–162. doi: 10.22054/JIEE.2017.7975

Rehan R, Knight M A, Unger A J, Haas C T, 2013. Development of a system dynamics model for financially sustainable management of municipal watermain networks. *Water Research*, 47(20): 7184–7205. doi: 10.1016/j.watres.2013.09.061

Rogers E M, Shoemaker F F, 1971. *Communication of Innovations: A Cross-Cultural Approach*. 2nd ed. New York: Free Press.

Rogers E M, 2003. *Diffusion of Innovations*. New York: Free Press.

Saneei A, Arkian F, Katiraeie P S, Raihani Parvari M, 2013. Survey of hail forecasting possibility by using radar data. *Journal of Marine Science and Technology Research*, 7(4): 85–97.

Schaller M, Barth E, Blies D et al., 2017. Scaling out climate smart agriculture: strategies and guidelines for smallholder farming in western Kenya. SLE Postgraduate Studies on International Cooperation for Sustainable Development. https://edoc.hu-berlin.de/bitstream/handle/18452/18653/SLE-269.pdf?sequence=4.

Steiner J T, 1988. Can we reduce the hail problem? *Weather and Climate*, 8(1): 23–32. doi: 10.2307/44279745

Stigter K, Mariani L, Failla O, 2010. Designs of (changes in) protection measures against extreme climate in agroforestry. *In:Stigter K (ed). Applied Agrometeorology. Berlin*, Heidelberg: Springer,689–691. doi: 10.1007/978-3-540-74698-0_73

Swanson E R, Huff F A, Changnon S A Jr, 1972. Potential benefits of weather modification for Illinois agriculture. *Illinois Agricultural Economics*, 12(1): 31–36. doi: 10.2307/1348769

Tufa A H, Alene A D, Manda J et al., 2019. The productivity and income effects of adoption of improved soybean varieties and agronomic practices in Malawi. *World Development*, 124: 104631. doi: 10.1016/j.worlddev.2019.104631

Wieringa J, Holleman I, 2006. If cannons cannot fight hail, what else? *Meteorologische Zeitschrift*, 15(6): 659–669. doi: 10.1127/0941-2948/2006/0147

Zakaria A, Alhassan S I, Kuwornu J K M et al., 2020. Factors influencing the adoption of climate-smart agricultural technologies among rice farmers in northern Ghana. *Earth Systems and Environment*, 4(1): 257–271. doi: 10.1007/s41748-020-00146-w