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Landholders' perception of conversion of steep lands to orchard schemes: Land use policy implications in North Iran

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ABSTRACT

This survey study aimed to explore landholders' perceptions of possible threats and opportunities of the CSLO scheme in the Chehel-Chay watershed located in Golestan province, Iran. Furthermore, the influence of these perceptions on the intention to adopt the scheme was assessed. For this purpose, 345 landholders were selected through multi-stage sampling, and the data were collected through a self-administered questionnaire. Results showed that most landholders in the study area were well-informed of CSLO threats rather than CSLO opportunities. For those landholders who cultivate in public land, "the seizure of land ownership by the government" was perceived as the most important threat of CSLO. Furthermore, the contribution of CSLO to the soil erosion mitigation and deterioration was found to be the most frequent perceived opportunity to the CSLO scheme. Based on the findings, the importance of uncertain future costs of implementing CSLO in the rapidly changing Minodasht County should not be ignored by policymakers. This study demonstrated the importance of examining both positive and negative perceptions of landholders about the opportunities and threats of the CSLO scheme. The study concluded that land use policymakers should take into account that the implementation of CSLO has positively contributed to landholders' perception. In other words, the landholders are willing to adopt the scheme. Therefore, policymakers should consider the importance of establishing the landholders' trust in long-term programs.

1. Introduction

One of the biggest constraints to enhance farm productivity is the loss of fertile topsoil and nutrient due to severe soil erosion (FAO, 2019; Jara-Rojas et al., 2013). Soil erosion and degradation and loss in crops' yield have become major threats to climate action, human health (FAO, 2019), and food security (Ascough et al., 2018). As one of the major soil threats, soil erosion can decrease the capacity of the soil ecosystem in providing multi benefits (i.e., ecosystem services) to the environment and humans. Sustainable soil management goals should therefore enhance soil ecosystem services and reduce soil threats (Ascough et al., 2018). The high level of land degradation in the northern part of Iran significantly complicates agricultural activities and poses many risks, including soil erosion, loss of natural resources, and environmental degradation (Zabihi et al., 2019; Nasiri et al., 2011; Bozarth et al., 2016). Especially in recent decades, declining soil fertility because of intense erosion has led to poor agriculture performance and food insecurity (Sunderland and Rowland., 2019). The combination of continuous cultivation, steep slopes, heavy rains, deforestation, and inappropriate farming practices generates some of the worst erosion in the area (Rahmani et al., 2012; Sadeghi, 2017). Although an estimate of the extent and rate of soil degradation is not available, the results of various studies emphasize the soil loss as a major and continuing problem (Zarea Khormizi et al., 2013; Sadoddin et al., 2015). In addition, continued soil erosion has a serious impact on small-scale farmers whose economic livelihoods are strongly associated with producing

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agricultural products and services (Sklenicka, 2002; Mahboubi et al., 2015; Bai et al., 2015).

Suitable policy intervention is a key to mitigate the rate of unwanted land conversion and land use. In Iran, efforts toward soil and water conservation measures, especially in cultivated steep and highland areas, were launched since the mid-1990s and 2000s (Runoff Consulting Engineers Company (RCEC), 2005). From that time, significant attempts have been made to rehabilitate degraded land and stop further degradation through conservation initiatives such as stone terraces, soil bonds, and mulching. However, albeit investment in public extension programs has been devoted to soil use and water conservation (SWC) measures, there has been a rapid and massive increase in soil erosion rate in steep land of most crop producing areas of Chehel-Chai watershed (Mahboubi et al., 2015). Barriers such as weak effectiveness of these measures for erosion control, farmers with poor skills, inadequate technical facilities, and incompatibility with farmers' financial situation considerably affected farmers' adoption decision (Sonter et al., 2015; Mahboubi et al., 2015; Mancosu et al., 2015; Mahboubi et al., 2005).

Therefore, in the mid-2000s, the Golestan Agriculture-Jihad Organization (GAJO) started a Sustainable Land Management (SLM) program focusing on conversion of steep land to orchards (CSLO) (GAJO, 2017). An effective way to prevent erosion and sedimentation is the orchard. It can control dust and reduce the potential for erosion by increasing infiltration, trapping sediments, sustaining the soil, and dissipating hard rain energy (Chen et al., 2019). The project was aimed at cultivation of orchards such as olive, walnut, hazelnut, and berry on the steep slopes to reduce the rate of erosion and enhance farm performance; therefore, there is an increasing farmer income for investment in further soil conservation measures. To enhance the CSLO scheme adoption, the GAJO provides various forms of support to farmers such as providing farmers with sapling for free, irrigating new orchards in the first years, and giving free access to technical and extension services. After 10 years of continuous support for further expansion of this scheme in steep lands of the watershed, according to the view of involved experts in this scheme, the adoption rates of the CSLO scheme have remained low, soil fertility has declined, and land deterioration has continued unabated. However, many farmers might keep traditional farming due to poor knowledge of potential threats and opportunities of the scheme and soil erosion impact on farm performance and the environment.

Although traditional farmers are the key decision-makers in the process of technological adoption, the extent of understanding and knowledge of the pros and cons of the modern technology or farming system inevitably affects their adoption rate (Abdollahzadeh et al., 2015). Perceived pros (opportunities) and cons (threats) of new technology were one of the key explanations for the high adoption of soil conservation technologies in previous studies (Lutz et al., 1994; Nakhumwa and Hassan, 2003; Hellin and Ridaura, 2016). Researchers have carried out extensive studies of the elements affecting farmers' adoption behavior. To be specific, gender, education degree, age, and risk preference affecting farmers' adoption of technology have been investigated by Bola et al. (2016); Ward and Singh (2015); Kabir and Rainis (2015); Murage et al. (2015), and Korir et al. (2015). The accessibility of large-scale farmland, a beneficial capital position, and plentiful source of labor support for farmers to adopt technology have been discovered by Grabowski et al. (2016); Allahyari et al. (2016), and Cavallo et al. (2014). It has been confirmed by Gao et al. (2018) and Verma and Sinha (2018) that farmers are likely to adopt technology if they feel it is useful and easy to implement. In general, it is the profitability of new technologies that drives adoption decision of farmers. Farmers often make a logical economic decision after measuring the costs and benefits of ongoing engagement with the technology. It is easy to understand that smallholder farmers always want to reduce unnecessary risks and will therefore abandon technology once their perceived benefits are significantly reduced or the costs involved do not appear to be compensated for (Nakhumwa and Hassan, 2003; FAO, 2017).

In recent decades, several studies have been conducted as part of the effort to identify the key factors influencing the adoption of SWC measures by farmers as well as activities aimed at minimizing soil erosion. Among the studied and identified factors, one can mention education (Huttunen, 2015; Tenge, 2005; Pender and Kerr, 1998; Mbaga-Semgalawe and Folmer, 2000), farmers' level of perception and knowledge on soil erosion problems (Sidibé, 2005; Nakhumwa and Hassan, 2003; Abebe and Sewnet, 2014; Udayakumara et al., 2012; Vignola et al., 2010), gender of the household head (Næss and Jensen, 2002; Udayakumara et al., 2012; Mugonola et al., 2013; Song et al., 2017), training on soil and water conservation (Abebe and Sewnet, 2014; Udayakumara et al., 2012; Kpadonou et al., 2017), ascertained advice from agricultural extension officers (Udayakumara et al., 2012; Mugonola et al., 2013; Abebe and Sewnet, 2014), past awareness about soil conservation technologies (Kpadonou et al., 2017; Udayakumara et al., 2012), off-farm income (Udayakumara et al., 2012), family size and access to family labor (Abebe and Sewnet, 2014; Kpadonou et al., 2017; Nakhumwa and Hassan, 2003), size of land holding (Kpadonou et al., 2017; Abebe and Sewnet, 2014; Mugonola et al., 2013; Nakhumwa and Hassan, 2003; Jara-Rojas et al., 2013), land tenure (Kpadonou et al., 2017), age of the household head (Nakhumwa and Hassan, 2003; Abebe and Sewnet, 2014;Amsalu and De-Graaff, 2007), farmers' access to credit services (Abebe and Sewnet, 2014; Jara-Rojas et al., 2013), government incentives (Jara-Rojas et al., 2013), output level (Nakhumwa and Hassan, 2003; Mugonola et al., 2013), common equipment availability, low application costs, ease of use, and compatibility with the existing farming system (Junge et al., 2009). However, these studies did not include perceived opportunities and threats of new technology in their variables. Moreover, these studies did not include a theoretical framework to assess the factors that impact the adoption of soil conservation practices.

In this study, Social Exchange Theory (Ekeh, 1974; Turner, 1974) was used to help understand the potential threats and opportunities understood by the CSLO scheme. Exchange theory assumes that after assessing benefits and costs, people select exchanges (Homans, 1961). Based on this idea, perceptions are affected by people's perceptions of exchange. Thus, individuals who assess the exchange as useful, perceive the same impact differently from someone who assesses the exchange as harmful. Since each farmer aims at the highest value in an activity, they tend to select activities that offer at least the same socio-economic and environmental benefits (Napier and Napier, 1991). In other words, this study attempts to examine the potential threats and opportunities of the CSLO scheme and analyze landholders' adoption behavior of this scheme. Favorable expectations have been described as "perceived opportunists", while unfavorable expectations are considered as "perceived threats".

The recognition of the landholders' perceptions is an essential factor in soil and water conservation decisions (Udayakumara et al., 2010). Many studies have been conducted to determine the effective factors in the behavior of landholders, especially in developing countries (Wachenheim 2019; Rosenberg and Margerum, 2008; Ma et al., 2012). However, the perception of potential threats and opportunities and the impact of these perceptions on the willingness to accept these plans in Iran and Golestan province have often been overlooked. Thus, this paper aimed to study landholders' perceptions of possible threats and opportunities of the CSLO scheme and the influence of these perceptions on the intention to the adoption of the scheme in the Chehel-Chay watershed located in the northeastern region of Golestan province, Iran. The findings of this study could be useful for policymakers in developing strategies toward the conversion of steep lands to orchards, improving sloping land management, raising awareness of the challenges of the project, and helping decision-makers to revive the failed CSLO scheme in the study area and similar areas. This research aims to address the following four research questions: (i) whether and to what extent landholders are aware of the possible threats and opportunities of the CSLO scheme, (ii) whether and to what extent landholders intend to adopt the CSLO scheme, (iii) whether and to what extent landholders'

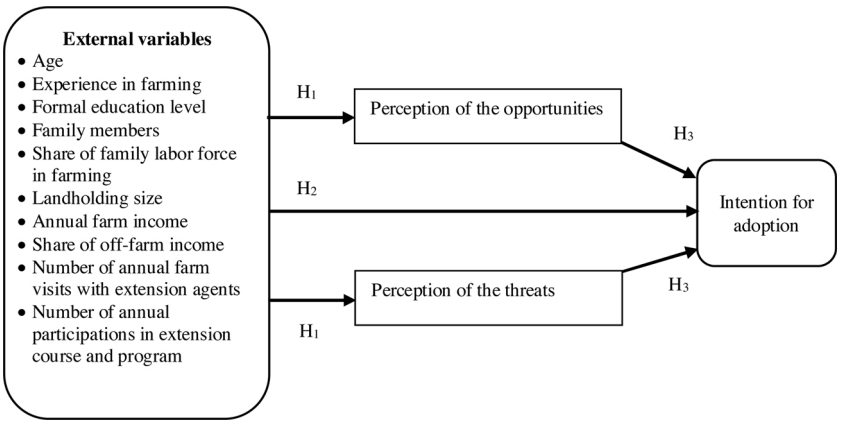

Fig. 1. Conceptual framework of the study.

personal attributes and farm characteristics can explain the perceived possible threats and opportunities of the CSLO scheme, and (iv) which variables are associated with the intention to adopt the CSLO scheme. Therefore, this study contributes to filling the gap of previous knowledge on SWC measures and determines the effective factors in the behavior of landholders based on the CSLO scheme. Fig. 1 shows the conceptual framework of the study. Based on the framework, four hypotheses were formulated and tested in this study as follows:

H_1: Landholders' personal attributes and farm characteristics are associated with the perceived possible threats and opportunities of the CSLO scheme.

H_0: $\beta = 0$

H_1: $\beta \neq 0$

H_2: Landholders' personal attributes and farm characteristics are associated with the intention to adopt the CSLO scheme.

H_0: $\beta = 0$

H_1: $\beta \neq 0$

H_3: Perceived possible threats and opportunities of the CSLO scheme are associated with the intention to adopt the scheme.

H_0: $\beta = 0$

H_1: $\beta \neq 0$

The paper structure is as follows. After the introduction part, section 2 discusses the research methodology. Section 3 indicates the results of our analysis. Section 4 concludes the paper by discussing the contributions of our research, as well as its implications and limitations.

2. Methods

2.1. Study area

Golestan province is one of the northern provinces of Iran, which has special importance and position due to the production of strategic crops and garden products. The most important crops in the province are soybeans, wheat, barley, rapeseed, cotton, sunflower seeds, and rice. Furthermore, the most important garden products include citrus fruits, peaches, persimmons, and almonds. The province plays an important role in the production of caviar, chicken, sheep, and silkworm cocoons (Jihad Agricultural Organization of Golestan, 2019). In this region, due to the variety of ecological conditions of livestock and poultry food resources, i.e., forage pastures, the possibility of cultivating all kinds of forage plants and the sub-yields, orchards, and factories of agricultural industries, there are very good breeding grounds for livestock farming in

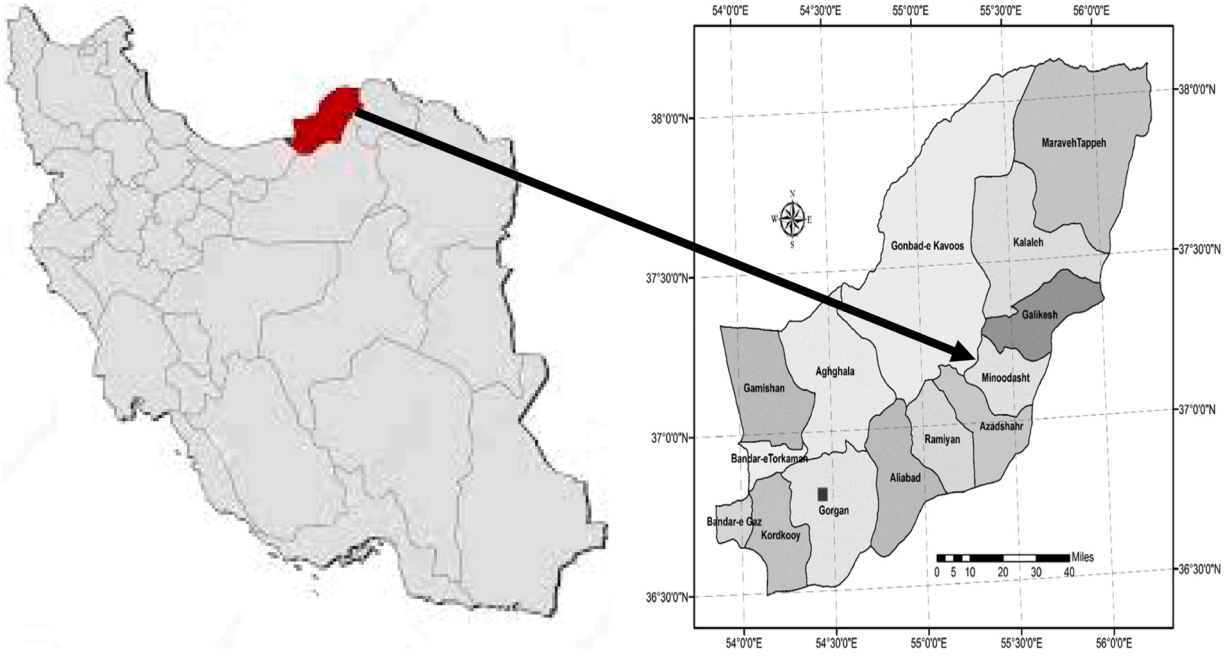

Fig. 2. The location of the study area.

this area. Livestock production in Golestan province, in addition to creating jobs and generating income, especially for the villagers and nomads of the region, is one of the most important centers of animal husbandry and related industries in the country. This sector in Golestan province consists of 79 thousand people, 4 million 134 thousand livestock units, and 672 thousand tons of livestock products (Gharehbash, 2013).

The Chehel-Chay watershed is situated in Minodasht County, in the northeastern region of Golestan province, Iran (Fig. 2). The region comprises of 26 villages and covers an area of about 25683.1 ha. The area is located between 36°57′30″-37°15′00″N and 30°22′55″-30°37′55″E. The elevation of the watershed ranges from 180 m in the valley bottom to 2555 m on the hill slopes. The average annual temperature is 16.7 °C and this means annual precipitation ranges from 707 to 798 mm. Maximum rainfall occurs from March to April. About 31.8 ha of the land area of the watershed is under cultivation, of which 59 % is steep land (Appendix Fig. A1). Average slope of the watershed is 45.82 %. Major crops grown are wheat, soya, barley, tobacco, rice, sunflower, cotton, and colza. Farming is almost completely rain-fed and depends on the weather. Soil erosion of agricultural land is the most significant contributor to soil degradation and soil quality impairment in the watershed (Nasiri et al., 2011; Rahmani et al., 2012). Most farmers within the watershed already have adopted stone terraces, soil bunds, contour plowing, crop rotations, and conservation practices which are relatively easy and inexpensive to implement.

In recent years, new methods have been adopted to control soil erosion in Iran, which can be implemented with changes in regional plans and programs. Accordingly, in Golestan province, various methods are used to protect the soil against destructive factors, usually including mechanical and non-mechanical methods (Baboli et al., 2015). Mechanical measures include operations such as terracing, diversion of waterways, and construction of dams, and non-mechanical methods include operations such as proper land use, fertilization, plowing, and crop rotation. Other direct methods to prevent erosion are the creation of horizontal banks along the level lines, the creation of protective and retention platforms, and the cultivation of vegetation that is compatible with the climatic conditions of the region (Abrishami, 1999; Boroushkeh and Sokuti, 2005; Bijani et al., 2017; Khodadadi et al., 2019; Rastgar, 2020). Farmers are practicing these methods to protect the soil in sloping lands based on the useful experiences of their predecessors in the hills that have high-grade (Khalili et al., 2012).

Further significant reductions in the rate of soil loss are necessary and the participation of the CSLO scheme has been strongly recommended. The watershed study was selected because of the high rates of erosion, leaching, pollution of surface water by nutrients, and the limited success of previous SWC measures to promote soil conservation.

2.2. Questionnaire

Previous literature (Winter et al., 2007; Dayer et al., 2017; Wachenheim 2019; Rosenberg and Margerum, 2008; Ma et al., 2012; Greaves et al., 2013) provides very little empirical evidence and few theoretical frameworks, without a holistic perspective on the topic. However, it was not possible to find all the specific items to measure the structures (opportunities and threats of the CSLO scheme for farmers). So, for this purpose, the SWC measures have been developed. Consequently, this study was based on the focus group method (Elliott et al., 1996) by asking key informants (farmers, local extension agents, and soil and horticulture experts) who are directly involved in each phase of the CSLO scheme to develop the survey. Through four focus group discussions with five informant farmers, four local extension agents, three experts from the department of land issues in Golestan Agri-Jihad Organization, and four faculty members (from the department of agricultural extension, agricultural economics, soil sciences, and horticulture), a preliminary questionnaire was designed. To determine the validity, the questions were reviewed by two local extension agents who had long working experience with the CSLO scheme to ensure that they would be easily understood by the respondents and identify possible interpretation problems. Then a pilot test was conducted with 25 farmers (whose responses were excluded from the final study) to further clarify questions. To further refine the questionnaire, the feedback and data obtained from these steps were used; some items were removed and some were added.

The finalized questionnaire consisted of five main sections: (1) farmers' personal attributes, (2) farm characteristics, (3) eleven items for perceived opportunities of the CSLO scheme, (4) thirteen items for perceived threats of the CSLO scheme, and (5) five items for the intention to participate. Each participant was asked to rate a 5-point Likert scale (1 = not important to 5 = very important) on how important each statement was to his or her decision whether to adopt the CSLO scheme or not. The reliability of scales was confirmed by estimating Cronbach's alpha. To pre-test the questionnaire, a pilot study was conducted. The final version of the questions was based on the pilot study results. The completed questionnaires were assessed using SPSS 19 software to calculate Cronbach's alpha. The general alpha coefficient for the research variables was 0.783 (perceived opportunities = 0.86; perceived threats = 0.77; intention to participate = 0.72).

Table 1
Socio-demographic variables associated with the intention to adopt the CSLO.

Variables	M*	SD	Max	Min
Age (years)	43.88	16.46	78	18
Experience in farming (years)	24.26	10.67	54	3
Formal education level (in years)	4.88	4.45	18	0
Family members	5.02	2.42	12	0
Share of family labor force in farming (%)	20.41	8.44	39.95	0
Landholding size (ha)	1.91	1.17	6.50	0.10
Annual farm income ($)	3091.93	980.94	6500	750
Share of off-farm income (%)	52.92	25.91	73.76	0
Number of annual farm visits by extension agents	6.17	3.33	15	0
Number of annual participation in extension courses and programs	6.42	3.36	16	0

*Mean (M); standard deviation (SD); Maximum (Max); Minimum (Min).

2.3. Samples

The empirical data for the present study were collected through a field survey of owners of steep land in the study area. The target respondents were drawn from the list of 3230 owners of steep land who had not adopted the CSLO scheme yet. For this purpose, statistics pertaining to the CSLO scheme (at the time of data collection) as published by Golestan Agri-Jihad Organization were considered. For the selection of samples, a multi-stage sampling procedure was used. In the first stage, 13 villages were selected randomly and proportionately to locate maximum climate variation, agricultural water resources, and water situation. The second stage consisted of the respondents' proportional allocation among the 13 villages selected. The random sampling technique was used in the third stage to select the stratified sample size required for each village. The questionnaires were administered verbally by seven local extension agents from the Agricultural Services Centre of Minodasht County who spoke local languages. A total of 345 landholders constituted the sample, out of which 337 provided usable data for the study. The data collection process took place from January to May 2017.

2.4. Data analysis

Data analysis was carried out using the Social Sciences Statistical Package (version 18.0). Moreover, to carry out statistical tests, the mean scores for each examined construct (perceived opportunities, perceived threats, and the intention to adopt) were calculated. Multiple linear regression models were then employed to predict the relationship

Table 2
Perception of farmers for soil erosion as a problem and effectiveness of SWC measures.

Variables	Frequency	Percent
Extent of soil erosion (N = 325)		
Severe	162	48.07
Moderate	102	30.27
Minor	61	18.10
Soil fertility condition (N = 326)		
Low fertility	144	42.73
Moderate fertility	115	34.12
High fertility	67	19.88
Actual effectiveness of previous SWC measures (N = 328)		
Highly effective	93	27.60
Slightly effective	45	13.35
Non-effective	190	56.38

Table 3
Descriptive data for land tenure security and access to water resource.

Variables	Frequency	Percent
Perceptions on land tenure security (N = 336)		
Secured	160	47.48
Unsecured	176	52.23
Access to water resource		
High	133	39.47
Low	204	60.53

between farmers' personal attributes, farm characteristics, perceived opportunities, and perceived threats and the intention to adopt the CSLO scheme. To evaluate the direction (positive versus negative) of the perception of landholders about the opportunities and threats of the CSLO scheme, a one-sample *t*-test was used.

3. Results

3.1. Characteristics of the sample

Table 1 illustrates the descriptive statistics of the key characteristics of farmers. The average age was 43.38 years (range = 18–78, standard deviation SD = 16.46), and all respondents were men. The average farming experience was 24.26 years, revealing experienced farmers in the survey sample. Farmers varied considerably in formal education level from 0 years (no education) to 18 years (M.Sc. education) with a mean of 4.88 years. The average size of family members is equal to 5.02 people, with an average of approximately 20.41 % of working-class household members. The average size of the landholding varies between 0.10 and 6.50 ha, with an average of 1.91 ha. The average annual farm income varies with an average of 3091.93 from 750 to 6500 USD. The households' share of off-farm income in the sample (mean value: 52.92 %) confirms that the sample includes households that are heavily involved in off-farm jobs. The number of annual farm visits by extension agents varies from 0 to 15 contacts with an average of 6.17, which reveals the extensive effort of extension agents in the area. The number of annual participation in extension courses and programs differs from 0 to 16 courses with an average of 6.42, which reflects attempts of provincial agriculture organizations in the study area.

About half of the respondents (48.07 %) rated the extent of the soil erosion problem as severe (Table 2). However, a solid fraction (30.27 %) expressed soil erosion problem as moderate, while a low proportion of the farmers (18.10 %) evaluated the extent of soil erosion as minor. Concerning perception of soil fertility condition, the majority of the respondents (42.73 %) reported low fertility condition in their land, while about one-third (34.12 %) mentioned moderate fertility condition in their land. On the other hand, almost one out of five (19.88 %) clearly expressed high fertility condition. Most farmers (56.38 %) believed that the previous SWC measures adopted were not effective in arresting soil

Table 4
Analysis of one-sample *t*-test regarding farmers' perceptions of the pros and cons of pesticides.

Items	Mean	Sd
Perceived threats of CSLO Mean scale = 3.19, t = 4.45**, mean differences = 1.884		
I am concerned about the potential impacts of climate change on Golestan's agriculture.	2.62	1.19
I am concerned about the potential impacts of natural disaster events (such as drought, freezing, and destructive flooding) on orchards performance.	2.59	1.17
I'm worried about the future of the scheme because of water resources limitation for orchards.	3.60	1.35
I'm concerned a lot about the efforts that I have to make to obtain the acceptable yields from orchards.	3.11	1.34
The skills needed to adopt the CSLO scheme would be too complex for the labor of our region.	3.07	1.37
It takes a long time to achieve economical production in the process of CSLO.	3.77	1.45
I believe the horticulture operation would be much more expensive than farming on dry land.	2.53	1.16
The costs involved in the adoption of CSLO would be far greater than the expected benefits.	2.51	1.21
I would have financial barriers (e.g., purchase of irrigation equipment and horticulture inputs expenses) in order to adopt CSLO.	3.12	1.51
My personal budget would not be enough to support the continuance of the scheme in the future.	3.47	1.41
Crop insurance service for horticulture production is not easily available.	3.17	1.39
I am concerned about the seizure of land ownership by the government for those landholders who cultivate in public land.	3.95	1.38
I'm worried about the discontinuance of governmental support for the scheme in the future.	3.91	1.37
Perceived opportunities of CSLO Mean scale = 3.06, t = 1.81 ^{ns}, mean differences = 0.056		
Adoption of CSLO will increase my land performance and chances of achieving better income.	3.53	1.17
Adoption of CSLO enables me to cultivate medicinal plants and forage through intercropping system	3.38	1.28
Adoption of CSLO improves my collaboration with local extension agents and agricultural experts.	2.78	1.27
Adoption of CSLO improves my image and reputation in society.	2.31	1.19
CSLO is compatible with the way in which the neighbor farmer likes to work.	2.20	1.14
Adoption of CSLO contributes to the reduction of soil erosion and deterioration.	4.02	1.26
CSLO would reduce water loss in the farm.	3.58	1.40
Supporting services such as providing farmers with free sapling and having easy access to extension agents are available in the CSLO scheme.	3.90	1.18
Golestan Agri-Jihad Organization would provide necessary technical, training, and financial support for the adoption of the CSLO scheme.	3.21	1.33
It would be easy to obtain financial support for the CSLO scheme from local banks and/or other financial institutions.	1.95	1.04
Local extension agents strongly encourage landholders for the adoption of CSLO by providing free training sessions.	2.75	1.22

* Significant at $p < 0.05$, ** Significant at $p < 0.01$.

Table 5
Analysis of one-sample *t*-test regarding farmers' intention to adopt CSLO.

Items	Mean	Sd
Mean scale = 2.98, t = 0.40 ^{ns}, mean differences = 0.014		
I believe that I will benefit from conversion of my steep land to orchard.	3.18	1.42
I recommend my neighbor farmers the conversion of their steep land to orchards.	2.44	1.12
I think adopting the CSLO scheme will be worthwhile for me.	2.82	1.30
I intend to change my steep land use to a fruit orchard in the future.	2.69	1.19
If I had access to facilitating conditions provided by provincial agricultural organizations, I would really change my steep land use to a fruit orchard.	3.77	1.42

* Significant at $p < 0.05$, ** Significant at $p < 0.01$, ns; non-significant.

Table 6
Regression analysis of factors influencing landholders' intention to adopt CSLO.

Independent Variables	B coefficients		Std. error	Std. beta	t-statistic	VIF
Model 1:	Perceived opportunities of CSLO					
Model statistics	$R^2 = 0.48$, Adjusted R-square = 0.45, F = 15.44**, D.W = 1.83					
Experience in farming (years)	0.009	**	0.003	0.169	2.644	2.087
Formal education level (in years)	0.026	**	0.008	0.205	3.076	2.272
Share of family labor force in farming (%)	0.009	*	0.005	0.140	2.036	2.427
Landholding size (ha)	0.066	*	0.031	0.139	2.106	2.223
Annual farm income ($)	1.875×10^{-5}		0.000	0.033	0.717	1.069
Share of off-farm income (%)	0.004	**	0.001	0.143	3.062	1.116
Number of annual farm visits by extension agents	0.020	**	0.008	0.118	2.604	1.049
Number of annual participation in extension courses and programs	0.003	*	0.008	0.018	0.383	1.092
Severe extent of soil erosion	0.095		0.070	0.086	1.363	2.024
Moderate extent of soil erosion	0.085		0.075	0.071	1.134	1.997
Secured perceptions on land tenure	0.073		0.051	0.065	1.432	1.066
Low fertility condition of soil	0.128		0.070	0.091	1.821	1.279
Moderate fertility condition of soil	−0.011		0.053	−0.010	−0.213	1.089
High effectiveness of the previous SWC measures	−0.122	*	0.056	−0.108	−2.181	1.257
Slight effectiveness of the previous SWC measures	−0.024		0.081	−0.015	−0.296	1.268
Low access to water resource	−0.085		0.054	−0.074	−1.557	1.152
Model 2:	Perceived threats of CSLO					
Model statistics	$R^2 = 0.28$, Adjusted R-square = 0.24, F = 6.47**, D.W = 1.65					
Experience in farming (years)	−0.016	**	0.006	−0.212	−2.815	2.087
Formal education level (in years)	−0.009		0.014	−0.051	−0.649	2.272
Share of family labor force in farming (%)	0.004		0.008	0.041	0.505	2.427
Landholding size (ha)	−0.055		0.052	−0.081	−1.043	2.223
Annual farm income ($)	-4.528×10^{-5}		0.000	−0.056	−1.036	1.069
Share of off-farm income (%)	−0.001		0.002	−0.036	−0.645	1.116
Number of annual farm visits by extension agents	0.010		0.013	0.042	0.781	1.049
Number of annual participation in extension courses and programs	0.005		0.013	0.020	0.362	1.092
Severe extent of soil erosion	−0.156		0.117	−0.099	−1.331	2.024
Moderate extent of soil erosion	0.005		0.125	0.003	0.043	1.997
Secured perceptions on land tenure	−0.190	*	0.085	−0.121	−2.239	1.066
Low fertility condition of soil	−0.490	**	0.117	−0.247	−4.179	1.279
Moderate fertility condition of soil	0.051		0.089	0.031	0.569	1.089
High effectiveness of the previous SWC measures	0.080		0.093	0.050	0.862	1.257
Slight effectiveness of the previous SWC measures	0.068		0.135	0.029	0.499	1.268
Low access to water resource	0.172		0.091	0.106	1.892	1.152
Model 3:	The intention to adopt CSLO					
	$R^2 = 0.77$, Adjusted R-square = 0.76, F = 49.18**, D.W = 1.91					
Perceived opportunities of CSLO	0.348	**	0.050	0.290	7.000	1.963
Perceived threats of CSLO	−0.114	**	0.030	−0.135	−3.841	1.412
Experience in farming (years)	0.007	*	0.003	0.104	2.383	2.192
Formal education level (in years)	0.013		0.007	0.088	1.952	2.354
Share of family labor force in farming (%)	0.015	**	0.004	0.182	3.922	2.470
Landholding size (ha)	0.074	**	0.025	0.130	2.925	2.265
Annual farm income ($)	1.102×10^{-5}		0.000	0.016	0.524	1.075
Share of off-farm income (%)	0.003	**	0.001	0.103	3.238	1.156
Number of annual farm visits by extension agents	0.015	*	0.006	0.074	2.407	1.081
Number of annual participation in extension courses and programs	0.009		0.006	0.047	1.538	1.093
Severe extent of soil erosion	0.111	*	0.056	0.083	1.966	2.049
Moderate extent of soil erosion	0.021		0.060	0.014	0.344	2.007
Secured perceptions on land tenure	0.111	**	0.041	0.083	2.690	1.092
Low fertility condition of soil	0.189	**	0.058	0.112	3.248	1.373
Moderate fertility condition of soil	0.076		0.043	0.055	1.776	1.090
High effectiveness of previous SWC measures	−0.094	*	0.045	−0.069	−2.070	1.281
Slight effectiveness of previous SWC measures	−0.115		0.065	−0.059	−1.762	1.269
Low access to water resource	−0.107	*	0.044	−0.078	−2.435	1.175

*Significant at $p < 0.05$, ** Significant at $p < 0.01$.
DW: Durbin-Watson value.

erosion problem, while 13.35 % evaluated these measures as slightly effective, and 27.60 found them as highly effective.

Concerning land tenure security, most farmers (52.23 %) are under the type of tenure insecurity, while 47.48 % of the respondents reside inside the forest reserve area without legal land registration (Table 3). Most respondents (60.53 %) reported low access or insecure access to water resources. Due to the regular need for irrigation systems of the orchards, this study assumes that farmers without access to safe water resources are suffering from a degree of uncertainty when it comes to CSLO adoption.

3.2. Perceived threats and opportunities of CSLO

The average number of perceived CSLO threats varied from 2.51 to 3.95 with a mean overall score of 3.18 (Table 4). The major concern was about the seizure of land ownership by the government for those landholders who cultivate in public land, whereas the least concern was about the costs of adopting CSLO (Table 4). Landholders were also worried about the discontinuance of governmental supports for the scheme in the future, taking a long time to achieve economic production in the process of CSLO, and water resources limitation for orchards.

However, landholders agreed with some opportunities of CSLO; the average scores of perceived opportunities of CSLO ranged from 1.95 to 4.02 with an overall mean score of 3.06 (Table 4). The considerable perceived opportunities of CSLO were the reduction of soil erosion and deterioration, whereas the least perceived opportunity was obtaining financial support for the CSLO scheme from local banks and/or other financial institutions (Table 4). Moreover, landholders believed that CSLO has major opportunities for the reduction of water loss on the farm and it also has easy access to support and extension services.

The results of the *t*-test of landowners' perceptions of CSLO's indicated that landholders' perceptions of threats of CSLO showed positive significance (mean score = 3.19, $p < 0.01$). However, landholders' perceptions of opportunities of CSLO was positive and non-significant (mean score = 3.06, $p > 0.05$).

3.3. The intention to adopt CSLO

Table 5 indicates the landholders' intention to adopt CSLO. Landholders did not support CSLO; with an overall mean score of 2.98, average scores ranged from 2.44 to 3.77. Actually, landholders revealed weak willingness to participate in the CSLO scheme. The one-sample *t*-test was used to evaluate the overall intention of landholder to adopt CSLO. The outcomes of this test showed no strong intention of landowners to adopt CSLO (overall mean = 2.98, $t = 0.40$, $p > 0.05$). Because of high perception of CSLO threats, landholders appeared less supportive of the CSLO scheme and showed low willingness to adopt and fully implement it in their field.

3.4. Multiple regression analysis

As shown in Table 6, this study used a number of linear regression analyses to examine possible relationships between variables. To be specific, models 1 and 2 are regression models which tested the relationship between perceptions of CSLO opportunities and certain socio-economic attributes of landowners (Model 1) or certain socio-economic attributes of landowners and threats to CSLO (Model 2). The relationship between the intention to adopt CSLO and landholders' perceptions of opportunities or threats of CSLO was tested in Model 3. The relationships between the intention to adopt CSLO and certain socio-economic characteristics of farmers have been tested in Model 3.

B-coefficient is the calculation resulting from a standardized regression analysis so that the variance of dependent and independent variables is 1. The Variance-Inflation Factor (VIF) is a multicollinearity measure. The VIF below 4 is generally regarded as being acceptable (Garson, 2007). In final models, in order to avoid multicollinearity, variables of family members and age have been excluded due to severe collinearity with variables of family labor force in farming. In addition, the Durbin-Watson values raised from 1.5 to 2.5, indicating that the residuals were not associated. The R^2 of 0.48 in Model 1 indicates that the variance in the sixteen independent variables explains 48 percent of the variance in the dependent variable perceived opportunities of CSLO. In model 1, experience in farming, formal education level, share of family labor force in farming, landholding size, share of off-farm income, number of annual farm visits by extension agents, and the number of annual participation in extension courses and programs had a statistically significant positive relationship with CSLO's perceived variable opportunities (Table 6). On the other hand, the high efficiency of previous SWC measures taken to stop erosion control had a statistically significant negative relationship with the variable perceptions of CSLO opportunities. This suggests that high efficiency levels of previous SWC metrics adopted to stop erosion control were linked with the lower probability of perceived opportunities for CSLO among landowners.

Model 2 showed that sixteen independent variables that only 28 % of the variance in the dependent variable perceived threats of CSLO. Farming experience, secure perceptions of land tenure, and low soil fertility had a statistically significant negative relationship with CSLO's perceived dependent variable threats (Table 5). Here, Models 1 and 2 suggest that farming experience has been a major predictor of landholders' perception of both CSLO opportunities and threats. Model 3 clarified 77 percent of the dependent variable variance (i.e., CSLO intention). When the intention to adopt CSLO as the dependent variable was used, it was found that the perception of the opportunities and threats of CSLO, as well as certain socio-economic attributes of the landowners, was statistically meaningful (Table 6). CSLO's perceived opportunities, farming experience, land tenure size, number of annual farm visits by extension agents, share of family labor in agriculture, share of off-farm income, severe soil erosion, secure perceptions of soil tenure, and low soil fertility status showed a statistically significant positive relationship with the intention to adopt CSLO. The perception of CSLO threats and opportunities by landholders is influenced by a range of variables. Some variables, such as agricultural experience, landholding size, share of family labor in agriculture, education, share of off-farm income, extension contacts, extension course, and high efficiency of previous SWC measures could explain the perception of CSLO opportunities by landowners. On the other hand, most socio-economic variables were unable to predict the perceptions of landowners of CSLO threats, with the exception of farming experience, secured perceptions of land tenure, and low soil fertility.

4. Discussion

4.1. Perceived threats and opportunities of CSLO

The landholders in the study area have identified CSLO threats but have not been aware of the opportunities. Specifically, the perception of CSLO opportunities among landholders was slightly lower than CSLO threats (overall mean: 3.06 vs. 3.19). This weak perception of CSLO opportunities could provide a clear response to this study's second research question, i.e., whether and to what extent landholders intend to adopt the CSLO scheme in their field. Due to the high perception of CSLO threats, landholders tended to be less supportive of the CSLO scheme and showed low willingness to adopt and fully apply it in their field. According to the findings, concern about the seizure of land ownership by the government for those landholders who illegally cultivate in public land and the withdrawal of government funding for the scheme can also explain the less support of landholders for the CSLO scheme. In addition, many landholders have argued that the CSLO scheme would not be cost-effective due to the long time taken to achieve economic development during the implementation of the CSLO scheme. Limited access to water resources and potential impacts of natural disaster events (such as drought, freezing, and destructive flooding) on orchards performance

are noted as the major threats to the adoption of the CSLO scheme. These results are consistent with the findings of Bewket (2007) and Nakhumwa and Hassan (2003).

More specifically, in a study by Rahimzadeh (2017), the findings showed that the landholders of Kinnaur District in India have identified CSLO threats but have not been aware of the opportunities. New opportunities and risks are emerging as the climate continues to change. Forests and pasturelands that were once uncultivated and less accessible are gradually becoming preferred orchard land, while some older elevation orchards experience lower productivity. His finding showed that climate change has contributed to changing agricultural production patterns, driving change in land use, and decreasing productivity of lower elevation orchards. Abbasi and Asadollahi Shahir (2013) have studied the quantitative effects of land use change on steep lands that can be turned into gardens in Golestan province. Their findings showed that steep lands are at the risk of extinction due to high susceptibility to erosion and runoff production caused by heavy erosive rainfall. Therefore, the best option to prevent it is to turn steep lands in to orchard. The results of calculating the amount of erosion showed that by converting sloping arable lands to orchards, the amount of erosion is reduced by 2.5 times and the amount of runoff is reduced by 37 %. Amirnejad (2013) applied the logit regression model to investigate the factors affecting farmers' desire to change land use in Mazandaran province. In his study, the effect of each factor on changing the use of agricultural land to orchard has been investigated. The results showed that the highest tendency to change the land use was related to housing construction.

4.2. Characteristics of sample and interpretation of multiple regression analysis

In this study, landholders who had long years of experience were less likely to encounter the CSLO threats and more likely to be introduced to CSLO opportunities. Although experienced landholders might not be very knowledgeable about innovative farming practices, they are more aware of soil problems and the consequences of the current farming system. As a result, most of the experienced landholders were more willing to participate in the scheme and avoided using traditional farming systems. Based on the relevant literature, the impact of age variables and experience on the response of farmers to SWC steps is unclear. However, Amsalu and De-Graaff (2007) and Cramb (2005) have documented a positive association between age, experience, and the acceptance of modern technologies.

They have stated that more experienced landholders are less aware of innovative farming practices, but they are more aware of the problems of soil erosion and the consequences of traditional agriculture due to their long years of experience. As a result, more experienced landholders were more likely to use and participate in the CSLO scheme and avoid using traditional farming systems. The findings of Abid et al. (2019) showed that features such as good spatial distribution, factors affecting cultivation and soil richness in steep agricultural lands and abandoned lands in mountainous areas will lead to the conversion of steep lands into orchards. Moreover, dominant influencing factors of farmland abandonment in the study area are natural factors such as slope and farmland quality. Also, socioeconomic factors including distance to road, peasant income, and labor force proportion are the factors influencing on landholders' perception of CSLO scheme. In addition, experimental farmers prefer basic adaptation measures over advanced measures, such as planting shade trees, soil conservation and crop diversification, including experience, changing crop varieties, input use and planting dates. The study by Abid et al. (2019) also recommends providing easy access to information, institutional services and training to farmers, especially major landholders, on the use of advanced measures to eliminate the negative impacts of CSLO. In a study by Stokes et al. (2010), the results showed that China has the longest history of soil bioengineering and soil degradation on steep slopes, due to the lack of experience in converting sloping lands into orchards, poor agricultural performance, deforestation, road construction and dam construction. Therefore, the central government has developed a set of important programs to reduce the exploitation of sloping forest resources by encouraging the conversion of arable land into forests based on CSLO scheme. In the above-mentioned studies, it has been shown that the presence of young and experienced soil and environmental engineers is of great importance in the implementation of CSLO scheme.

The educational parameters are positive and significant in Model 1, suggesting that educated landholders are more likely to adopt the CSLO scheme. It seems there is a better capacity for educated landholders to recognize CSLO opportunities compared to less educated ones. Chadwick (2016) stated that landholder with higher education are more inclined to CSLO scheme. They believe that this method will prevent the destruction of soil structure and erosion. Considering the positive relationship between the share of family labor in agriculture and the perception of the CSLO opportunities by landholders, an explanation for this relationship could be the ability of family labor to facilitate orchard activities. Higher numbers of family members who can provide more agricultural labor are very important for both farming and soil conservation activities. The variables of landholding size and share of off-farm income have a positive impact on the perception of the CSLO opportunities. This finding shows that large-scale farmers and farmers with additional income from off-farm activities tend to pay more attention to positive aspects of the scheme. This group of farmers may be interested in long-term investments in new agricultural activities and practices and often are looking for new methods to improve the performance of their land. As shown by the model, contacts with extension agents and participation in extension courses and programs have a positive effect on perception of the CSLO opportunities. It can be assumed that extension programs that enhance awareness about the consequences of soil degradation and advantages of SWC measures are important factors in decision-making in support of conservation activities. The results of the study by Udayakumara et al. (2012) confirm these findings.

The results of their study showed that landholding scale variables and the share of off-farm profits have a positive effect on the understanding of the possibilities of applying CSLO scheme. Their findings showed that the size of the farm and the large farmers with higher incomes tend to pay attention to the positive aspects of this plan. They are often looking for new techniques to improve their ground performance, therefore, large farmers will welcome the CSLO scheme.

Two variables, namely secured perceptions on land tenure and low fertility condition of soil, were also negatively related to landholders' perceptions of CSLO threats. Generally, in the study area, many farmers are cultivating public steep lands owned by the government, and they are less likely to invest in soil conservation. With regard to the relationship between low soil fertility status and the perception of CSLO opportunities by landholders, a possible reason for this relationship could be the potential risk often linked with the performance reduction threat due to the continuous low soil fertility status. It is understandable that landholders who face continuing low fertility conditions tend to focus on CSLO opportunities as an alternative way to keep soil fertility.

Wairiu (2017) findings showed that land tenure and low fertility condition of soil is a threat and degraded land has become a serious concern in many countries in recent years. According to his findings, inappropriate agricultural practices, deforestation, overgrazing, population pressure, land tenure problems and climate change are among the causes of land degradation. These activities have threatened the environment and the growing population's food security. Sustainable land

management practices are being embarked on to address land degradation and safeguard the resources for their future generation, such as CSLO scheme Thus, it is understandable that landholders who face continuing low fertility conditions tend to focus on other opportunities such as CSLO scheme an alternative way to keep the soil fertility.

Model 3 provided a response to this study's fourth research question, i.e., which variables are linked with the intention of adopting the CSLO scheme. Some socio-economic variables, e.g., farming experience, share of family labor in farming activities, landholding size, share of off-farm income, number of annual farm visits with extension agents, severe soil erosion, secure land tenure perceptions, increasing soil erosion rate over time, and perceived opportunities of CSLO, showed a positive statistically significant relationship with the intention to adopt CSLO (Table 6). On the other hand, variables such as high effectiveness of previous SWC measures, low access to water resources, and perceived threats of CSLO showed a statistically significant negative relationship with the intention to adopt CSLO (Table 6). The findings of Chadwick (2016); Abid et al. (2019); Udayakumara et al. (2012); Dissanayake et al. (2019); Mu et al. (2017) showed that socio-economic variables, experience, share of family members' work in agricultural activities, land size, off-farm income, annual farm visits with development factors, soil erosion, land reclamation, have a significant relationship with the decision to use CSLO scheme. The results of the study by Carreño et al. (2012) showed that different regions react differently to human intervention, both in socio-economic and ecological terms, and any attempt to apply the CSLO system to different biomes can lead to desirable results.

Therefore, landholders' perceptions of both opportunities and threats of CSLO could strongly predict the intention for adoption (or rejection) of the scheme. Landholders who perceive opportunities of CSLO were more likely to be supportive of the scheme, while landholders who perceive threats of CSLO were less likely to be supportive. Landholders who perceive opportunities of CSLO accept that this scheme has major advantages, such as reduction of soil and water erosion and easy access to support and extension services. As a result, these landholders are often more positively inclined towards alternative ways of erosion control and thus appeared inclined to adopt CSLO in their field. On the other hand, landholders who perceive threats of CSLO are usually worried about the disadvantages such as the seizure of land ownership by the government, discontinuance of governmental supports, taking a long time to achieve economic production, and water resources limitation. As a result, these landholders have a propensity to prefer the current mode of farming more than CSLO and welcome other SWC measures. These findings showed that landholders' perceptions of opportunities and threats of SWC measures are essential to support the adoption of the CSLO scheme in the farm. Many studies highlighted that the characteristics of the technology such as feasibility, profitability, and acceptability may play important roles in determining the adoption of technologies. These results also imply that farmers value the CSLO scheme in a manner consistent with the theory of social exchange. By carefully assessing opportunities and threats, landholders who found the exchange beneficial to their self-interest are interested in adopting CSLO and have positive feedback on the scheme. Landholders who consider the exchange difficult will oppose CSLO. Previous researches showed that farmers' values of SWC measures can vary according to their needs (Nakhumwa and Hassan, 2003; Swinkels and Mugonola et al., 2013), and the way they believed the erosion had to be managed was also evolving. Their findings showed that landholders who perceive threats of CSLO are usually concerned about the disadvantages such as the seizure of land ownership by the government, discontinuance of governmental supports, taking a long time to achieve economic production, and water resources limitation.

Experienced landholders seemed more willing to adopt a scheme for CSLO. Hence, experienced landholders were more willing to turn to various methods of conservation agriculture such as the CSLO scheme. This is consistent with other related research findings (Illukpitiya and Gopalakrishnan, 2004), which show experiences that help farmers gain a better understanding of conservation management strategies.

Furthermore, farmers with a high share of family labor in agriculture revealed more willingness to adopt a CSLO scheme than farmers with a lower share of family labor in agriculture. A possible explanation for this result might be regarding the additional effort and the labor required to achieve the acceptable yields from orchard fields. Acceptable yield requirements involve the use of adequate quantities of pesticides and fertilizers, determining the appropriate time to start the pruning operation, and accurate orchard field monitoring to avoid loss of drought, freezing, and pest control. The entire activity is highly labor intensive and is carried out only with the help of the workforce of the family in the study area. This result is in line with other similar research findings (e.g. Abebe and Sewnet, 2014; Kpadonou et al., 2017; Nakhumwa and Hassan, 2003). The results of these studies showed that experience helps farmers better understand conservation management strategies. In addition, more help from their family members showed a greater willingness to adopt a CSLO scheme than farmers with a lower share of family work in agriculture. Because to achieve the desired performance, labor is needed to be able to optimally manage the gardens.

Landholding size had a positive impact on the intention to adopt CSLO, suggesting that landholders with larger farms are more likely to invest in conservation practices such as the CSLO scheme. In the study area, given the poor performance of steep land as well as small scaling farming (with the average landholding size of 1.91), most landholders are heavily involved in off-farm employment for their livelihood. As a result, landholders apply various alternative methods to improve farm productivity. For example, they apply the CSLO scheme to obtain more income. This finding is line with studies by Bekele and Drake (2003) and Asafu-Adjaye (2008). The off-farm income in total annual income had a positive association with the intention to adopt the CSLO scheme. However, this finding is inconsistent with a few previous studies. For example, Mbaga-Semgalawe and Folmer (2000); Bravo-Ureta et al. (2006), and Tenge et al. (2004) found a negative and significant relationship between off-farm work and SWC measures adoption. Their findings showed that large farmers with larger plots of land would be more willing to participate in CSLO scheme. Because in their opinion, the implementation of these projects in larger lands will be more cost-effective.

The numbers of annual farm visits by extension agents and numbers of annual participation in extension courses and programs had a positive effect on the intention to adopt CSLO. Agricultural extension services have a very important role in raising the landholders' awareness about the opportunities and threats of CSLO. In Iran, extension agents' visits to the individual farmers or farmer groups are regarded as encouragement by farmers to motivate them to acquire technical information about new technology and how to adopt it. Particularly, in this scheme, the landholders heavily rely on governmental supports such as supporting services like providing farmers with free saplings, irrigating new orchards in the first years, and free access to technical and extension services which can motivate landholders to adopt the scheme. These results are in line with the findings of the prior literature that highlights the importance of extension material in decision-making process for the adoption of SWC measures (Udayakumara et al., 2012; Mugonola et al., 2013; Abebe and Sewnet, 2014).These studies showed that the number of annual field visits by experts and the number of people participating in training courses and extension programs had a positive effect on landholders' intention to adopt CSLO scheme. Landholders' perception of severe extent of soil erosion was found to have a positive and

significant effect on the intention to adopt CSLO. This indicates that the landholders who have a perception of the severe extent of soil erosion problem were more likely to use alternative measures of soil conservation, such as CSLO. Although facing the severe extent of soil erosion would entail reduced farm yields and consequently a reduction in household income, farmers could engage in innovative ways including CSLO to conserve their land and minimize nutrient losses. Secured perceptions on land tenure that represent the possession of private land with a legal land title had a positive impact on the intention to adopt CSLO. In the study area, most farmers cultivate public land owned by the government and they have no perception of land tenure security. This is why landholders with a favorable perception of land tenure security were more likely to be highly supportive of the CSLO scheme. Tenure security has been reported to influence the adoption of new technologies in the study of Knowler (2004). Other studies also found positive effects of farmers' perception of soil erosion problem on the adoption of SWC measures (Sidibé, 2005; Nakhumwa and Hassan, 2003; Abebe and Sewnet, 2014; Udayakumara et al., 2012; Vignola et al., 2010). Their results showed that farmers perceived the existence of a problem of soil erosion on their farmland and had strong reasons to participate in SWC activities.

Based on the results presented in Table 6, landholders' perception of the fertility condition of their land has a significant impact on their intention to adopt the CSLO scheme. Landholders who perceive that their land requires minimal fertility amendments tend to continue the current farming system, while landholders who perceive that their land is not in favorable fertile conditions and requires maximum fertility amendments welcome other methods of soil conservation like CSLO. Maybe the landholders perceive the negative effects of fertility decline on household wealth, at least in the short run, and they will probably be more willing to implement CSLO in their farms. This result indicates that landholders who perceived high effectiveness of the previous SWC measures adoption in arresting soil erosion were more likely to be less supportive of CSLO. Based on informal discussion groups in the survey, participants who handled their land through certain preservation structures showed the research team that the technology they used improved their land productivity. Consequently, these landholder groups expressed their willingness to continue to maintain the structures established. In this study, CSLO was less supported by landholders with less access to water resources, while CSLO was strongly supported by landholders with reliable access to water resources (owned private water well, well-defined local river shares, and dams). Most of the steep lands in the study area are under rainfed cultivation and long-term investments because orchards require reliable water resources. Therefore, investment in the development of irrigation and drainage networks in the region to advance the scheme is essential. The results of a study by Amsalu and De-Graaff (2007) are consistent with the results of the current research. Their findings showed that the use of SWC measures will have a negative effect on preventing soil erosion. Therefore, landholders are willing to use CSLO scheme. Also, according to a study by Zegeye et al. (2010), SWC actions will have a negative effect on the implementation of CSLO scheme and will not support these projects.

4.3. Study limitation

There are still certain limitations to this study. First, the data for the study were collected from the owners of sloping land in only one county of Golestan province, one among the thirty-one provinces in Iran. Consequently, the findings of this study may not be applicable to other farmers operating on non-sloping land or using other SWC measures. Further research is needed to corroborate these findings with diverse landholder populations, including the owners of non-sloping land and adopters of other SWC measures, to increase the generalization of the results across the country. Second, the data obtained are cross-sectional in nature, and not longitudinal. The study on different trends of adoption and potentials of SWC measures is recommended for future research. Third, the CSLO scheme investigated in this study was in its initial phase of development, and it appears that the perception of CSLO by landholders tends to change during the life cycle of the scheme. Nevertheless, if the magnitude of the scheme persists, more time and energy will be spent on the understanding of the landholders to assess the development phases of the scheme. Finally, only the determinant of the CSLO adoption intention was examined in the study. It is suggested to find out how other drivers affect the adoption of the CSLO scheme and other SWC measures.

5. Conclusion

5.1. Suggestions

The obtained results in this study come to several conclusions that provide insight into ways to increase CSLO adoption. Most owners of the steep land in the study area were well informed about the threats of CSLO and were not well informed about the opportunities of CSLO. They were therefore less supportive of the CSLO scheme and showed little willingness to adopt it. Therefore, alternate policy tools, structures, and programs will also be planned and built for expansion, assistance, and preparation in order to enhance understanding of the CSLO's incentives for landholders and facilitate the implementation of the system. It is also assumed that landholders' perceptions of the CSLO scheme opportunities and threats could explain potential differential reactions to CSLO's adoption (or rejection). Results strongly support this assumption and provide vital information on how farmers view CSLO's opportunities and threats and how those perceptions could shape CSLO's potential for effective support (or refusal) in their farms. As a result, the opportunities of CSLO must be clearly perceived by the landholders to help them develop a positive assessment and lead to the adoption of CSLO. According to this finding, encouraging the adoption of CSLO through enhancing landholders' awareness of opportunities of CSLO is crucial. This study suggests for the first time that agricultural development programs should be planned for successful implementation of the CSLO scheme. This study underlines a need for increasing the information required about the opportunities and threats of these projects, not only for the landholders who intend to adopt them but also for the use of other people. Furthermore, based on the research results, it is recommended that policymakers should implement the CSLO scheme as this scheme contributes to landholders' understanding of the productivity of their land. Involvement of policymakers has a significant impact on their decision to adopt the CSLO scheme and encourage farmers to escape the hard-manual labor needed to sustain orchards on sloping land. The high perception of the CSLO scheme threats causes the landholders to be less supportive of the scheme and show low willingness to adopt it. Thus, policymakers should take into account the establishment of landholders' trust in long-term programs, especially in a society in constant turmoil. It is the key step towards the successful implementation of the CSLO scheme.

Therefore, the findings of this study can formulate strategies, identify opportunities and threats to turn sloping lands into orchards, improve the management of the CSLO scheme, ease their implementation challenges, and help policymakers and decision-makers revive failed programs.

5.2. Policy implications

The importance of uncertain future costs of implementing the CSLO scheme in Minodasht County should not be overlooked by policymakers. This study demonstrated the importance of examining both positive and negative landholders' perceptions of the opportunities and threats of the

CSLO scheme. Consequently, it should be considered by policymakers that successful implementation of the CSLO scheme will depend on correct understanding/interpretation of landholders' perceptions. There are important policy implications for successful implementation of the CSLO scheme as follows:

- In rural areas, land degradation has significant consequences not only for those living there but also for those living downstream. The conservation of soil quality, safety, biodiversity, and productivity should be a major concern of land-related policies.
- All policies affecting farm families should be framed with consideration of how policies can be perceived so that policymaking decisions have desired favorable effects on the land.
- Policies on subsidies to farmers should ensure that farmers are being paid fairly in producing off-farm costs and resources.
- Finally, national policies should promote and encourage any necessary improvements in consultancy practice, science, training, and institutions. In this way, there is interdisciplinarity in a government hierarchy between agencies at the same level, as well as consistency between departmental policies, national policies, and international agreements.

5.3. Future research direction

The results presented in this paper highlight the urgent need to encourage the adoption of the CSLO scheme by increasing landholders' awareness of opportunities, and the following recommendations for further research outline important ways forward. Future work should address the fact that what kind of information about the benefits and costs of SWC interventions can serve as an incentive for landholders to implement soil conservation technologies such as the CSLO scheme. The respondents of this study, small-scale wheat farmers who cultivate on public land for their livelihood, had long experience of using simple conservation activities such as stone terraces, soil bunds, and crop rotations for erosion reduction. Thus, this is probably why most of them were more perceived of threats of the CSLO scheme and expressed less support for its implementation. Through the collaboration of stakeholders, detailed assessment should be carried out to recognize better management options that reduce soil erosion and improve farm performance due to the complexity of the land ownership system and livelihood strategy. Moreover, the perception of the opportunities and threats of the CSLO scheme is not a sufficient reason for implementing it. Future researches should focus on the influence of promotional activities and support services provided by governmental institutions to adopt and continue SWC measures such as the CSLO scheme.

Credit author statement

Gholamhossein Abdollahzadeh performed the study and developed the main text. Hossein Azadi, Mohammad Sharif Sharifzadeh and Leila Jahangir provided instructions and comments for the research design and approaches. Kristina Janečková, Petr Sklenička, Rong Tan and Frank Witlox helped the others to address reviewers' comments and enrich the paper.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

Fig. A1. Steep orchard land in the Chehel-Chay watershed in Minodasht County.

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.landusepol.2020.105205.

References

Abdollahzadeh, G., Sharifzadeh, M.S., Damalas, C.A., 2015. Perceptions of the beneficial and harmful effects of pesticides among Iranian rice farmers influence the adoption of biological control. Crop Prot. 7, 124–131.
Abebe, Z.D., Sewnet, M.A., 2014. Adoption of soil conservation practices in North Achefer District, Northwest Ethiopia. Chin. J. Populat. Res. & Environ. 12 (3), 261–268.
Abid, M., Scheffran, J., Schneider, U.A., et al., 2019. Farmer perceptions of climate change, observed trends and adaptation of agriculture in Pakistan. Environ. Manage. 63, 110–123.
Allahyari, M.S., Damalas, C.A., Ebadattalab, M., 2016. Determinants of integrated pest management adoption for olive fruit fly (Bactrocera oleae) in Roudbar. Iran. Crop Protect. 84, 113–120.
Amsalu, A., De-Graaff, J., 2007. Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. Ecol. Econ. 61 (2), 294–302.
Asafu-Adjaye, J., 2008. Factors affecting the adoption of soil conservation measures: a case study of Fijian cane farmers. J. Agri. Res. Econ. 33 (1), 99–117.
Ascough, J.C., Flanagan, D.C., Tatarko, J., Nearing, M.A., Kipka, H., et al., 2018. Soil erosion modeling and conservation planning. In: Delgado (Ed.), Precision Conservation: Geospatial Techniques for Agricultural and Natural Resources Conservation. Agronomy Monograph. Soil Science Society of America, Madison, WI, USA, pp. 1–25.
Bai, M., Sadoddin, A., Salman-Mahini, A., 2015. Uncertainty Analysis in Predicting Ecological Impacts of Management Scenarios in the Chehl-Chai Watershed, Gorganrood River Basin. Iran. J. Appl. Ecol. 3 (10), 77–89 (In Persian).
Bekele, W., Drake, L., 2003. Soil and water conservation decision behaviour of subsistence farming in the Eastern Highlands of the Ethiopia: a case study of the Hunde-Lafto area. Ecol. Econ. 46, 437–451.
Bewket, W., 2007. Soil and water conservation intervention with conventional technologies in northwestern highlands of Ethiopia: Acceptance and adoption by farmers. Land Use Policy 24 (2), 404–416.
Bijani, M., Ghazani, E., Valizadeh, N., Fallah Haghighi, N., 2017. Pro-environmental analysis of farmers' concerns and behaviors towards soil conservation in central district of Sari County. Iran. Int. Soil and Water Conserv. Res. 5 (1), 43–49.
Bola, A.A., Aziz, A.K., Aliou, D., 2016. Agricultural technology adoption, commercialization and smallholder rice farmers' welfare in rural Nigeria. Agri. Food Sci. 4 (1), 1–24.

Bozarth, M.A., Farrish, K.W., Damoff, J.A., VanKley, J., Young, J.L., 2016. Spatial distribution of earthworms in an east texas forest ecosystem. Agric., Ecosyst. Environ., Appl. Soil Ecol. 104, 91–103.
Bravo-Ureta, B.E., Solis, D., Cocchi, H., Quiroga, R.E., 2006. The impact of soil conservation and output diversification on farm income in Central American hillside farming. Agri. Econ. 35 (3), 267–276.
Cavallo, E., Ferrari, E., Bollani, L., Coccia, M., 2014. Strategic management implications for the adoption of technological innovations in agricultural tractor: the role of scale factors and environmental attitude. Technol. Anal. Strateg. Manag. 26 (7), 765–779.
Chadwick, D., 2016. Defining a Formal Model of Edutainment That Enhances the Learning of Cyber Security Subjects by Higher Education Students. EdD Thesis. University of Greenwich.
Chen, Z., Wang, L., Wei, A., Gao, J., Lu, Y., Zhou, J., 2019. Land-use change from arable lands to orchards reduced soil erosion and increased nutrient loss in a small catchment. Sci. Total Environ. 648 (15), 1097–1104.
Cramb, R., 2005. Social capital and soil conservation: evidence from the Philippines. Australian J. Agri. & Res. Econ. 49, 211–226.
Dayer, A.A., Lutter, S.H., Sesser, K.A., Hickey, C.M., Gardali, T., 2017. Private landowner conservation behavior following participation in voluntary incentive programs: recommendations to facilitate behavioral persistence. Conserv. Lett. 0 (0), 1–11.
Dissanayake, D., Morimoto, T., Murayama, Y., Ranagalage, M., Handayani, H.H., 2019. Impact of urban surface characteristics and socio-economic variables on the spatial variation of land surface temperature in Lagos City. Nigeria. Sustainability 11, 25.
Ekeh, P., 1974. Social Exchange Theory. Harvard University Press, Cambridge, MA.
Elliott, L., Gruer, L., Farrow, K., Henderson, A., Cowan, L., 1996. Theatre in AIDS education: a controlled study. AIDS Care 8, 321–340.
FAO, 2019. Proceedings of the Global Symposium on Soil Erosion. Rome.FAO. 2017. Smallholder Agriculture and Market Participation. http://www.fao.org/3/a-i7841e.pdf.
Gao, Y., Li, P., Wu, L., Lu, J., Yu, L., Yin, S., 2018. Preferences of for-profit pest control firms on support policy in China. J. Clean. Prod. 181, 809–818.
Garson, D., 2007. Multiple Regression from Statnotes: Topics in Multivariate Analysis. , accessed 8 June 2007. Bhttp://www2.chass.ncsu.edu/garson/pa765/statnote.htm.
Gharehbash, A.M., 2013. Changing the traditional sheep and goat breeding system, the need to rehabilitate and improve pastures in golestan province. In: Proceedings of the First National Conference on Natural Resource Management. March 29, 2014. Gonbad Kavous University.
Grabowski, P.P., Kerr, J.M., Haggblade, S., Kabwe, S., 2016. Determinants of adoption of minimum tillage by cotton farmers in eastern Zambia. Agric., Ecosyst. Environ., Appl. Soil Ecol. 231, 54–67.
Greaves, M., Zibarras, L.D., Stride, Ch, 2013. Using the theory of planned behavior to explore environmental behavioral intentions in the workplace. J. Environ Psych. 34, 109–120.
Hellin, J., Ridaura, L.R., 2016. Soil and water conservation on CentralAmerican hillsides: if more technologies is the answer, what is the question? AIMS Agric. and Food. 1 (2), 194–207.
Homans, G., 1961. Social Behavior: Its Elementary Forms. Harcourt Brace Jovanovich, New York.
Huttunen, S., 2015. Farming practices and experienced policy coherence in agri-environmental policies: the case of land clearing in Finland. J. Environ Policy & Planning. 17 (5), 573–592.
Illukpitiya, P., Gopalakrishnan, C., 2004. Decision-making in soil conservation: application of a behavioral model to potato farmers in Sri Lanka. Land Use Policy 21 (4), 321–331.
Jara-Rojas, R., Bravo-Ureta, B.E., Engler, A., Díaz, J., 2013. An analysis of the joint adoption of water conservation and soil conservation in Central Chile. Land Use Policy 32, 292–301.
Junge, B., Deji, O., Abaidoo, R., Chikoye, D., Stahr, K., 2009. Farmers' adoption of soil conservation technologies: A case study from Osun state. Nigeria. J. Agri Edu & Exten. 15 (3), 257–274.
Kabir, M.H., Rainis, R., 2015. Adoption and intensity of integrated pest management (IPM) vegetable farming in Bangladesh: an approach to sustainable agricultural development. Environ Dev Sustain. 17 (6), 1413–1429.
Khodadadi, M., Mabit, L., Zaman, M., et al., 2019. Using 137Cs and 210Pbex measurements to explore the effectiveness of soil conservation measures in semi-arid lands: a case study in the Kouhin region of Iran. J. Soils Sediments 19, 2103–2113. https://doi.org/10.1007/s11368-018-2205-y.
Knowler, D.J., 2004. The economics of soil productivity: local, national and global perspectives. Land Degrad. & Dev. 15 (6), 543–561.
Kpadonou, R.A.B., Owiyo, T., Barbier, B., Denton, F., Rutabingwa, F., Kiema, A., 2017. Advancing climate-smart-agriculture in developing drylands: Joint analysis of the adoption of multiple on-farm soil and water conservation technologies in West African Sahel. Land Use Policy 61, 196–207.
Lutz, E., Pagiola, S., Reiche, C., 1994. The costs and benefits of soil conservation: the farmers' viewpoint. World Bank Res. Obs. 9 (2), 273–295.
Ma, Z., Butler, B.J., Kittredge, D.B., Catanzaro, P., 2012. Factors associated with landowner involvement in forest conservation programs in the U.S.: implications for policy design and outreach. Land Use Policy 29 (1), 53–61.
Mahboubi, M.R., Irvani, H., Rezvanfar, A., Kalantari, K., Mohseni, S.M., 2005. Factors affecting the adoption behavior regarding soil conservation technologies in the Zarrin Gol Watershed, Golestan Province. Iran. J. Natural Res. 57 (4), 595–606 (in Persian).
Mahboubi, M.R., Najdabbasi, N., Toosi, O., 2015. An investigation of motivation factors affecting on farmer's participation in terrace cropping operations in agricultural land case study: chehel-Chai Watershed, Golestan Province. J. Water Manage Res. 6 (12), 88–97 (in Persian).
Mancosu, E., Gago-Silva, A., Barbosa, A., De-Bono, A., Ivanov, E., Lehmann, A., Fons, J., 2015. Future land-use change scenarios for the Black Sea catchment. Environ. Sci. Policy 46, 26–36.
Mbaga-Semgalawe, Z., Folmer, H., 2000. Household adoption behaviour of improved soil conservation: the case of the North Pare and West Usambara Mountains of Tanzania. Land Use Policy 17 (4), 321–336.
Mu, J.E., Sleeter, B.M., Abatzoglou, J.T., et al., 2017. Climate impacts on agricultural land use in the USA: the role of socio-economic scenarios. Clim. Change 144, 329–345.
Mugonola, B., Deckers, J., Poesen, J., Isabirye, M., Mathijs, E., 2013. Adoption of soil and water conservation technologies in the Rwizi catchment of south western Uganda. I. J. Agric. Biotechnol. Sustain. Dev. 11 (3), 264–281.
Murage, A.W., Midega, C.A.O., Pittchar, J.O., Pickett, J.A., Khan, Z.R., 2015. Determinants of adoption of climate-smart push-pull technology for enhanced food security through integrated pest management in eastern Africa. Food Secur. 7 (3), 709–724.
Næss, P., Jensen, O.B., 2002. Urban land use, mobility and theory of science: exploring the potential for critical realism in empirical research. J. Environ Policy & Plan. 4 (4), 295–311.
Nakhumwa, T.O., Hassan, R.M., 2003. The adoption of soil conservation technologies by smallholder farmers in Malawi: A selective TOBIT ANALYSIS. Agrekon. 42 (3), 271–284.
Napier, T.L., Napier, A.S., 1991. Perceptions of conservation compliance among farmers in a highly erodible area of Ohio. J. Soil & Water Conserv. 46 (3), 220–224.
Nasiri, M., Najafi, N.A., Darijani, A., Sadoddin, A., 2011. Evaluating socio-economic influencing factors on terracing adoption: using logit model, case study, Chamany Watershed, Golestan Province. Iran. J. Agri Econ Dev. Res. 43 (2-4), 531–540 (in Persian).
Pender, J.L., Kerr, J.M., 1998. Determinants of farmers' indigenous soil and water conservation investments in semi-arid India. Agric. Econ. 19, 113–125.
Rahimzadeh, A., 2017. Political ecology of climate change: shifting orchards and a temporary landscape of opportunity. World Dev Perspectives 6, 25–31.
Rahmani, K.M., Kiani, F., Dordipour, E., Parsamehr, M., 2012. Effects of terracing on soil quality attributes in chehel-chay watershed, Golestan Province. J. Water & Soil Conserv. 19 (3), 1–25 (in Persian).
Rastgar, Sh., 2020. Payments for Ecosystem Services Based the Cost of Soil Conservation Function of Range Plants Vegetation in North of Iran-lar Dam. Grassland Production and Utilization.
Rosenberg, S., Margerum, R.D., 2008. Landowner motivations for watershed restoration: lessons from five watersheds. J Environ. Plan Manage. 51 (4).
Runoff Consulting Engineers Company (RCEC), 2005. Multifunctional Forest Management Plan for Chehel-chai Watershed. Ministry of Agriculture Jihad, Forestry, Rangeland and Watershed Organization. Department of Natural Resources of Golestan Province.
Sadeghi, S.H.R., 2017. Soil erosion in Iran: state of the art, tendency and solutions. Agri & Forest. 63 (3), 33–37.
Sadoddin, A., Alvandi, E., Sheikh, V.B., 2015. Developing a decision support system for participatory and integrated management of the chehel-chai watershed, Golestan Province. J. Water Manage Res. 6 (11), 124–136 (In Persian).
Sidibé, A., 2005. Farm-level adoption of soil and water conservation techniques in northern Burkina Faso. Agric. Water Manage. 71 (3), 211–224.
Sklenicka, P., 2002. Temporal changes in pattern of one agricultural Bohemian landscape during the period 1938-1998. Ekologia(Bratislava)/Ecology(Bratislava) 21 (2), 181–191.
Song, D., Pan, K., Tariq, A., Sun, F., Li, Z., Sun, X., Zhang, L., Olusanya, O.A., Wu, X., 2017. Large-scale patterns of distribution and diversity of terrestrial nematodes. Agric., Ecosyst. Environ., Appl. Soil Ecol. 114, 161–169.
Sonter, L.J., Barrett, D.L., Moran, C.J., Soares-Filho, B.S., 2015. A Land System Science meta-analysis suggests we underestimate intensive land uses in land use change dynamics. J. Land Use Science. 10 (2), 191–204.
Sunderland, T.C.H., Rowland, D., 2019. Chapter 6 - forests, land use, and challenges to climate stability and food security. Sustain Food & Agric. 95–116.
Tenge, A.J., 2005. Participatory Appraisal for Farm Level Soil and Water Conservation Planning in West Usambara Highlands, Tanzania. ph.d. Dissertation. Wageningen University, Wageningen.
Turner, J.H., 1974. The Structure of Sociological Theory. Dorsey Press, Homewood, IL.
Udayakumara, E.P.N., Shrestha, R.P., Samarakoon, L., Schmidt-Vogt, D., 2010. People's perception and socioeconomic determinants of soil erosion: A case study of Samanalawewa watershed, Sri Lanka. I. J. Sediment Res. 25 (4), 323–339.
Udayakumara, E.P.N., Shrestha, R.P., Samarakoon, L., Schmidt-Vogt, D., 2012. Mitigating soil erosion through farm-level adoption of soil and water conservation measures in Samanalawewa Watershed, Sri Lanka. Acta. Agric. Scandinavica, Section B-Soil & Plant Sci. 62 (3), 273–285.
Verma, P., Sinha, N., 2018. Integrating perceived economic wellbeing to technology acceptance model: the case of mobile based agricultural extension service. Technol. Forecast. Soc. Change 126, 207–216.
Vignola, R., Koellner, T., Scholz, R.W., McDaniels, T.L., 2010. Decision-making by farmers regarding ecosystem services: factors affecting soil conservation efforts in Costa Rica. Land Use Policy 27 (4), 1132–1142.
Wairiu, M., 2017. Land degradation and sustainable land management practices in Pacific Island Countries. Reg. Environ. Change 17, 1053–1064.
Ward, P.S., Singh, V., 2015. Using field experiments to elicit risk and ambiguity preferences: behavioural factors and the adoption of new agricultural technologies in rural India. J. Dev. Stud. 51 (6), 1–18.

Winter, S.J., Prozesky, H., Esler, K.J., 2007. A case study of landholder attitudes and behaviour toward the conservation of renosterveld, a critically endangered vegetation type in Cape Floral Kingdom, South Africa. Environ. Manage. 40, 46–61.
Zabihi, M., Pourghasemi, H.R., Motevalli, A., Zakeri, M.A., 2019. Gully erosion modeling using GIS-based data mining techniques in Northern Iran: a comparison between boosted regression tree and multivariate adaptive regression spline. In: Pourghasemi, H., Rossi, M. (Eds.), Natural Hazards GIS-Based Spatial Modeling Using Data Mining Techniques. Advances in Natural and Technological Hazards Research, vol. 48. Springer, Cham.
Zarea Khormizi, M., Najafinejad, A., Noura, N., Kavian, A., 2013. The Effects of Soil Properties on Runoff and Soil Loss Generation in the Farm Lands of the Chehel-Chai Watershed, Golestan Province. JWSS. 17 (64), 173–183 (in Persian).
Zegeye, A.D., Steenhuis, T.S., Blake, R.W., Kidnau, S., Collick, A.S., Dadgari, F., 2010. Assessment of soil erosion processes and farmer perception of land conservation in Debre Mewi watershed near Lake Tana. Ethiopia. Ecohydrol. Hydrobiol. 10 (2), 297–306.