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Structural Analysis of Factors Affecting Agricultural Sustainability in Qazvin Province, Iran

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ABSTRACT

Agricultural sustainability refers to the ability of a farm to produce food indefinitely, without causing irreversible damage to ecosystem health. The main objective of this study was to formulate a structural model to analyze the effects of ecological, social, and economic factors on sustainable agricultural development in Qazvin Province of Iran. To achieve this aim, a structural model with 4 latent variables and 14 observed indicators was used. Required data were collected by questionnaire from 220 wheat cropping farmers who were selected through a stratified sampling design from four counties located in Qazvin Province. Linear structural relationships were used to calculate the impact of various factors on sustainability of agriculture. The computer software of LISREL was used to specify, fit, and evaluate structural equation model. The result of the analysis showed that ecological, social, and economic sustainability positively affected the agricultural sustainability, but, ecological sustainability had a greater impact on agricultural sustainability (0.642) than economic (0.604) and social (0.568) sustainability. The model gives right signals on what has been happening to agricultural development in Iran. The result of this study can also assist agricultural planners and policy-makers in identifying appropriate policies and in monitoring the effectiveness of policy interventions.

Keywords: Ecological sustainability, Economic sustainability, LISREL, Social sustainability.

INTRODUCTION

The concept of sustainability has emerged in the past thirty years as a leading framework for understanding economic, social, and ecological development around the world (Schlossberg and Zimmerman, 2007). Although the volume of information about sustainability and sustainable development has grown exponentially since the 1960s, early efforts to define sustainability focused almost exclusively on the relationship between human economic activities and the impact of those activities on the natural environment (Meadows, 1994; Hardin, 1998). Many early advocates for sustainability and sustainable development were scientists and economists interested in the use of models to predict sustainable levels of natural resource extraction, economic production, and consumption. Two key reports of this early era included "The Limits to Growth" (Meadows, 1974) and "Our Common Future" (World Commission on Environment and Development, 1987), which placed environmental degradation and carrying capacity at their center. By defining sustainability as an ongoing process in which people take actions leading to development that meets the present needs without compromising the ability of future generations to meet their needs. "Our Common Future" did open up the possibility

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for an expanded notion of sustainability beyond purely environmental terms [World Commission on Environment and Development (WCED), 1987]. The concept of agricultural sustainability, as it often appears today, attempts to reach beyond the pure environmental approach and embrace elements of the economic and social sustainability. It has begun to look at reconciling the 'three E's': environment, economy, and equity (Brugmann, 1997; Jepson, 2001; Michalos, 1997). That is, a new definition of sustainability focusing on intra-generational equity, as well as inter-generational equity as delineated in the WCED's definition, is increasingly of concern to policy makers (Farrell and Hart, 1998). Over the past two decades, worldwide efforts to identify indicators of sustainability have resulted in the creation of hundreds of indicators. Most of the indicators identified are linked to environmental sustainability. A 1998 report by the Organization for Economic Co-Operation and Development (OECD) listed 51 environmental indicators designed to measure progress toward sustainable development. The indicators are broken down into environmental indicators and socio-economic indicators (OECD, 1998).

Un-sustainability in agricultural sector is a serious phenomenon. There are indications that the highly productive fertilizer and seed technologies introduced over the past four decades may be reaching a point of diminishing returns (Cassman *et al.,* 2005). In developing countries, harsh climatic conditions, population pressure, land constraints, and the decline of traditional soil management practices have often reduced soil fertility (Bumb and Baanante, 2004). Because agriculture is a soil-based industry that extracts nutrients from the soil, effective and efficient approaches to slowing that removal and returning nutrients to the soil will be required in order to maintain and increase crop productivity and sustain agriculture for the long term (Alavi Panah *et al.*, 2008). The overall strategy for increasing crop yields and sustaining them at a high level must include an integrated approach to the management of soil nutrients, along with other complementary measures. An integrated approach recognizes that soils are the storehouse of most of the plant nutrients essential for plant growth and that the way in which nutrients are managed will have a major impact on plant growth, soil fertility, and agricultural sustainability (Dregne, 2002). According to sustainable paradigm, mechanization, fertilizer consumption, alternation cultivation, pesticides consumption, and irrigation cycle are the main indications of sustainable agriculture (Gahinl, 1998).

New systems of agricultural sustainability indicators are appearing that stretch beyond the discrete measurement of environmental and economic conditions. Emphasis on social sustainability is influencing the make-up of current sustainability indicators (Meadows, 1994). Thus, good measurements of ecological and economic conditions remain very important to gauging progress toward sustainability, however, other indicators, especially social indicators, are playing a role in determining sustainability in general and agricultural sustainability in particular (Roseland, 1998). Thus, sustainable agricultural development includes three inter connected, mutually inclusive themes, or spheres: the ecology, society and economics (Figure 1). According to the sustainability paradigm no single dimension should be allowed to dominate a development decision. In fact, each of the spheres should be taken into equal consideration prior to any economic decision.

The parameters of sustainable agriculture have grown from an original focus on ecological aspects to include first economic and then broader social dimension. The core concerns of sustainable agriculture are to reduce negative environmental and health externalities, to enhance and utilize local ecosystem resources, and preserve biodiversity. More recent concerns include topography, slope, and soil quality in broader recognition for ecological

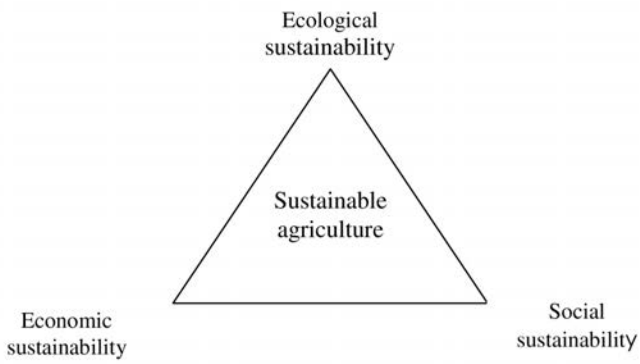

Figure 1. The three dimensions of sustainable agriculture.

sustainability in agricultural activities. Economic perspectives on sustainable agriculture attempt to assign value to ecological parameters and include area under cultivation, agricultural productivity, and income earned from agriculture. In social aspect, sustainable agriculture is often associated with farmer participation, their satisfaction, technical knowledge, ability of farmers and their social capital.

This study was an attempt to find out the impacts of ecological, social and economic, factors on sustainable agricultural development. Agricultural sector in Iran is one of the most important economic sectors and comprises a considerably high percentage of production and employment. About 25% of the Gross National Product (GNP), 33% of employment, 25% of non-oil exports, and 80% of food requirements have been provided by the agricultural sector in Iran (Karbasioun *et al.*, 2008). Nevertheless, there is various evidence that agriculture still lags far behind its real potential in Iran, considering the country's available resources. In addition, sustainable land use has not yet been achieved. For instance, about 30% of the forests located in the north of Iran were destroyed during the last two decades. Furthermore, large portions of pastures and grasslands were rendered unproductive because of overuse by the cattle of the nomadic communities and farmers (Darvishi, 2003). As illustrated by a qualitative comparative case study (Karami and Rezaei-Moghaddam, 1998), socio-economic characteristics and environmental conditions of the farm have led to the relative impoverishment of Iranian farmers. Smallholder farmers in unfavorable socio-economic and environmental conditions are relatively poorer. Their findings also illustrated that poverty was a major cause of unsustainable agriculture. Poor farmers' insufficient management competencies lead to higher soil erosion, over-fertilization, inadequate application of manure, lack of fallow, overgrazing, burning of crop residue, and over-use of pesticides (Karbasioun *et al.*, 2008; Vaezi *et al.*, 2010). The main purpose of this study was to find out factors affecting sustainability of agriculture in Qazvin Province, Iran.

Qazvin Province is located in the north of Iran and had a population of 1.24 million people by the 2011 census, of which 69.05% lived in urban and 30.95% in rural areas. The province emerges among developed provinces of Iran in terms of agriculture, with 13,000 km² under cultivation, covering 12% of the cultivable lands of the country. Water is supplied by numerous Qantas, deep and semi-deep wells, and a large irrigation canal that originates from Taleghan and Ziaran areas. The agricultural produce of the land is grape, hazelnut, pistachio, almond, walnut, olive, apple, wheat, barley, sugar beet, pomegranate, fig, and maize. Livestock raising, fish farming, and poultry production are developed throughout the province.

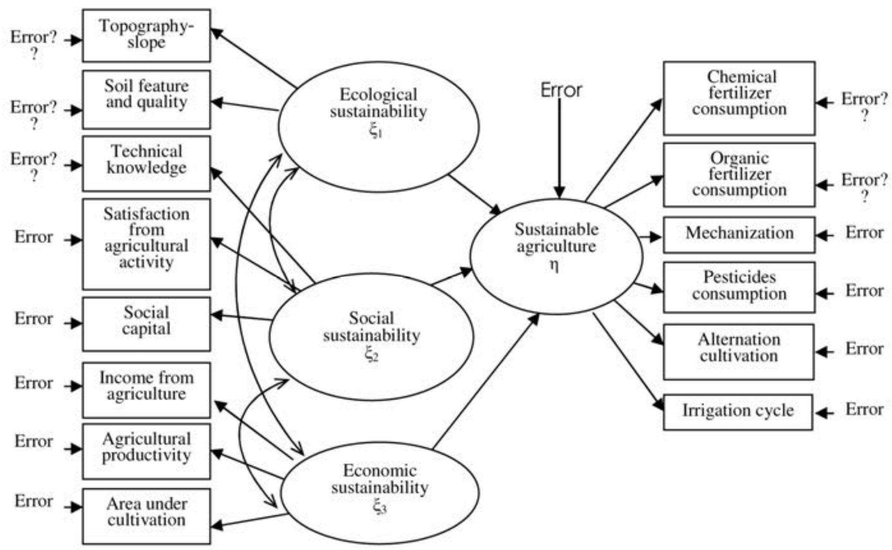

Figure 2. Structural model of factors affecting agricultural sustainability.

MATERIALS AND METHODS

In the present study, a model for sustainable agriculture (Figure 2) was formulated as a cause/effect chain to work out structural analysis. As the qualitative variables of this model were measured through various items in the form of Likert type scale, by adding up these items, a quantitative set of data for each of the variables was obtained and the structural analysis was calculated. This model consists of two parts: the measurement model and the structural equation model. The structural model specifies how latent variables (ξ_1, ξ_2, ξ_3 and η) depend upon or are indicated by the observed variables. It describes the measurement properties (reliabilities and validities) of the observed variables, and is defined by the following equations:

Structural equation

$$\eta = \gamma_{11}\xi_1 + \gamma_{12}\xi_2 + \gamma_{13}\xi_3 + \zeta_1 \quad (1)$$

Measurement equations

$$y = \lambda\eta + \varepsilon \quad (2)$$

$$x = \lambda\xi + \delta$$

Where, η is an $m\times 1$ random vector of latent dependent (endogenous) variables; γ is an $m\times n$ matrix of coefficients of the ξ-variables; ξ is an $n\times 1$ random vector of latent independent xogenous) variables; ζ is an $m\times 1$ vector of equation errors (random disturbances) in the structural relationship between η and ξ; λ is a $p\times m$ matrix of coefficients of the regression (loading) of y on η or, is a q x n matrix of coefficients of the regression (loading) of x on ξ; δ is a $q\times 1$ vector of measurement errors in x, ε is a $p\times 1$ vector of measurement errors in y.

To examine the reliability of the latent variables, composite reliability value for each latent variable was calculated. To do this, the information on indicator loadings and error variances calculated by LISREL were used and by applying the following formula, the composite reliability of various latent variables was calculated (Diamantopoulos and Siguaus, 2000).

$$P_c = (\Sigma\lambda)^2 / \left[(\Sigma\lambda)^2 + \Sigma(\theta)\right] \quad (3)$$

Where, Pc= Composite reliability; λ= Indicator loadings; θ= Indicator error variance (ie. variances of the δs or εs),

Table 1. Composite reliability of latent variables.

Latent variables	Composite reliability
Sustainable agriculture	0.831
Ecological sustainability	0.792
Social sustainability	0.811
Economical sustainability	0.788

Σ = Summation over the indicators of the latent variables.

Table 1 shows the composite reliability for all four latent variables included in the structural model.

The statistical population of this study consisted of wheat cropping farmers of Qazvin Province of Iran. Sample size included 220 persons selected through stratified sampling method from four counties of Qazvin (80 persons), Takistan (55 persons), Bouein Zahra (60 persons) and Abyak (30 persons). A questionnaire, including open and closed questions, was prepared and used for data collection. In designing the closed questions, a 5-point Likert-type scale was applied. The scale used ranges from 1 (very little) to 5 (very much). To pilot test the survey questionnaire, 25 interviews were carried out with selected wheat growing farmers and some questions were changed, added, or deleted where necessary. A total of 220 questionnaires were completed and various quantitative methods of data analysis were applied. Descriptive statistical analyses, such as frequency tables, percentage, and mean were used to determine the general status of the studied society. Furthermore, Linear Structural Relationships were used to calculate the impact of virus factors on sustainable agriculture. The computer software of LISREL (LInear Structural RELationships), developed by Jöreskog and Sörbom (1996), was used to specify fit and evaluate structural equation model.

RESULTS AND DISCUSSION

The results of descriptive analysis of the data showed that, in terms of age structure, about 19% of the farmers were under 30 years, 23.5% were in their 40s, 24% in their 50s, 22% in their 60s, and 11.5% in their 70s. In respect of literacy, about 38% of farmers were illiterate, 19% primary school, 21% of them had received secondary and high school education, and 22% of them had high school graduation certificate. Income of farmers is also a crucial factor in achieving sustainable agriculture. The income level of the respondents is shown in Table 2. The average of farming land size and cultivated lands in the studied area were 10 and 4.5 hectares, respectively. The average wheat production per hectare was 4.5 tons.

Agricultural Sustainability

To assess the sustainability of agricultural sector in Qazvin Province, 6 set of indices were studied including: chemical fertilizer application, organic fertilizer application, mechanization, pesticides consumption, and rotational cultivation and irrigation cycle,

Table 2. Respondents by income.

Monthly income level (Rls.)	Number	Percent
Less than or equal to 1000000	17	7.23
1000001-2000000	61	27.73
2000001-3000000	87	39.54
3000001-4000000	37	16.82
4000001 and more	18	8.18
Total	220	100

each containing several indices. The aggregation of these indices showed the agricultural sustainability, which is presented in Figure 3. The result revealed that agricultural sector in Qazvin Province is unsustainable.

Structural Analysis

Here, the conceptual framework presented in Figure 2 was evaluated by using structural equation modeling. The purpose of estimation is to generate numerical values for the free (and constrained) parameters in the model designed for sustainable agriculture. Hence, the maximum likelihood (ML) (the more statistically efficient method) was used to estimate the parameters of the model. The results produced by the program are shown in Table 3. These are presented in equation form, whereby (a) each observed variable is expressed as a linear function of its underling latent variables of ecological, social, economical, and agricultural sustainability. More specifically, the first 14 equations describe the measurement part of the model. The last equation describes the structural part of the sustainability model. Un-standardized parameter estimate, its standard error, and the relevant *t*-value for each parameter in each equation was calculated.

The standardized parameters show the resulting change in a dependent variable from a unit change in an independent variable, with all other independent variables being held constant. Thus, the last equation shows that one unit change in ecological sustainability affects 0.541 unit change in agricultural sustainability. Whereas one unit change in social sustainability results in 0.325 unit, and one unit change in economic sustainability results in 0.362 unit changes in agricultural sustainability (Table 3).

In Table 3, Standard error of each parameter was calculated below each parameter estimates in the equations. The smaller value of standard errors shows the better estimations. If the estimated value of a parameter is divided by its standard error, the t-value is obtained. The *t*-value between -1.96 and 1.96 indicates that the corresponding parameters in not significantly different from zero, at the 5% significance level (Steenkamp and Trijp, 1999). In our model, the t-value obtained in the equations indicates that it is different from zero in the case of all variables used in the model. The coefficient of determination (R^2) displayed for each equation shows the amount of variance in the dependent variable accounted for by the independent variable (s) in the equation. Thus, the R^2 of 0.791 in sustainable agriculture equation indicates that 79.1% of the variance in agricultural sustainability is jointly explained by ecological, social and economic sustainability (Table 3). The

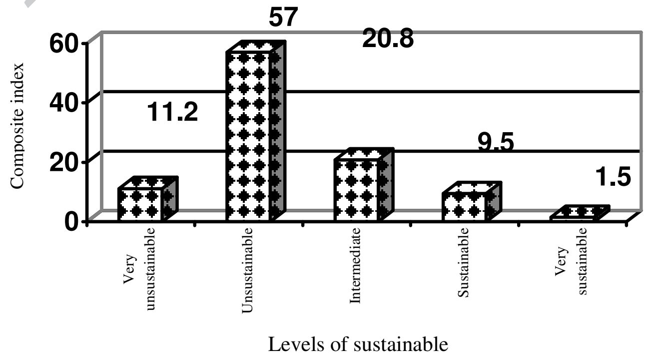

Figure 3. Levels of Agricultural Sustainability in Qazvin Province.

Table 3. LISREL Estimates: Structural equations of agricultural sustainability model (Maximum Likelihood).

(A) Measurement equations		
Chemical= 1.000×Sus Agri	*Chemical= 1.000×Sus Agri*	*R^2 = 0.842*
	(0.219)	
	3.101	
Organic= 0.223×Sus Agri,	*Errorvar.= 4.845,*	*R^2= 0.457*
(0.0820)	(0.464	
2.716	10.432	
Mechaniz= 0.424×Sus Agri	*Errorvar.= 6.506*	*R^2 = 0.809*
(0.0960)	(0.627)	
4.417	10.376	
Poison= 1.023×Sus Agri,	*Errorvar.= 0.625*	*R^2 = 0.858*
(0.0711)	(0.227)	
14.390	2.754	
Alternat= 0.227×Sus Agri	*Errorvar.= 4.845*	*R^2 = 0.470*
(0.0820)	(0.465)	
2.765	10.430	
Irrigati= 0.408×Sus Agri,	*Errorvar.= 5.754,*	*R^2= 0.745*
(0.0904)	(0.555)	
4.510	10.372	
Topogra= 1.000×Ecol Sus,	*Errorvar.= 2.162*	*R^2 = 0.970*
	(0.465)	
	4.649	
Soil= 0.406×Ecol Sus,	*Errorvar.= 3.627*	*R^2 = 0.689*
(0.128)	(0.422)	
3.157	8.589	
Knowled= 1.000×Soci Sus,	*Errorvar.= 3.773,*	*R^2= 0.421*
	(0.382)	
	9.876	
Satisfac= 1.735×Soci Sus,	*Errorvar.= 3.428,*	*R^2= 0.485*
(0.257)	(0.495)	
6.743	6.924	
Scapital= 2.511×Soci Sus,	*Errorvar.= 3.354,*	*R^2= 0.850*
(0.427)	(0.776)	
5.875	4.322	
Income= 1.000×Econ Sus,	*Errorvar.= 2.153,*	*R^2= 0.529*
	(0.556)	
	3.871	
Producti= 0.679×Econ Sus,	*Errorvar.= 3.855,*	*R^2= 0.424*
(0.161)	(0.449)	
4.217	8.588	
Area= 0.733×Econ Sus,	*Errorvar.= 3.220,*	*R^2= 0.487*
(0.169)	(0.421)	
4.335	7.640	

(B) Structural equations

Sus Agri= 0.541×Ecol Sus+0.325×Soci Sus+0.362×Econ Sus, Errorvar.= 2.924, R^2= 0.791

(0.120) (0.137) (0.107) (0.418)

* Ecol Sus= Ecological Sustainability; Soci Sus= Social Sustainability; Econ Sus= Economical Sustainability, Sus Agri= Sustainable Agriculture.

squared multiple correlations of the observed variables are indicative of the degree to which the indicators are free from measurement error (the closer to 1, the better the observed variable acts as an indicator of the corresponding latent variable) (Goldberger and Duncan, 1973).

The results of equations in Table 3 show that the R^2 values are moderate to high (ranging between 0.421 and 0.970), indicating that the observed variables are reasonably successful as measures of the latent variables i.e. ecological, social, economic and agricultural sustainability, of the model. The R^2 of sustainable agriculture (0.791) shows that independent latent variables (ecological, social and economic sustainability) explain a considerable portion of the variance in sustainable agriculture. The type of relationship between exogenous and endogenous latent variables and their estimates are presented in Figure 4.

Model Fit

Here, we refer to the extent to which "sustainable agriculture" model is consistent with the data. This will be done by: (a) the assessment of overall fit; (b) the assessment of the measurement part of the model, and (c) the assessment of the structural part of the model. There are wide ranges of goodness of fit indices that can be used for model's overall fit. Table 4 shows the range of fit indices produced by the LISREL Program. The root mean square error of approximation (RMSEA) is a measure for evaluating overall model fit. According to this fit statistics, values less than 0.05 are indicative of good fit, between 0.05 and under 0.08 of reasonable fit, between 0.08 and 0.10 of mediocre fit and > 0.10 of poor fit (Browne *et al.*, 1993). For our sustainable agriculture model, *RMSEW= 0.055*, which indicates an acceptable fit. The *ECVI* is another useful indicator of a model's overall fit. In our model, *ECVI= 3.613*, which is lower than the E*CVI* for saturated model (3.959) and the *ECVI* for independence model (6.685). Thus, this is another sign of the model's fit (see table 4). The next set of fit measures are two criteria, namely, Akaike's information criterion (AIC) and the consistent version of *AIC (*CAIC). Smaller values for the *AIC* and *CAIC* represent a better fit of the model. For our sustainable agriculture model, *AIC= 810* and *CAIC= 940.565*, both of which are lower than those for the independence and saturated models. Therefore, they can be considered as additional criteria for the goodness of fit of the model. The next three measures of *NNFI= 0.910, CFI= 0.918* and *RFI= 879* also indicate a reasonable fit of the model. All these indices have a range between 0 and 1 and values close to 1 represent good fit. The next sets of measures of fit (GFI, AGFI

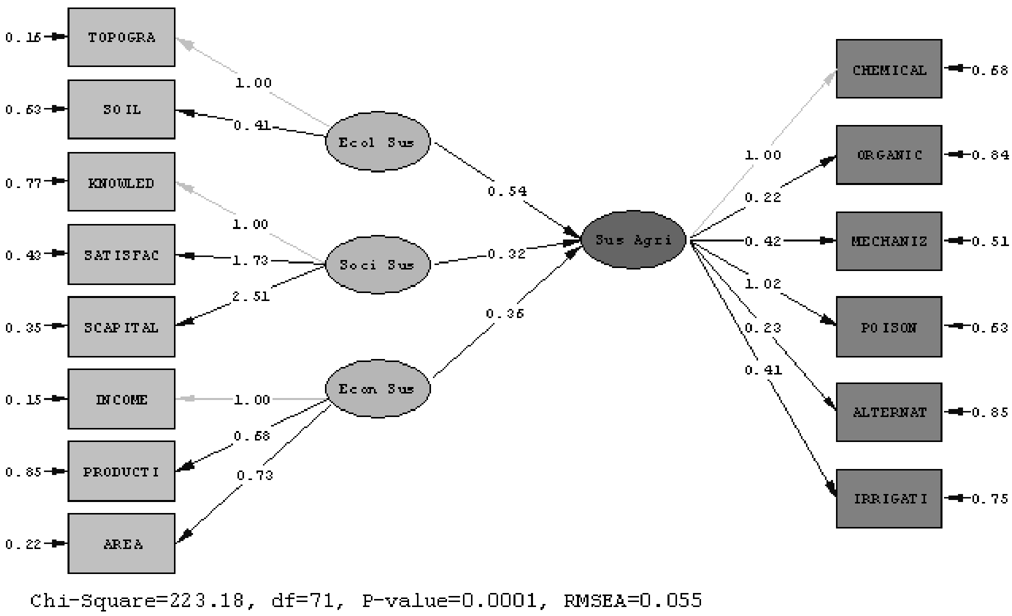

Figure 4. The path diagram produced by LISREL program for explaining factors affecting agricultural sustainability in Qazvin Province.

Table 4. Goodness of Fit Statistics of agricultural sustainability model.

Fit statistics	Fit values
Root Mean Square Error of Approximation (RMSEA)=	*0.055*
P-value for Test of Close Fit (RMSEA< 0.05)=	*0.000*
Expected Cross-Validation Index (ECVI)=	*3.613*
90 Percent Confidence Interval for ECVI=	*(3.236; 4.024)*
ECVI for Saturated Model=	*3.959*
ECVI for Independence Model =	*6.685*
Independence AIC=	*1463.969*
Model AIC=	*791.181*
Saturated AIC=	*810.000*
Independence CAIC=	*1525.480*
Model CAIC=	*940.565*
Saturated CAIC=	*971.331*
Non-Normed Fit Index (NNFI)=	*0.910*
Comparative Fit Index (CFI)=	*0.918*
Relative Fit Index (RFI)=	*0.879*
Goodness of Fit Index (GFI)=	*0.979*
Adjusted Goodness of Fit Index (AGFI)=	*0.926*
Parsimony Goodness of Fit Index (PGFI)=	*0.959*

and PGFI) are absolute fit indices. These indices indicate how well the covariances predicted from the parameter estimates reproduce the sample covariance (Browne and Cudeck, 1993; Kalantari, 2009). Values of these indices should range between 0 and 1 and values > 0.90 are taken as reflecting acceptable fit (Kalantari, 2009). For our model, *GFI= 0.979, AGFI= 0.926* and *PGFI= 0.959*, thus, the picture painted by these indices also indicate better fit of our sustainable agriculture model presented in Figure 4.

In evaluating the measurement part of the model, we focused on the relationships between the latent variables and their indicators i.e. the observed variables. Error variances presented in the equation of Table 3 show that, in all cases, t-values exceed 1.96 in absolute terms, which provides validity evidence in favor of the indicators used to represent the structures of ecological, social, economic and agricultural sustainability. One problem with relying on unstandardized loadings and associated t-value is that it may be difficult to compare the validity of different indicators measuring a particular construct. This problem arises because indicators of the same construct may be measured on very different scales. For this reason, the magnitudes of the standardized loadings are also inspected and results of the completely standardized solution are given in Table 5, where it is revealed that all the observed variables used for measuring ecological, social, economic and agricultural sustainability are valid. Inspection of the standardized loadings shows that chemical fertilizer consumption (CHEMICAL), (0.917) and pesticides consumption (POISON), (0.926) are the most valid indicators for sustainable agriculture, while rotational cultivation (ALTERNAT), (0.792) is the least valid indicator. Similarly, topography and slope of the land (TOPOGRA), (0.985), technical knowledge of farmers (KNOWLED) (0.985), and productivity (PRODUCIT), (0.974) are the most valid indicators of ecological, social, and economical sustainability, respectively (Table 5).

In evaluating the structural part of the model, we focus on the substantive relationships between the exogenous variables of ecological, social and economic sustainability and endogenous variable of sustainable agriculture. The aim here is to determine whether the theoretical

Table 5. Completely Standardized Solution.

	LAMBDA-Y		LAMBDA-X	
variable	Sus Agri	Ecol Sus	Soci Sus	Econ Sus
Chemical	0.917			
Organic	0.889			
Mechaniz	0.801			
Poison	0.926			
Alternat	0.792			
Irrigation	0.807			
Topogra		0.985	--	--
Soil		0.835	--	--
Knowled		--	0.971	--
Satisfac		--	1	--
Scapital		--	0.875	--
Iincome		--	--	0.727
Producti		--	--	0.974
Area		--	--	0.836

relationships specified at the conceptualization stage (Figure 2) are indeed supported by the data. Thus, the model presented in Figure 2 was used to fit data, and it resulted in a structural model as presented in Figure 4. This model consists of three exogenous variables, i.e. ecological, social, and economic sustainability, and one endogenous variable, i.e. sustainable agriculture. The relative effect of each independent variable on sustainable agriculture is given in Table 6. It shows that ecological, social and economic sustainability positively affect the agricultural sustainability, but, ecological sustainability (0.642) has a greater impact on agricultural sustainability than economic (0.604) and social (0.568) sustainability.

CONCLUSIONS

The key contributions of this research are characterizing sustainability along three domains instead of just the single environmental domain common to current sustainability discussion. This gives users the ability to make the linkages between the different elements of sustainability. The indices developed for this research move a step closer to both understanding sustainability more holistically and developing a method for policy makers at the province level. This paper discusses in detail how to build a model of sustainable development indicators by using structural equations with latent variables. The model of sustainable development indicator, obtained in this study, gives right signals on what has been happening to agricultural development in Qazvin Province. The results of the study show that the prevailing agricultural development in Qazvin Province is unsustainable (Figure 3). The relative impacts of independent variables show that ecological factors have an important impact on sustainable agriculture. Thus, it is recommended that these results should be taken into account in any intervention in agricultural soils of the province and agricultural activities on steep slopes.

Table 6. Relative impact of each independent variable on sustainable agriculture.

	Ecol Sus[a]	Soci Sus[b]	Econ Sus[c]
Sus Agri[d]	0.642	0.568	0.604

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تحلیل ساختاری عوامل موثر بر پایداری کشاورزی در استان قزوین

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چکیده

توسعه پایدار کشاورزی اشاره به توانایی یک مزرعه برای تولید غذا به طور نامحدود، بدون ایجاد آسیب برگشت ناپذیر به سلامت اکوسیستم دارد. هدف اصلی این مطالعه تدوین یک مدل ساختاری به منظور تحلیل اثرات عوامل اقلیمی، اجتماعی و اقتصادی بر توسعه پایدار کشاورزی در استان قزوین است. برای دستیابی به این هدف یک مدل ساختاری با چهار متغیر نهفته و ۱۴ شاخص آشکار تدوین شد. داده‌های مورد نیاز برای تحلیل این مدل از طریق ۲۲۰ نفر از گندمکاران استان قزوین که به روش نمونه‌گیری طبقه‌بندی شده از چهار شهرستان انتخاب و گردآوری شد. مدل خطی ساختاری برای محاسبه اثرات متغیرهای مختلف بر پایداری کشاورزی مورد استفاده قرار گرفت و از نرم افزار LISREL برای انجام محاسبات و برآوردها و بررسی برازش مدل استفاده شد. نتایج نشان داد که پایداری اقلیمی، اجتماعی و اقتصادی بر پایداری کشاورزی اثر مثبت دارند اما پایداری اقلیمی (۰/۶۴۲) اثر بیشتری بر پایداری کشاورزی در مقایسه با پایداری اقتصادی (۰/۶۰۴) و اجتماعی (۰/۵۶۸) دارد. این مدل وضعیت پایداری در کشاورزی ایران را نشان داده و نتایج آن می‌تواند برنامه ریزان و سیاستگزاران بخش کشاورزی را در تدوین سیاست‌های مناسب و نظارت بر این سیاست‌ها کمک کند.