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Farmers' perception of sustainable agriculture and its determinants: a case study in Kahramanmaras province of Turkey

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Abstract The primary purpose of this study was to assess in quantitative terms farmers' perceptions of sustainable agriculture and to determine how those are influenced by different socio-economic characteristics and information-seeking behavior of the farmers. The study was conducted in Kahramanmaras province of Turkey and comprised a stratified sample of 208 farmers from four districts of the province. The farmers rated each of the 21 selected sustainable agricultural practices for importance on a 5-point scale, and the total of these ratings formed the sustainable agriculture perception index. The index score was calculated for each farmer and was treated as the dependent variable in the stepwise regression analysis procedure. The independent variables were such socio-economic characteristics as the farming system, the total and irrigated area of the farm, membership of a cooperative society and participation in village administration, and age, education, and income of the farmer; components of information-seeking behavior included use of the mass media (newspapers, radio, and television), use of the Internet, travel, and participation in farming events. The results of the study showed that the higher the socio-economic status (more frequent contact with extension services, higher education, ownership of land, etc.) and the greater the access to information, the greater the perceived importance of sustainable agricultural practices. It is concluded that if policy-makers and extension organizations concentrate on these factors, they are more likely to succeed in making farmers more favorably disposed toward sustainable agriculture.

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1 Introduction

If farmers are to adopt the sustainable agricultural practices being promoted by governmental institutions, e.g. the ministry of agriculture, the farmers first need to believe that the practices are indeed useful. The perceived importance of sustainability among farmers differs from farmer to farmer and is influenced by socio-economic characteristics as well as information-seeking behavior of the farmers. Since this study explored the degree of importance that farmers attach to different sustainable agricultural practices and factors that influence it, it is useful to define sustainability. The most commonly used definition of sustainable development is the development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (WCED 1987). To be sustainable, a developmental process should integrate three dimensions, namely environmental, economic, and social: environmental sustainability is achieved through the protection and effective management of natural resources; economic sustainability is attained by a mix of occupations that provide long-term and stable incomes; and social sustainability is ensured by means of active community participation and a strong civil society (Goodland 1995).

Sustainable agriculture includes a dynamic set of practices and technologies that minimize damage to the environment while providing income to the farmer over a long time (Flora 1992). Although some scientists may consider sustainable agriculture as low-input agriculture, the assumption is unfair because sustainable agricultural systems use "the best available technology" in a balanced, well-managed, and environmentally responsible manner (Hess 1991). The operational goals of sustainable agriculture, as stated by Benbrook (1991), are as follows: "(1) More thorough incorporation of natural processes such as nutrient cycling, nitrogen fixation, and beneficial pest–predator relationships into the agricultural production process; (2) reduction in the use of off-farm inputs with the greatest potential to harm the environment or the health of farmers and consumers; (3) productive use of the biological and genetic potential of plant and animal species; (4) improvement in the match between cropping patterns and the productive potential and physical limitations of agricultural lands; and (5) profitable and efficient production with emphasis on improved farm management, prevention of animal diseases, optimal integration of livestock and cropping enterprises, and conservation of soil, water, energy, and biological resources." As these goals indicate the environmental and ecological dimensions of sustainable agriculture, those who ultimately benefit from the achievement of these goals are farmers and rural people. Therefore, sustainable agricultural practices that will lead farmers and rural people to achieve these goals must also provide long-term economic benefits and be socially attainable (Pugliese 2001).

In many developing countries, agriculture plays a vital role in the economy, and sustainability in the agricultural sector must address the issues of poverty alleviation, food security, and stable income generation for a rapidly growing population (Lee 2005; Bhutto and Bazmi 2007). In Turkey also, agriculture has traditionally been one of the most important sectors: in 2005, it accounted for 12% of the gross national product (GNP) and 9% of the total exports and provided employment opportunities to about 35% of the total population, which lives in rural areas and generates income from agriculture and other

rural livelihoods (TSA 2007). Although agriculture plays a vital role in the economy, there have been concerns about the ability of the sector to alleviate rural poverty and to provide food security as well as stable incomes to farmers and other rural people. These concerns have been raised because the farming environment and rural areas have faced unprecedented environmental problems over at least the last two decades. The high rate of population growth has put more pressure on agricultural land and the natural resource base, resulting in smaller farms and conversion of rangelands into farm lands and, in turn, in environmental problems and poverty. Thus, sustainable agricultural development should be considered as a developmental strategy to combat both poverty and environmental degradation in Turkey. The most serious obstacles to this goal are probably erosion and desertification, which drastically lower soil productivity because of the loss of plant nutrients and water and degradation of land (Jordan et al. 2002; Tanrıvermiş 2003). According to the Ministry of Environment and Forestry (MEF), the risk of erosion is severe in 63% of the total area, moderate in 20%, and low in 14%—only 3% of the total area, which mostly consists of rocky surfaces, is free from such risk. The extent of damage from erosion in Turkey is 12 times more than that in Europe and 17 times more than that in Africa; 500 million tons of productive soil is lost every year (MEF 2007).

Kahramanmaras is one of the most productive agricultural areas of the north-eastern Mediterranean region of Turkey. The 357,560 ha of agricultural land in the province accounts for approximately 2% of Turkey's total cultivated area. Red pepper, cotton, wheat, sunflower, and a large variety of vegetables and fruit can be grown economically in the province (Boz et al. 2005). However, Kahramanmaras, like the rest of Turkey, suffers greatly from erosion and desertification. "The main causes of erosion in the district can be identified as water, including irrigation run-off, wind and the direct effect of tillage. All of these processes are accelerated by agriculture and facilitated by steep terrain and fragile vegetative cover, creating problems such as poor soil quality, a major constraint in the realization of sustainable land use" (Jordan et al. 2002). Unsustainable land use will probably diminish the quality and quantity of farm production, which will jeopardize the nutrition and well-being of future generations in the province.

To ensure environmental, economic, and social sustainability, farmers must adopt different farm-level practices such as judicious use of chemicals, integrated pest management, adequate irrigation, and proper care of plant and animal health. Especially, the relationship between pest sellers and farmers behavior about the proper use of pesticides is very important. In a research conducted by Aktas (2001), the place of pest sellers in the agricultural extension system was investigated and it was found that at the macro level there is a lack of law and regulations which will direct the optimal use of chemicals and pesticides. At the micro level the study concluded that most of the pest sellers are lack of information and experiences about plant protection and pesticides, a 25% of the pest sellers underestimate farmers' knowledge and experiences on this issue, as well as, some farmers have no trust on pest sellers' recommendations. In addition, the study found that earning more profit for pest sellers is more important than providing proper information to farmers. Since there is no strict law on judicious use of pesticides, some pest sellers may take advantage of this situation and try to sell unnecessary pesticides which are really not needed by farmers. As long as this is the situation with pest sellers and private companies which provide inputs to agricultural sector, we decided that farmers' seeking information from public agricultural extension service would be a better indicator for their perceptions on sustainable use of agricultural resources.

Soil pollution in the locality is basically caused by improper use of farm machinery, improper use of chemical fertilizers and pesticides, improper irrigation and lack of modern

irrigation systems such as trickle and drip irrigation, deforestation, early and excessive gazing of range lands, and farm land being used for housing and industrialization purposes (Bahcesel.Com 2008). Either because of farmers' lack of information about taking adequate measurements for soil pollution or lack of law and regulations to control farmers' behaviors on this issue, the causes of soil pollution are still in process.

Although the Ministry of Agriculture and Rural Affairs (MARA) has been promoting such farm-level sustainable agricultural practices, research on the importance that farmers attach to these practices and on the factors that influence their judgment has been lacking. If farmers are to adopt sustainable agricultural practices, the farmers first need to believe that the practices are important, provide a safe rural environment, and will bring in stable and long-term income. Therefore, measuring farmers' perceptions and studying the socio-economic characteristics and information-seeking behavior that influence those perceptions should be the preliminary step in developing extension programs to promote sustainability among farmers and rural population. The present study was intended to be such a step.

The objectives of the study were as follows:

(a) to measure the importance that farmers accord to each of the selected sustainable agricultural practices,
(b) to describe the socio-economic characteristics and information-seeking behavior of the farmers, and
(c) to determine the extent to which selected socio-economic characteristics and information-seeking behavior influence the importance the farmers attach to sustainable agriculture.

Many studies have focused on measuring farmers' perceptions of the importance of different aspects of farming. The International Institute for Tropical Agriculture (Annual Report 1997), in collaboration with Nigeria's Institute of Agricultural Research, measured farmers' perceptions of soil degradation in northern Guinea savanna of Nigeria and found that proper management of resources, good planning, and hard work are commonly perceived as distinguishing features of better farmers. Mulder (2000) measured soil fertility in Antagora region of Benin, using Janssen's et al. (1990) quantitative evaluation of fertility in tropical soils (QUEFTS) model and compared the results with farmers' perceptions. The study found that the QUEFTS's model tended to overestimate the yields, indicating the need for a more general model that takes into account other inputs. Rao and Hall (2003) measured how Indian farmers perceive the fodder quality of coarse cereals and found that farmers perceived local varieties as giving higher grain and straw yields despite low rainfall and therefore considered the adoption of new varieties in low-rainfall years risky. Rahman (2003) found that farmers in Bangladesh believe that modern agricultural technology has such adverse environmental impacts as lower soil fertility, ill health, reduced fish catch, and greater incidence of diseases in crops.

Different indicators have been constructed to measure farm-level sustainability focusing on different aspects of farming. Taylor et al. (1993) constructed a farm-level sustainable agricultural indicator for use on Malaysian farms, which took into account such aspects as pest control, management of soil fertility, and control of soil erosion. Another farm-level sustainability indicator was developed by Gomez et al. (1996) in the Philippines, which took into account yield, profit, frequency of crop failure, soil depth, organic matter, and permanent ground cover. Drost (1998) assessed sustainable agriculture among Utah's vegetable growers by developing a perception and farming index, which included farming practices related to integrated pest management, nutrient management, and field operations. Smith et al. (2000) constructed a threat identification model for assessing the

sustainability of agricultural land management at the level of a unit of land area, identifying a number of land management practices. A farm-level index similar to that developed by Taylor et al. was constructed by Rigby et al. (2001) in the UK, which measured sustainability in terms of seed sources, pest control, maintenance of soil fertility, and crop management.

Being the first study in Turkey to measure farmers' perceptions of sustainability in quantitative terms, the present study differs from the earlier studies in two aspects. First, the majority of farms in Turkey follow a mixed crop-livestock system, which provides many benefits for the farmer, such as a diversity of sources of income, reduced risk, and more evenly distributed work over the year. As long as such a mixed farming system is dominant, any indicator of sustainable agriculture must include items from both crop production and livestock production, and this study is intended to fulfill this requirement. Secondly, farm enterprises in Turkey are mostly family businesses; they are not isolated from the rural environment (Inan 2006). The majority of farms in the region in which this research was conducted are also of this type and their access to natural resources is not limited only to their own properties but extends to state-owned rangelands, bushes, and forests. Although farmers do not own these resources, they have some legal rights to utilize them to some extent. Since these are common lands, their protection and development must be taken care of by the farmers who live close to them. However, the use of such common assets is not governed by strict laws, nor are penalties for excessive use stringent enough. Proper use thus largely depends on the sensitivity to public opinion, and this may vary from person to person. Therefore, the index developed in this study includes items related not only to farming practices but also to conservation of publicly owned natural resources in rural areas.

Previous studies showed that in order to alleviate poverty and attain sustainable use of natural resources, developing countries must control soil erosion and land degradation, proper use of fertilizers and pesticides, and invest in agricultural research and extension services (Bhutto and Bazmi 2007). Either lack of governmental funds or farmers perceptions on modern agricultural technologies as it appeared in Rao and Hall (2003) study in India and Rahman (2003) study in Bangladesh, make it difficult for government agencies to reduce poverty and provide sustainability in agricultural sector.

In designing process of this study, we first investigate environmental, social, and economic dimensions of farming and rural environment in the research area. High level erosion and desertification in Jordan et al. (2002) study and also in MEF (2007) reports, farm land being used for housing and industrialization purposes in Tanrıvermiş (2003) study, and reducing livestock numbers and fodder cropping areas in Boz et al. (2005) and Ozturk (1999) studies were the basic concerns which threat agricultural resources and rural livelihoods. Then we decided on what kind of farming practices farmers must adopt in the region to provide sustainable use of these resources. In this stage, we extensively used the Taylor et al. (1993), Hansen (1996), Gomez et al. (1996), Drost (1998), Smith et al. (2000), Mulder (2000), Rigby et al. (2001), Rahman (2003), and Boz et al. (2005) studies, especially in selecting sustainable agricultural practices which are consistent with environmental social and economic dimension of farming in the region.

Determining the best available sustainable agricultural practices and promoting them to farmers may not result in adoption because of lack of information about farmers' perceptions. First, farmers must perceive that the promoted practice is useful and it can be applied in their own situations. So, we first intend to measure farmers' perceptions on selected sustainable agricultural practices and then the extent to which various socioeconomic factors and information seeking behavior influencing their perceptions.

2 Materials and methods

The main source of data for the study was the questionnaire completed by 208 participants who practiced farming in four districts of Kahramanmaras province, namely the central district and Pazarcik, Elbistan, and Turkoglu districts. The methods of sampling and data collection and data analyses procedures are described below. The target population was defined as farm operators in the central district and the three surrounding districts. The accessible population of this study was determined by using the method described by Boz et al. (2005) and lists of farmers in 12 predetermined villages were obtained from researchers. The villages were selected based on their agricultural potential, location, population density, and the extent to which they represented the socio-economic characteristics of rural life in the region. To determine the optimal size of the sample from the accessible population for this study, the formula developed by Yamane (2001) for stratified samples was used. Based on the frequency distribution by size of the farm in the accessible population, three strata were demarcated, namely 1–50 decares, 51–150 decares, and more than 150 decares. To reduce the variance and draw a more representative sample, very large farms were excluded from the sampling procedure. The sampling formula is given below:

$$n = \frac{N\sum N_h S_h^2}{N^2 D^2 + \sum N_h S_h^2} \qquad D^2 = \frac{e^2}{t^2}$$

where n = optimum sample size, N = accessible population, Nh = number of people in a stratum, Sh = standard deviation within a stratum, D^2 = desired variance, e = accepted error from the mean, and $t = t$ value corresponding the accepted confidence interval. Accepting a 5% error from the mean (e) and a 95% confidence interval ($t = 1.645$), the minimum sample size arrived at was 208. This number was proportionally distributed among the three strata and respondents were selected randomly from each stratum. The location of Kahramanmaras is showed in Fig. 1 (CIA 2008).

Fig. 1 Map of Turkey. Kahramanmaras, where this research is conducted is located in the Eastern Mediterranian Region of Turkey. *Source*: CIA 2008. The Word Fact Book

The questionnaires were completed by visiting the farms as well as by meeting with the farmers in coffee shops and in the fields. Those who could not be reached were replaced with others within the same stratum. It took 15–20 min to complete one questionnaire.

Data collection was completed by administering a two-section instrument. The first section, which was meant to assess the farmers' perceptions, comprised a list of 21 practices related to sustainable agriculture compiled after taking into account earlier work by Taylor et al. (1993), Hansen (1996), Gomez et al. (1996), Drost (1998), Drost et al. (1997), Smith et al. (2000), Mulder (2000), Rigby et al. (2001), Rahman (2003), and Boz et al. (2005) and also the socio-economic, political, and environmental conditions of farming in the region. All the items were assumed to be useful practices for sustainable use of agricultural lands and the state-owned but publicly utilized natural resources in rural areas. The respondents were asked to rank each item on a 5-point Likert-type scale: 1 = No importance, 2 = Low importance, 3 = Moderate importance, 4 = High importance, and 5 = Very high importance. Each item in the index was properly worded to correspond with the Likert-type responses. For example, one of the sustainable agricultural items in the index was "leaving the farm to one heir only" to prevent land division. The question for this item was phrased as follows: "To provide a long-term sustainable agricultural and rural environment for the future generations, what is the importance level of leaving your farmland to only one of your children?" Responses falling in the "very high importance" category and those closer to it were taken to reflect greater concern about land division and fragmentation; accordingly, for this item, these respondents were assumed to attach greater importance to sustainability. If a respondent assigned the maximum rating of 5 to every practice, he or she was assumed to have the highest perception of sustainability ($5 \times 21 = 105$); on the other hand, if a respondent assigned the minimum rating of 1 to every practice, he or she was assumed to have the lowest perception of sustainability ($1 \times 21 = 21$). Therefore, the dependent variable in the study could take any value between 21 and 105.

The second section of the questionnaire consisted of questions that sought information on the socio-economic characteristics and information-seeking behavior of the respondents. The socio-economic characteristics were as follows: the farming system, age, education, income, farm size, extent of irrigated land, ownership status, mechanization (whether the farmer owned a tractor), use of credit, membership of a cooperative society, and participation in village administration. To assess the information-seeking behavior, the following variables were employed: reading a newspaper, listening to the radio, watching the television, accessing the Internet, traveling to the nearest town, participating in any agricultural event, and interacting with agricultural extension personnel. Of all these variables, age, farm size, and the extent of irrigated land were measured as continuous variables while the rest were treated as categories. For the purpose of the study, dummies were created for all of the variables.

The variables were selected based on the generalizations about adopter categories described by Rogers (2003) as well as earlier studies conducted in the region. These variables are commonly used by many researchers to compare or to study the influence of different factors on some behavior of a specific group of people (Boz and Akbay 2005).

A panel of experts validated the data collection instrument. The questionnaire was pretested and revised as appropriate to establish its reliability. To confirm the reliability for the Likert-type items in the index, Cronbach's Alpha internal consistency coefficient was calculated from the data collected. The value of the coefficient was 0.87. The data were collected in November and December 2005. SPSS version 11.5 (2002) was used for data analyses.

Descriptive statistics including the means and standard deviations were used to accomplish the first two objectives of the study. For the first objective, an interpretive scale was developed with the means 1.00–1.49 = No importance (NI), 1.50–2.49 = Low importance (LI), 2.50–3.49 = Moderate importance (MI), 3.50–4.49 = High importance (HI), and 4.50–5.00 = Very high importance (VHI). For the second objective, the means and standard deviations were used to describe the farmers' socio-economic characteristics and information-seeking behavior. The stepwise regression analysis procedure was used to accomplish the third objective of the study. The dependent variable was calculated by adding up the farmers' responses to the 21-item and 5-point Likert-type scale, which sought to measure the farmers' perception of sustainability, and this was treated as a continuous variable. The independent variables were entered in the model as described in Table 2.

3 Results and discussion

Table 1 presents the importance the farmers attach to each of the selected sustainable agricultural practices (Objective 1). Based on the interpretive scale described above, 5 items were placed in the high-importance (HI) category, 11 items in the medium-importance (MI) category, and 5 in the low-importance (LI) category. No practice was rated to be of either very high importance (VHI) or no importance (NI). The 5 practices placed in the

Table 1 Perceived importance of selected sustainable agricultural practices

Rank	Sustainable agricultural practice	Mean	SD	Category
1	Leaving the farm to one heir only	3.89	1.39	HI
2	Long-term crop rotation	3.85	1.27	HI
3	Not burning residues after harvest	3.68	1.35	HI
4	Proper care of animal health	3.62	1.18	HI
5	Personal involvement in commodity marketing	3.53	1.41	HI
6	Avoiding early and excessive grazing of rangelands	3.42	1.36	MI
7	Protective measures for pastures and meadows	3.26	1.45	MI
8	Proper irrigation	3.24	1.47	MI
9	Proper use of pesticides	3.23	1.62	MI
10	Owning adequate farm machinery	3.21	1.49	MI
11	Reforestation of less advantaged farm environment	3.06	1.44	MI
12	Proper use of chemical fertilizers	3.01	1.61	MI
13	Enlarging farm by buying more land	2.98	1.59	MI
14	Using animal manure	2.86	1.58	MI
15	Not using fallow	2.78	1.47	MI
16	Taking adequate measures to control soil erosion	2.68	1.58	MI
17	Using legume crops in rotation	2.39	1.49	LI
18	Pasture grazing rotation	2.38	1.41	LI
19	Proper use of energy sources in agriculture	2.15	1.42	LI
20	Growing cover crops	1.99	1.20	LI
21	Conducting soil test	1.95	1.19	LI
	Overall index (min. = 38, max. = 79)	59.58	8.24	

HI category were as follows: "living the farm to one heir only", "long-term crop rotation", "not burning the residues after harvest", "proper care of animal health", and "personal involvement in crop and animal products' marketing". The 3 practices placed in the LI category were "proper use of energy sources in agriculture", "using cover crops", and "conducting soil test".

"Leaving the farm to one heir only" was considered the most important practice related to sustainable agriculture in the region. Because of the law that makes equal distribution of inheritance mandatory (Turkish Civil Code 2005), farmland is required to be divided equally among the heirs unless the owner transfers its rights to only one of the heirs. This is of course not an easy task given that there are few employment opportunities other than agriculture available to people in the farm sector. Lack of higher education and specialized skills and of capital makes it more difficult for farmers to find employment other than agriculture or to start an agribusiness on their own. These socio-economic and judicial conditions, combined with the annual growth rate of 1.6% in the population, will force the farm population to survive on progressively smaller and fragmented farmland in the foreseeable future.

Long-term crop rotation was ranked as the second important indicator of sustainable agriculture. A well-planned crop rotation improves soil fertility and soil tilth. This is covered under tilth, facilitates soil water management, and reduces pest problems, soil erosion, and allelopathic or phytotxic effects (Peel 1998) besides significantly increasing the long-term productivity of soil. The farmers stressed that crop rotation in a mixed farming system (crop-livestock) is regarded as a mechanism to reduce economic risk. If forage crops are included in crop rotation, they not only increase the yield of the main crops but also make significant contributions to livestock production, which enables farmers to earn a more stable income during the year. Long-term crop rotation also provides a variety of foodstuffs for household consumption.

Burning crop residues after the harvest is a common problem in rural Turkey. Although it is prohibited by law (Republic of Turkey Official Journal 1998), many farmers, especially those who live in areas of dry climate in western, central, eastern, and south-eastern Anatolian regions, burn the residues in their fields because it is easier—and more energy-efficient—to do so. Some farmers believe that burned fields require less labor and gasoline. However, modern agriculture does not consider that burning residues is useful: the fire kills many beneficial soil microorganisms, lowers organic matter and yields, reduces soil infiltration capacity, and promotes soil erosion (Suzer 2002). It is often hard to control or put out the fire, particularly when the weather is windy. Uncontrolled fire causes serious environmental problems. Fortunately, not burning the residues after harvest was placed in the HI category, a rating that marks the practice as an important indicator of sustainable agriculture. Both legal restrictions and awareness on part of the farmers may curb the practice in the future.

Proper care of animal health was ranked fourth in the order of importance. Livestock systems in the region are numerous and diverse, although some common features can be recognized. Small livestock is the predominant component, with farmers cultivating only a few crops. A large proportion of livestock is supervised by roaming shepherds, who graze the animals for cotton farmers, and individuals working in other sectors of the economy (Jordan et al. 2002).

Livestock contributes to the economy in many ways. Consumption of animal products is closely related to the development level of a country. Availability of meat in most countries is particularly closely related to the economic status of their people and the level of their agricultural technology (Taylor 1995). In Turkey, livestock production accounts for

approximately 23% of total agricultural production in monetary terms. The sector contributes to ensuring a balanced diet for the population and, as a supplier of raw material, is a driving force behind the growing textile and leather industries (Yurdakul et al. 1999). From the standpoint of sustainability, livestock provides manure, enables farmers to grow fodder and cover crops on land unsuitable for other crops, increases labor productivity, and lowers financial risks (Duzguneş and Eliçin 1986). However, some respondents stressed that small livestock, especially goats in mountainous areas, damage the environment. Unplanned and uncontrolled grazing in newly planted and young forests and publicly owned rangelands makes it impossible for any reforestation or amelioration effort to succeed. Since demand for goat milk is high, producers are reluctant to give up goat farming. Therefore, small livestock in the region will continue to contribute to deforestation and erosion.

Personal involvement in commodity marketing is the last item in the HI category. The main source of income in the region is cotton, followed by wheat, maize, red pepper, fresh fruit and vegetables, and livestock. The farmers sell their produce either to merchants or to the government in more or less equal proportion—the difference lies in terms of payment: the merchants usually pay promptly but offer a slightly lower price whereas the government, although it offers a higher price, buys on credit (Jordan et al. 2002). The principal purchaser of red pepper, fresh fruit and vegetables, and animals for slaughter is the retail trade, which buys through wholesale dealers from the local market. Such trade reduces the producers' profits. If producers set up marketing cooperatives, they can sell to the final consumers directly, which will ultimately increase their income. Therefore, personal involvement in marketing will contribute to the sustainability of agriculture in rural areas. For this reason, farmers need to be encouraged—even supported—to establish marketing cooperatives.

The explanation for the choice of these five practices for the HI category lies in the farmers' level of production, the farming system, and income-generating capacity of the farms. For example, the respondents rated the practice of leaving the farm to one heir only as very important for sustainability because they believed that continued subdivision and fragmentation of land will decrease sustainability, particularly by lowering incomes in rural areas. On the other hand, using legumes in a rotation, rotational grazing in pastures, and growing cover crops rated low probably because these practices are new. The farmers may regard any new practice as risky and less productive; also, their attitudes and beliefs make it difficult for them to adopt new ideas. For instance, many farmers believe that they use energy efficiently and that know more than an expert does about the kind of fertilizers their soils need; therefore, they do not consider it necessary to have their soils tested—a belief reflected in the lowest rating they assigned to soil testing. This finding of the study is similar with Rao and Hall (2003) study which found that Indian farmers perceived local varieties of coarse cereals give higher grain and straw yields than new varieties; and with Rahman (2003) study which found that farmers in Bangladesh have negative perceptions on modern agricultural technology as reduces the productivity of agricultural resource base.

Table 2 presents descriptions of the socio-economic characteristics and information-seeking behavior of the farmers (Objective 2): 70% of the respondents followed mixed farming systems; the average age was 46 years; 20% had studied beyond elementary school; and 27% had high income. The average farm was 55 decares while the area under irrigation averaged 23 decares. Landowners formed 81% of the respondents; 27% had tractors; 18% used credit for inputs; 14% were members of a cooperative society; and 8% took part in village administration. With regard to their information-seeking behavior, 45%

Table 2 Socio-economic characteristics and information-seeking behavior of respondents

Variables: definition and codes	Variable name	Mean	SD
Independent variables			
Socio-economic characteristics			
Farming system	FARMINGSYST.		
Mixed (crop-livestock) = 1; 0 otherwise		0.70	0.45
Age (Continuous variable)	AGE	45.63	11.84
Younger than 40 = 1; 0 otherwise		0.511	0.501
Education	EDUCATION		
Higher than elementary school = 1; 0 otherwise		0.202	0.402
Income	INCOME		
High income = 1; 0 otherwise		0.27	0.45
Farm size (Continuous variable)	FARM SİZE	55.25	42.25
Larger than 55 decares = 1; 0 otherwise		0.37	0.48
Amount of irrigated land	IRRIGATED LAND	23.24	26.39
Larger than 23 decares = 1; 0 otherwise		0.38	0.50
Ownership of land	LAND		
Own land = 1; 0 otherwise		0.81	0.39
Ownership of a tractor	TRACTOR		
Own a tractor = 1; 0 otherwise		0.27	0.45
Investing in farm	INVESTMENT		
Invested = 1; 0 otherwise		0.20	0.44
Credit use	CREDİT		
Use credit = 1; 0 otherwise		0.18	0.39
Membership of a cooperative	COOP.		
Member = 1; 0 otherwise		0.14	0.35
Participation in village administration	ADM.		
Participate = 1; 0 otherwise		0.08	0.27
Information-seeking behavior			
Reading a newspaper	NEWSPAPER		
Several times a month = 1; 0 less frequently		0.45	0.49
Listening to the radio	RADIOUSE		
At least 5 h a week = 1; 0 otherwise		0.54	0.49
Watching TV	Tv.USE		
At least 5 h a week = 1; 0 otherwise		0.89	0.30
Use of the Internet	INTERNET		
At least 1 h a week = 1; 0 otherwise		0.06	0.24
Traveling to the nearest town	TRAVELS		
At least once a week = 1; 0 otherwise		0.57	0.49
Participating in farming events	EVENTS		
Yes = 1; 0 otherwise		0.07	0.27
Contacting extension services	EXTCONT		
At least once a month = 1; 0 otherwise		0.24	0.42
Dependent variable	INDEX		
Sustainability index (min. = 38, max. = 79)		59.58	8.25

of the respondents read newspapers several times a month; 54% listened to the radio for at least 5 h a week; 89% watched television for at least 5 h a week; 6% used the Internet for at least 1 h a week; 57% traveled to the nearest town at least once a week; 7% participated in farm events such as conferences, meetings, or field days; and 24% contacted the agricultural extension service at least once a month.

Table 3 presents the extent to which selected socio-economic characteristics and information-seeking behavior influence the farmers' perceptions of the importance of sustainable practices (Objective 3). This objective was accomplished using multiple regression analysis. The dependent variable (sustainability index) took the values from 38 to 79 (Table 2). The other variables were treated as independent variables and stepwise entry of the variables was used because of the explanatory nature of this part of the study. In the equation, variables were added that increased the explained variance by 1% or more as long as the regression model remained significant.

Table 3 Results of multiple regression analysis

Source of variation	Degrees of freedom	Sum of squares	Mean square	*F*-Ratio	*P*-Value
Regression	8531.583	7	1218.789	44.119	<0.001
Residual	5525.027	200	27.625		
Total	14056.611	207			

Variables in the equation

Variables	R^2 Cumulative	R^2 Change	*F* Change	*P* Change	Beta
Extension contacts	0.261	0.261	72.645	<.01	0.351
Ownership of land	0.439	0.179	65.313	<.01	0.285
Farming system	0.518	0.079	33.332	<.01	0.254
Education	0.557	0.039	17.912	<.01	0.153
Farming events	0.582	0.025	12.220	<.01	0.161
Reading printed material	0.597	0.014	7.203	<.01	0.133
Investment	0.607	0.010	5.129	.025	0.106

Variables not in the equation

Variables	Beta	*t*	Sig-*t*
Age	−0.023	−0.508	0.612
Cooperative membership	−0.002	−0.034	0.973
Participation in village administration	−0.002	−0.041	0.967
Farm size	0.037	0.816	0.415
Extent of irrigated land	−0.051	−1.092	0.276
Income	0.049	1.026	0.306
Tractor ownership	−0.077	−1.684	0.094
Agricultural investments	0.020	0.409	0.683
Listening to the radio	−0.005	−0.098	0.922
Watching the TV	−0.044	−0.920	0.359
Using the Internet	−0.057	−1.231	0.220
Traveling to the nearest city	−0.076	−1.675	0.095

The variable that entered the regression model first was "extension contacts." Considered alone, this variable explained 26% of the variance in the sustainability index. The variable that entered the model second was "farm owning status" and explained 18% of the variance. Five additional variables explained additional 17% of the variance in the sustainability index, namely "farming system", "education", "farming events", "reading printed material", and "investment". The seven variables together explained 61% of the variance in the sustainability index among the farmers in the region selected for the study.

Extension contacts was the factor that exercised the greatest influence on the farmers' perceptions of the importance of sustainable agriculture, a finding supported by an earlier study (Boz and Akbay 2005) that explored the factors that influenced adoption of maize in Kahramanmaras. Agricultural extension service in Turkey is run by the Ministry of Agriculture and Rural Affairs (MARA). Every province has a Province Agricultural Directorate and every district, a District Agricultural Directorate. MARA develops and implements many local regional and national programs to promote sustainability in different ways. Recently, it has been a government policy to increase subsidies for growing fodder crops, improving animal production, and adopting recommended sustainable agricultural practices (MARA 2007).

Besides MARA, private entities such as dealers and input providers as well as private veterinarians also provide extension services to farmers. However, the primary purpose of these entities is to increase their profits. Therefore, although private extension services may influence the farmers' perceptions of sustainability, such services were not included in this study; this aspect needs to be a subject of further research.

Ownership of land, the farming system, education, and investing in farm were the four most significant socio-economic variables affecting the farmers' perceptions of the importance of sustainable agricultural practices. Those who cultivate their own land perceive sustainability as more important than those who do not own the land they work on, probably because they do not see farming as a long-term source of income but are ready to give it up as soon as they find a better job in any other sector. Carolan (2005) also found lack of ownership of land to be a barrier to adoption of sustainable agriculture. The type of farming system also turned out to be a significant factor in the study by Boz et al. (2005), who found that farmers who practiced mixed farming (crop-livestock) attached greater importance to sustainability. Education and investment were also found to be significant variables in another study by Boz and Akbay (2005).

Besides contacts with extension staff, participating in farming events such as field days, demonstrations, and workshops and reading printed material such as newspapers, booklets, and farm magazines were the other two information-seeking activities of the farmers that influenced their perceptions of sustainability. Along with extension contacts, these two variables may also indicate that farmers who use these channels of communication more than the other channels or other farmers receive more information about sustainability, which is likely to make them more favorably disposed toward sustainable agriculture.

4 Conclusions and recommendations

From the findings of this study, it can be said that the importance that the farmers attached to the 21 useful sustainable agricultural practices was influenced by their current farming system, their experiences, and their attitudes and beliefs toward change. For instance, if some practices are new to their current farming system and entail changes, farmers may perceive these practices as risky and will not consider them important. However, such

perceptions may change from farmer to farmer and may be influenced by the personality of the farmer and his or her socio-economic and socio-cultural characteristics.

The overall index score for a farmer should measure his or her perception of sustainability. However, the score does not predict whether farmers will actually adopt these practices themselves, and further research is needed to find out if they are likely to do so. Additional research is also needed to find out the measures the farmers are likely to adopt to protect publicly owned natural resources and to determine the characteristics of farmers that promote or hinder the adoption of sustainable agriculture.

A finding of this study that raises a major concern is land division and fragmentation. To prevent land division and fragmentation, landowners need to leave their farms to only one of their heirs—the one who is committed and willing to continue farming. At the same time, the government's macroeconomic policies need to play an important role in encouraging industrial investments that can attract unemployed labor from the farm sector. Rural livelihoods other than farming need also be encouraged and even supported; if not, the increasing pressure on land as the sole means of livelihood for the growing population will threaten the sustainability of agriculture.

Of the socio-economic characteristics, ownership of the land turns out to be the most significant factor. It is only natural that farmers will take greater care of their own property. Unless formal agreements are in place, tenant farmers or sharecroppers may not be willing to adopt sustainable agricultural practices that may reduce their income: for example, they may not want to limit the use of chemicals and fertilizers or they may exploit publicly owned grazing land beyond its carrying capacity because, not being permanent residents, they have no permanent stake in such a resource. On the contrary, their aim is likely to be to maximize profits as quickly as possible—and move on. The perspective of landowners is very different: they are the permanent residents, and their welfare is tied to long-term sustainability of the land; if they fail to manage the natural resources sustainably, their future generations will have a hard time meeting their own needs.

Any government policy that seeks to promote sustainability should offer incentives to farmers to own the land they till, to raise livestock, to invest more on farming, and to use natural resources sustainably. Formal and informal education is also necessary to increase public awareness of sustainability.

The Division of Farmers Education and Extension of MARA is the only public institution that provides advice on sustainable agriculture to farmers. The findings of this study prove that as MARA's extension services reach more farmers in rural areas, especially those who are hard to reach, and as more farmers attend farming events, farmers' perceptions of the importance of sustainability will go up. Consequently, the farmers are more likely to be sensitive to the need to protect and maintain their land as well as publicly owned natural resources.

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