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Identifying Factors Driving US Citizens' Preferences about Multifunctional Agriculture

Wanki Moon
Department of Agribusiness Economics
Southern Illinois University
Carbondale, IL 62901
(Tel) 618-453-6741
(Email) wmoon@siu.edu

Jae Bong Chang
Department of Food and Resource Economics
Yeungnam University
Gyeongsan, Korea
jbchang@yu.ac.kr

Jebaraj Asirvatham
Department of Agribusiness Economics
Southern Illinois University
Carbondale, IL 62901
jebaraj@siu.edu

Abstract

This paper examines US citizens' preferences about the notion of multifunctional agriculture using survey data collected by the Ipsos-Observer in 2007. The survey provided a box of information about multifunctional roles of US agriculture to respondents and sought to measure their attitudes and perceptions about various components of multifunctional agriculture. Data analysis showed that considerable segment of US citizens agreed that US agriculture produces an array of nonmarket goods and services in addition to marketed commodities. In particular, US citizens rated national food security as the most important multifunctional role of US agriculture when compared to cultural heritage, farmland amenities, or vitality of rural communities. Regression analysis demonstrates that perceptions about environmental services and national food security make the strongest contribution to explaining US citizens' attitudes toward multifunctional agriculture.

Key words: multifunctional agriculture, food security, US agriculture.

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1. Introduction

The concept of multifunctional agriculture has emerged in the 1990s as a framework/narrative playing a perceptible role in shaping WTO multilateral trade liberalization talks and farm policy-making processes in developed countries (Potter, 2006; Potter and Tilzey, 2005). Multifunctional agriculture refers to nonmarket goods and services that agriculture produces with varying degrees of jointness with either farm outputs or farm/rural landscapes. Such nonmarket goods and services typically include national food security, rural amenities, recreational opportunities, cultural heritage, viability of rural communities, and a broad range of ecosystem services encompassing nutrient recycling, carbon sink, or groundwater recharge (Batie, 2003; Abler, 2004). Although suspected of disguised protectionism by the proponents of market-oriented reforms, the concept has gained considerable legitimacy during the Uruguay Round talks and subsequent international conferences hosted by the FAO, the WTO, and the OECD in the late 1990s and early 2000s (Swinbank, 2001; OECD, 2003; Sakuyama, 2005).

Given the wide recognition by the major international organizations shaping the global order of agriculture, researchers have examined multifunctional agriculture from diverse disciplines and perspectives such as Economics, Law, Ecology, Sociology, Political Economy, and Geography (e.g., Smith, 2000; Potter and Tilzey, 2007; Potter and Burney, 2002; Losch, 2004; Boody et al 2005). In particular, research from the economics perspective examined a sequence of issues that should be resolved prior to operationalizing the notion of multifunctional agriculture to designing WTO trade rules: (i) identifying particular types of multifunctional goods and services on specific geographic scopes (Lee, Paarlberg, and Bredahl, 2005), (ii) measuring nonmarket values based on local, regional or national preferences (Randall, 2002;

Hall et al 2004; Moon and Griffith, 2011), (iii) evaluating the degree of joint production relationship with either market commodities or farm/rural lands (Abler, 2001; Havlik et all, 2005), (iv) assessing whether market failures are involved (i.e., whether underprovided), and (v) measuring transaction costs associated with policies specifically targeted at promoting the production of multifunctional goods and services (Romstad, 2000; Vatn, 2001; Vatn, 2002). While the five issues above are interconnected with each other, the first two issues are largely concerned with the general public's (consumers or taxpayers) preferences and the latter three issues deal with supply/production side and policy instrument choice problems.

The first two issues are important as preconditions needed for advancing knowledge on the latter three steps and for an eventual implementation of the concept to harmonizing WTO trade rules in practice. Nevertheless, there are considerable disagreements/controversies on what to accept as legitimate components of multifunctional agriculture among researchers, policy-makers and trade negotiators, hampering the discussion from moving forward ((Randall, 2002; Benett, Bueren and Whitten, 2004; Hall et al, 2004; Bergstrom and Ready, 2009; Maudureira, Rambonilaza, and Karpinski, 2007). The disagreements are especially pronounced across countries/regions as has been revealed through the failures of successive Doha ministerial meetings to converge on the issues among various groups such as the G20, G33, G10, G90, the US, and the EU (Moon, 2015).

This paper aims at making a contribution to the literature addressing consumers/taxpayers' preferences particularly from the US perspective. Specifically, this paper examines US citizens' attitudes toward the notion of multifunctional agriculture (i.e., what they think of the notion of multifunctional agriculture) and their perceptions about the relative importance of various types of multifunctional goods (i.e., what specific components of

multifunctional agriculture do they value). Subsequently, the paper develops regression models linking US citizens' overall attitudes toward multifunctional agriculture to perceived attributes of multifunctional agriculture, and measure their relative importance in explaining the variations in the attitudes toward multifunctional agriculture. In this study, we pose seven attributes of multifunctional goods and services including national food security, ecosystem services, farmland amenities, cultural heritage, recreational opportunities, wildlife habitat, and viabilities of rural economies.

2. Relevance of Public Preferences in Research on Multifunctional Agriculture

The multifunctional roles of agriculture were officially recognized by the Uruguay Round Agreement on Agriculture (AoA) as manifested in its Preamble stating

> "Commitments under the reform programme should be made in an equitable way among all Members, having regard to NTC (Nontrade Concerns), including food security and the need to protect the environment; having regard to the agreement that special and differential treatment for developing countries is an integral element of the negotiations."

The rise of the concept of multifunctional agriculture induced the GATT/WTO to devise the so called 'traffic light box system' (green, blue, and amber boxes) that distinguishes agricultural policies and subsidies based on two criteria: (i) whether or not they distort trade patterns and (ii) whether or not they are targeted at supporting the multifunctional roles of agriculture. The box system is designed to permit countries to foster the supply of nonmarket goods and services of agriculture while ensuring that such support is decoupled from production decisions, thereby minimizing trade distortion.

This creative device gave rise to the now widely used terms like decoupling, targeting, direct payments, and cross-compliances (Potter and Barney, 2002), laying the groundwork for accomplishing the following three goals simultaneously: (i) reduced farm subsidies in

industrialized countries and reduced trade barriers in the developing world, (ii) liberalized agricultural trade, and (iii) permitting each country to pursue its own goals with respect to multifunctional agriculture. The Doha Round was launched with the specific mandate of advancing the three goals. With respect to the multifunctional roles of agriculture, the Doha Round regarded it as an important issue to be negotiated as stated in the Doha Declaration,

> "We take note of the non-trade concerns reflected in the negotiating proposals submitted by Members and confirm that non-trade concerns will be taken into account in the negotiations as provided for in the Agreement on Agriculture"

Yet, the Doha Round officially broke down in 2008 due to disagreements between developed and developing countries and also within each group on the size of reduction in trade-distorting subsidies and on issues largely related to the multifunctional roles of agriculture (i.e., whether to abolish the blue box; whether to expand the scope of the green box; and to what extent to allow policy instruments for sensitive and special products (Josling, 2004; Anania and Bureau, 2005; Blandford and Boisvert, 2005).

In particular, developed countries were concerned about *import-sensitive products* that are more susceptible to competition from foreign countries, while developing countries were insisting that *special products* should be exempt from reduction requirements in protection because of their importance in development, food security, and rural livelihood. In general, proponents of agricultural multifunctionality (mostly developed countries) argue that the scope of the green box needs to be expanded to accommodate production-linked subsidies; opponents (largely middle-income developing countries) contend that the current green box is either overused or abused as a disguised protectionism; and yet another group of countries (food insecure developing countries) advocate for the creation of Developing/Food Security Box

comparable to the Green Box. The debate illustrates the wide divergence in the way the notion of multifunctional agriculture is perceived across countries (Moon, 2015).

The upshot is that the lack of clear guidelines regarding what multifunctional roles of agriculture to consider in designing trade rules is hampering multilateral trade talks from progressing beyond the URAA (Lim, 2005; Schoenbaum, 2005; Moon, 2010). In practice, the determination of such guidelines would be affected by various forces such as international politics through international organizations (the WTO), domestic political economy (interest groups' lobbying), and national strategic goals about the agricultural sector. In addition, in an economy in which resource allocations are primarily determined by market forces, consumers/taxpayers/voters' preferences should play a substantive role in shaping the guidelines on multifunctional agriculture. Indeed, theoretical and empirical research on measuring public preferences and demand for multifunctional agriculture have been growing steadily in developed countries over the last decades. They, however, fall far short of being able to provide confirmative answers to the question of what types of nonmarket goods and services of agriculture should be recognized as legitimate components of multifunctional agriculture, and subsequent questions such as whether or not they are different across countries, and whether the values of multifunctional goods and services identified in each country should be measured at the local, regional or national level (e.g., Randall, 2002; Hellerstein et al, 2003; Bennett et al, 2004; Hall et al, 2004; Hyytia and Kola, 2006; Bergstrom et al, 2010). When there are convergences on such issues, the WTO can advance trade negotiations on the scope of the Green Box, the magnitudes of subsidies allowed for each country, and the types of policy instruments permitted for each type of multifunctional agriculture in each country.

The EU has been at the center of the debate on multifunctional agriculture, strongly advocating for the concept since its inception in the 1990s. Prior to the emergence of the notion of multifunctional agriculture, the EU used the notion of the European Model of Agriculture (EMA) as a conceptual framework in support of agricultural subsidies in the region. Consistent with such a policy environment, the literature on multifunctional agriculture has been extensive in Europe and there exists a large number of published studies reporting the general public's preferences or willingness-to-pay for a wide-range of multifunctional goods and services encompassing agrarian cultural heritage, adequate supply of food, agricultural landscapes, recreational opportunities, social cohesion, biodiversity, soil conservation, and flood control (e.g., Brouwer and Slangen, 1998; Hall et al, 2004; Kallas et al. 2007; Madureira, Rambonilaza, and Karpinski, 2007). Researchers in the US have seldom accepted the term multifunctional agriculture explicitly, but used the term "farmland preservation programs" to represent policies/programs designed to assist farm producers to promote the production of public benefits associated with farmlands. Thus, despite the reluctance to fully embrace the notion of multifunctional agriculture as the EU does, US farm/rural policies and programs recognize that agriculture produces diverse benefits that are not priced in the market (Hellerstein, 2001; Freshwater, 2002; Boody et al, 2005; Bergstrom and Ready, 2009; Dorfman et al, 2009).

Research in the US tends to underline nonmarket goods and services of agriculture such as farmland amenities, open space amenities, recreational and tourism opportunities, ecosystem services (flood prevention; groundwater recharge; nutrient recycling), biodiversity, viable rural communities, and wildlife habitat (Rosenberger and Walsh, 1997; Kline and Wichelns, 1998; Irwin Nickerson and Libby, 2003). Abler (2004) identified negative as well as positive

externalities as presented in Table 1.[1] Building on the prior research, this study considers seven different types of multifunctional goods and services including national food security, ecosystem services, farmland amenities, cultural heritage, recreational opportunities, wildlife habitat, and viabilities of rural economies; examines the general public's perceived importance of them; and estimate the relative importance of such perceptions in determining their overall attitudes toward the notion of multifunctional agriculture.

Table 1 Multifunctional Goods (Bads) and Services

Positive Externalities/Public Goods	**Negative Externalities**
Landscape & Open-space amenities	Eutrophication
Cultural heritage	Sedimentation and turbidity
Rural economic viability	Drinking water contamination
Domestic food security	Odors from livestock operations
Prevention of natural hazards	Animal welfare
Groundwater resource recharge	Irrigation-overuse, salinization
Preservation of biodiversity	Loss of biodiversity
Greenhouse gas sinks	Greenhouse gas emissions

Source: Abler (2004)

3. Survey Design and Administration

Survey instrument was designed to shed light on the general public's perceptions and attitudes about the multifunctional roles of the U.S. agriculture.[2] The final questionnaire was administered as an online survey in June 2008 to a nationally representative web-based household panel maintained by the Ipsos-Observer, a market research/consulting firm specializing in research of consumer behavior on various social issues. The sample was stratified by geographic regions, household income, education, and age in accordance with the

[1] Most countries tightly regulate negative externalities (e.g., emitting air/water pollutants) from nonfarm sectors, while exempting farmers from regulatory restraints (or from paying fines) for negative externalities from agriculture (e.g., chemical run-offs). Rather, developed countries including the US offer monetary incentives (environmental payments) for farmers to voluntarily reduce such negative externalities. .

[2] The full survey instrument is available upon request.

2000 U.S. Census. Questionnaires were emailed to a sub-sample of 5,000 participants of this panel that was representative of the U.S. population. A total of 1,070 consumers completed the online survey within seven days, accounting for a response rate of 24 percent. The on line survey elicited sociodemogprahic information including respondents' age, education, income, household size, geographic region, gender, and ethnic background. The Ipsos-Observer survey discloses demographic information for nonrespondents as well as respondents, thereby facilitating assessment of potential nonresponse bias. Comparison of socio-demographic characteristics between respondents and nonrespondents shows that males were more likely to choose not to respond (62 % vs. 56 %) and whites were slightly more likely to respond to the survey (87 % vs. 80.6). The difference between the survey sample and the analytic sample is less than 7 percentage points and hence may not cause significant bias. Other than these two categories, there are no major discrepancies between respondents and nonrespondents, suggesting that there is little reason to be concerned about potential biases due to systematic nonresponses from particular groups of nonrespondents.

The survey instrument consists of two broad sets of questions. The first set asks respondents to consider the current U.S. agriculture with a particular emphasis on the positive and negative externalities associated with it and the role of USDA farm policies in dealing with them (see the Appendix for the entire information box). The information box concisely characterizes the USDA's policy goals as manifested in its strategic plan framework (USDA, 2008).[3] This strategic plan is directly connected with the preservation of the multifunctional

[3] The strategic framework includes; (i) Enhancing international competitiveness of American agriculture, (ii) Enhancing the competitiveness and sustainability of rural and farm economies, (iii) Supporting increased economic opportunities and improved quality of life in rural America, (iv) Enhancing protection and safety of the Nation's Agriculture and Food supply, (v) Improving the Nation's Nutrition and Health, and (vi) Protecting and enhancing the Nation's Natural Resource Base and Environment

roles of the U.S. agriculture. Given this information box, respondents were posed with two questions intended to measure public attitudes toward the multifunctional roles of agriculture in the US: (i) agriculture produces intangible goods and services that are not traded in markets; and (ii) government should compensate farmers for their supply of such intangible goods and services. Respondents were given a seven-point scale ranging from strongly disagree (=1) to strongly agree (=7). Since the respondents' responses are contingent upon the information box, the results of this study should be interpreted within this context. The second set includes further sets of questions designed to evaluate respondents' perceived rankings/ratings about specific nonmarket goods and services associated with multifunctional agriculture including national food security, cultural heritage, wildlife habitat, recreational opportunities, viable rural economies, farmland amenities. Respondents were asked first to rate the importance of the seven attributes using seven-point scale ranging from strongly disagree to strongly agree, and then to rank them from 1 (most important) to 7 (least important).

4. Data Analysis of US Citizens' Attitudes

This section presents descriptive data analysis that can shed light on US citizens' attitudes toward multifunctional agriculture. Figures 1 and 2 show the distribution of responses to the two attitudinal questions: (i) agriculture produces intangible goods and services that are not traded in markets, and (ii) government should compensate farmers for their supply of such intangible goods and services. A substantial percentage of respondents (64 percent) sided with that statement; while 28 percent were neutral. Less than 8 percent disagreed to some degree that agriculture produces intangible non-tradable benefits. Less than half of the respondents (44.77 percent) expressed agreement with respect to the second question that focuses on the need for

government compensation; nearly 19 percent disagreed; and 36 percent were neutral. Three discrepancies are notable in the distribution of responses between the first and second questions: (i) the percentage of respondents in agreement declines from 64 percent to 45 percent; (ii) the percentage of respondents in disagreement increases from 8 percent to 19 percent; and (iii) the percentage of respondents neither agreeing nor disagreeing increases from 28 percent to 36 percent. Taken together, these results suggest that government involvement, specifically monetary compensation, is a more controversial issue than the concept of multifunctional agriculture itself: i.e., while US citizens may recognize the multifunctional roles of agriculture and see that there are market failures, they may not necessarily be in favor of direct government intervention aimed at correcting such market failures.

Figures 3 through 5 present respondents' relative perceptions about seven specific nonmarket goods and services of multifunctional agriculture. First, figure 3 shows the mean ranking of the importance of the seven attributes of multifunctional agriculture (1=most important; 7=least important). National food security was ranked first with a mean score of 2.1, followed by ecosystem services (3.6), health of rural communities (3.7), farmland amenities (3.9), cultural heritage and wildlife habitat (4.2), and recreational opportunities (5.9). The importance of national food security is confirmed in figure 4 displaying the percent of the frequency of being ranked first: 61 percent of the respondents chose national food security as the most important with other attributes ranging from 10 percent (ecosystem services) to 3 percent (recreational opportunities).

Representing ratings among five nonmarket goods and services of multifunctional attributes (1=least important; 7=most important), figure 5 reinforces the results of the ranking data: i.e., adequate supply of food was perceived as the most important multifunctional attribute

of the US agricultural sector with a mean score of 5.5, with other attributes scoring around 4.5. Other than that, the ratings data do show that there are not much variations in US citizen's preferences among different types of multifunctional goods and services. This invariability is notable given that the rankings data represent the results when respondents had to rank, whereas for the ratings data respondents were asked to simply rate various multifunctional goods and services using the scale of 1= least important and 7=most important without necessarily placing them on relative terms. Given the greater flexibility for respondents in expressing their preferences for the rating method, the ratings data are likely to be more appropriate measure of US citizens' preferences among various multifunctional goods and services than the ranking data. Regardless of the differences in the methods, the general finding is that US citizens perceive securing sufficient capacity for agricultural production as the most important multifunctional role of the agricultural sector.

5. Model Specification

This section specifies regression models to identify factors shaping US citizens' attitudes toward the notion of multifunctional agriculture. We use the following two attitudinal questions on multifunctional agriculture as dependent variables in this study: (1) Agriculture provides intangible benefits that cannot be sold; and (2) Government should compensate farmers for the intangible benefits produced by agriculture. The first question measures the degree of US citizens' agreement/disagreement with the contention that agriculture produces nonmarket benefits to our society, while the second questions measures the degree of US citizens' agreement/disagreement with the suggestion that government should play a role in promoting the provision of such nonmarket benefits. Given the ordinal nature of the measurements of the two

variables (1=strongly disagree; 7=strongly agree), we use ordered probit models for estimation. The structural equation for ordered probit model could be written as

(1) $y_i^* = \mathbf{x_i}\boldsymbol{\beta} + \varepsilon_i$,

where y_i^* is a latent variable representing *i*th individual's attitude toward multifunctional agriculture, $\mathbf{x_i}$ is a vector of independent variables and $\varepsilon_i \sim N(0,1)$. The relationship between latent and observed ordinal variables can be described as

(2) $y_i = 1$, if $y_i^* \leq \mu_1$,

$y_i = 2$, if $\mu_1 < y_i^* \leq \mu_2$,

$y_i = 3$, if $\mu_2 < y_i^* \leq \mu_3$,

…

$y_i = 7$, if $\mu_6 \leq y_i^*$

where the μ's are unknown 'threshold' parameters that determine the spacing between the seven categories of y.

Subsequently, we construct a single dependent variable by summing up the responses to the attitudinal questions and use it as an overall index of the general public's attitudes toward the notion of multifunctional agriculture. Given the seven-point scale used to measure respondents' attitudes for each question, the constructed variable would range from 2 (the lowest value) to 14 (the highest value). The index variable is then bounded by the lower end and higher end, indicating that it is censored at the two ending points, and we use two limit Tobit models to estimate the model integrating the two dependent measures. The observed index variable, y_i , is related to y_i^* by

(3) $y_i = 2$, if $y_i^* \leq 2$

$y_i = y_i^*$, if $2 \leq y_i^* \leq 14$, and

$y_i = 14$, if $14 \leq y_i^*$.

Independent variables in this study include two sets: (i) US citizens' perceptions of the five components of multifunctional agriculture (vitality of rural communities; food security; farm amenities; environmental services; recreational opportunities), and (ii) socio-demographic profiles of respondents such as age, education, income, gender, race, and geographical origin. We are particularly interested in examining the relative contribution of the five components in explaining the variations of the dependent variable. Table 1 shows question items used to construct indices measuring respondents' attitudes toward multifunctionality of agriculture and perceived ratings about the five components of multifunctional agriculture along with summary statistics.

Given that the regression model includes two sets of explanatory variables (perception variables and socio-demographic profiles), the former may mediate the effects of the latter. That is, if socio-demographic profiles are important in explaining respondents' attitude toward multifunctional agriculture, the effect may be either direct or mediated by the perception variables. To incorporate and test for such mediating relationships, we follow Baron and Kenny (1986) and estimate three regression models: Model A including only socio-demographic profiles, Model B including only the perception variables, and Model C including both sets of variables. If a significant effect of a socio-demographic profile in Model A remain unchanged in Model C, then the effect is direct on the dependent variable. If the mediation hypothesis holds valid, then socio-demographic profiles' effects would be embedded in the effects of the perception variables and their coefficients will become statistically insignificant or the size of the coefficients would become substantially smaller in Model C that includes both perceptions and

socio-demographic profiles. The comparison of estimated parameters and standard errors among Models A, B, and C will permit us to determine the presence/absence of mediating relationships.

6. Results

In this section we discuss the results of the econometric estimations. We first discuss the ordered probit estimates that measure the effects of socio-demographic profiles (Model A); perceived attributes of multifunctional agriculture (Model B) and both sets of variables (Model C) on attitudes towards multifunctional agriculture. The LHS variable in Table 2 is the extent of agreement with the statement that agriculture produces intangible benefits that cannot be traded in markets. Results from Model A show that socio-demographic characteristics including gender, age, race, college education and regional dummy (Midwestern residence) were statistically significant: females are likely to exhibit more favorable attitudes toward the notion of multifunctional agriculture than male respondents; older, White, college educated, and living in the Midwest are more likely to do so than the younger, nonwhite, non-college educated, and living in regions other than the Midwest. Income did not show any systematic covariation with the attitudes towards non-tradable benefits of agriculture.

Among the nonmarket attributes, two attributes (Ensuring an adequate supply of food and Environmental Services) were positively and significantly associated with attitudes toward multifunctional agriculture, while the attribute of Farmland Amenities was marginally significant. That is, respondents who perceive agriculture as providing the service of ensuring national food security, environmental benefits, or farmland amenities were more likely to agree that US agriculture provides non-tradable intangible benefits. Respondent's

perceptions about Vitality of Rural Community and Cultural Heritage did not contribute to explaining US citizens'attitudes toward multifunctional agriculture. Results from Model C can be used for the purpose of testing for the hypothesis of mediation. Including both sets of demographic and nonmarket attributes of agriculture, Model C shows that there are some changes in the estimates of socio-demographic profiles. For example, White becomes insignificant in Model C (b=0.100 se=0.097 from b=0.199 se=0.095 in Model A), indicating that the effect of race is largely mediated by the perception variables. The effect of education (BSDegree) changes slightly between b=0.330; se=0.069 (Model A) and b=0.297; se=0.070 (Model C), suggesting that college education has a largely direct effect on attitudes toward multifunctional agriculture, but not mediated by the perception variables. The effect of age changes from b=0.010; se=0.002 (Model A) to b=0.005; se=0.002 (Model C), indicating that the effect is reduced by half in the full model and that it is partially mediated by the perception variables. Lastly, the effect of gender changes from b=0.113; se=0.066 (Model A) to b=0.017; se=0.068 (Model C), indicating that it is largely mediated by the perception variables.

Table 3 shows the estimated results for the dependent variable representing respondents' attitudes toward governmental compensation for the intangible benefits produced by agriculture. Model A shows that gender, age, and income were statistically significant: females are likely to exhibit more favorable attitudes than males toward the notion of compensating farm producers for the nonmarket goods and services that agriculture produces; the older the less likely to be in favor of government compensation. Two income categories above $ 60,000 household income were negatively associated with the statement on governmental compensation. Results from Model B shows that four attributes of

multifunctional agriculture including vitality of rural community, farmland amenities, environmental services, and cultural heritage exerts significant influences on US citizens' attitudes toward government compensation for multifunctional agriculture. When respondents perceive agriculture as performing the services of helping rural communities to maintain economic vitality and providing farmland amenities, environmental services, and cultural heritage, they are predisposed to be more in agreement with the notion of government compensation for such services of the farm sector. However, national food security was conspicuously insignificant with large standard error, indicating that respondents who perceive national food security as an important service of agriculture are not likely to be more supportive of government compensation for promoting multifunctional agriculture. This is intriguing and in contrast with the result of the previous ordered probit model (in Table 2). Given that there was a significant association between perceived national food security and the degree of agreement with the notion of multifunctional agriculture, a plausible explanation is that US citizens may perceive that US agriculture is strong and competitive internationally so that it does not need any additional public support or that there are alternative ways of helping agriculture (other than direct government compensation) to fulfill its task of ensuring national food security.

Regarding the hypothesis of mediation, the effect of gender was partially mediated by the perception variables with the coefficients and standard errors changing from b=0.300 and se=0.065 to b=0.201 and se=0.066; the effects of income were largely mediated by the perception variables with the changes from b=-0.230 se=0.122; b=-0.222 se=0.131 to b=-0.187 se=0.124; b=-0.168 se=0.134).

Table 4 shows estimated results from the two-limit Tobit model using the index that sums up responses from the two attitudinal questions as the dependent variable. In this model, all of the five perception variables turn out to exert significant influences on the overall attitudes toward the notion of multifunctional agriculture. We calculated their marginal effects and standardized coefficients so that we could compare the magnitudes of the effect across the five perceived attributes of multifunctional agriculture (Table 7). It shows that Environmental Services had the strongest effect (0.49), followed by National Food Security (0.43), Vitality of Rural Community (0.35), Farmland Amenities (0.29), and Cultural Heritage (0.25).

7. Conclusions

This study was designed to shed lights on public attitudes toward two issues: (i) the concept of multifunctional agriculture and (ii) government intervention to compensate farmers for the supply of multifunctional goods and services in the US. Survey data were collected in the summer of 2008 using web-based panel maintained by the Ipsos-Observer. The Opsos-Observer data reveal three major findings between the first and second attitudinal questions: (i) the percentage of respondents in agreement declines from 64 percent to 45 percent; (ii) the percentage of respondents in disagreement increases from 8 percent to 19 percent; and (iii) the percentage of respondents neither agreeing nor disagreeing increases from 28 percent to 36 percent. These findings suggest that the issue of compensating farmers for their role in promoting multifunctional agriculture is more controversial than the concept itself. The data further shows that US citizens consider national food security as the most important component of the multifunctional roles of the US agricultural sector.

Regression analysis shows that US citizens' attitudes toward multifunctional agriculture are most significantly influenced by their perceived environmental services and national food security, followed in the order of vitality of rural community, farmland amenities, and cultural heritage. On the one hand, the result of the strong role of environmental services in shaping US citizens' attitudes toward multifunctional agriculture is congruent with the emphasis that United States Department of Agriculture places on programs designed to help farmer producers to conserve natural resources and protect the environment. On the other hand, the strong role of National Food Security relative to other attributes demonstrates that, despite their perception that US agriculture is strong and competitive internationally, US citizens consider the agricultural sector's role of ensuring national food security as a more important component of multifunctional agriculture than others such as the provision of rural amenities, cultural heritage, or recreational opportunities.

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Figure 1. Two Attitudinal Questions on Multifunctional Agriculture

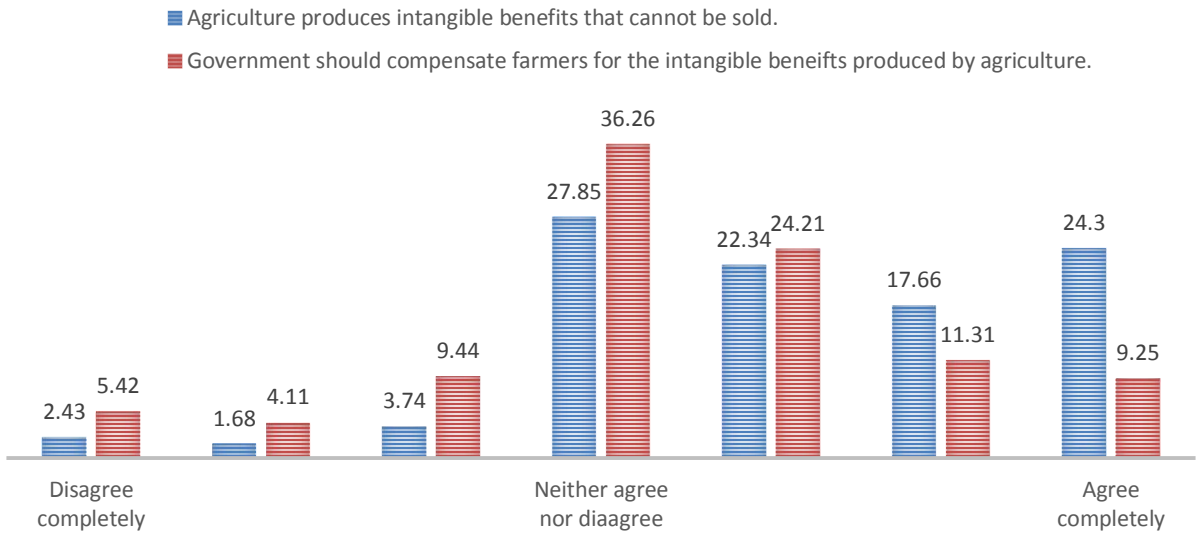

Figure 2. Mean Ranking of the Importance of Nonmarket Goods of Agriculture (1=most important; 7=least important)

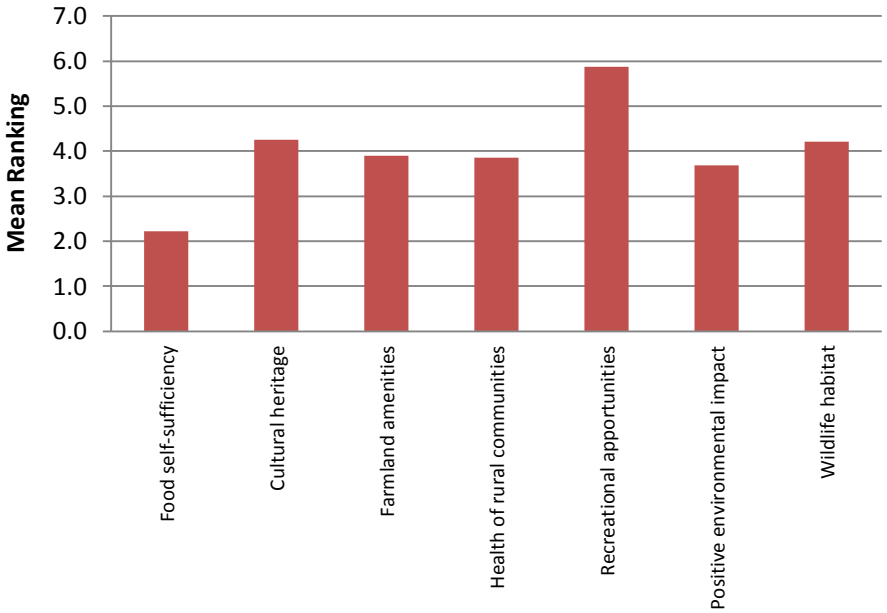

Figure 3. Percent of respondents who ranked each of the seven nonmarket goods and services as their first.

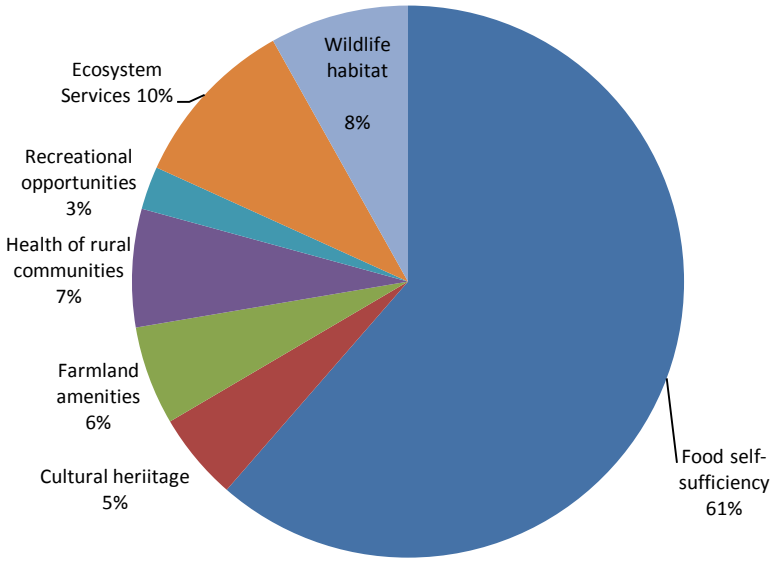

Figure 4. Mean Rating of the Importance of nonmarket goods and services associated with agriculture (1=least important; 7=most important)

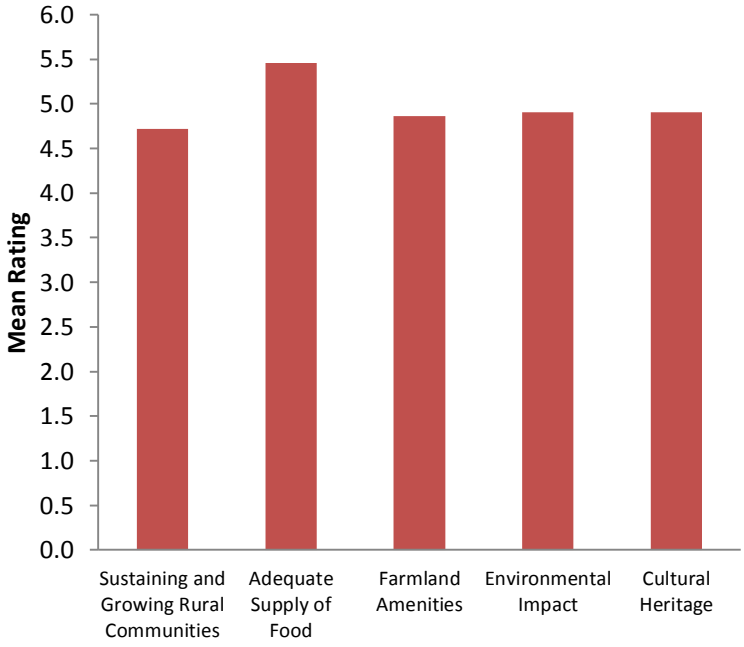

Table 1. Description and summary statistics of variables used in estimation.

Variable	Description	Mean	St. Dev.
Attitudes Toward Multifunctional Agriculture	1. Agriculture provides intangible benefits that cannot be sold	5.16	1.44
	2. Government should compensate farmers for the intangible benefits produced by agriculture	4.40	1.45
Vitality of Rural Communities	Sustaining and growing rural communities is the most important function that agriculture performs in addition producing products for sale	4.72	1.32
National Food Security	Ensuring an adequate supply of food (national food security) is the most important service that agriculture produces in addition to producing products for sale	5.46	1.28
Farmland Amenities	Farmland and open space amenities are the most important services that agriculture produces in addition to producing products for sale	4.86	1.30
Environmental Services	Positive ecological services are the most important function that agriculture produces in addition to producing products for sale	4.91	1.33
Farm Cultural Heritage	Preservation of our farming cultural heritage is the most important function that agriculture performs in addition to producing products for sale	4.90	1.43
Female	1 if subject female; 0 if male	0.44	0.50
Age	Age, in years	48.96	16.00
BSdegree	1 if subject had some college education or more; 0 otherwise	0.52	0.50
Household size	The number of household members	2.90	1.36
Income	Household income Less than $20,000=1, $20,000~$39,999=2, $40,000~$59,999=3, $60,000~$99,999=4, More than$100,000=5	3.28	1.24
Geographic regions	Dummy variable (yes=1, no=0)		
	Northeast	0.19	
	Midwest	0.24	
	South	0.33	
	West	0.24	
Ethnic Background	1 if respondent is white; 1 otherwise	0.85	0.35

Table 2. Ordered Probit Models Estimation Results for Attitudes toward Multifunctional Agriculture

Variable	*Model A*	*Model B*	*Model C*
Constant	*1.071***	*-0.592***	*-1.037***
	(0.207)	*(0.181)*	*(0.252)*
Vitality of Rural Community		*0.024*	*0.038*
		(0.035)	*(0.036)*
Food Security		*0.284***	*0.262***
		(0.031)	*(0.032)*
Farmland Amenities		*0.066**	*0.060*
		(0.037)	*(0.037)*
Environmental Services		*0.137***	*0.146***
		(0.033)	*(0.034)*
Cultural Heritage		*0.030*	*0.038*
		(0.033)	*(0.034)*
Female	*0.113**		*0.017*
	(0.066)		*(0.068)*
Age	*0.010****		*0.005***
	(0.002)		*(0.002)*
BSDegree	*0.330****		*0.297****
	(0.069)		*(0.070)*
Hhsize	*0.008*		*-0.002*
	(0.025)		*(0.025)*
Income2	*-0.036*		*-0.157*
	(0.128)		*(0.130)*
Income3	*-0.027*		*-0.039*
	(0.127)		*(0.129)*
Income4	*-0.127*		*-0.153*
	(0.124)		*(0.126)*
Income5	*0.151*		*0.193*
	(0.134)		*(0.137)*
Midwest	*0.137*		*0.230***
	(0.099)		*(0.101)*
South	*0.138*		*0.079*
	(0.093)		*(0.095)*
West	*0.034*		*0.016*
	(0.100)		*(0.102)*
White	*0.199***		*0.100*
	(0.095)		*(0.097)*
Threshold parameter 1	*0.244****	*0.253****	*0.260****
	(0.056)	*(0.058)*	*(0.059)*
Threshold parameter 2	*0.580****	*0.601****	*0.616****
	(0.073)	*(0.076)*	*(0.077)*
Threshold parameter 3	*1.675****	*1.771****	*1.823****
	(0.087)	*(0.090)*	*(0.093)*
Threshold parameter 4	*2.269****	*2.428****	*2.501****
	(0.090)	*(0.094)*	*(0.096)*
Threshold parameter 5	*2.778****	*3.016****	*3.101****
	(0.093)	*(0.098)*	*(0.101)*
Number of observations	*1,070*	*1,070*	*1,070*
Log likelihood	*-1,701*	*-1,598*	*-1,573*
Pseudo-R^2	*0.021*	*0.080*	*0.094*
Chi-squared statistic	*71.101****	*277.070****	*325.660****

Note: Single asterisk (*), double asterisks (**), and triple asterisks (***) denote significance at 10%, 5% and 1%, respectively. Numbers in parentheses are standard errors.

Table 3. Ordered Probit Models Estimation Results for Attitudes toward Government Internvention.

Variable	*Model A*	*Model B*	*Model C*
Constant	*1.788***	*-0.765***	*-0.266*
	(0.202)	*(0.174)*	*(0.244)*
Vitality of Rural Community		*0.183***	*0.162***
		(0.034)	*(0.035)*
Food Security		*-0.005*	*0.033*
		(0.031)	*(0.032)*
Farmland Amenities		*0.103***	*0.122***
		(0.036)	*(0.037)*
Environmental Services		*0.165***	*0.152***
		(0.033)	*(0.033)*
Cultural Heritage		*0.089***	*0.102***
		(0.032)	*(0.033)*
Female	*0.300***		*0.201***
	(0.065)		*(0.066)*
Age	*-0.005***		*-0.013***
	(0.002)		*(0.002)*
BSDegree	*-0.101*		*-0.097*
	(0.067)		*(0.069)*
Hhsize	*0.034*		*0.015*
	(0.024)		*(0.025)*
Income2	*0.038*		*-0.029*
	(0.126)		*(0.128)*
Income3	*-0.137*		*-0.126*
	(0.125)		*(0.127)*
Income4	*-0.230**		*-0.187*
	(0.122)		*(0.124)*
Income5	*-0.222**		*-0.168*
	(0.131)		*(0.134)*
Midwest	*-0.095*		*-0.043*
	(0.098)		*(0.099)*
South	*0.105*		*0.062*
	(0.092)		*(0.093)*
West	*-0.061*		*-0.085*
	(0.099)		*(0.100)*
White	*0.094*		*0.024*
	(0.093)		*(0.095)*
Threshold parameter 1	*0.307***	*0.333***	*0.342***
	(0.045)	*(0.048)*	*(0.049)*
Threshold parameter 2	*0.753***	*0.808***	*0.832***
	(0.058)	*(0.062)*	*(0.064)*
Threshold parameter 3	*1.789***	*1.941***	*1.996***
	(0.068)	*(0.073)*	*(0.075)*
Threshold parameter 4	*2.494***	*2.749***	*2.827***
	(0.074)	*(0.081)*	*(0.083)*
Threshold parameter 5	*3.014***	*3.378***	*3.478***
	(0.082)	*(0.092)*	*(0.095)*
Number of observations	*1,070*	*1,070*	*1,070*
Log likelihood	*-1,781*	*-1,660*	*-1,632*
Pseudo-R^2	*0.015*	*0.082*	*0.097*
Chi-squared statistic	*53.902****	*295.940****	*351.960****

Note: Single asterisk (*), double asterisks (**), and triple asterisks (***) denote significance at 10%, 5% and 1%, respectively. Numbers in parentheses are standard errors.

Table 4. Two-Limit Tobit Models Estimation Results

Variable	*Model A*	*Model B*	*Model C*
Constant	*8.34***	*2.75***	*2.78***
	(0.46)	*(0.32)*	*(0.46)*
Vitality of Rural Community		*0.29*	*0.27***
		*(0.07)***	*(0.07)*
Food Security		*0.33***	*0.34***
		(0.06)	*(0.06)*
Farmland Amenities		*0.21***	*0.22***
		(0.07)	*(0.07)*
Environmental Services		*0.39***	*0.38***
		(0.06)	*(0.06)*
Cultural Heritage		*0.16**	*0.18***
		(0.06)	*(0.06)*
Female	*0.64***		*0.32**
	(0.15)		*(0.13)*
Age	*0.01*		*-0.01**
	(0.00)		*(0.00)*
BSDegree	*0.31**		*0.25**
	(0.16)		*(0.13)*
Hhsize	*0.07*		*0.03*
	(0.06)		*(0.05)*
Income2	*0.04*		*-0.22*
	(0.30)		*(0.25)*
Income3	*-0.24*		*-0.22*
	(0.30)		*(0.24)*
Income4	*-0.53**		*-0.45**
	(0.29)		*(0.24)*
Income5	*-0.12*		*-0.01*
	(0.31)		*(0.26)*
Midwest	*0.09*		*0.27*
	(0.23)		*(0.19)*
South	*0.37**		*0.20*
	(0.22)		*(0.18)*
West	*0.02*		*-0.03*
	(0.23)		*(0.19)*
White	*0.45**		*0.19*
	(0.22)		*(0.29)*
Sigma	*2.45****	*2.05****	*2.02****
	(0.06)	*(0.05)*	*(0.18)*
Number of observations	*1,070*	*1,070*	*1,070*
Log likelihood	*-2,395.1*	*-2,202.3*	*-2,188.7*
Pseudo-R^2	*0.0084*	*0.0882*	*0.0939*
Chi-squared statistic	*893.5****	*2,284.5****	*3,799.3****

Note: Single asterisk (*), double asterisks (**), and triple asterisks (***) denote significance at 10%, 5% and 1%, respectively.

Numbers in parentheses are standard errors.

Table 7. Marginal Effects for Two-Limit Tobit Model

Variable	*Marginal Effect*	*Standardized Coefficient*
Constant	*2.74***	
	(0.45)	
Vitality of Rural Community	*0.26***	*0.35*
	(0.07)	
Food Security	*0.33***	*0.43*
	(0.06)	
Farmland Amenities	*0.22***	*0.29*
	(0.07)	
Environmental Services	*0.37***	*0.49*
	(0.06)	
Cultural Heritage	*0.18***	*0.25*
	(0.06)	
Female	*0.32**	*0.16*
	(0.13)	
Age	*-0.01**	*-0.16*
	(0.00)	
BSDegree	*0.25**	*0.12*
	(0.13)	
Hhsize	*0.03*	*0.03*
	(0.05)	
Income2	*-0.22*	*-0.09*
	(0.24)	
Income3	*-0.22*	*-0.09*
	(0.24)	
Income4	*-0.44**	*-0.20*
	(0.24)	
Income5	*-0.01*	*0.00*
	(0.25)	
Midwest	*0.27*	*0.11*
	(0.19)	
South	*0.19*	*0.09*
	(0.18)	
West	*-0.03*	*-0.01*
	(0.19)	
White	*0.19*	*0.07*
	(0.18)	
Scale factor	*0.98*	

Note: Single asterisk (*), double asterisks (**), and triple asterisks (***) denote significance at 10%, 5% and 1%, respectively.

Numbers in parentheses are standard errors.

Appendix

Less than 2% of the U.S. population is currently engaged in farm production. While the U.S. both imports and exports food, the U.S. is essentially self-sufficient in terms of being able to produce the food it needs for its population. However, some other countries are not so lucky and have a strategic goal of achieving a socially acceptable minimum level of self-sufficiency in terms of food production. This minimum level is desired in order to promote national food security (defined as an access to a sufficient amount of food in crises such as war and disruptions in crop supply due to adverse weather).

Intensively managed farming practices using pesticides, fertilizers, and herbicides can negatively impact the environment, polluting ground and surface water. However, when these negative effects are controlled, the U.S. agricultural system is able to produce a wide range of positive effects on the environment including ground water purification, reduction of carbon in the atmosphere, increase in wildlife habitat areas, and recycling nutrients back into the soil. Some people also believe that farmland increase the amount of open space in the country with the aesthetics and amenities open space provides. And that it also enriches our culture by continuing the farming heritage.

Therefore, U.S. agriculture produces not only products for sale (e.g., market commodities such as corn and soybeans), but also provides us with intangible benefits (such as national food security, positive environmental impact, open space, and cultural heritage) that cannot be traded in markets. While farmers are not paid for providing these intangible goods and services, everyone in our society is able to experience agriculture's direct and indirect benefits. Further, people may attach value to the mere existence of farms in our country. Although it is difficult to place a monetary value or price on these intangible goods and services, people would sorely miss these intangible benefits if they were not there.

U.S. agricultural policies have played an important role in shaping today's agriculture. The policies include programs/subsidies that offset the negative environmental effects of farming, enhance rural economies, and boost farm incomes. These policies are at least partly in place in recognition of the intangible goods and services agriculture provides to our society. While the cost of these programs/subsidies vary year by year, the U.S. government spends on average approximately [$X billion], which translates into about [$Y] per each person 20 years and older per year.