DRIVERS FOR EFFICIENT WATER USE IN AGRICULTURE: AN EMPIRICAL ANALYSIS OF FAMILY FARMS IN ALMERÍA, SPAIN [1]

(Shortened title: Drivers for efficient water use in agriculture)

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SUMMARY

This paper aims to determine the influence of family farming features on efficient use of water. The analysis focuses on a random sample of family farms in the province of Almería, southeast Spain. A hierarchical regression model was conducted to determine how the water efficiency is related to environmental awareness and certain characteristics of farmers, decision-makers and the family farm itself. The results show that these family farms strive to be more efficient in their use of water when they are going to be inherited, when there are younger decision-makers who have received a better education, and also when women are involved. Moreover, this efficiency is positively related to more ecological production and to the farmer's habitual behavior with respect to water economy. The study provides evidence regarding the influences of socio-economic and environmental features of family farming on water use efficiency that may prove useful for other analyses and policy makers on water management in agriculture.
Keywords: Environmental awareness; family farms; hierarchical regression; water use efficiency.

INTRODUCTION

The current water shortage in Spain is mainly due to the poor management of this resource in agriculture. Though it represents only 3% of the GDP, it accounts for nearly 80% of Spanish water consumption. Therefore, problems inherent to water shortage in Spain could be solved to a great extent by applying efficient agricultural water use practices. In this context, our purpose is to relate environmental impact and water use efficiency to the system of relationships and organization in the agricultural sector. Specifically, we considered family farms in the province of Almería in southeast Spain, as our reference case. Their use of water is highly efficient compared to other Spanish agro-food systems. Recent analyses show that the environmental impact of water use in horticulture in Almería, as measured by its water footprint (WF), is twenty times lower than the mean in the rest of Spanish agriculture (Sotelo, 2011), and water use is six times lower than farms in the rest of Spain (Fernández *et al.*, 2007). For this reason, it is important to examine facets of these family structures that have a bearing on better water use, in order to apply the results to other regions and/or countries.

The agricultural system in the province of Almería in southeast Spain, known as the "Almería model" (Ferraro-García *et al.*, 2000; Molina-Herrera, 2005; Aznar-Sánchez and Picón, 2010; Galdeano-Gómez *et al.*, 2011), has undergone unprecedented transformation in the recent history of

[1] Version accepted for publication. Subject to the Cambridge Core terms of use. Copyright © Cambridge University Press 2016. Published in Experimental Agriculture, 2018, 54(1), 31-44. https://doi.org/10.1017/S0014479716000661. Link: https://www.cambridge.org/core/journals/experimental-agriculture/article/abs/drivers-for-efficient-water-use-in-agriculture-an-empirical-analysis-of-family-farms-in-almeria-spain/A9F437130F5826F8AE574ECAA9A63BD8

this country. Its success is due to the intensive farming of fruits and vegetables in a productive organization based on small family farms, the local marketing structure composed mainly by cooperatives, and related secondary industries. Environmental components have also played a major role, particularly in the efficient use of natural resources, as the production system has become more and more respectful of its surroundings (Galdeano-Gómez *et al*., 2008) due to the technology employed in horticulture.

The first feature of this farming system that should be considered is its origins relied on the exploitation of underground aquifers that were sufficient to supply its early development in this semi-arid province, which is practically a desert. The initial technological step was to introduce the technique known as "sandy soil", which consists of covering the soil with a layer of sand, thus transforming unproductive land into prosperous farms with larger yields in winter. In the 1960s the next major technological improvement introduced was the greenhouse, built to protect the crops from wind and low winter temperatures, but which also contributed to water conservation. In the 40 years since then, the area devoted to greenhouse cultivation in the province has undergone spectacular growth, from 3,000 hectares in 1970 to 29,035 in 2014 (Fundación Cajamar, 2014), making it the province with the largest area of greenhouse crops in Spain. This structure has reduced erosion caused by the strong winds and occasionally heavy rainstorms characteristic of semiarid regions.

At first, the enormous expansion of the area under cultivation generated strong pressure on available water, and some symptoms of aquifer degradation appeared, such as salinization near the coast. In the late eighties, some solutions to this problem began to be introduced, such as systems for saving water (drip irrigation, control of demand of water from aquifers, etc.) and increasing its availability (desalination plants, reservoirs and reuse). Sandy soil was also replaced by non-soil cultivation or hydroponic systems supplemented by efficient water use techniques. Since the early 2000s, the area devoted to production under greenhouses has not increased as rapidly because of increased costs and a trend toward stability of sale prices. This has led to a higher investment in technology to increase the productivity of crops and optimize resource efficiency. To improve water use, growers have installed several structures for collecting and storing rainwater. These changes are also promoted by farmers' organizations, mainly cooperatives (marketing, financing, inputs supply) and irrigation communities, which play an important role in several agricultural changes (Galdeano-Gómez *et al.*, 2016). As a result, Almería is currently the most efficient irrigation area in Spain, with wide use of drip irrigation systems and increased water treatment, recycling and reuse. Thus, water use in agriculture in Almería has a small impact on the environment, compared to the rest of Spain (Sotelo, 201; Tolón-Becerra *et al*., 2013). This would not have come about without a change in attitude on the part of the growers, who are more ecologically aware than those in other places in Spain (Medina, 2014).

Some previous studies have analyzed the characteristics and behavior of the family farms with regard to its capacity for innovation (Spriggs *et al*., 2012), environmental measures (Medina, 2014; Delmas and Gergaud, 2014) or social responsibility (Cruz *et al*., 2014), but not its water use. Many studies (Sotelo, 2011; Hoekstra and Mekonnen, 2012; Tolón-Becerra *et al.*, 2013; Duarte *et al.*, 2014) have also calculated the WF for different countries, regions, sectors, etc., but few analyze the factors that influence water usage. This paper bridges a major gap in the literature related to lowering the environmental impact of water use and the family farm. To this aim, an empirical analysis was developed in order to evaluate the influence of socio-economic factors and management structure features of family farms on water use efficiency.

MATERIALS AND METHODS

Empirical setting and data analysis

A total of 55 intensive greenhouse family farms were chosen by random cluster sampling by area in the province of Almería, and they were surveyed during the 2014-2015 fruit and vegetable growing season (September to June). At the same time, interviews were carried out in irrigation communities in the province. The design of the surveys was composed by four dimensions, which enabled us to evaluate their approach to environmental awareness and efficient water use: current status of the family farm; fruit and vegetables grown by the family farm; environmental awareness; and perspective on water use efficiency.

Irrigation communities were also interviewed to supplement the information collected in the grower surveys on: plans, improvements, innovations and new technologies for more efficient water use, and the type of support or government subsidies; and water use and management awareness programs. When the surveys and interviews were completed, the information had to be validated to avoid any errors in their collection and analysis. Table 1 includes the information obtained from analysis of the dimensions that comprise the family farm.

(Insert Table 1 about here)

Description of variables

<u>Dependent variable</u>

Efficiency indicates the efficiency of water usage, which was measured by the sum of three items (for a similar approach, see Tang *et al*., 2013): whether the family farm received *environmental certification*, and if so, *to what extent this was related to efficient water use* – scored from 0 (not certified or certification unrelated to water) to 5 (when the family farm was fully certified for water use efficiency); whether the family farm was carrying out any *water use efficiency plan*, dummy variable scored from 0 (No) to 1 (Yes); and whether the family farm had simply implanted some *improvement, innovation or new technology for reducing water use*, dummy variable scored 0 (No) and 1 (Yes). This was tested with the standardized variable, but the results did not vary substantially.

<u>Independent variables</u>

The determinants of whether the family farm is more or less aware of water vary considerably, but they usually include the characteristics of the farm, sociodemographic factors and environmental factors (see e.g., Jones and Dunlap, 1992).

Control variables - family farm characteristics

- *generation*: Number of generations that have run the family farm, as an indication of its age. The generation, like other indicators of the family farm's age, is a variable commonly used as a control variable for analyzing its behavior (e.g., Spriggs *et al*., 2012; Delmas and Gergaud, 2014). Greater generational participation in a family farm may increase the complexity of its governing structures (Ling and Kellermanns, 2010), and thereby, decision-making on water efficiency.
- *area*: Number of square meters currently cultivated by the family farm as an indication of its size. The size of the family farm is also often used as a control variable (as in Spriggs *et al*., 2012; Delmas and Gergaud, 2014). According to McGrath (2001), the size of the family farm could bias its capacity for innovation, for instance regarding water use efficiency.
- *workers*: Number of people working for the family farm, as another indication of its size.
- *work_m2*: Number of workers per square meter of area cultivated.
- *sale_m2*: Family farm sales per square meter of cultivated area.
- *sales*: Total family farm sales.

Variable related to who inherits the family farm

- *inherit*: Dummy variable scoring 1 if the farmer thinks the next generation will inherit the family farm or 0 when he does not. Delmas and Gergaud (2014) also enter this variable as a determinant of environmental certification. The family farms make investments for long-term benefits to family members (Habbershon and Pistrui, 2002). Taking steps for the efficient use of water enables growers to invest in long-term sustainability of their firm to the benefit of the next generation. On the contrary, the impossibility of passing on the business reduces the farmer's incentive for investing beyond his own life expectancy.

Variables related to family farm decision-makers

- *dec.-makers*: Number of people in the family farm making decisions. As Spriggs *et al*. (2012), for example, conclude, the more there are, the more complicated making decisions on investing in improvements for more efficient water use becomes.
- *age_under45*: Dummy variable, 1 if the mean age of decision-makers is under 45 or 0 when it is not. The figure of 45 was chosen as it is the farmers' average age. In previous studies, results with respect to age have been ambiguous. Older growers have usually had more problems with water shortages than younger people, so from this point of view, the older the decision-makers are, the more aware of water the family farm would be expected to be (Lee and Zhang, 2008). However, younger growers could be more aware because they have a longer life expectancy and a longer time ahead of them to be earning income (Arcury and Christianson, 1990). Therefore, the impact of age on awareness is an empirical question and no a priori hypothesis can be made on its impact.
- *education*: Average education of family farm decision-makers. The education of each was measured on a scale of 1 (no education), 2 (primary education), 3 (middle school), 4 (high school or vocational training) or 5 (university or higher education). Many studies have shown that more education usually makes individuals more aware of environmental problems in general (Jones and Dunlap, 1992; Lee and Zhang, 2008). Therefore, we expected a positive relationship between the education of decision-makers and their water awareness.
- *women*: Number of woman decision-makers. According to Farmar-Bowers (2010), the contribution of female growers to strategic business decisions on sustainable development is very important. Therefore, family farms with more women decision-makers might be expected to be more aware of efficient water use.

Variables related to environmental and water awareness of the family farm and the surrounding area

- *integrated_m2*: Integrated Pest Management (IPM), organic and other certifications of environmental quality of production (in kilograms per square meter of total cultivated area). A weighted mean of all the crops was calculated.
- *aid*: Dummy variable of 1 if the family farm has received any government aid or subsidy for implanting their plans, improvements or innovations for using water more efficiently and 0 if none.
- *environmental*: This variable shows whether the main reason for the family farm using water more efficiently is environmental awareness and/or thinking of future generations. The variable is 0 if neither of these are reasons, 1 if one of them is a reason and 2 if both are reasons.
- *economic*: This variable shows whether the main reason for the family farm using water more efficiently is saving costs and/or increased sales. This variable is 0 if neither of these are its reasons, 1 if one of the two is and 2 if both.
- *sector*: This variable shows the farmer's evaluation of the importance of other family farms in the sector being aware of water use. Measured on a scale of 1 (unimportant) to 5 (very important).
- *daily_life*: How much the farmer tries to use less water in his daily life (e.g. taking a shower instead of a bath, recycling used water for other purposes, avoiding leaving taps open longer than necessary, etc.). Measured on a scale of 1 (not at all) to 5 (very much).

To make these variables easier to understand, Table 2 shows the descriptive statistics. Before entering the variables into the regression model, multicollinearity and normality have been studied (Table 3). There was only a high correlation between sales and area, but they are both control variables. The rest of the correlations were much lower, and so each variable can be said to represent a different concept.

(Insert Tables 2 and 3 about here)

RESULTS

As in Spriggs *et al*. (2012), a hierarchical regression model was used to test the influence of the different groups of independent variables on the efficiency of water usage. Thus, the variables were entered in four steps in the following sequence: model 1 – Control variables (*generation, area, workers, work_m2, sales_m2 and sales*); model 2 – The *inherit* variable was added to the above; Model 3 – The variables related to family farm decision-makers were added (*decision-makers*, *age_under45*, *education* and *women*); and Model 4 – The variables related to environmental and water awareness of the family farm (*integrated_m2*, *aid*, *environmental*, *economic*, *sector* and *daily_life*) were included. For each step, the variance explained (R^2), significance level (p value) and increase in R^2 and F values were evaluated (Table 4).

(Insert Table 4 about here)

Model 1 includes the control variables and shows that the family farms that have been passed down through more generations, and are therefore older, take more measures to use water more efficiently. This result coincides with the findings of Delmas and Gergaud (2014) on taking environmental measures. The control variables were positively influenced by sales and number of workers per square meter. However, size, measured by the number of workers and area cultivated by the family farm, has a negative influence on water use efficiency, though less intensely and significantly than age.

The *inherit* variable was entered in Model 2 and shows that the intention of leaving the family farm to the next generation in inheritance has a strong positive impact on the effort to use water more efficiently. This result is in agreement with those of other studies such as the one by Delmas and Gergaud (2014). Compared to Model 1 as the control, there was a 3.26% increase in explained variance in Model 2, and the model as a whole is significant.

The variables related to decision-makers were then added in Model 3. This reveals that family farms attempt to be more efficient in the use of water when there are fewer people making decisions, when the decision-makers are under 45 (as in Arcury and Christianson, 1990; Tang *et al*., 2013), and above all, when they are women. Contrary to expectations, education is hardly significant, and its influence is negative, as in Spriggs *et al*. (2012). This model had a moderate increase of 3.9% in explained variance and is still significant as a whole.

Model 4 incorporates variables related to awareness of the environment and of water usage in the family farm, and some changes appear in the estimated coefficients of the variables entered in the three previous steps. In this case, the *generation* variable had a negative influence (as in Spriggs *et al*., 2012) as did the number of workers per square meter. This means that the family farm strives to use water more efficiently when it is younger, smaller, less intensive in work and sales per square meter, earns more income, and is going to be inherited. The educational level of the decision-makers has a positive influence and gains in significance. Therefore, according to Model 4, family farms use water more efficiently when fewer people are making decisions, they are younger, more educated, and female. The latter variable has a higher weight and is more significant. With regard to new variables incorporated, family farms take more measures for efficient water use when they display greater awareness of water and environmental issues (as in Tang *et al*., 2013), specifically when: a) they have a larger amount of Integrated Pest Management per square meter; b) they receive government subsidies for it; c) their reasons are economic (cost saving and/or increased sales) as well as environmental; d) they believe that the other family farms in the sector are doing the same, e) and the farmer also tries to reduce water use in his daily life. Among all variables, the most determining and significant one is having received government aid, followed closely by the number of women who make decisions in the family farm and thirdly the fact that the farm is to be inherited. Model 4 implies an important increase in the variance explained (7.6%) and a fit of up to almost 84%.

DISCUSSION

The water shortage in Spain is partly due to poor management of the resource in the agricultural sector. It is therefore important to ascertain which factors have an impact on water efficiency in this productive activity. In the present study, we have analyzed how certain characteristics of a family farm and its decision-makers influence the extent of its awareness of efficient water use, taking as a single case reference family farms in the fruit and vegetables sector in Almería, Spain. The data from the surveys carried out have been analyzed and a hierarchical regression model was estimated.

Characteristics of family farms

According to our results, the family farms that are most aware and strive to use water more efficiently have the following characteristics: (a) They are younger and have been in the hands of fewer generations. Results on the influence on the family farm's behavior of this generational participation are similar to those of Ling and Kellermanns (2010) on the ease in making decisions, and Spriggs *et al.* (2012) on capacity for innovation, although this is not the case in Delmas and Gergaud (2014) on environmental measures in general; (b) They are smaller, with fewer workers and a smaller area cultivated. These results agree with the findings of McGrath (2001) on capacity for innovation in business; Grant *et al.* (2002) on their polluting activities; and Berrone *et al.* (2010) and Delmas and Gergaud (2014) on environmental measures. The ethical, social and environmental values of the farmer/decision-maker of small and medium-sized farms are usually important in defining their mission and strategy (Delmas and Gergaud, 2014); (c) They intend to leave the farm to the next generation. This is the case of 90% of the farms surveyed, since all of them are family businesses. This factor has a very strong impact and shows that the owners who intend to leave their farms to their children, taken on a longer-term view, are more receptive to the needs of future generations and the sustainability of their family farms. The literature on stakeholders has demonstrated how businesses have to respond to the pressures of these groups by adopting ecological practices (Delmas and Toffel, 2004). However, this framework usually ignores family farms and the connections they have with the future of their own family members (with exceptions, such as Bingham *et al.* 2011). Our contribution to this literature is to show that future generations should be considered as the main stakeholders, since their existence influences the decisions of the farmers on general environmental matters and water in particular (corroborating the results found by Delmas and Gergaud, 2014); (d) There are fewer decision-makers, as is usually the case in smaller farms (see also Berrone *et al*., 2010; Spriggs *et al*., 2012); they are younger (as in Arcury and Christianson, 1990; Berrone *et al*., 2010; Tang *et al*., 2013); and they are better educated (as in Jones and Dunlap, 1992); (e) They have more women among their decision-makers. This is one of the most significant and influential variables. Only 36% of all decision-makers in these family farms are women and only 40% of those who form part of the family farm participate in their decisions. Some studies have analyzed the contribution of women to different types of strategic decision-making in business (Farmar-Bowers, 2010; Grubbström *et al*., 2014). However, the difference in environmental awareness between men and women is not usually studied; (f) They have more Integrated Pest Management and other certifications of environmental quality of production. The concept of IPM is founded on a more sustainable approach based on the criteria of good agricultural practices, implying the efficient use of means and factors. In fact, it fosters, for example, irrigation techniques that promote water savings; (g) They receive government subsidies to implant these measures. This is the most determining and significant variable. Family farms that have received government aid are more aware and have taken the most water efficiency measures (see Karali *et al*., 2014, for general environmental measures). In addition, we can observe economic motivations, such as reducing costs or increasing sales, should also be taken into account. Most family farms take water efficiency measures to decrease the costs associated with water use. We can therefore conclude that in addition to being desirable for sustainability, this type of measure should also be profitable for the family farm (Kienzler *et al*., 2012). They consider the other companies in the sector to be aware of efficient water use. Competitors are one of the most common interest groups, or stakeholders, of businesses (Freeman, 1984). Our study corroborates that the awareness of other family farms in the sector of efficient water use positively influences the family farm's water strategy (as in Liu *et al*., 2009, for general environmental measures).

How to improve water use efficiency?

According to the results expounded, some influential drivers can be identified as key factors when designing agri-environmental-water measures. It is important for governments to promote the creation of new farms and renew instruments and technologies related to water use. Moreover, policy makers should promote family farms, as the presence of a successor generally makes the farm more receptive to the needs of future generations and sustainability. This driver can be seen as an opportunity for policy-makers to encourage a greater involvement of the successor in the decision-making process. Although women contribute significantly to society's knowledge and sensitivity from different spheres, their influence is not sufficiently visible because they are not adequately represented in discussion forums or decision-making circles. Policies that promote the access of women to management, both by teaching equality in schools and by measures that allow family and work commitments to be reconciled, could therefore have the externality benefit of bringing more farms into water efficiency.

There is no doubt that family farms in Almería have received scant government assistance, as only 11% of the sample received financial aid, most of which derived from European funding. This kind of aid is very scant in Spain, especially since the economic crisis, and most of it comes from the Common Agricultural Policy (CAP) via Operative Programs of the Fruit and Vegetable sector. In these subsidy programs investment should be made one year previously and only half of the amount is subsidized (with a limit of 4% of the farmer's sales), so not all farmers can invest. In addition, this aid goes to all types of infrastructure and it does not only focus on the use of water. If there is no major public investment, water shortages cannot be solved by the farmers' efficient water usage alone. In this sense, the low public budgets in Spain due to the recession are an additional problem. It would be recommendable for governments at all levels to provide more support to these family farms through agro-environmental lines, defraying part of the expenses derived from certification and implanting water efficiency measures, for instance by providing personalized advisory services to growers.

On the other hand, cooperatives play a key role in the development of respectful environmental actions. Most farms are family-farms and therefore cooperatives, as producer organizations in an intermediate position within the food system, should aim to introduce environmental practices including efficiency in water use, covering the whole process in the home market. They offer advice on investment aid and on new irrigation technologies and methods. Therefore, they are certainly a factor that should be taken into account in studies of this type and they were originally intended for inclusion. However, 85% of the surveyed farmers (similar to the average of farmers in the sector) are part of a production, purchase or consumption cooperative, so it is hardly a differentiable variable. Nonetheless, it is true that future policies should focus on the cooperative aspect for saving water.

Neighboring farmers' experiences about water efficiency measures can influence other farmers' behavior. Workshops and other activities showing the advantages and results obtained with these measures could be developed to promote the benefits of water efficient use. Policy makers could even take advantage of their efficient water usage to act as advocates for farms located in other areas. Finally, we insist on the need for government institutions to develop environmental awareness policies in schools and directed at both farmers and the population as a whole.

In general, the study provides evidence regarding the influences of family farming features and behavior on water efficiency that may prove useful for analyses on agriculture, and particularly those concerning family farming systems. This evidence could be used in other Mediterranean regions with an important fruit and vegetables sector and similar characteristics, such as the south of Europe (e.g., south of Italy, Greece or Turkey, or Israel) and/or the north of Africa. Or even in other non-Mediterranean areas such as the south of Morocco (e.g., Agadir). This research is not exempt from limitations, and overcoming them would provide research lines for future studies. Firstly, the analysis was limited to the agricultural sector in the province of Almería. As explained, this is a particular case in which the productive structure is based on small family farms. It would therefore be of interest to explore similar matters in other more international contexts or even in other farming sectors. Secondly, the data was concentrated on water use efficiency, but future work could also include other sustainable practices. Additionally, the surveys collected data on variables at a specific moment in time. A longitudinal analysis would determine whether the relationships identified in this study persist over time.

Acknowledgments. This research was partially funded by Spanish MCINN and FEDER aid (project ECO2014-52268) and by Andalusian Regional Government (project SEJ-5827, Consejería de Economía, Innovación y Ciencia).

Data availability statement: Data will be made available under reasonable request.

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Table 1. Survey results

Organizational structure			
Gender	64% Men 36% Women		
Age (mean)	45		
Predominant education	High school		
Number of workers	65% By contract: 35% Family:	55.93% Men 9.26% Women 24.07% Men 10.74% Women	
Production Activity			
Mean area (hectares)	3.59		
Number of crops	1-2 crops: 3 or more crops:	87.96% 12.04%	
Action taken to improve water use			
Means of reducing use of water (growers)	78.18%		
Subsidies[a]	89% No 11% Yes		
Efficiency plans	43.64%		

[a] Growers who received subsidies or aids for improvement, innovation or new technology for reducing use of water.
Source: The authors, based on family business surveys.

Table 2. Descriptive statistics of variables used

Variable	Mean	Std Dev.	Min	Max
Efficiency	1.5818	1.1657	0	5
generation	1.9454	.7557	1	4
area	35,690.91	32,137.65	4,000	200,000
workers	4.9091	3.3625	1	20
work_m2	.000177	.000111	.000057	.00065
sales_m2	6.3048	1.4202	2.5035	10.0783
sales	215,713.3	181,970.2	28,920.41	985,923
inherit	.9454	.2292	0	1
dec.-makers	1.9636	.9421	1	4
age_under45	.5273	.5038	0	1
education	3.1114	.9869	1	5
women	.7091	.5985	0	2
integrated_m2	8.9458	2.7300	1.7308	15.6586
aid	.1091	.3146	0	1
enviromental	.8727	.5791	0	2
economic	.8545	.5584	0	2
sector	3.3818	1.5927	0	5
daily_life	4.1454	1.0957	0	5

Table 3. Pearson correlations

	Efficiency	generation	area	workers	work_m2	sale_m2	sales
Efficiency	1.0000						
generation	0.1418	1.0000					
area	0.0758	0.0626	1.0000				
workers	0.0941	-0.0676	0.8018	1.0000			
work_m2	0.0164	-0.2024	-0.4049	0.0961	1.0000		
sales_m2	-0.0152	0.2174	-0.0784	-0.1888	-0.1586	1.0000	
sales	0.1476	0.0643	0.9668	0.7634	-0.4282	0.0339	1.0000
inherit	0.2596	0.1964	0.0656	-0.0546	-0.0731	0.1124	0.0735
dec.- makers	0.0028	-0.0809	0.2116	0.1860	-0.0982	0.0328	0.1653
age_under45	0.0671	0.1256	-0.0767	0.1053	0.3389	-0.1935	-0.0992
education	0.0021	0.0443	0.2078	0.0675	-0.0859	-0.0036	0.2213
women	0.1674	0.0052	0.0698	-0.0042	-0.1024	0.1547	0.0598
integrated_m2	0.1427	0.1899	0.1172	0.0427	-0.1355	0.7340	0.2341
aid	0.3791	0.2592	0.1517	0.1671	-0.1475	0.2408	0.2083
environmental	0.0020	0.0262	-0.1335	-0.1487	0.0072	0.2299	-0.1165
economic	0.2747	0.1564	-0.0645	0.1210	0.2814	-0.1842	-0.0735
sector	0.3070	0.0176	0.0496	0.1034	0.1530	-0.0185	0.0689
daily_life	0.1500	-0.0797	-0.1031	-0.0667	-0.0221	0.0266	-0.0755

	inherit	dec.-makers	age_under45	education	women	integrated_m2	aid
inherit	1.0000						
dec.-makers	-0.0951	1.0000					
age_under45	-0.0671	0.0021	1.0000				
education	0.1092	-0.0288	0.1526	1.0000			
women	-0.1178	0.7691	-0.2188	-0.1218	1.0000		
integrated_m2	0.2115	0.0905	-0.0754	0.0766	0.0559	1.0000	
aid	0.0840	-0.1738	-0.0191	-0.1592	-0.1234	0.1862	1.0000
environmental	0.0863	-0.2462	-0.0196	0.2388	-0.0554	0.0296	0.0776
economic	-0.0631	-0.1863	0.2118	0.0941	-0.1290	-0.0920	-0.0134
sector	0.1088	0.0341	0.0676	-0.0026	0.0021	0.2019	0.1001
daily_life	-0.1153	0.0411	-0.1415	-0.1743	0.0375	-0.0800	0.1143

	environmental	economic	sector	daily_life
environmental	1.0000			
economic	0.0562	1.0000		
sector	0.0938	0.1677	1.0000	
daily_life	0.1173	0.0655	0.3920	1.0000

Table 4. Results of Hierarchical Regression Analysis

Variable	Model 1	Model 2	Model 3	Model 4
generation	.402352* (.20734)	.2609656 (.20675)	.1599387 (.21330)	-.1024682 (.20211)
area	-.0000391 (.00002)	-.0000519* (.00002)	-.0000546* (.00002)	-.0000296 (.00002)
workers	-.0182544 (.12320)	.0461064 (.12076)	.0983491 (.12426)	-.0180018 (.11868)
work_m2	2843.655 (2,234.59)	948.8315 (2,278.047)	-289.3122 (2,418.205)	-28.50183 (2,296.759)
sales_m2	-.0231785 (.08656)	-.1352063 (.09511)	-.1628875 (.10380)	-.3228162* (.15775)
sales	8.76e-06* (3.73e-06)	9.31e-06** (3.57e-06)	8.95e-06** (3.62e-06)	5.58e-06 (3.50e-06)
inherit		1.444993* (.60613)	1.791823** (.61668)	1.460396** (.56301)
dec.-makers			-.4122908 (.27389)	-.4324218 (.28377)
age_under45			.4046419 (.35081)	.3716318 (.31681)
education			-.0007448 (.151986)	.0613982 (.15141)
women			1.097544** (.43789)	1.231153** (.42149)
integrated_m2				.0919095 (.08852)
aid				1.455107** (.49005)
environmental				-.162527 (.26955)
economic				.4806488 (.26618)
sector				.0689711 (.10307)
daily_life				.1182982 (.12793)
R^2	*0.6918*	*0.7244*	*0.7639*	*0.8399*
ΔR^2		*0.0326*	*0.0395*	*0.076*
F	*18.33****	*18.02****	*12.94****	*11.72****

Note: Standard errors in parentheses.
*p<0.05. **p<0.01. ***p<0.001.