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THE SHOEMAKER'S CHILDREN GO BAREFOOT. THE PROBLEM OF FOOD INSECURITY IN SMALL-SCALE FARMS IN POLAND[1]

Key words: food security, HFIAS, small-scale farmers, zero-inflated Poisson regression

ABSTRACT. The problem of food insecurity of small-scale farms is often addressed in the literature, but there is a research gap with regard to food insecurity of small-scale farms in developed countries. This issue is important especially in countries with a fragmented agrarian structure, including Poland. Hence, this article aims to identify the level of food insecurity of small-scale farms in Poland and its determinants. It is based on a survey (710 questionnaires) distributed among small-scale farmers in Poland. The survey was conducted in 2018 and included the modified Household Food Insecurity Access Scale (HFIAS). According to the HFIAS algorithm, 56.5% of small-scale farms in Poland declared to be food secure, 23.5% of farms were classified as mild food insecure, 11.3% as moderate food insecure and 8.6% as severe food insecure. In order to find determinants of the level of food insecurity of small-scale farms, a zero-inflated Poisson regression model was used. Results revealed that farm households with an older manager, with children, with a higher disposable income per capita and using own products in the daily diet experienced a lower level of food insecurity. Farm households producing dairy cows and having five or more household members experienced higher food insecurity.

INTRODUCTION

It is assumed that the problem of food insecurity is of marginal importance in developed countries and concerns only a small percentage of people. According to FAO research [FAO 2018], in 2015-2017, the prevalence of undernourishment in Northern America and Europe was generally less than 2.5% and the prevalence of severe food insecurity was even less. However, according to some other research [Coleman-Jensen et al. 2018], in 2017, in the USA, almost 12% of households declared at least temporary problems with food security. Another study conducted in 2011 in the Paris metropolitan area reported 6.3% of households that had experienced food insecurity, among which 3.9% low food security and 2.4% very low food security, i.e. an estimated 326,000 adults were living in food insecure households, with 124,200 of them living in households with very low food security [Martin-Fernandez et al. 2013]. The study conducted by the ACF-International in Madrid in 2014 reported 5.7% food insecure households and a further 12.8% low food

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security households [Castell et al. 2015]. Similar studies have rarely been conducted in Europe and, generally, the issue of food security in developed countries, especially at a household level, is rather neglected in the scientific literature [Nyambayo 2015, Borch, Kjaernes 2016].

Food insecurity, however, often affects socially vulnerable groups, such as small farm households. The problem of food insecurity in small farms and their meaning in achieving food security and improved nutrition [Ruane, Knickel 2016] is often addressed in the literature, but mostly in relation to developing countries [Maxwell et al. 2014, Tibesigwa, Visser 2016, Ahmed et al. 2017, Reincke et al. 2018]. To the best of our knowledge, there is no such research for small farm households in Europe. In our opinion, this is a serious research gap, especially when considering the number of small farms in developed countries with a fragmented agrarian structure, including Poland [Davidova et al. 2013, Toader, Roman 2015].

Therefore, in this paper, the experience-based food insecurity scale method i.e. the Household Food Insecurity Access Scale (HFIAS) is used and the aim is to examine the level of food security in small-scale farms in Poland. Our complementary goal is to define the determinants of small-scale farm food insecurity, for which a zero-inflated Poisson regression model is used.

DATA AND METHODS

DATABASE

This paper is based on a primary survey distributed among 710 small-scale farmers in 16 voivodships in Poland, in 2018, by the net of national agricultural extension officers who provide data for the Polish FADN. To design the sample size FADN sampling methodology was used. FADN typology of a very small and small farm (nES9 type 1 and 2) is applied, according to which a very small and small farm is a farm of economic size: EUR 4 000 – 15 000 of standard output. Since the aim was to analyse farmers and other members of the household active in agriculture, additional criteria of 75% of farm AWU to be engaged in farm activities was set. These households were visited and household heads were interviewed face-to-face, using a structured questionnaire that was carefully designed and pretested. Besides socio-demographic data, the survey also covered a set of questions related to household food security.

HFIAS INDICATOR

The food security part of the survey included the experience-based food insecurity scale based on HFIAS (Household Food Insecurity Access Scale) developed by the Food and Nutrition Technical Assistance (FANTA) programme of US-AID. It is a brief survey instrument based on nine questions which aims to assess whether households have experienced problems with accessing food during the last 30 days [Coates et al. 2007]. Questions were translated into Polish and upon which pilot studies were modified to reflect better Polish conditions (for the HFIAS questions see Table 1).

Besides the occurrence, respondents were also asked about frequency i.e. if it had occurred rarely (once or twice in the past month), sometimes (three to ten times in the past month) or often (more than ten times in the past month). Based on the scores generated from the nine questions, two indicators were computed:

– The HFIAS category: according to the categorisation algorithm recommended by the HFIAS Indicator Guide [Coates et al. 2007], respondents can be classified into four categories: food secure, mildly food insecure, moderately food insecure, severely food insecure. This indicator was used to examine the level of food insecurity in small-scale farms in Poland;
– The HFIAS score: which is a count measure of the degree of food insecurity with a range from 0 to 27, where households have four possible responses to each of the nine questions, from "0" which is "never" to "3" which is "often". The higher the score, the more food insecure a household is. This indicator was used as a dependant variable in the modelling strategy to define the determinants of small-scale farm food insecurity.

ECONOMETRIC STRATEGY

For analysis of potential determinants of food insecurity among Polish smallholder farms, the HFIAS score was used as a dependant variable. Since the HFIAS score is a count measure with 0 to 27, a Poisson regression model is typically assumed for this type of data. This model assumes the equidispersion of data. In our case, however, there

Table 1. The Household Food Insecurity Access Scale survey among Polish small-scale farms in 2018 (number of positive responses)

Have you or your household members had the following problems with ensuring food security due to financial problems:	Last 30 days					In the last year	
	1-2 times	3-10 times	> 10 times	total	total [%]	it happened regularly last year	%
Worry about not having enough food	**41**	**14**	**2**	57	8.0	24	3.4
Do not eat your preferred food	**160**	**59**	**14**	233	32.8	115	16.2
Limit the diversity / quality of meals	**137**	**55**	**7**	199	28.0	91	12.8
Consume products that you would not like to eat in a better material situation	**137**	**59**	**8**	204	28.7	92	13.0
Limit the number of meals	**51**	**11**	**1**	63	8.9	26	3.7
Limit eaten food portions	**30**	**13**	**1**	44	6.2	23	3.2
Skip a meal because you could not afford to buy food	**33**	**15**	**1**	49	6.9	28	3.9
Go to sleep being hungry	**20**	**2**	**0**	22	3.1	13	1.8
Go without food all day	**10**	**0**	**0**	10	1.4	10	1.4

Note: No. obs. = 710, Cronbach's alpha 0.79
HFIAS category: ☐ food secure, ☐ mild food insecure, ☐ moderate food insecure, ☐ severe food insecure
Source: own survey

are many zeros in the dependent variable, therefore the mean is not equal to the variance value of the dependent variable and a zero-inflated Poisson regression is more suitable [Mouatassim, Ezzahid, 2012]. It assumes that with probability p the only possible observation is 0, and with probability $1 - p$, a Poisson random variable is observed [Saffari 2013]. In other words, it assumes that the excess zero counts come from a logit model and the remaining counts come from a Poisson model[2].

Our set of independent variables for the Poisson part of the model (see Table 2) resulted from the literature review and theory on food security. Previous research has shown that farm household food security is determined by socio-economics factors such as age, gender, education, family size, household income, distance to the market, market integration and production type [De Cock 2013, Broussard 2019]. For the logit model that determines whether the count is zero an additional variable that specifies the self-perception of food security of a farmer on a scale of 1 to 5 is used, where 1 means very difficult and 5 means very good.

RESEARCH RESULTS

Among 710 surveyed small-scale farms, 56.5% declared to be food secure. According to the HFIAS algorithm, 23.5% were classified as mildly food insecure. These were mainly farmers, who declared that they had to reduce the quality of consumed food or eat less preferred food. 11.3% of farmers were classified as moderately food insecure, which means that these farmers mainly declared a lower intake of food. 8.6% were classified as severely food insecure, which was related to the experience of hunger (see Table 1). 30 respondents declared that they even go to sleep being hungry or go without food all day and 23 of them pointed out that it happened regularly last year. These results reveal a relatively unfavourable food situation of small farms in Poland trying to make a living solely from farming and are quite unexpected taking into consideration Eurostat data according to which severe material deprivation in Poland declined from 17% in 2007 to 6.9 % in 2017.

The results of the analysis of the determinants of food insecurity presented in Table 2 show that if a household is having a problem with food insecurity (i.e. the HFIAS score is greater than zero), then the age of the farm manager, having children in the household, a higher disposable income per capita and the important role of own products in a diet have statistically significant negative[3] influences on household food insecurity (i.e. a lower HFIAS score). On the contrary, a family size of 5 or more and production type dairy cows have statistically significant positive influences on household food insecurity (i.e. a higher HFIAS score).

[2] For a more detailed explanation on zero-inflated Poisson regression (see [Atkins, Gallop 2007] or [Kopczewska et al. 2009]).

[3] It is worth emphasizing that HFIAS is an indicator of food insecurity, which means that a negative sign of a parameter in the Poisson regression model reduces the level of food insecurity, i.e. in fact such a farm has less problems with ensuring food security. On the contrary, a positive sign of the parameter increases the level of food insecurity, which means that a farm has more problems with food security.

Table 2. Parameter estimates of the zero-inflated Poisson regression model for the determinants of food insecurity

Variables	Coef.	Std. Err.	z	P > z	[95% Conf. Interval]	
HFIAS score model						
Age of farm manager (dummy): < 30 ref.						
30-39	**-0.275**	**0.136**	**-2.020**	**0.044**	**-0.542**	**-0.008**
40-49	**-0.464**	**0.135**	**-3.440**	**0.001**	**-0.729**	**-0.199**
50-59	**-0.365**	**0.131**	**-2.800**	**0.005**	**-0.621**	**-0.109**
> 59	**-0.504**	**0.153**	**-3.290**	**0.001**	**-0.804**	**-0.204**
Gender (dummy): Female ref.						
Male	-0.082	0.082	-1.010	0.314	-0.242	0.078
Education (dummy): No ref.						
Primary	0.835	0.725	1.150	0.250	-0.587	2.256
Vocational	0.989	0.715	1.380	0.167	-0.413	2.391
Secondary	0.650	0.750	0.870	0.386	-0.819	2.119
Higher	0.804	0.726	1.110	0.268	-0.618	2.227
Family size (dummy): 1-2 ref.						
3-4	0.094	0.090	1.050	0.294	-0.082	0.270
5 and more	**0.320**	**0.118**	**2.730**	**0.006**	**0.090**	**0.551**
Children in household (dummy): No ref.						
Yes	**-0.224**	**0.084**	**-2.670**	**0.008**	**-0.389**	**-0.060**
Distance to market (km) (cont.)	-0.002	0.004	-0.510	0.612	-0.011	0.006
Production type (dummy): Crops ref.						
Horticultural crops	-0.047	0.189	-0.250	0.803	-0.417	0.323
Permanent crops	0.265	0.143	1.860	0.064	-0.015	0.546
Dairy cows	**0.374**	**0.130**	**2.890**	**0.004**	**0.120**	**0.628**
Grassland animals	-0.072	0.123	-0.580	0.560	-0.314	0.170
Grain animals	0.266	0.225	1.180	0.237	-0.174	0.706
Mixed	-0.003	0.079	-0.040	0.969	-0.159	0.153
Disposable income per capita [EUR] (dummy): <162 ref.						
163-232	0.029	0.078	0.370	0.710	-0.124	0.183
233-348	**-0.348**	**0.108**	**-3.230**	**0.001**	**-0.559**	**-0.137**
349-465	**-0.539**	**0.162**	**-3.340**	**0.001**	**-0.856**	**-0.223**
> 465	-0.188	0.191	-0.980	0.326	-0.563	0.187

Table 2. Cont.

Variables	Coef.	Std. Err.	z	P > z	[95% Conf. Interval]	
Form of market integration (dummy): No sales ref.						
No contracts	-0.481	0.314	-1.530	0.126	-1.097	0.135
Short term contracts	-0.501	0.321	-1.560	0.119	-1.131	0.128
Long term or cooperative	-0.476	0.348	-1.370	0.171	-1.158	0.206
Role of own products in diet (dummy): Not important ref.						
Important	**-0.490**	**0.067**	**-7.270**	**0.000**	**-0.622**	**-0.358**
_cons	1.611	0.779	2.070	0.039	0.084	3.138
Zero-Inflated model						
Food security self-perception (count)	**2.004**	**0.337**	**5.940**	**0.000**	**1.343**	**2.666**
_cons	-5.926	1.019	-5.810	0.000	-7.923	-3.928
Zero-inflated Poisson regression		Number of obs. = 709				
Nonzero obs. = 311		Zero obs. = 398				
Inflation model = logit						
LR $chi^2(27)$ = 155.39						
Log likelihood = -1,131.668						
Prob. > chi^2 = 0.0000						

Note: bolded parameters are significant at $p < 0.05$
Source: own calculations

Most of these results are expected and confirm previous studies of determinants of food insecurity in small-scale farms [Baiyegunhi et al. 2016, De Cock 2013, Broussard 2019]. However, it should be emphasized that the results of other studies relate to developing countries and, to the best of our knowledge, there are no similar studies in developed countries, especially in Poland.

Some results, however, are in conflict with common beliefs. In most of the research, food insecurity is more prevalent in larger families, especially those with more children. In our case, having children in the household improves food security. This result can be explained by the introduction of the social programme "500+" in which a family receives an extra ~120 euro per child, monthly.

Another interesting result is that higher disposable income per capita has statistically significant negative influences on household food insecurity (i.e. a lower HFIAS score). This result does not hold for the highest income range (> 465 EUR). A closer look at the database has allowed us to explain this phenomenon. Among observations in the highest income range, there were mainly people running single-person households. It can be assumed that the fixed cost of running a single-person household, even with high disposable incomes, lead to difficulties in ensuring food security.

CONCLUSIONS

1. This study examined the occurrence and determinants of food insecurity in small-scale farms in Poland based on the modified HFIAS measure. The results of the study have proved high incidence of food insecurity among the surveyed sample, which is a quite unexpected result.
2. The zero-inflated Poisson regression model estimates showed that expected socio-economic variables such as the age of the farm manager, a higher disposable income and size of household are statistically significant. These findings are consistent and correlated with other studies and reports.
3. There are, however, some contributing results, which could give a direction for policy intervention. The important role of own products in the diet have statistically significant negative influences on household food insecurity (i.e. a lower HFIAS score), Therefore, promoting home gardens and using your own products in the diet has the potential to reduce household dietary deficit for rural households.
4. The findings from this paper, although somewhat surprising, provide useful information for launching a debate on the identification of vulnerable households among rural citizens and indicate a need for more and extensive research on food insecurity among small-scale farms in developed countries.

BIBLIOGRAPHY

Ahmed Umar Iaz, Liu Ying, Muhammad Khalid Bashir, Muhammad Abid, Farhad Zulfiqar. 2009. Status and determinants of small farming households' food security and role of market access in enhancing food security in rural Pakistan. *PLoS ONE* 12(10): e0185466. DOI: 10.1371/journal.pone.0185466.

Atkins David, Robert Gallop. 2007. Rethinking how family researchers model infrequent outcomes: A tutorial on count regression and zero-inflated models. *Journal of Family Psychology* 21 (4): 726-735. DOI: 10.1037/0893-3200.21.4.726.

Baiyegunhi Lloyd, Beatrice Oppong, Grany Senyolo. 2016. Mopane worm (Imbrasia belina) and rural household food security in Limpopo province, South Africa. *Food Security* 8: 153-165. DOI: 10.1007/s12571-015-0536-8.

Borch Anita, Unni Kjaernes. 2016. Food security and food insecurity in Europe: An analysis of the academic discourse (1975–2013). *Appetite* 103: 137–147. DOI: 10.1016/j.appet.2016.04.005.

Broussard Nzinga. 2019. What explains gender differences in food insecurity? *Food Policy* 83: 180–194. DOI: 10.1016/j.foodpol.2019.01.003.

Castell Gemma, Carmen Rodrigo, Joy de la Cruz, Javier Bartrina. 2015. Household Food Insecurity Access Scale, *Nutricion Hospitalaria* 31 (Supl. 3): 272-278. DOI:10.3305/nh.2015.31.sup3.8775.

Coates Jennifer, Anne Swindale, Paula Bilinsky. 2007. *Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (v.3).* Washington. DC: Food and Nutrition Technical Assistance Project (FANTA). Academy for Educational Development, http://www.fao.org/fileadmin/user_upload/eufao-fsi4dm/doc-training/hfias.pdf.

Coleman-Jensen Alisha, Matthew Rabbitt, Christian Gregory, Anita Singh. 2018. Household Food Security in the United States in 2017. *Economic Research Report No. 256*. ERS USDA. https://www.ers.usda.gov/webdocs/publications/90023/err-256.pdf?v=0, access: 30.06.2019.

De Cock Nathali, Marijke D'Haese, Nick Vink, Johan van Rooyen, Lotte Staelens., Hetti Schonfeldt. 2013. Food security in rural areas of Limpopo province: South Africa. *Food Security* 5: 269–282. DOI: 10.1007/s12571-013-0247-y.

Davidova Sophia, Alaister Bailey, Janet Dwyer, Emil Erjavec, Matthew Gorton, Kennet Thomson. 2013. *Semi-subsistence farming: Value and directions of development. Study.* European Parliament, https://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/495861/IPOL--AGRI_ET(2013)495861_EN.pdf, access: 30.06.2019.

FAO, IFAD, UNICEF, WFP, WHO. 2018. *The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition*. Rome. FAO, http://www.fao.org/3/I9553EN/i9553en.pdf, access: 30.06.2019.

Kopczewska Katarzyna, Tomasz Kopczewski, Piote Wójcik. 2009. *Metody ilościowe w R. Aplikacje ekonomiczne i finansowe* (Quantitative methods in R. Economic and financial applications). Warszawa. Cedewu.pl, Wydawnictwa Fachowe.

Martin-Fernandez Judith, Francesca Grillo, Izabelle Parizot, France Caillavet, Pierre Chauvin. 2013. Prevalence and socioeconomic and geographical inequalities of household food insecurity in the Paris region, France, 2010. *BMC Public Health* 13: 486. DOI: 10.1186/1471-2458-13-486.

Maxwell Daniel, Bapu Vaitla, Jennifer Coates. 2014. How do indicators of household food insecurity measure up? An empirical comparison from Ethiopia. *Food Policy* 47: 107-116. DOI: 10.1016/j.foodpol.2014.04.003.

Mouatassim Younez, Hadj Ezzahid. 2012. Poisson regression and Zero-inflated Poisson regression: application to private health insurance data. *European Actuarial Journal* 2: 187-204. DOI: 10.1007/s13385-012-0056-2.

Nyambayo Isabella. 2015. Food Security In Developed Countries (Europe and USA) – Is It Insecurity and Insufficiency or Hunger and Poverty in Developed Countries? *BOAJ Nutrition* 1: 1-7.

Reincke Katrin, Elisa Vilvert, Anja Fasse, Frieder Graef, Stefan Sieber, Marcos Lana. 2018. Key factors influencing food security of smallholder farmers in Tanzania and the role of cassava as a strategic crop. *Food Security* 10: 911-924. DOI: 10.1007/s12571-018-0814-3.

Ruane John, Karlheinz Knickel. 2016. *Background document to the FAO e-mail conference on "Exploring the contribution of small farms to achieving food security and improved nutrition*". Rome. Italy. 10-23.10.2016. www.fao.org/3/a-bp488e.pdf, access: 30.06.2019.

Saffari Seyed, Robiah Adnan, William Greene, Meizah Ahmad. 2013. A Poisson regression model for analysis of censored count data with excess zeroes. *Jurnal Teknologi (Sciences and Engineering*) 63 (2): 71-74. DOI: 10.11113/jt.v63.1915.

Tibesigwa Byela, Martine Visser. 2016. Assessing Gender Inequality in Food Security among Small-holder Farm Households in urban and rural South Africa. *World Development* 88: 33-49. DOI: 10.1016/j.worlddev.2016.07.008.

Toader Maria, Gheorghe Roman. 2015. Family Farming – Examples for Rural Communities Development. *Agriculture and Agricultural Science Procedia* 6: 89-94. DOI: 10.1016/j.aaspro.2015.08.043.

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SZEWC BEZ BUTÓW CHODZI. PROBLEM BRAKU BEZPIECZEŃSTWA ŻYWNOŚCIOWEGO W MAŁYCH GOSPODARSTWACH ROLNYCH W POLSCE

Słowa kluczowe: bezpieczeństwo żywnościowe. HFIAS, małe gospodarstwa, regresja Poissona z nadwyżką zer

ABSTRAKT

Problem braku bezpieczeństwa żywnościowego w małych gospodarstw rolnych jest często poruszany w literaturze, ale istnieje luka badawcza w odniesieniu do tego zagadnienia w krajach rozwiniętych. Ta kwestia jest ważna, zwłaszcza w krajach o rozdrobnionej strukturze agrarnej, w tym w Polsce. Dlatego celem artykułu jest określenie poziomu braku bezpieczeństwa żywnościowego w małych gospodarstw rolnych w Polsce i wskazanie jego determinant. Analizy oparto na danych pozyskanych w badaniach pierwotnych (710 kwestionariuszy) prowadzonych wśród małych gospodarstw rolnych w Polsce. Ankieta została przeprowadzona w 2018 roku i zawierała m.in. zmodyfikowany wskaźniki bezpieczeństwa żywnościowego na poziomie gospodarstw domowych – HFIAS (*Household Food Insecurity Access Scale*). Według algorytmu HFIAS, 56,5% małych gospodarstw rolnych w Polsce zadeklarowało bezpieczeństwo żywnościowe, 23,5% sklasyfikowano jako borykające się z problemem łagodnego braku bezpieczeństwa żywnościowego, 11,3% odnotowało średnie problemy, a 8,6% wskazało na poważne problemy z bezpieczeństwem żywnościowym. Aby zidentyfikować czynniki wpływające na poziom braku bezpieczeństwa żywnościowego w małych gospodarstwach rolnych, zastosowano model regresji Poissona z nadwyżką zer. Wyniki badań wskazują, że gospodarstwa mające starszego kierownika, z dziećmi, posiadające wyższe dochody dyspozycyjne *per capita* i korzystające z własnych produktów w codziennej diecie, odczuwały mniejsze problemy z bezpieczeństwem żywnościowym. Z kolei gospodarstwa hodujące krowy mleczne i mające co najmniej pięciu członków gospodarstwa domowego charakteryzowały się większymi problemami z zapewnieniem bezpieczeństwa żywnościowego.

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