Analytical assessment of some variables in cross-compliance control on livestock production farms in Croatia

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ABSTRACT

In the survey, some variables were analyzed of cross-compliance control on livestock production farms in Croatia from 2011 to 2018. Collected data covered three animal production groups: cattle, sheep and goats, and pigs, for which the following parameters were monitored: wrongly marked breed, wrong gender, incorrect labeling, no animal on the holding, and no evidence of the animal in the farm register or in the national one. A total of 621,146 animals were surveyed, and in 92,523 (14.89%) of them noncompliance was found. It ranged from 9.66% in 2012 to 26.30% in 2018. Out of 221,311 investigated cattle, 373,515 sheep and goats and 26,320 pigs, noncompliance was found in 18.74%, 13.28% and 5.58% respectively. More noncompliance was detected in 2011 when the on-the-spot control started, followed by a decrease in the amount of noncompliance observed in 2012. However, in 2013, 2014 and 2018 an increase in the proportion of noncompliance was detected (17.54%, 16.86% and 26.30% respectively), due to the introduction of new parameters, *i.e.* new risk factors used in monitoring, and a lack of adequate education of farmers to adapt to new conditions. The value of the correlation coefficient (r) between the proportion of a particular production group of animals in the total number of animals, and the proportion of non-compliant animals in that production group for cattle was -0.232, for sheep and goats 0.637, and for pigs -0.317. For cattle and pigs this implies a negative but very weak correlation, and for sheep and goats a positive but moderate correlation. This means that there is not sufficient evidence of a strong negative correlation between those two variables, which was the hypothesis. The most important noncompliance item in cattle was no identification in the central register (26.25%), and the wrong gender (25.00%) in sheep and goats. The findings imply that more frequent training, as well as improvement of cooperation between all stakeholders should be obligatory measures for better farm management, resulting in reduced frequency of noncompliance.

Key words: Common Agricultural Policy; livestock production farms; income support; cross-compliance; control strategy

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Introduction

Agricultural activities in the EU have been regulated by the Common Agricultural Policy (CAP), aimed at increasing farm sustainability by defining standards for livestock production, and animal, plant and public health, animal welfare as well as environmental protection and food safety. The main instrument of the CAP is cross-compliance (EC, 2003) introduced in 2003, which includes two elements: the Statutory Management Requirements (SMR) with 19 standards in the areas of the environment, food safety, animal health and welfare, and the Good Agricultural and Environmental Conditions (GAEC) referring to the soil, habitat and water protection standards. The cross-compliance policy is a policy for implementing environmental objectives, and it is a way to organize and reward good public agricultural production. The aim of the cross-compliance is to help EU farmers through income support and market measures, ensuring sustainable rural development. In order to enhance cross-compliance, in 2007 the Farm Advisory System (FAS) was implemented and the Integrated Administration and Control System (IACS) introduced within CAP (EC, 2003; SCHRAMM and SPILLER, 2003; GAY et al., 2005; HOFFSTADT, 2008; EC, 2009a; EC, 2009b; EC, 2010; DARIE, 2013; JOVANIC and DELIC, 2013; MEYER et al., 2014; BOZZINI and HUNT, 2015; SPERONI et al., 2015; KNUTH et al., 2018; ABBASI et al., 2019).

Implementation and organization of the FAS in the EU had no specified criteria and therefore the structure of the FAS has been characterized by high diversity, and is usually organized under the responsibility of coordinating bodies (as public or private bodies, or mixed public and private bodies), ministries of agriculture, or chambers of agriculture at national and regional levels. In most Member States (MS) it was set at a national level, while in some MS, such as Italy, Great Britain, Belgium and Germany, the FAS policy was implemented at regional levels (EC, 2013a; EC, 2013b; JOVANIC and DELIC, 2013; KNUTH et al., 2018). Basic monitoring systems include: monitoring of advice application at the farm level, monitoring of the operating advisory bodies, and monitoring of the overall functioning of the system (JOVANIC and DELIC, 2013). Veterinarians have an important role in the FAS. In Germany, the "Integrated Veterinary Herd - Health Advisory System" (IVAS) has been implemented in all independent controlling systems, with a strong emphasis on animal husbandry, animal health, food safety and quality, which play a decisive role in the Farm Advisory System (PFLUG and MANSFELD, 2009).

In Croatia, the FAS and cross-compliance have been organized at the national level and were implemented in 2011 by the Paying Agency in Agriculture, Fisheries and Rural Development, which was established according to the Law regulating the Paying Agency in Agriculture, Fisheries and Rural Development (OFFICIAL GAZETTE 30/09). This Agency was established as a public institution aiming to implement the CAP through market and structural support measures in agriculture, fisheries and rural development. Immediately after its establishment, the Integrated Administration and Control System (IACS) was implemented in order to identify applicants accurately and to monitor the results of on-the-spot control. On-the-spot controls, including on-the-spot checks, are activities to control cross-compliance *e.g.* to verify the fulfilment of requirements under the conditions for which aid is paid out. On-the-spot controls are conducted in accordance with the Ordinance on Cross Compliance (OFFICIAL GAZETTE 32/15, 45/16, 26/18, 84/18), which defines the statutory management requirements described for each production group of animals.

The aim of this study was to provide, for the first time, an analysis of the FAS policy process and outcomes in Croatia, by monitoring the results of on-the-spot controls, in order to enhance farm sustainability through cross-compliance, as well as to evaluate the results regarding the improvement of attitudes towards domestic animals and their production.

Materials and methods

The implementation of the cross-compliance control process was analyzed using the Integrated Administration and Control System (IACS) database, applied and managed in the Republic

of Croatia by the Paying Agency for Agriculture, Fisheries and Rural Development from 2011 to 2018. Implementation of cross-compliance and the Common Agricultural Policy in general were analyzed on the basis of on-the-spot control identification methodology (EC, 2009b). Cross-compliance was determined for each production group of animals according to the Specify field No II of the Regulation (EC, 2009a) of the Statutory Management Requirements (SMR) applied for identification and registration of pigs (SMR 6), cattle (SMR 7) and sheep and goats (SMR 8) (DARIE, 2013).

From 2011 to 2018, a total of 17,344 holdings and 621,146 animals were monitored, including 221,311 cattle, 373,515 sheep and goats, and 26,320 pigs. The farms included in the study were selected on the basis of a mix of random and risk-based samples of farmers. The risk analysis included monitoring and control of 23 risk factors that can be identified and used for each year individually, depending on the current legislation, audit recommendations or previous experience, which are part of the prescribed procedure (Selection procedure for field controls by random selection and risk analysis (L1_PO of April 22nd, 2013) and the Ordinance on Cross Compliance (OFFICIAL GAZETTE 32/15, 45/16, 26/18, 84/18). In order to ensure the representativeness of the sample, the overall selection was carried out by random selection of 20-25% of all the farms and 75-80% of the risk-based farms.

The cross-compliance was determined as the result of on-the-spot controls with a finding of noncompliance. Noncompliance was observed for each production group of animals as follows: (1) wrongly marked breed, (2) wrong gender, (3) incorrect labeling, (4) no animal on the holding, (5) no evidence of the animal in the farm register, (6) no evidence of the animal in the national register, according to the Ordinance on Cross Compliance (OFFICIAL GAZETTE 32/15, 45/16, 26/18, 84/18).

The analysis of the results included temporal as well as spatial characterizations. The data were analyzed using the univariate (frequency) and two-variate (chi-square test) method, correlation and linear regression. Differences at P<0.05 or lower were considered statistically significant.

Results

The results of the on-the-spot controls performed during the 8-year study period, from 2011 to 2018, are presented in Table 1. Out of 621,146 observed animals noncompliance was found in 92,523 or 14.89% of animals, which ranged from 9.66% in 2012 to 26.30% in 2018. Out of 221,311 investigated cattle, 373,515 sheep and goats, and 26,320 pigs, noncompliance was found in 18.74%, 13.28% and 5.58%, respectively. In 2011, out of 83,904 observed animals noncompliance was detected in 12,112 or 14.44% of all the animals. Out of all the animals observed, a statistically significant higher percentage of noncompliance was found in cattle (30.61%) as compared to sheep and goats (9.40%) and pigs (3.72%) (P<0.05).

The temporal trend of the proportion of animals presenting with noncompliance between 2011 and 2018 is shown in Fig. 1. The highest percentage of noncompliance in cattle was observed in 2011 (30.61%), 2014 (21.92%) and 2018 (37.85%), in sheep and goats in 2013 (18.89%), and in pigs in 2015 (15.57%).

Table 2 shows the results of on-the-spot controls made in the individual Croatian counties from 2011 to 2018. Out of the total number of animals observed, the lowest proportion of noncompliance was found in animals in central northern counties, while the majority of noncompliance was found in eastern and southern counties.

The changes in trends show that the highest amount of noncompliance in animals compared with 2011 was found continuously in Primorsko-Goranska County with the peak in 2017. The second significant peak of noncompliance in animals was determined in Međimurje County in 2015. A higher proportion of noncompliance compared to the first year of cross-compliance implementation, was detected in 11 counties in 2014, ranging from 5% (Zadar County) to as much as 83% (Vukovar-Srijem County), and in 18 counties in 2018 it ranged from 15% (Krapina-Zagorje County) to 90% (Zagreb County).

Table 1. The number of investigated animals and noncompliance found from 2011 to 2018

Year	All animals			Cattle			Sheep and goats			Pigs		
	Number of investigated animals	Noncompliance found		Number of investigated animals	Noncompliance found		Number of investigated animals	Noncompliance found		Number of investigated animals	Noncompliance found	
		N	%		N	%		N	%		N	%
2011	83,904	12,112	14.44	21,574	6,602	30.61	56,153	5,279	9.40	6,177	230	3.72
2012	74,119	7,163	9.66	24,233	3,078	12.70	47,508	3,942	8.30	2,378	143	6.01
2013	70,881	12,430	17.54	14,292	2,104	14.73	54,285	10,254	18.89	2,304	72	3.13
2014	58,011	9,781	16.86	8,695	1,906	21.92	45,777	7,776	16.98	3,539	100	2.83
2015	72,354	8,212	11.35	21,757	1,116	5.13	45,884	6,364	13.87	4,713	734	15.57
2016	74,384	8,006	10.76	33,422	1,708	5.11	38,354	6,236	16.26	2,608	62	2.38
2017	88,220	8,720	9.88	39,096	2,910	7.44	46,299	5,752	12.42	2,825	59	2.09
2018	99,273	26,099	26.30	58,242	22,044	37.85	39,255	3,984	10.15	1,776	68	3.83
Total	621,146	92,523	14.90	221,311	41,468	18.74	373,515	49,587	13.28	26,320	1,468	5.58

Comparing the results of the current year with those of the past period (past year) noncompliance was higher in a large number of counties, *e.g.* in 17 counties in 2013, 14 counties in 2016, 10 counties in 2017, and 20 counties in 2018. A significant increase in noncompliance was detected in 2018 compared to 2017, especially in Vukovar-Srijem County (P<0.05).

Comparison of all noncompliance found in a particular production group of animals (cattle, sheep and goats, and pigs) as well as in each county during the study period is presented in Fig. 2,3,4.

As can be seen in Fig. 2, the majority of noncompliance found in cattle during the study period was detected in 2011 (30.61%), 2013 (14.73%), 2014 (21.92%) and in 2018 (37.85%).

Out of all the cattle observed in 2011 and 2013, the highest proportion of noncompliance was found in the counties located in Southern Croatia, including Istria, Lika-Senj, Split-Dalmatia and Zadar County, it and ranged from 50.82% (Lika-Senj County) to 94.84% (Zadar County) in 2011 and from 54.10% (Split-Dalmatia County) to 93.10% (Zadar County) in 2013. In 2014 it was found in Osijek-Baranja (72.94%) and Vukovar-Srijem County (78.38%), which was significantly higher than in other counties (P<0.05).
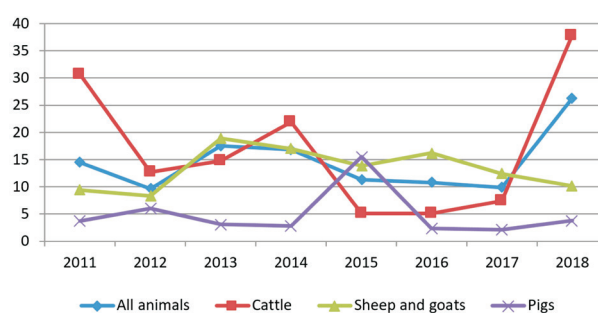

Fig. 1. The temporal trend of the proportion of noncompliance found in animals between 2011 and 2018 in Croatia

The highest amount of noncompliance in sheep and goats was found in 2013 (18.89%) and 2014 (16.98%). A significantly higher incidence of noncompliance in sheep and goats was found in Zagreb County (61.80%), and slightly less, but still significantly higher than in other counties, in Istria, Primorje-Gorski Kotar, Split-Dalmatia and Šibenik-Knin County, where it ranged from 23.75% to 29.83% (Fig. 3).

Out of all the pigs observed, the highest amount of noncompliance in this production group was found in 2015 (15.57%) and 2012 (6,01%) (Table 1). In 2015 a statistically higher proportion (87.00%) of noncompliance was found in Međimurje County (P<0.05) (Fig. 4).
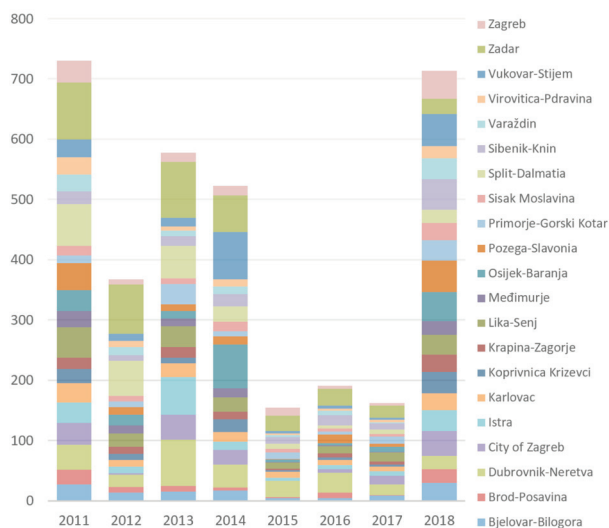
Fig. 2. The proportions of noncompliance found for cattle by counties from 2011 to 2018

The results of the analysis of noncompliance by group of production animals, based on individual variables, showed that the most important noncompliance items in cattle were the wrong breed and sex assessment during 2015 and 2016, incorrect labeling in 2017, and in 2018 "not found on the farm". In sheep and goats, in 2015 and 2016, the largest non-compliance was the lack of an ear tag and misjudged gender. These deficiencies were reduced in 2017 and 2018, but there was an increase in the number of animals that were not registered or were not present on the farm.
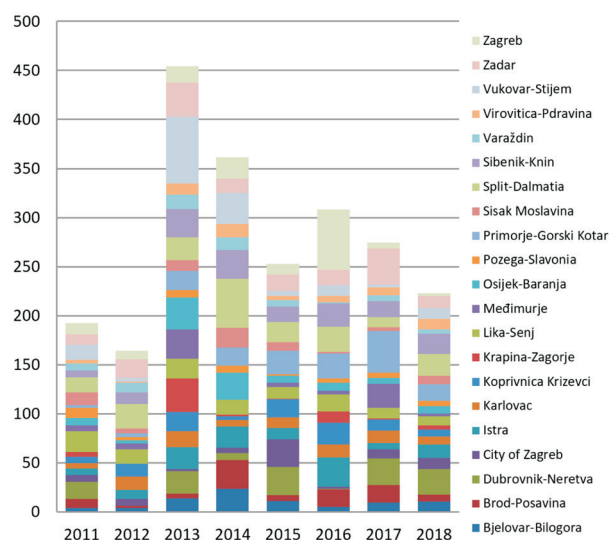

Fig. 3. The proportions of noncompliance found for sheep and goats by counties from 2011 to 2018
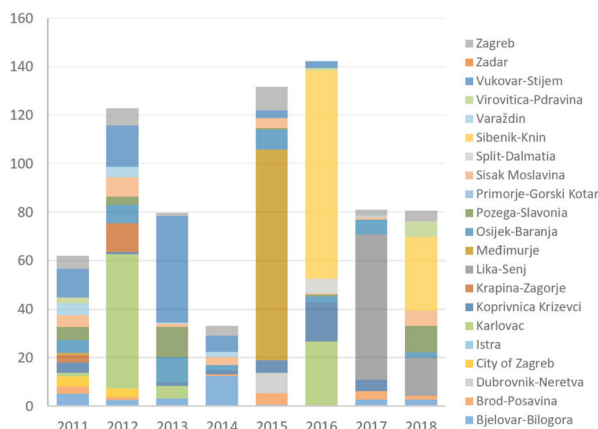

Fig. 4. The proportions of noncompliance found for pigs by counties from 2011 to 2018

$y=ax+b$
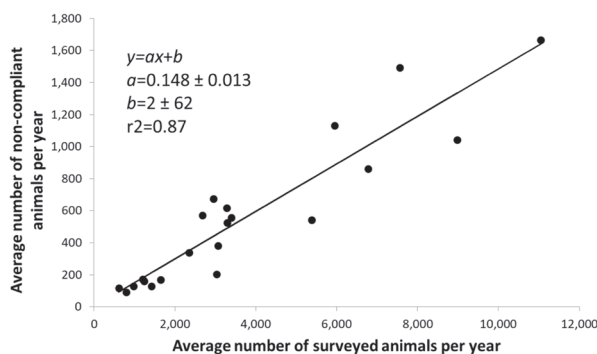$a=0.148 \pm 0.013$
$b=2 \pm 62$
$r2=0.87$

Fig. 5. The dependence of the number of non-compliant animals on the number of surveyed animals

Table 3 shows the proportion of production group, proportion of non-compliant animals, the average number of surveyed, and the average number of noncompliant animals. In the whole sample, the average non-compliance per county was most frequent in cattle (19.63%), then in sheep and goats (12.24%) and then in pigs (7.24%).

The dependence of the number of non-compliant animals on the number of surveyed animals shows the expected linear dependence (Fig. 5)

Table 2. The results of on-the-spot checks undertaken in individual Croatian counties between 2011 and 2018

County	All animals			Cattle			Sheep and goats			Pigs		
	Observed	Noncompliance found N	%	Observed	Noncompliance found N	%	Observed	Noncompliance found N	%	Observed	Noncompliance found N	%
Bjelovar-Bilogora	71,869	8,327	11.59	33,998	4,824	14.19	34,893	3,390	9.72	2,978	113	3.79
Brod-Posavina	13,152	1,348	10.25	7,128	900	12.63	4,466	409	9.16	1,558	39	2.50
Dubrovnik-Neretva	4,903	926	18.89	1,207	317	26.26	3,684	608	16.50	12	1	8.33
City of Zagreb	7,784	1,017	13.07	1,799	525	29.18	5,580	488	8.75	405	4	0.99
Istria	9,667	1,372	14.19	3,502	548	15.65	6,049	824	13.62	116	0	0.00
Karlovac	24,493	3,057	12.48	8,071	1,233	15.28	15,705	1,797	11.44	717	27	3.77
Koprivnica-Križevci	47,609	9,051	19.01	39,018	8,194	21.00	6,430	791	12.30	2,161	66	3.05
Krapina-Zagorje	6,387	725	11.35	3,786	491	12.97	2,005	231	11.52	596	3	0.50
Lika-Senj	88,400	13,318	15.07	12,606	2,777	22.03	75,760	10,529	13.90	34	12	35.29
Međimurje	9,901	1,273	12.86	4,387	454	10.35	2,235	214	9.57	3,279	605	18.45
Osijek-Baranja	54,250	6,899	12.72	28,742	4,873	16.95	22,359	1,861	8.32	3,149	165	5.24
Požega-Slavonia	27,177	4,448	16.37	9,795	3,498	35.71	15,866	904	5.70	1,516	46	3.03
Primorje-Gorski Kotar	18,847	2,708	14.37	1,519	245	16.13	17,312	2,463	14.23	16	0	0.00
Sisak-Moslavina	43,078	4,334	10.06	18,432	2,224	12.07	23,351	2,068	8.86	1,295	42	3.24
Split-Dalmatia	21,401	4,563	21.32	2,815	441	15.67	18,499	4,117	22.26	87	5	5.75
Šibenik-Knin	26,245	4,941	18.83	3,689	882	23.91	22,526	4,046	17.96	30	13	43.33
Varaždin	11,317	1,030	9.10	4,124	565	13.70	4,723	429	9.08	2,470	36	1.46
Virovitica-Podravina	24,275	1,635	6.74	7,699	813	10.56	15,302	811	5.30	1,274	11	0.86
Vukovar-Srijem	23,594	5,391	22.85	12,821	4,110	32.06	8,644	1,118	12.93	2,129	163	7.66
Zadar	60,483	11,953	19.75	3,635	1,422	39.01	56,819	10,531	18.52	29	0	0.00
Zagreb	26,314	4,207	15.99	12,538	2,132	17.00	11,307	1,958	17.32	2,469	117	4.74
Total	621,146	92,523	14.90	221,311	41,468	18.74	373,515	49,587	13.28	26,320	1,468	5.58

Table 3. The proportions of production group, and non-compliant animals, and the average number of surveyed and non-compliant animals

		Counties																				
		Zagreb	Zadar	Vukovar-Srijem	Virovitica-Podravina	Varaždin	Šibenik-Knin	Split-Dalmacija	Sisak-Moslavina	Primorje-Gorski Kotar	Požega-Slavonia	Osijek-Baranja	Međimurje	Lika-Senj	Krapina-Zagorje	Koprivnica-Križevci	Karlovac	Istra	City of Zagreb	Dubrovnik-Neretva	Brod-Posavina	Bjelovar-Bilogora
Proportion of production group in total number of animals from 2011 to 2018 (%)	Cattle	27.30	4.04	15.00	20.14	12.59	6.04	10.20	26.95	3.96	19.29	20.50	20.61	14.13	27.59	44.23	28.73	25.54	29.83	19.83	11.46	35.26
	Sheep and goats	15.12	95.36	8.62	29.49	10.18	92.78	81.07	37.62	94.52	37.94	11.07	8.31	84.52	10.04	8.40	48.45	59.50	20.64	78.27	9.24	31.95
	Pigs	57.58	0.59	76.38	50.37	77.23	1.18	8.73	35.43	1.52	42.77	68.43	71.08	1.35	62.37	47.37	22.82	14.96	49.53	1.90	79.30	32.80
Proportion of non-compliant in surveyed animals by county from 2011 to 2018 (%)	Cattle	17.00	39.01	32.06	10.56	13.70	23.91	15.67	12.07	16.13	35.71	16.95	10.35	22.03	12.97	21.00	15.28	15.65	29.18	26.26	12.63	14.19
	Sheep and goats	17.32	18.52	12.93	5.30	9.08	17.96	22.26	8.86	14.23	5.70	8.32	9.57	13.90	11.52	12.30	11.44	13.62	8.75	16.50	9.16	9.72
	Pigs	4.74	0.00	7.66	0.86	1.46	43.33	5.75	3.24	0.00	3.03	5.24	18.45	35.29	0.50	3.05	3.77	0.00	0.99	8.33	2.50	3.79
Average number of surveyed animals per year		3,289	7,561	2,949	3,034	1,415	3,281	2,675	5,385	2,356	3,397	6,781	1,238	11,050	798	5,951	3,062	1,208	973	613	1,644	8,984
Average number of non-compliant animals per year		526	1,493	674	204	129	618	570	542	339	556	862	159	1,665	91	1,131	382	172	127	116	169	1,041

Discussion

Agriculture is an important sector for the Croatian economy, comprising 4% of the total Croatian Gross Value Added (GVA) and employing around 7.6% of the employed population in 2016. Croatia has been facing a declining trend in agricultural output ever since 2008, when the highest value of EUR 3.1 bn was reached, with only EUR 2.2 bn in 2016. As estimated by Eurostat, Croatian agricultural output dropped by approximately 30% during the period from 2012 to 2016 (EUROPEAN INVESTMENT BANK, 2018). Therefore, in the framework of the CAP, since the accession of the Republic of Croatia to the European Union, the Paying Agency has been implementing agricultural and market policies and rural development measures financed by the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Fund for Rural Development (EAFRD) (EC, 2013a; EC, 2013b), in full compliance with the rules and regulations of the European Union, for which it has been accredited in accordance with the content of the Treaty concerning the accession of the Republic of Croatia to the European Union (ANONYM., 2011). Recently, the Rural Development Programme of the Republic of Croatia for 2014-2020, adopted by the EC on May 26th 2015, describes the priorities in rural development. More than EUR 3.5 bn will be invested in the Croatian farming sector and rural areas under the CAP in the financial period from 2014 to 2020. These priorities include restructuring and modernization of the farm and food sectors, as well as enhancement of biodiversity, with investment support for approximately 2000 agricultural holdings and about 5000 farmers starting development of small farms, and around 1000 young farmers. In order to achieve these objectives, cross-compliance has been introduced as a mechanism for encouraging farmers to fulfill certain environmental conditions, and to organize and reward good agricultural public production (MEYER et al., 2014.).

In this research, implementation of cross-compliance has been analyzed for the first time according to the results of on-the-spot checks, at the level of the total number of domestic animals and individual animal production groups.

Based on these results, it is evident that during the investigated period (2011-2018), 14.90% of noncompliance in keeping animals was found (Table 1). A large amount of noncompliance was detected in 2011 when on-the-spot checks started, followed by a decrease in the incidence of noncompliance observed in 2012. In that year 1.49 times less noncompliance was found than in 2011, which indicates a good approach in educating livestock farmers as well as all stakeholders in livestock production. However, in 2013, 2014 and 2018 increases in the proportion of noncompliance were detected. In 2013, 17.54% of noncompliance was found, which is almost twice that in 2012 and about 18% higher than in 2011, when monitoring started (Table 1, Fig. 1).

The reason for the increase in the proportion of noncompliance in 2013 and 2014, was the introduction of new parameters, i.e. new risk factors used in monitoring, and at the same time a lack of adequate education of farmers to help them adapt to new conditions. FOČIĆ et al. (2013) determined that after the accession of the Republic of Croatia to the European Union, Croatian farmers did not have adequate information about the new environmental standards of the CAP and how those environmental standards will affect their future work and business decisions, which resulted in the farmers' belief that adjustment of Croatian agriculture to the CAP would be demanding, as a consequence of the generally bad situation in the country, the poor education of farmers and the large administrative burden imposed by the EU. In 2014, fewer farms were inspected than in 2013, but at the same time an increase in the proportion of noncompliant farms was detected. The main reason was the relative unpreparedness of farmers to the newly introduced animal identification and labeling requirements. With the introduction of training for farmers in 2015, the proportion of noncompliance in the total number of animals was reduced over the following two years (Table 1).

The statistically significant increase in the proportion of noncompliance in 2018 was found after the introduction of new parameters related to animal welfare (control of animal welfare risk factors), which was not proportionally followed by the pace of farmers' adaptation to the new regulatory requirements.

The proportions of noncompliance found in Croatia are in accordance with cross-compliance infringements reported by Member States from 2011 to 2015 based on checks performed on a mix of random and risk-based samples of farmers. Namely, in Member States, 21% of noncompliance was found in 2011, in 2012 and 2013 a small decrease (20%) was detected, followed by an increase in 2014 (25%) and 2015 (29%) (MILIONIS et al., 2016).

The results of on-the-spot controls made in the individual counties between 2011 and 2018 showed that a significantly higher percentage of noncompliance in the total number of animals was detected in Vukovar-Srijem County (22.85%) and Split-Dalmatia County (21.32%). In Vukovar-Srijem County, which is one of the most important agricultural areas, especially in cattle and pig production, non-compliance was found in all production groups, (in cattle 32.06%, in sheep and goats 12.93%, in pigs 7.66%). In Split-Dalmatia County the highest number of noncompliance was found in sheep and goats (22.26%) and then in cattle (15.67%). (Table 2).

An analysis of the temporal characteristics of noncompliance according to counties, using the trend index showed that a significant increase in non-compliance compared to 2011 was found in Primorsko-Goranska County because of the very high number of noncompliance in cattle, in Međimurje County in 2015 (an increase in the amount of noncompliance in pigs (87.00%)) and in all counties in 2018.

An analysis of the chain index trend can monitor changes (increases or decreases) in noncompliance during the observed period, comparing the result of the current conditions (year) with that of the past year. The chain index trend showed that the amount of noncompliance found in 2012 was similar to the noncompliance in 2011, *e.g.* at the beginning of the implementation of the cross-compliance policy. However, in the following year the amount of noncompliance was higher in all counties except in Split-Dalmatia County. In the subsequent years an increase was evident in the amount of noncompliance in 2015 in Međimurje County, Dubrovnik-Neretva County and the City of Zagreb,

in 2016 in Požega-Slavonia County, and in 2017 in Dubrovnik-Neretva County. In total, in 2012 there were eight counties with more noncompliance than in 2011. In 2013 there were seventeen counties, 11 counties in 2014, 14 in 2016, 10 in 2017, and 20 in 2018, which showed an increase in noncompliance compared to the previous year.

Analysis of the frequency of noncompliance at the level of each individual standard/requirement showed that the most important noncompliance items in cattle were identification of animals (wrong breed (24.99%) and gender assessment (25.00%), incorrect labeling (23.98%)) and registration (animals were not found on farms (23.46%) or no identification in the register on the farm (23.57%) or in the central register (26.25%)). In EU countries no identification and registration of cattle was found to account for about 28% of all noncompliance (Milionis et al., 2016). Similar results were also found for sheep and goats. The largest amount noncompliance related to the lack of ear tags (23.33%) and wrong gender (25.00%). The frequency of wrong identification of sheep and goats was slightly higher than that in other Member States, where about 13% was determined (MILIONIS et al., 2016).

Our hypothesis was that the higher the proportion of a particular production group of animals the lower the proportion of non-compliant animals in that production group (Table 3). The reason for this is that the higher the proportion of a particular production group of animals is, the less likely it is that farmers will make mistakes in meeting cross-compliance standards for that group of animals, since they are more highly trained in taking appropriate care of them. This implies a strong negative correlation between the proportion of a production group in the total animals and the proportion of non-compliant animals in that group. However, a comparison of the proportion of the production groups of animals in the total number of animals per county in that period (2011-2018) with the proportion of non-compliant animals in that production group points to the conclusion that average noncompliance per county is most frequent in cattle (19.63%), then in sheep and goats (12.24%), and lastly in pigs (7.24%) regardless of

their high proportion in the total number of animals per county. The value of the correlation coefficient (r) between the proportion of a particular production group of animals in the total number of animals and the proportion of noncompliant animals in that production group for cattle is -0.232, for sheep and goats 0.637 and for pigs -0.317. The r values for cattle and pigs imply a negative but very weak correlation, and the value for sheep and goats a positive but moderate correlation. Therefore, our hypothesis was disproved which means that there is not sufficient evidence of a strong negative correlation between those two variables.

The dependence of the number of non-compliant animals on the number of surveyed animals shows the expected linear dependence (Fig. 5). This is a consequence of the assumption that (a priori) the probability of finding a non-compliant animal is the same in all counties. The linear dependence of the number of non-compliant animals with respect to the surveyed ones shows that there are no additional significant factors that differ by county, which could affect non-compliance. However, a finer analysis of the data shows that, compared to the expected number of non-compliant animals, in some counties the actual number of non-compliant animals deviates significantly. For example, in Vukovar-Srijem it is 52% and in Split-Dalmatia 42% higher, while in Virovitica-Podravina it is 55% and in Varaždin County 40% lower than expected.

A more detailed interpretation of these relationships is limited by the lack of more precise data on the socio-economic structure of the livestock holdings on which cross-compliance controls are carried out. The conclusions of this research are solid guidelines and a valuable framework for further more detailed analysis.

According to the temporal and spatial analyses of the implemented cross-compliance strategy, it may be seen that, despite the different structure of agricultural holdings in Croatia (in 2016 there were 96.86% family farms, 1.50% companies, 1.29% small private businesses ("crafts") and 0.23% (cooperatives) (EUROPEAN INVESTMENT BANK, 2018), as compared to the EU Member States, the frequency of noncompliance found between 2011 and 2018 was not much different from that reported for the Member States. However, significant fluctuations in the amount of noncompliance was found between the years and between the counties, as well as the different production groups (cattle, sheep and goats, and pigs). Statistically significant temporal fluctuations in the amount of noncompliance were usually related to the introduction of new requirements and the lack of timely education.

Therefore, more frequent training as well as the improvement of the cooperation of all stakeholders involved in the implementation of agricultural policy in Croatia are the obligatory measures for increasing the awareness of individual farmers about the proper and sustainable management of their farms, which would result in reduced frequency of noncompliance.

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SAŽETAK

U ovom su istraživanju analizirani učinci nekih varijabli kontrole višestruke sukladnosti na stočarskim farmama u Hrvatskoj od 2011. do 2018. godine. Prikupljeni podaci obuhvaćaju tri proizvodne skupine životinja: goveda, ovce i koze, te svinje, za koje su praćeni sljedeći parametri: pogrešno označena pasmina, pogrešan spol, pogrešno označivanje, životinje nema na gospodarstvu, životinja nije navedena u registru poljoprivrednog gospodarstva ili u središnjem registru. Ukupno je istraženo 621 146 životinja, a u njih 92 523 (14,89 %) utvrđena je nesukladnost. Ona se kreće u rasponu od 9,66 % u 2012. godini do 26,30 % u 2018. godini. Nesukladnost je utvrđena u 18,74 % od 221 311 istraženih goveda, u 13,28 % od 373 515 ovaca i koza te u 5,58 % od 26 320 svinja. Velik broj nesukladnosti utvrđen je 2011., kad je započela terenska kontrola, te je zatim smanjen 2012. godine. No zatim je zbog uvođenja novih parametara, tj. novih čimbenika rizika i nedostatka odgovarajuće edukacije poljoprivrednika za prilagodbu novim uvjetima, uočen porast nesukladnosti, i to 17,54 % u 2013., 16,86 % u 2014. i 26,30 % u 2018. godini. Vrijednost koeficijenta korelacije (r) između udjela određene proizvodne skupine životinja u ukupnom broju životinja i udjela nesukladnih životinja u toj proizvodnoj skupini za goveda iznosi -0,232, za ovce i koze 0,637, a za svinje - 0.317. Kod goveda i svinja korelacija je negativna, ali vrlo slaba, a kod ovaca i koza pozitivna, ali umjerena. To znači da nema dokaza o snažnoj negativnoj korelaciji između tih dviju varijabli, što je bila hipoteza. Najvažnija nesukladnost u goveda bila je nepostojanje životinje u središnjem registru (26,25 %), a kod ovaca i koza pogrešan spol (25,00 %). Rezultati upućuju na to da su učestalije edukacije i poboljšanje suradnje svih dionika u kontroli višestruke sukladnosti nezaobilazne mjere za bolje upravljanje poljoprivrednim gospodarstvima te time i smanjenje nesukladnosti.

Ključne riječi: zajednička poljoprivredna politika; stočarske farme; potpore dohotku; višestruka sukladnost; strategija kontrole