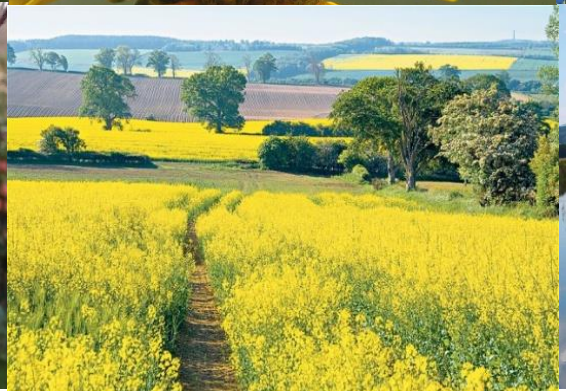
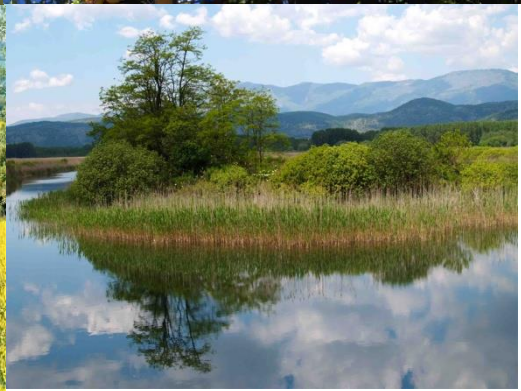
NATIONAL ACTION PLAN TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES

REDUCING RISKS, INCREASING ENVIRONMENTAL PROTECTION AND HUMAN AND ANIMAL HEALTH





REPUBLIC OF CROATIA
GOVERNMENT OF THE REPUBLIC OF CROATIA
MINISTRY OF AGRICULTURE

NATIONAL ACTION PLAN TO ACHIEVE SUSTAINABLE USE OF PESTICIDES for the period 2013–2023

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CONTENTS

INTRODUCTION

The National Action Plan to achieve the sustainable use of pesticides (NAP) has the objective of reducing risks to human and animal health and to the environment associated with pesticide use, and stimulating integrated and alternative measures to controling pests, in such a way that it:

- develops a better understanding of the methods of pesticide use,
- ensures the application of scientific and other evidence to recognise pesticides and procedures requiring attention, aimed at developing and promoting measures and procedures that will reduce the detrimental impacts of the use of these chemicals, and enable the user to economically control pests, diseases and weeds,
- ensure the recognition of the roles of all stakeholders and interest groups in achieving the common goal to achieve the sustainable use of pesticides.

The NAP pertains only to those pesticides that are considered plant protection products, as defined in Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 on the placing of plant protection products on the market.[1]

The draft NAP is prepared by the authorised directorate of the Ministry of Agriculture, and is adopted by the Government of the Republic of Croatia. The NAP will be developed and implemented in cooperation with key stakeholders, interest groups, scientific and expert institutions, associations and organisations. The NAP is adopted for the period 2013–2023 and is reviewed at least once every five years.

The NAP establishes the quantitative assumptions, objectives, measures and timetables to reduce the risks and impacts of pesticides on human health and the environment, and stimulates the development and implementation of integrated pest management, and of alternative approaches or techniques in order to reduce dependency on the use of pesticides. These objectives may cover different areas of concern, for example worker protection, protection of the environment, residues, use of specific techniques or use in specific crops.

The NAP also includes indicators to monitor the use of plant protection products (PPP) containing active substances of particular concern,[2] especially if alternatives are available.

In the drafting and revision of the NAP, account is taken of the health, social, economic and environmental impacts of the measures envisaged, of specific national, regional and local conditions and all relevant stakeholder groups. Other legal provisions regulating the use of pesticides shall also be taken into consideration, such as the measures prescribed by Directive 2000/60/EC European Parliament and of the Council.[3]

LEGAL BASIS

At the EU level, adoption of Council Directive 91/414/EEC[4] on the placement of plant protection products on the market in 1991, the common criteria were given for the assessment of active substances and preparations, and the assessment of risk for human and animal health and environmental protection. Despite the establishment of the common legislative framework at the EU level, undesired pesticide residues can still be found in the soil, water and environment. Also, in a certain percentage of agricultural products of plant and animal origin, pesticide residues above the maximum residue levels (MRLs) can also be found.

For the above reasons, in 2002 the Thematic Strategy on the Sustainable Use of Pesticides was adopted at the EU level. This established a series of measures to achieve the general objectives, to reduce the risks to the environment, human and animal health.

Following adoption of the Strategy, a series of legislative measures ensued, aimed at creating the legal basis for achieving the general objectives. In 2005, the new *Regulation on maximum residue levels of pesticides in or on food and feed of plant and animal origin*[6] was adopted. The Directive on the establishment of a framework for Community action to achieve sustainable use of pesticides,[7] Regulation concerning statistics on plant protection products[19] and the Directive on the certification of pesticide application equipment[8] were adopted in 2009. For complete achievement of the Strategy objectives, it was necessary to perform a revision of the Directive on the placement of PPPs on the market, which was replaced with the new *Regulation on the placement of plant protection products on the market*.[1]

In Croatia, the provisions of the Act on Plant Protection Products[5] governs the system of authorization and the issuance of decisions on the authorization of PPPs that approves their placement on the market, use, conditions of their use, restriction of use, terms for distributors and users of PPPs, conditions for pesticide application equipment, post-authorization control of PPPs, monitoring of pesticide residues, inspection control and other requirements pertaining to PPPs and their use.

The provisions of this Act are aligned with the provisions of the Council Directive 91/414/EEC[4] on the placement of plant protection products on the market. The said Act has also established an action framework at the national level in those segments that are not regulated at the European Union (EU) level. The said Directive[4] was replaced by Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October concerning the placing of plant protection products on the market[1]. The application of this Regulation[1] for EU Member States began on 14 June 2011, and as of the date of accession of the Republic of Croatia (RH) in full EU membership, it will be directly applicable in Croatia. This Regulation establishes higher requirements and standards for the assessment of active substances used in PPPs and ensures greater environmental protection and human and animal health.

Regulation (EC) 396/2005 of the European Parliament and of the Council of 23 February 2005 on the maximum residue levels of pesticides in or on food and feed of plant and animal origin[6] establishes a higher level of consumer protection from exposure to pesticide residues through food. The provisions of this Regulation[6] were transposed into the national legislation[6] in 2008. The Regulation will be directly applicable as of the date of accession of Croatia into full EU membership, and the national legislation[6] transposing the provisions of this Regulation[6] will cease to have effect.

With the adoption of Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 on the establishment of a framework for Community action to achieve sustainable use of pesticides[7] and the transposition of its provisions into the national legislation,[7] the legal grounds were put in place for the drafting and adoption of the NAP for achieving the sustainable use of pesticides in Croatia.

PLANT PROTECTION PRODUCTS

Plant protection products are pesticides, primarily of chemical origin, though they can also be of biological origin. They are used in agriculture, forestry and non-agricultural and public areas for the control and eradication of plant pests, such as plant pathogens and diseases, insects, nematodes, mites, pest rodents and weeds and other harmful plant organisms.

Based on their intended use or targeted pest organism, they are classified as:

- insecticides (controling insects),
- acaricides (controling mites),
- nematocides (controling phytoparasite nematodes),
- limacides (controling snails and slugs),
- corvifuges (controling attacks by birds - repellents),
- rodenticides (controling rodents),
- fungicides (controling phytopathogenic fungi),
- herbicides (controling weeds),
- growth regulators (impacting the life processes of plants other than nutrition).

Considering that the majority of PPPs are of chemical origin, it is imperative to know their chemical, physical and biological properties and their influences on humans, impacts on human health and animals, including those useful in agriculture and forestry (bees and other pollinators, other useful insects, fish, birds, mammals and other non-target organisms) and impacts on the environment. For that reason, the authorization, placement on the market and use of PPPs is governed by demanding regulations and standards. PPPs may be placed on the market and used in the territory of the Republic of Croatia only if the Ministry of Agriculture has issued a decision on their authorization. There are differences in the data on consumption of PPPs in Croatia, depending on the source of data. According to the data kept by the Ministry of Agriculture, in the period from 2004 to 2007, PPP imports were between 3600 and 4300 tonnes, and production ranged from 2800 to 5400 tonnes. The sum of imported and produced quantities of PPPs in this period ranged from 7500 to 9600 tonnes. According to the data delivered by legal persons placing PPPs on the market for the purpose of calculated fees for financing water management, a total of 7614 tonnes was placed on the market in 2011.

Table 1: *Import and production of plant production products in tonnes. Source Ministry of Agriculture 2004-2007*

PPPs (intended use)	2004	2005	2006	2007
Fungicides	3072.2	2735.5	3220.2	3851.10
Herbicides	2777.9	3039.5	4266.7	3365.33
Insecticides	978.1	765.8	783.7	627.21
Other	658.9	424.7	310.8	1728.00
TOTAL	**7487.1**	**6965.5**	**8581.6**	**9571.64**

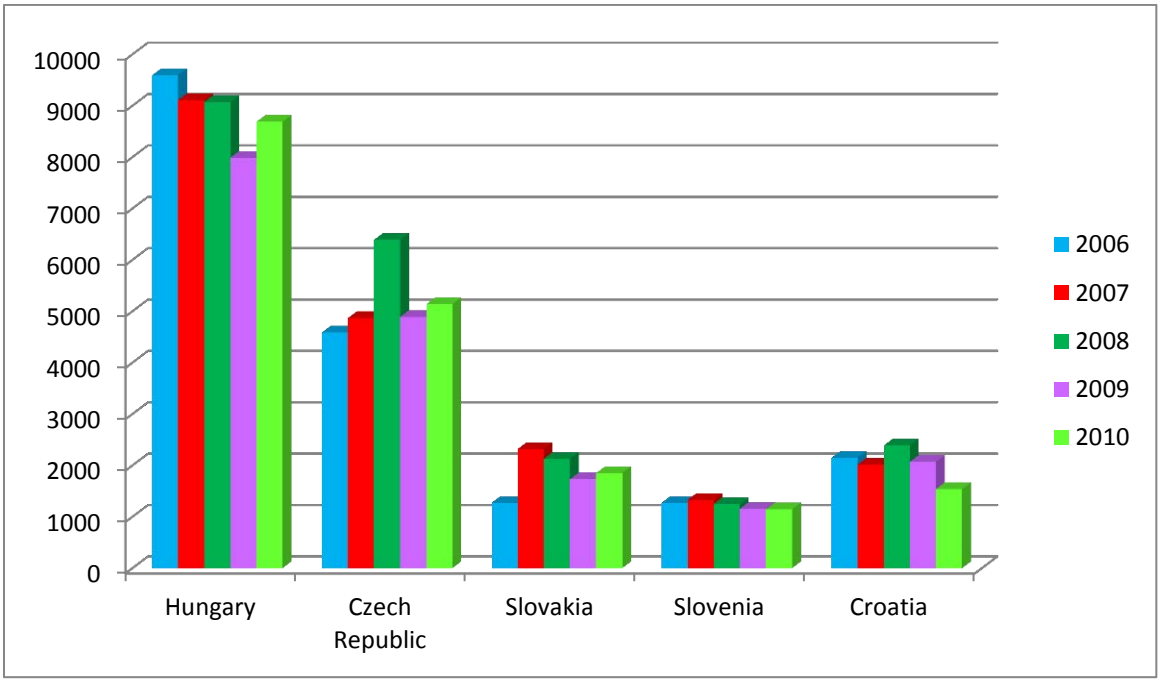
It is necessary to consider that in a year, not all quantities of PPPs imported and produced were sold to end users. Certain quantities of PPPs were also exported. Though there are no precise data on the consumption of PPPs, the Ministry of Agriculture estimates that consumption is between 4500 and 6000 tonnes per year. The use of PPPs varies through the year depending on the climatic, ecological, economic and other conditions. The Ordinance on the establishment of a framework for action to achieve the sustainable use of pesticides[7] prescribes the obligation to keep records for importers, suppliers, wholesale, retail and professional users. Distributors selling PPPs to end users are obliged to submit data on sales

to the Ministry of Agriculture to the Phytosanitary Information System (PIS) via electronic forms.

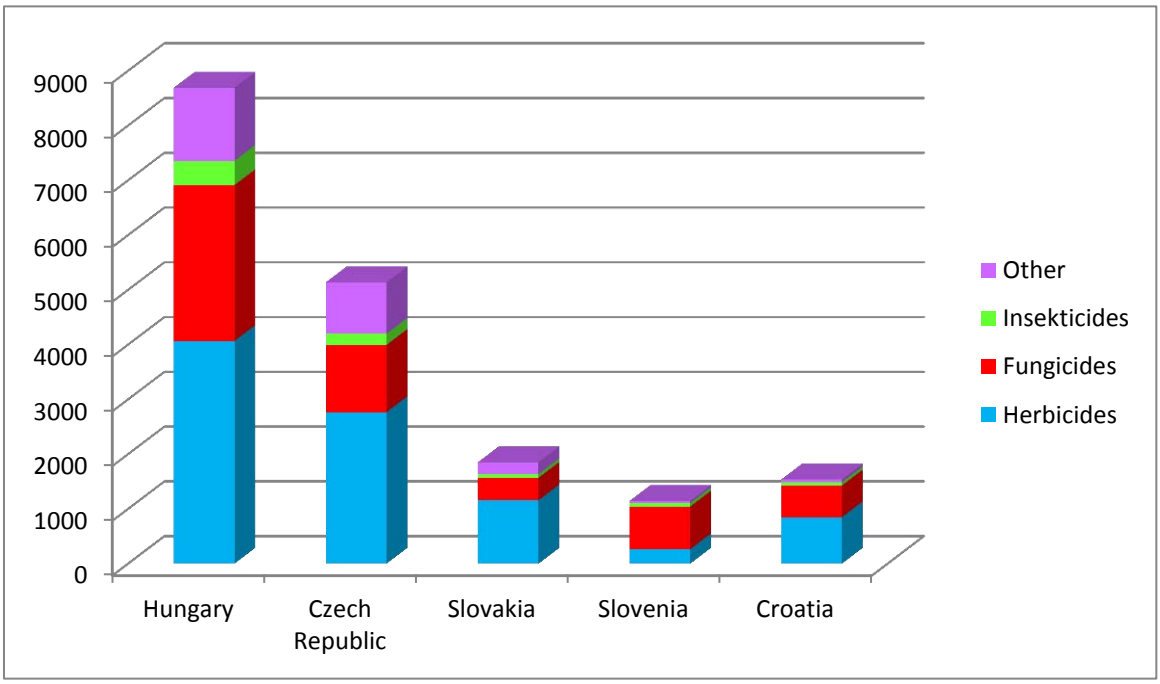
The Association of Manufacturers and Representatives of Plant Protection Products in Croatia (CROCPA) has approximate and internal data on the total sales of Association members, which was about 3605 tonnes in 2011. In the past few years, the total net sales of the Association were about EUR 52,000,000.

According to the data of the European Crop Protection Association (ECPA) collected from industry in recent years, there has been a reduction in pesticide use in EU countries and in Croatia. The highest consumption of pesticides in the EU is in France, which totalled 61,903 tonnes of active substances in 2010, followed by Italy where the consumption was 37,630 tonnes of active substances in agriculture and horticulture in 2010. The total quantity of active substances used in agriculture and horticulture in the period from 2006 to 1010 in individual EU Member States and Croatia is shown in Graph 1. The consumption of active substances in agriculture and horticulture in 2010 in individual EU Member States and in Croatia by intended use is shown in Graph 2.

Graph 1: *Consumption of active substances in '000 kg in agriculture and horticulture 2006-2010. Source: ECPA-Processing MA*



Graph 2: *Consumption of active substances in '000 kg in agriculture and horticulture and by intended use in 2010. Source: ECPA – processing MA*



The cautious use of PPPs and use in line with the label and instructions for use can achieve a significant benefit for the social community, such as an increase in yield in agricultural crops and ensuring a greater quantity of high quality agricultural products, with more competitive food prices, especially for fruits and vegetables, and high standards of communal hygiene and an urban environment. However, though PPPs fall into the class of chemicals whose properties and effects are the most researched, their use with regard to the properties of the active substances and preparations can be dangerous for humans, animals and the environment, as there are many risks associated with their use. Therefore, it is imperative that those risks be accurately and precisely estimated, and that all measures to reduce risks are taken.

In Croatia, the PPP authorization system and the plant protection measures implemented are governed by law in such a way that aims to achieve the highest degree of environmental protection and to protect human and animal health.

The majority of PPPs are used in agriculture, and there are approximate data as to the quantities used annually. The data on PPP quantities used in forestry are available, and in the past four years have averaged about 33 tonnes per year. However, there are no approximate data on the quantities of PPPs used on non-agricultural surfaces. In order to preserve biological diversity in forests, the use of biological and biotechnical PPPs are permitted, while chemical PPPs may be used only in exceptional cases if a causative agent appears that could cause significant economic damages, and there is no appropriate biological or biotechnical PPP.

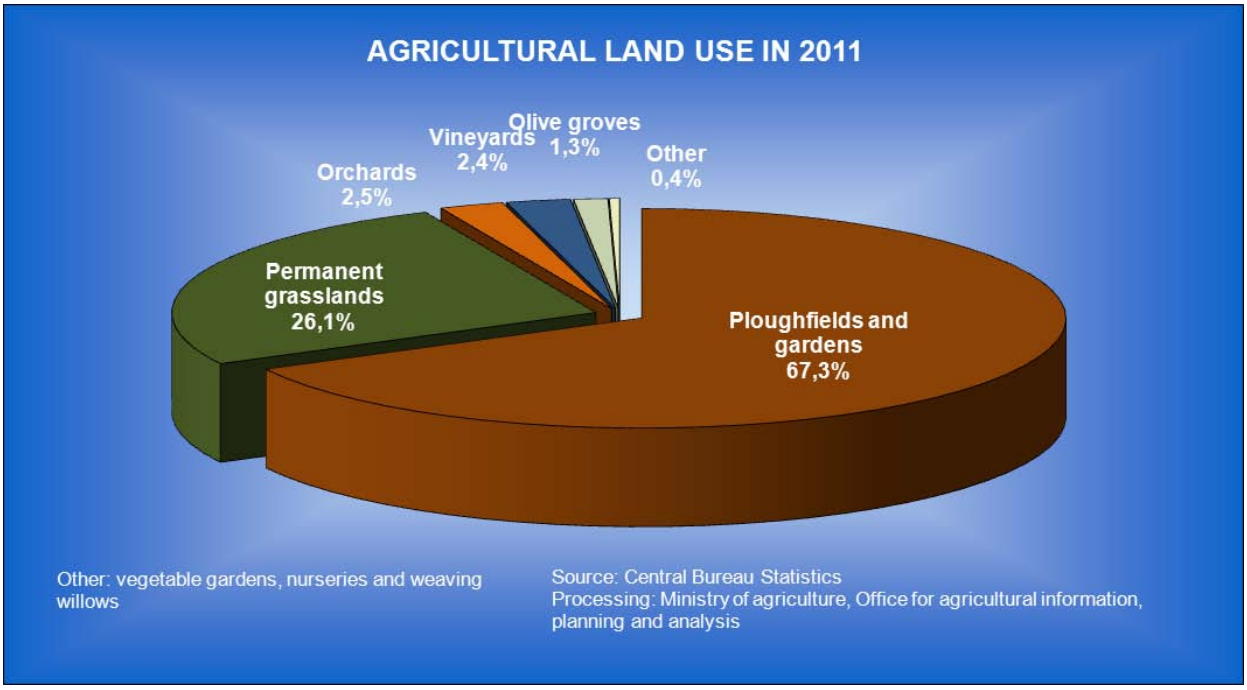
The use of PPPs on non-agricultural surfaces and in public green areas is further hindered, as they must ensure the highest level of human protection, particularly for children and other sensitive groups, and for animals and pets. Therefore, the use of pesticides in public green areas requires special measures for the protection of human and animal health and of the environment.

PLANT PRODUCTION IN CROATIA

The total surface area of the Republic of Croatia is 87,661 km^2, of which 56,594 km^2 is the terrestrial land area. The total area of forests and forest lands as established in the Forest Management Plan for 2006–2015 was 26,887 km^2, i.e. covering 47% of the total land area. Various forms of forest vegetation cover 24,028 km^2, or 42% of the land area. Land areas under permanent or preventative protection cover 8.44% of the total territory of the Republic of Croatia. Croatia has favourable agro-climatic conditions that enable diverse agricultural production. According to the data of the Central Bureau of Statistics (CBS), plant production accounted for 54.7% of the total gross production in 2011, and livestock production with 45.3%.

In 2011, a total of 1,326,083 ha of agriculture land was used for plant production, while the categories of ploughfields and gardens accounted for 67.3%, vegetable gardens for 0.3%, permanent grasslands (meadows and pastures) 26.1%, orchards 2.5%, vineyards 2.4%, olive groves 1.3% and nurseries and weaving willows 0.1%.

Graph 3: *Agricultural lands in use in 2011*



The highest share in the total agricultural plant production is the production of cereals. In the structure of cereal production, corn is the dominant crop, accounting for 64.6%, wheat with 26.1%, barley 7.3%, oats 1.9% and rye 0.1%.

The harvest areas under oil crops vary by year. In the structure of oil crops, soy is the dominant crop (65.9%), followed by rapeseed (26.7%) and sunflower (7.4%).

The production of vegetables for the market also shows oscillations in production and has recorded a slight decline. The most common types of vegetables in domestic production are

green cabbage, tomatoes, watermelon, onions and peppers, with a total production of 154,892 tonnes in 2011.

Fruit production has recorded an increase in area under permanent plantations. The total fruit production in 2011 was 244,619 tonnes of yield in 2011. In Croatia in 2011, the two most common fruits produced were apples and mandarins. A total of 17,200 ha of land was olive groves in 2011, with total olive production of 31,423 tonnes.

The total land area under vineyards in Croatia in 2011 was 32,485 hectares, with a total of 133 million vines. Grape production totalled 204,373 tonnes.

The production of industrial plants in 2011 was within the following frame: tobacco production in 2011 was 10,643 tonnes on a land area of 5,905 hectares. Production of sugar beets has been declining in recent years. In 2011, 1,168,015 tonnes of sugar beets were produced. The production of legumes for drying has been sharply declining over the past five years. In 2011, 3,776 tonnes were produced, which was only 45% the yield of 2005. The most common legumes are beans and peas for drying. A large drop in the land area under beans for drying has been recorded. A slight increase was recorded in the area under peas for drying in comparison to 2010.

In 2011, production of root and tuber crops (potatoes, fodder turnips, fodder kale and fodder pumpkins) took place on 11,795 hectares, with a total yield of 182,280 tonnes. The most common tuber crop is potato. In 2011, potatoes were grown on 10,881 hectares, with an average yield of 15.4 tonnes per hectare and a total production of 167,524 tonnes. Production of fodder plants (silage corn, other annual green fodder, clover, lucerne, grass and grass-clover mixtures, permanent grasslands, meadows and pastures) in 2011 took place on 815,833 hectares. The total recorded production in 2011 was 3,043,861 tonnes of fodder plants. The most common fodder crop was silage corn, which accounted for 31.82% of the total production of fodder plants in 2011.

Graph 4: *Ploughfields and gardens by use in 2011*

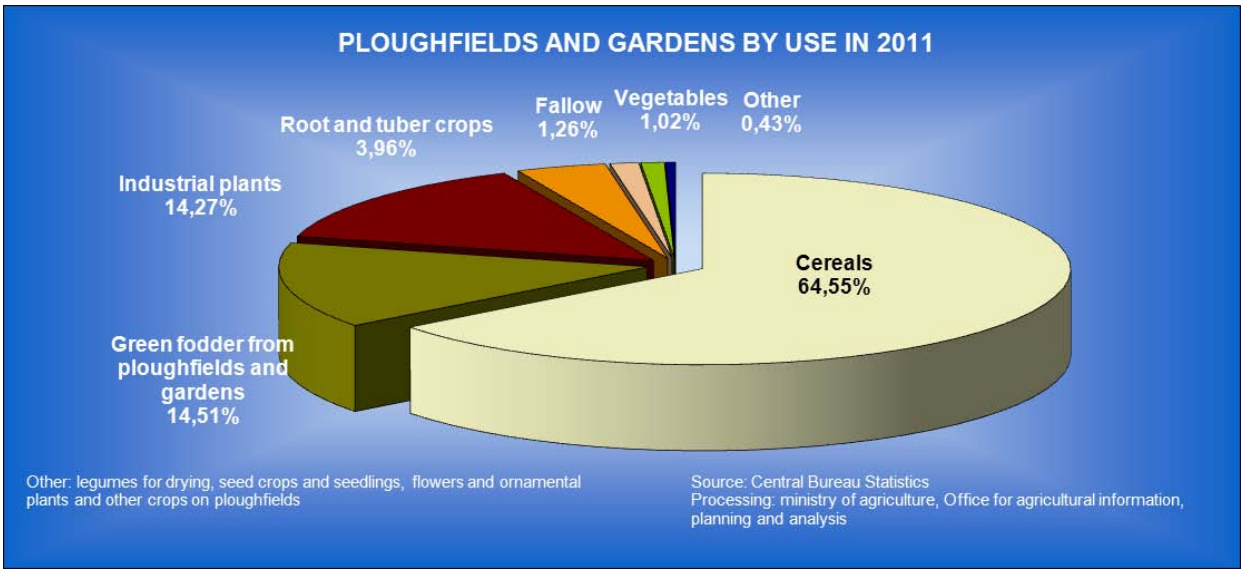


Table 2: *Land use areas, 2007-2011*

Hectares (ha)	2007	2008	2009	2010	2011
Used agricultural surfaces	**1,201,756**	**1,289,091**	**1,299,582**	**1,333,835**	**1,326,083**
Ploughfields and gardens	**846,73**	**855,416**	**863,023**	**899,594**	**892,221**
Cereals	558,59	562,47	563,132	584,663	575,938
Legumes for drying	4,843	2,958	3,016	2,889	2,534
Root and tuber crops	53,311	38,306	38,105	38,260	35,299
Industrial crops	94,055	107,668	111,310	125,209	127,343
Vegetables	12,399	12,942	12,965	9,374	9,132
Green fodder from ploughfields	105,589	117,154	120,044	126,297	129,479
Other crops on ploughfields and gardens	128	167	168	220	158
Fallow land	16,895	12,715	13,074	11,633	11,200
Flowers and ornamental plants	106	300	300	300	409
Seed crops and seedlings	814	736	909	749	729
Vegetable gardens	**5,275**	**5,337**	**5,315**	**4,902**	**4,233**
Permanent grasslands	**269,745**	**342,430**	**343,262**	**345,389**	**346,403**
Meadows	159,935	159,961	160,089	162,464	
Pastures	109,810	182,348	183,173	182,925	
Orchards, vineyards and olive groves	**79,520**	**84,645**	**86,343**	**82,694**	**82,245**
Orchards	32,720	35,933	36,659	32,889	32,560
Vineyards	32,454	33,741	34,380	32,709	32,485
Olive groves	14,346	14,971	15,304	17,096	17,200
Nurseries	**210**	**346**	**579**	**429**	**389**
Weaving willows	**276**	**917**	**1,016**	**827**	**592**
Source: CBS	Processing: Ministry of Agriculture				

According to survey data on the structure of agricultural farms, conducted by the CBS in 2010, agriculture production unfolded on a total of 232,990 agricultural farms in which 1,315,000 ha of arable lands were cultivated. In terms of their organisational form, of the total number of agricultural forms, 99% or 230,750 farms were family farms, and only 1% or 2240 farms were businesses. In 2010, one agricultural farm used an average of 5.6 ha of agricultural lands.

According to the data from the Register of agricultural farms in 2011, a total of 169,085 agricultural farms were registered, possessing 1,099,644 ha of arable lands. The average farm size was 6.5 ha. The majority of farms, 95,933 farms (accounting for 57% of the total number of farms from the Register), have less than 3 ha of agricultural lands, 65,326 farms (39% of the total number of farms from the Register) had from 3 to 20 ha of arable lands, and less than 5% of farms had 20 or more hectares of land. In terms of their organisation of operations in 2011, the majority of farms were family agricultural farms. Of the total number of farms entered into the Register of agricultural farms, 97% of farms were family farms, 1.4% of

farms were registered as crafts, and 0.9% of farms were registered as companies and 0.2% of farms were registered as cooperatives.

OBJECTIVES

General objections of the NAP are:

- To further reduce the risks associated with the use of PPPs to the health of humans, animals and the environment based on recognised risks associated with the use of certain PPPs, in particular those PPPs the use of which is the cause of particular concern,
- To reduce the levels of pesticide residues in food, drinking water and the environment including strengthening laboratory and administrative capacity for the implementation of monitoring and the number of active substances and metabolites that can be identified and including the use of non-chemical plant protection measures,
- To establish a system of training on the safe use of pesticides for professional users of pesticides, distributers and advisors with the aim of reducing risks associated with the use of pesticides and to prevent the import, procurement, distribution, sale, advising and use of PPPs targeted to professional users to persons without the appropriate permit,
- To establish a system for the regular inspection at authorised testing stations of pesticide application equipment in use, and for regular calibration and technical inspection to establish that pesticide application equipment is in good working order prior to the application of pesticides by professional users,
- The application of the principles of good agricultural practice and the fundamental principles of integrated pest management in overall plant production, the promotion of innovation in plant protection (e.g. the use of devices for the application of pesticides with aerial support, drift-reducing nozzles, new methods and techniques, etc.) and improvements to integrated pest management and the promotion, improvement and increase of areas under organic plant production,
- The application of PPPs based on harmful organism appearance forecasts made on the basis of monitoring data produced in the frame of reporting tasks,
- To improve pesticide distribution and sales systems with regard to: the facilities and rooms in which PPPs are stored and sold, equipment, record-keeping on the inventory and sales of PPPs, the quality of advice and information on safe use, restrictions to use and risks to the health of humans, animals and other organisms and the ecological risks,
- To secure the availability of information concerning pesticides to the broader public, the publication of correct data on registered PPPs, in particular in relation to risks associated with their use,
- To develop an effective system of information exchange, reporting and monitoring on progress and accomplishments in achieving the objectives of this NAP, including the establishment of specific indicators.

Specific objectives of the NAP are:

- To implement Step 1, verifying the identity of the active substance, its impurities, the types and amounts of impurities for each manufacturing facility and check all use restrictions as set forth in Part A of the Implementing Regulation listing the active substance on the list of approved active substances,
- To complete 90% of the re-assessment (re-registration) of PPPs that are registered in accordance with national legislation for alignment with the new legislation and EU standards and authorization in accordance with uniform assessment principles with the aim of achieving a higher level of safety for the protection of the environment, human and animal health,
- To develop indicators for monitoring pesticide consumption and improve the monitoring of pesticide residues in food, drinking water, groundwater and surface water and to collect monitoring results,
- To prevent the use of non authorized PPPs and unapproved uses thereof, to improve the PPP use control system in agriculture, forestry, non-agricultural areas and public areas as well as the system for the disposal of remaining stock, unused quantities, non-compliant plant protection substances, PPPs that have passed their expiry date and empty packaging,
- To improve the monitoring of PPP formulation in order to assess the compliance of PPPs on the market and to undertake appropriate action if necessary,
- To improve the level of knowledge and competence of all professional users of pesticides on the safe use of PPPs, and to ensure that all professional users, distributors and advisors complete a initial training module and regularly renew their knowledge through additional training,
- To conduct at least one regular inspection of all devices for the application of pesticides subject to inspection and to train professional users of pesticides to verify compliance and calibrate pesticide application equipment prior to the first application of the season,
- To complete development of the PIS for the authorization of PPPs, train professional pesticide users, distributors and advisors, regular inspection of pesticide application equipment, sales networks, annual PPP sales to end users and to raise public awareness about pesticides,
- To improve conditions for the application of PPPs on the basis of forecasts of detrimental pest organisms based on data from the monitoring of pests in the frame of reporting tasks,
- To collect specific relevant data related to pesticides, such as annual sales volumes, annual consumption, monitoring results, human and animal poisoning, animal mortality, bee die-off and other data related to the risk of pesticide use,
- To conduct regular NAP audits at least every five years based on collected data and the calculation of risk indicators.

Economic, social, environmental and health impacts, the current economic and financial conditions in the country and a long-term recession have been taken into consideration in the selection of measures aimed at achieving the objectives of the NAP.

MEASURES FOR ACHIEVING THE OBJECTIVES

Authorization of plant protection products

The PPP authorization system in Croatia was aligned with EU standards and requirements in the period from 2005 to 2007. Since then, the legislation has continually been aligned with new EU legislation. Documentation review and risk assessment of the active substances and their approval is conducted at the EU level. In late 2007 PPP authorization commenced pursuant to the requirements laid out in Directive 91/414/EEC[4]. At that time on the market were cca 800 PPPs and about 240 active substances authorized pursuant to national regulations. A Programme for their re-assessment (re-registration) was adopted with the aim of aligning the authorizations of existing plant protection products with EU standards and requirements and of achieving a greater level of safety to the health of humans, animals and the environment. Existing PPPs were classified into eight re-registration groups, with a deadline set for each group by which applicants were required to submit additional documentation for the re-assessment of their PPP. Meanwhile, new requests for the authorization of PPPs were conducted pursuant to the requirements set out in Directive 91/414/EEC[4] as were the measures being undertaken. The measures undertaken significantly contributed to reducing risk and achieving a greater level of protection of human health, animals and the environment. The key measures were:

- Establishing a single competent body for the authorization of PPPs pursuant to the requirements of Council Directive 91/414/EEC[4],
- Revoking the authorization of PPPs that contain active substances for which a decision has been adopted at the EU level to not include these active substances in the list of approved active substances in PPPs. As a consequence of these measures, the placement on the market and application of 162 PPPs and 75 active substances that lack documentation pursuant to EU standards or are not supported has been prohibited,
- Revoking the authorization of PPPs from re-registration groups I to VI for which the the authorization holders did not submit additional documentation for their re-assessment. The placement on the market and application of 113 PPPs was prohibited,
- 57 PPPs were re-assessed and 37 new PPPs were registered pursuant to the new authorization system,
- A review and change of authorization was conducted with the aim of harmonising approved uses with stipulated MRLs for pesticides in food and risk mitigation measures for bees and other pollinators,
- Performance of a detailed risk assessment pursuant to EU requirements and standards for every PPP prior to authorization,
- The introduction of elaborated risk mitigation measures for the environment and non-target organisms,
- Much more information for the safe application of PPPs is placed on the approved label for individual PPPs, thereby providing conditions for the safe application of PPPs,
- Through the recognition procedure of EU authorization of PPPs are approved more applications per PPP, which puts our agricultural producers in a more equal position in relation to agricultural producers in the EU, and provides them with the ability to more effectively protect plants from harmful organisms.

PPP authorization is conducted on the basis of an application submitted by an applicant/company/producer/distributor of a PPP. The Ministry of Agriculture is the competent body for the authorization of PPPs and for the issue of approvals. Two institutions are authorised for evaluation of the documentation and risk assessment in the authorization procedure:

The Croatian Centre for Agriculture, Food and Rural Affairs' - Institute for Plant Protection (CCAFRA-IPP) conducts documentation evaluation and risk assessment in the following areas: identity and physical - chemical characteristics of active substances and preparations, analytical methods, effectiveness, pesticide residues in food, ecotoxicology, fate and behaviour in the environment (ground, water, air) and the exposure of operators, workers and other persons present; and the Institute for Medical Research and Occupational Health (IMI) conducts the assessment of documentation and risk in the area of mammal toxicology and the exposure of operators, workers and other persons present.

When deciding on an application for authorization, companies take into account the expected profits from future sales of a given PPP with regard to its purpose, the number of harmful organisms it suppresses the number of crops on which it is applied, and their representation in the structure of production. For this reason, PPPs containing active substances with a lower risk (herbal extracts, substances used in human and animal nutrition, pheromone traps, microorganisms) are generally less prevalent and less used because they lack the appropriate economic justification.

The legislative framework for the authorization of PPPs at the EU level has been amended. Council Directive 91/414/EEC[4] has been replaced with Regulation (EC) No 1107/2009[1] which entered into force on 14 June 2011 for EU Member States. The direct application of this Regulation[1] in Croatia commences as of its date of accession to the EU.

Measure 1: Revoke PPPs authorizations from the remaining re-registration groups (VI-VIII), for which the authorization holders have not submitted additional documentation for their re-assessment and revoking registration of all PPPs that do not satisfy the requires laid out in Step 1 in the re-assessment procedure by 1 July 2013.

Measure 2: Withdrawal the authorizations of PPPs for which regulations are adopted at the EU level that do not approve an active substance for use in PPPs.

Measure 3: The Ministry of Agriculture shall continue the re-assessment of all registered PPPs issued according to the national legislation with the aim of harmonising their registration and use with EU requirements and standards and to reduce risks associated with their use to the environment and the health of humans and animals.

Measure 4: New legislation will provide for the direct application of Regulation (EC) No 1107/2009[1] placing of plant protection products on the market and the existing Plant Protection Products Act[5] shall be replaced by a new act.

Measure 5: The Ministry of Agriculture shall consistently, strictly and fully take into account the latest scientific knowledge on the impact of active substances and PPPs on the health of humans, animals and other organisms, and adverse effects on the environment in accordance with Regulation (EC) No 1107/2009[1] and restrict or prohibit specific PPPs that pose an unacceptable risk.

Measure 6: Registration costs will be reduced for applicants submitting an application for the authorization of a PPP containing an active substance from the group of active substances that pose less risk to the health of humans and animals and the environment (plant extracts, substances used in human and animal nutrition, pheromone traps, microorganisms, PPPs containing basic substance or active substances of low risk).

Measure 7: The Ministry of Agriculture shall adopt a new regulation on fees in the PPP registration procedure and stipulate lower fees for low-risk PPPs.

Measure 8: Continue to monitor the deadlines set by the EU when re-approving active substances at the EU level and initiate re-registration procedures for these substances in line with the stipulated deadlines.

Measure 9: Begin comparative risk assessment for active substances that are candidates for substitution when the EU guidelines for performing risk assessments are published.

Post-authorization control of plant protection products

The goal of the PPP post-authorization control programme (formulation monitoring) is to verify the compliance of registered PPPs based on the selected active substances on the market and to verify if their physical chemical properties are consistent to their authorization. Every change to a PPP may lead to the change in the effectiveness of a PPP or to threats to humans, animals or the environment.

When selecting a specific active substance, the number of PPPs based on this active ingredient on the market, previously known quality and compliance issues, lack of data on quality and compliance, and the availability of analytical methods are taken into account.

The programme is prepared and coordinated by the Ministry of Agriculture. Sampling is conducted by the agricultural inspection, while laboratory analysis of samples is conducted by CCAFRA-IPP.

Table 3: *Active substances and the number of analysed and non-compliant PPP samples. Source: MA 2007-2012.*

Programme	2007	2008	2009	2010	2011	2012
Active substance	*2,4-D & dicamba*	*pendimethalin & acetochlor.*	*bentazone*	*imidacloprid*	*chlorpyrifos*	*alpha-cypermethrin*
Total number of analysed PPP samples	35	59	44	38	39	27
Number of incompliant PPP samples	6	4	4	0	9	0

The compliance of PPPs covered by the post-authorization control programme in the period from 2007 to 2012 continues to be monitored in the frame of regular inspection controls conducted by the agricultural inspection.

The goal, along with the verification of compliance, is to warn authorization holders or their legal representatives in Croatia of the observed non-compliance and to remove non-compliant PPPs from the Croatian market.

The post-authorization control programme seeks to cover the greatest possible number of samples from the most represented (dominant) PPP batches present on the market, in order to create a clearer picture of the compliance of specific plant protection products.

Measure 1: Additional efforts need to be invested in increasing the analytical capacity of the CCAFRA-IPP laboratory, in particular for the qualitative analysis of pesticides and toxicologically relevant substances in PPP formulations, by the introduction of advanced chromatography techniques in conjunction with mass spectrometry that provides for the advanced identification of substances in samples. This would simultaneously also strengthen analytical activity in the qualitative sense and the laboratory could provide high-level support in terms of parallel import and uncovering counterfeit pesticides, the problem which becomes more relevant on the EU level .

Pesticide residues monitoring in food

The National programme for the monitoring of pesticide residues in and on products of plant origin was established pursuant to the Plant Protection Products Act[5] and has been in force since 2007.

The programme is prepared and coordinated by the Ministry of Agriculture. Sampling is conducted by the sanitary inspection of the Ministry of Health and laboratory analysis of samples by the Croatian National Institute of Public Health (CNPH). Every year, the Ministry of Agriculture revises and expands the Programme and Guidance for implementation of the programme in accordance with new insight and amendments to the EU legislation.

The objective of monitoring is to determine the quantity of pesticide residues in food and to verify compliance with stipulated MRLs.

This provides insight into the extent to which pesticide residues exceeding MRLs pose a risk to people who consume foods containing this level of pesticide residues.

Sampled products are selected according to the Commission's Implementing Regulations[20] concerning a coordinated multiannual control programme of the Union for a three year period in order ensure compliance with maximum residue levels of pesticides and to assess the consumer exposure to pesticide residues in and on food of plant and animal origin.

Products are also selected based on their importance in the diet of the population of Croatia, pesticide residues found in previous monitoring programmes, products that have not been covered by the programme and products that, because of their lower accessibility on the market, were not sampled in the planned number. The Ministry of Health samples products in accordance with the Guidance for the monitoring implementation prepared every year by the Ministry of Agriculture.

Sample collection and control procedure is conducted in large shopping centres—central distribution warehouses, wholesale markets and refrigeration plants where complete batches are more readily accessible, in shops and markets.

Cities are selected with regard to the size of the population and the prior representation of cities in the Programme.

The benefits of conducting monitoring are:

- Gaining insight into the quantity of pesticide residues in food on the Croatian market and the control of the illegal use of PPPs on products of plant origin,
- Preventing risk to people in the event that the quantity of pesticide residues exceeds MRLs,
- Acquiring information related to the use of PPPs pursuant to the instructions on labels and good agricultural practice.

Appropriate measures are taken for samples with pesticide content exceeding stipulated MRLs, taking into account measurement uncertainty.

Due to insufficient laboratory capacities, only products of plant origin are sampled and analyzed, and the number of active substances and metabolites analyzed does not satisfy the requirements of EU regulations.

In the latest Regulation (EU) No 788/2012 for 2013, 2014 and 2015, the number of active substances requiring analysis in products of plant origin is 191, while the relevant number of active substances in products of animal origin is 65.

In the frame of pesticide residue monitoring in Croatia, products of plant origin are analyzed for residues of 110 pesticide active substances (multi-residue method) as the CNPH laboratory has only a GC/MS (gas chromatography/mass spectrometry) device at its disposal.

The national monitoring programme for 2012 included the monitoring of pesticide residues in a total of 15 types of products. A total of 417 samples were analysed. Sample analysis was conducted on 110 active substances and their metabolites. 300 samples did not contain pesticide residues, 112 samples were found to have residues below MRLs while 1 sample (0.24%) contained pesticide residues above the MRL.

Table 4: *Active compounds and number of samples in which MRLs were exceeded. Source: Ministry of Agriculture 2007-2012*

Programme	2007	2008	2009	2010	2011	2012
EU regulation	Recommendation 2007/225/EC	Recommendation 2008/103/EC	Regulation (EC) 1213/2008	Regulation (EC) 901/2009	Regulation (EC) 915/2010	Regulation (EU) 1274/2011
Number of product types	9	14	14	15	15	15
Number of active substances	77	87	87	88	107	110
Number of cities	5	6	7	7	7	7
Number of analysed samples	112	246	292	409	416	417
Number of samples (%) without residues	78 (70 %)	180 (73 %)	207 (70.9 %)	353 (86 %)	299 (71.9 %)	300 (72 %)
Number of samples (%) with residues below MRLs	26 (23 %)	55 (23 %)	79 (27.1 %)	52 (13 %)	116 (28.1 %)	112 (27 %)
Number of samples (%) with residues above MRLs	8 (7 %)	11 (4 %)	6 (2.05 %)	4 (1 %)	1 (0.24 %)	1 (0.24 %)
MA financing (in HRK)	200,000	500,000	707,168	1,000,000	1,000,000	1,000,000

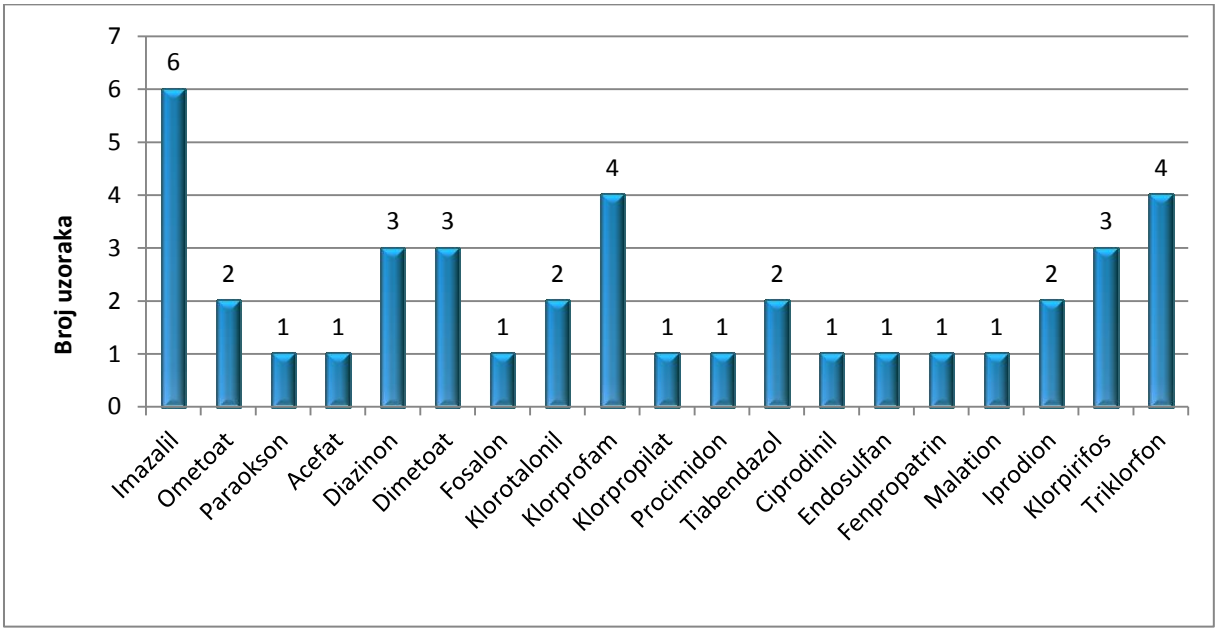
Although it could be assessed from the cited data on the results of monitoring that the exposure of consumers to pesticide residues in Croatia is relatively low, given that only 1–2% of products contained exceeding pesticide residues (above MRL values), it should be considered that analyses in Croatia are conducted for a smaller number of active substances than stipulated by Commission Regulation (EU) No 788/2012.

Currently, products of plant origin in Croatia can be analysed for 110 pesticide active substances, while the Regulation stipulates 191 active substances for which products of plant origin are to be analysed. Monitoring should, therefore, be improved such that it complies with the Regulation and that it preferably includes as many of the active substances currently in use.

Consequently, it can be assumed that an increase in laboratory capacities and the number of analytes (active substances and their metabolites) will also increase the number of analysed samples found to exceed MRL values.

Following are the active substances for which values above the MRLs were measured in the programme implementation period from 2007 to 2012.

Graph 5: *Active substances and the number of samples in which it was determined that the MRL was exceeded. Source: MA 2007–2012*



Some of the cited active substances had already been prohibited at the EU level at the time of monitoring, such that there were also no registered PPPs in Croatia containing these active substances, while some of the active substances were prohibited by the Ministry of Agriculture in the meantime, following EU decisions.

Active substances that are no longer permitted at the EU level and in Croatia are: *endosulfan, paraoxon (parathion), acephate, chlorpropylate, fenpropathrin, omethoate, phosalone, trichlorfon, diazinon, malathion* and *procymidone.*

Measure 1: Equip and authorise a laboratory with the appropriate analytical equipment for products of plant origin in order to be able to analyse the active substances cited in Regulation (EU) No 788/2012 and every following regulation and secure the appropriate number of trained staff.

Measure 2: Equip and authorise a laboratory with the appropriate analytical equipment for the analysis of active substances in products of animal origin pursuant to Regulation (EU) No 788/2012.

Measure 3: Complete accreditation of laboratories and accreditation and validation of analytical methods.

Measure 4: Keep records of data for each individual sample in line with the Standard Sample Description (SSD). The cited standard sample description contains 73 types of data for each individual sample.

Measure 5: Reassign one officer in the Department for the Sustainable Use of Pesticides on permanent contract to tasks related to the preparation, coordination and reporting for the needs of monitoring.

Measure 6: Create and render fully functional a computer application for the needs of pesticide residues monitoring such that it provides for the keeping of all necessary data, data processing and reporting on the results of monitoring to the general public and the European Food Safety Authority (EFSA).

Training of professional pesticide users, distributers and advisors

To date, there was no integrated system of training related to placing on the market, distribution, sale and use of pesticides and advising on the safe and proper use of PPPs in Croatia. The previously existing system of training was conducted on the basis of a programme of courses in plant protection to train employees for work in agricultural pharmacies established pursuant to the *Regulations on the conditions to be met by legal persons engaged in wholesale and retail trade in plant protection products and the manner and procedure for training employees that store and issued plant protection compounds*. The training was conducted by CCAFRA-IPP. The cited Ordinance was replaced with the Ordinance establishing a framework for action to achieve the sustainable use of pesticides[7] that established a new system of training for professional pesticide users, distributors and advisors.

The chief shortcomings of the previously existing training system are listed below:

- The training programme did not cover all categories of those required to undergo training, but rather only a part of the advisors in PPP retail that lacked the appropriate education qualifications. Other advisors in sales were not required to receive training as they possessed the appropriate education qualifications as stipulated by the Ordinance,
- A lack of categorisation of all entities dealing with the marketing and use of PPPs, which should be covered by the training system, as well as the division of PPPs for professional and non-professional use. For this reason, the current categories (professional pesticide users, distributors and advisors) were not at all covered by the training programme,
- The course programme was largely not harmonised with the requirements set out in Annex I of Directive 2009/128/EC[7], in particular in the part relating to the protection of the environment, the health of operators, people and animals and integrated pest management.

The new training system consists of initial and additional training and will cover all professional users of pesticides, distributors and advisors taking into account their respective roles and responsibilities. The initial training module includes at least 15 school hours. Training for all those for whom it is compulsory must regularly update their knowledge with additional training within five years of acquiring initial or additional training. The additional module consists of at least five school hours. The training system will cover all areas listed in Annex I of Directive 2009/128/EC[7], in particular the principles of integrated pest management, the use of pesticide application equipment, the calibration of this equipment, their maintenance, special application techniques and work with the least possible risk to the health of professional users, agricultural workers, other persons, non-target animals and plants, birds, mammals, bees and the environment—including surface and groundwaters, the aquatic environment and the health of humans through food containing pesticide residues.

Measure 1: Create an integral handbook for the implementation of training for all categories of training obligors. Experts from the Ministry of Agriculture, CCAFRA-IPP, IMI and the Agricultural Advisory Service (AAS) are involved in creating the handbook. The handbook will be available free-of-charge with the aim of reducing the burden on training obligors, in particular professional users of pesticides in agriculture.

Measure 2: Authorizations and identity cards are to be issued to lecturers who meet the stipulated conditions for authorised lecturers.

Measure 3: Authorisations are to be issued to institutions for the implementation of training that meets the stipulated conditions.

Measure 4: The expansion of PIS modules is to be completed as is their full functionality, which will enable the keeping of necessary data, the issue of certificates on completed training and records on professional pesticide users, distributers and advisors that have acquired training.

Measure 5: The implementation of training is to commence in the second half of 2013 in order to allow all professional pesticide users, distributers and advisors to acquire the initial training module by 26 November 2015.

Measure 6: As of 26 November 2015 the import, procurement, distribution, sale and use of PPPs targeted to professional users and the provision of advice on the use of the cited PPPs can be conducted only by persons that have completed the initial training module and possess the specific identity card.

Measure 7: Ensure regular additional training for all those for whom training is compulsory.

Regular inspections of pesticide application equipment

To date, regular inspections of pesticide application equipment in use was not mandatory in Croatia. A certain share of the pesticide application equipment is inspected on a voluntary basis and based on the requirements of commercial standards such as the Global GAP international trade standard. The Ordinance establishing an action framework to achieve the sustainable use of pesticides established a system of mandatory periodic inspection of pesticide application equipment in use.

New pesticide application equipment ìs placed on the market in accordance with the Technical Requirements for Products and Conformity Assessment Act and the Ordinance on the safety of machinery[8]. New equipment sold after 1 January 2013 is subject to regular inspection at least once in the period five years following purchase, and later subject to regular inspection at least once every three years. Pesticide application equipment in use is subject to regular inspection at least once every three years after the last inspection. Regular inspections of devices will be carried out by authorised testing stations that must meet the stipulated requirements on equipment and employees. The inspection verifies whether the devices satisfy the requirements set out in Annex II of Directive 2009/128/EC[7] and relevant standards in order to achieve a high level of safety, human health protection and environmental protection. Test stations issue a sticker indicating an inspection has been conducted for devices for the application of pesticides that meet the cited inspection requirements. Inspections of pesticide application equipment conducted in other EU Member States are recognised as equivalent to inspections conducted in Croatia if the inspection is in accordance with the requirements of Annex II of Directive 2009/128/EC[7] and relevant standards, provided that the time interval since the last inspection carried out in another EU Member State is equal or shorter than the inspection frequency applicable in Croatia. On the

basis of an assessment of the risk to human health and the environment and frequency of use, handheld pesticide application equipment, manual, battery and motor powered backpack sprayers and motorised backpack atomizers are exempt from regular inspection. Instructions will be prepared for these devices that will contain all necessary information, in particular about the need for the regular replacement of worn parts, the specific risks associated with this equipment, and professional users will be trained in their proper and safe use during training at modules for professional users.

Measure 1: A training programme is to be created for responsible persons and workers to be employed in future authorised test stations to conduct regular inspections of pesticide application equipment. The Department of Agricultural Engineering of the Faculty of Agriculture at the Universities of Zagreb and Osijek, as the institutions authorised to implement this training will create the uniform training programme.

Measure 2: Responsible persons and workers in future authorised test stations conducting regular inspection of equipment shall complete training; the owner(s) of test stations shall obtain the necessary equipment to carry out the regular inspection of devices; and the authorised institution shall issue a certificate of fulfilling the prescribed conditions regarding equipment for the conduct of the regular inspection of pesticide application equipment.

Measure 3: The upgrade of PIS modules is to be completed to render them fully functional, which shall allow for the entry, transfer and keeping of the necessary data, the issue of reports and inspection stickers and records of inspected devices.

Measure 4: The Ministry of Agriculture shall issue authorisations to test stations for the performance of regular inspections of pesticide application equipment.

Measure 5: The inspection of pesticide application equipment is conducted. Equipment manufactured prior to 1995 must be inspected by 26 November 2014, and all pesticide application equipment must be inspected at least once by 26 November 2016.

Trade and sale of plant protection products

Up to the end of 2012, the existing system of commerce and sales in Croatia was regulated by the national legislation. Legal and natural persons engaged in the import, procurement and wholesale and retail sale of PPPs were obliged to satisfy conditions pertaining to facilities, rooms, equipment and the professional qualifications of employees. The chief shortcomings of the existing system were:

- Plant protection products were accessible to all persons irrespective of their professional qualifications and knowledge. The only exceptions to this were PPPs designated as very poisonous (T^+) and that were not permitted in open sale and a number of PPPs targeted to the treatment of seeds,
- Training for professional users, distributers and advisors was not mandatory. Minimal professional qualifications were stipulated for responsible persons engaged in placing PPPs on the market and employees. Only those employees lacking the lowest stipulated professional qualifications were obliged to undertake regular initial and additional training,
- The existing training did not cover all areas cited in Annex I of Directive 2009/128/EC[7],

- Records were not established of legal and natural persons placing PPPs on the market (importers, suppliers, wholesale, retail) as a result of which the exact number of legal and natural persons engaged in placing plant protection products on the market in Croatia is not known,
- There was no stipulated requirement to keep records of the sales of PPPs.

The Ordinance establishing an action framework to achieve the sustainable use of pesticides[7] set out new conditions for legal and natural persons engaged in placing PPPs on the market. These conditions pertain to the establishment of a Register of legal and natural persons engaged in placing PPPs on the market in the frame of the PIS, conditions for responsible persons and employees, general and specific conditions regarding facilities and rooms, additional conditions regarding facilities and rooms, PPP sales conditions, the obligations of responsible persons and employees and to keeping records on sales.

Measure 1: Complete the upgrade of PIS modules and render them fully functional, which will enable the submission of data through electronic forms on the legal and natural persons placing PPPs on the market (importers, suppliers, wholesale, retail), responsible persons and employees.

Measure 2: Establish record keeping on sold quantities of PPPs and report to the Ministry of Agriculture on total annual sales of PPPs to end consumers.

Measure 3: Conduct training for all distributers and advisors in sales with the aim of raising the level of knowledge and improving the quality of advice provided to end professional users of pesticides.

Measure 4: Separate PPPs targeted to professional users and approve a number of PPPs targeted to non-professional users (amateurs) who shall not be obliged to acquire initial and additional training.

Measure 5: Prohibit the sale, provision of advice and purchase of PPPs targeted to professional users to persons who have not acquired initial training. The ban shall be in force as of 26 November 2015. Upon acquiring initial training, those for whom training is compulsory shall be required to undertake additional training at least once every five years.

Measure 6: Strengthen PPP controls as one of the measures aimed at preventing the appearance of non-compliant or counterfeit PPPs in the sales chain. In this regard, post-authorization control must also be strengthened, including strengthening the capacity of the CCAFRA- IPP laboratory through the procurement of equipment and an increase in the number of samples as a very small number of PPP samples are currently covered, which does not provide a true insight into the state of compliance of PPPs on the market.

Exposure of operators, farm workers and bystanders

An exposure assessment during PPP application is conducted for PPP operators, agricultural workers and bystanders during the procedure of authorization of plant protection products in Croatia in accordance with the standards set out in Directive 91/414/EEC[4].

In addition to a risk assessment for the cited segments of the population—binding under EU legislation—since the new authorization system came into force the risk of exposure for the population living in the immediate vicinity of areas where PPPs are used has also been

assessed in Croatia. Mathematical models are applied that take into account acute and cumulative exposure over a year and models that allow the assessment of the risks to children as a particularly vulnerable segment of the population. According to Regulation (EC) No 1107/2009[1] an assessment of the risk to the general population has also been mandatory at the EU level since 2011. As an additional national standard, Croatia also applies a combined risk assessment for PPPs containing more than one active substance if they have adverse effects on the same target organs and organ systems. Croatia will monitor and harmonise with the European guidelines on the assessment of exposure for operators, workers, other persons present and the general population—still in the development phase—and has already applied the study assessment standards cited in the scientific opinion of the EFSA in 2010. As reliable data on different types of devices and methods of application of plant protection products in Croatia were not previously available, the data collected during mandatory regular inspections of application devices will be analysed in order to ensure that exposure levels for all methods applications relevant to the Croatian agricultural practices are verified during the process of authorization. For a large number of PPPs, safe levels of exposure during application are provided only through risk mitigation measures of which is the most important is the use of personal protection equipment. Due to the insufficient training of PPP users, there is a real danger that personal protective equipment is not used in accordance with the instructions on the label and information shall be gathered during the training of professional users on the extent of the use and knowledge of the proper use of protective clothing, footwear, gloves, protection for the respiratory tract and other measures to reduce the risk to health.

Measure 1: An analysis of data available via PIS on inspections conducted of application devices and the creation of a standard operational procedure for exposure assessment for all methods of the application of plant protection products in Croatia.

Measure 2: An analysis of data on the proper use of personal protective equipment during the training programme for professional users and a proposal for further measures for training and raising awareness on health protection during work with PPPs.

Environmental and nature protection

Nature protection – biological diversity

One of the goals of Directive 2009/128/EC[7] and the NAP, pursuant to the Ordinance establishing an action framework to achieve the sustainable use of pesticides[7], is to reduce the risk of pesticide use on biological diversity. In the process, special attention is afforded to specific areas of particular significance. Taking biological diversity into consideration, in specific areas (including areas covered by the NATURA 2000 ecological network) the use of pesticides should be reduced to the smallest possible measure or prohibited outright. Appropriate risk management measures should also be undertaken in these areas, i.e. PPPs of lower risk should be used and precedence given to biological prevention and control measures.

National regulations in the area of nature protection only indirectly regulate the issue of pesticide use.

The Strategy and Action Plan for the Protection of Biological and Landscape Diversity in the Republic of Croatia[15] includes strategic guideline *6.1.8 Sustainable use of PPPs and mineral*

fertilisers in agricultural production. Envisaged for implementation are activities *6.1.8.1 Reduce the use of pesticides, in particular broad spectrum pesticides, and use selective pesticides, and encourage the use of biological methods*, and *6.1.8.2 Improve monitoring and conduct education on the use of chemical PPPs in agriculture*. One of the planned activities relates to the use of pesticides in forestry: *6.2.2.2 Determine the impact of chemical, biological and biotechnical PPPs on forest ecosystems in the example of three nature parks.*

The Nature Protection Act[16] establishes that, with the aim of preserving biological diversity, meadows are managed by grazing and a mowing regime adapted to the types of grasses present, along with PPP and mineral fertiliser use acceptable to nature. In relation to forestry and with the aim of preserving biological diversity in forests, the Nature Protection Act[16] permits the use of biological and biotechnical PPPs, while chemical PPPs may only be used exceptionally and with permission in the event of the appearance of a causative agent that could cause significant economic damage when there are no appropriate biological or biotechnical PPPs.

The Nature Protection Act[16] defines two groups of specific areas to which the provisions of Directive 2009/128/EC[7] may pertain. These are protected areas and areas encompassed by the ecological network. Although the Directive[7] refers directly to the areas of the NATURA 2000 ecological network, the NAP also takes into consideration other areas of national significance in the preservation of biological diversity. There are not many of these as most protected areas of this kind are also a part of the proposed NATURA 2000 ecological network.

a) Protected areas

The Nature Protection Act establishes nine categories of protected areas, the goals of their protection and methods of management. According to the Register of Protected Areas of the Ministry for Environment and Nature Protection (January 2013), there are a total of 435 protected areas in Croatia, of which three areas are under preventive protection. The protected areas cover 8.44% of the total territory of Croatia, i.e. 11.99% of the land territory and 1.97% of territorial waters.

The categories of protected areas are: strict nature reserves, national parks, special nature reserves, nature parks, regional parks, nature monuments, significant landscapes, forest parks and park architecture monuments. The first three give priority to the protection of biological diversity and imply a "stricter" protection regime. Nature parks and regional parks are categories that cover expansive areas that are important to the preservation of biological diversity, but are also rich in landscape, education, culture and historical and tourism-recreation values. The Act does not explicitly prohibit or limit the use of pesticides in any of these categories, with the exception of the exclusion of their use in strict nature reserves where economic and other activities are prohibited. There are presently only two strict nature reserves in Croatia: Bijele Stijene/Samarske Stijene and Hajdučki Kukovi/Rožanski Kukovi in the Velebit mountain range—i.e. preserved alpine areas in which there are no activities that would require the use of pesticides.

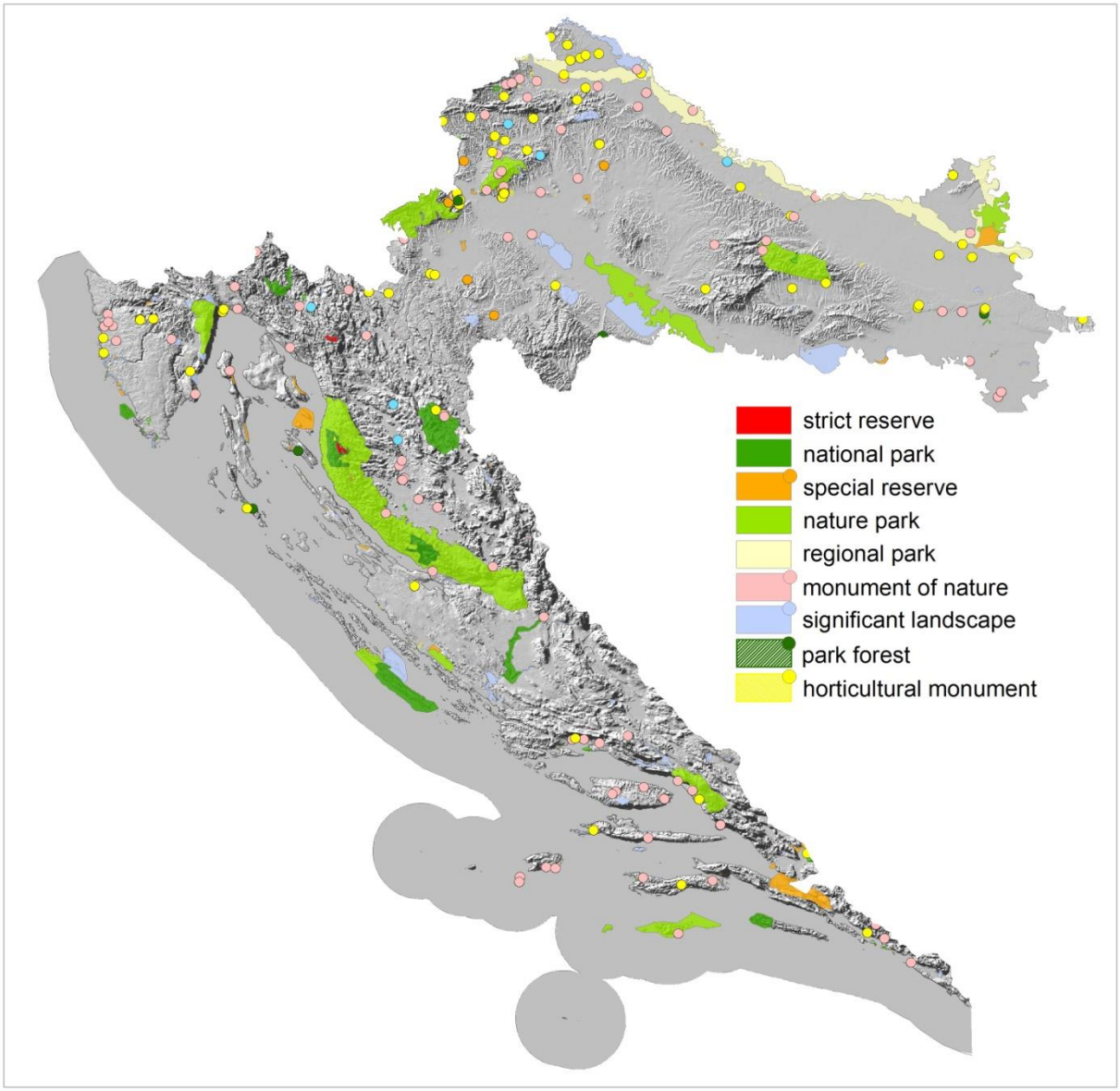
The management of strict nature reserves, national parks, nature parks, regional parks, special nature reserves and significant landscapes is set out in detail in management plans through which the use of pesticides in specific areas can be regulated. Management plans have been adopted or are in the development phase for national parks and nature parks—they do not, however, address the issue of pesticide use.

Table 5: *Protected areas based on the Nature Protection Act. Source: SINP (as of 7 January 2013)*

CATEGORY	NUMBER			Area (ha)	% of Croatian territory
	PA	**PPA**	**TPA**		
Strict nature reserve	2	0	2	2,395.35	0.027
National park	8	0	8	95,472.36	1.019
Special nature reserve	79	1	80	44,105.89	0.502
Nature park	11	0	11	419,622.03	4.402
Regional park	2	0	2	102,791.82	0.979
Nature monument	84	1	85	207.00	0.002
Significant landscape	86	1	87	128,898.06	1.461
Forest park	32	0	32	3,267.88	0.037
Park architecture monument	128	0	128	937.62	0.011
Sections within larger protected areas:				58,275.08	0.665
Total protected areas in Croatia	**432**	**3**	**435**	**739,422.92**	**8.44**

PA – Number of protected areas
PPA - Number of areas under preventive protection
TPA – Total number of protected areas

Figure 1: *Protected areas in Croatia. Source: SINP*



b) Ecological network NATURA 2000

The Nature Protection Act[16] defines the ecological network as a system of ecologically significant areas that are intended for the conservation of endangered species and habitats at the national and European levels. It stipulates that Croatian Government shall, by the date of accession to the EU, determine the area of the NATURA 2000 ecological network.

NATURA 2000 is one of the basic mechanisms of nature protection in the EU. It is a European network of areas important for the conservation of endangered European species and habitat types. The legal basis for the creation of this network are the Council Directive 2009/147/EC on the conservation of birds and Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, which aims to maintain or improve the state of conservation of certain listed species and habitat types. Under the Birds Directive, the state declares Special Protection Areas (SPA) for the 194 endangered species listed in Appendix I to the Directive and for all regular migratory birds. The Habitats Directive covers all other European species and habitat types for which the Member States are obliged to designate Special Areas of Conservation (SAC), after passing biogeographical seminars and obtaining the approval of the European Commission. These include about 1,000 species and more than 230 habitat types. Together these two groups of areas (SPA and SAC) form the NATURA 2000 ecological network.

In December 2012, the State Institute for Nature Protection (SINP) tabled a final proposal for the territories of the NATURA 2000 ecological network as an expert report for a Regulation on NATURA 2000 areas to be adopted by Croatian Government by the date of accession to the EU. The NATURA 2000 proposal encompasses 794 areas on 29.64% of the total territory of Croatia (36.92% on land and 16.6% territorial waters). It is worth noting that NATURA 2000 includes all strict nature reserves, national parks, and nature parks and almost all special nature reserves in Croatia.

Of the area covered by NATURA 2000 (644,000 ha), 31% consists of agricultural land. Target species and habitat types in the ecological network include a great number of those subject to the use of pesticides in agriculture and forestry. It is important, therefore, that the impact of use on sensitive species and habitats be assessed, and if necessary, in accordance with NAP, possibly prohibit or restrict the use of pesticides in some areas, i.e. to give precedence to lower risk PPPs and biological control measures. In the process, funding should be earmarked in the European Agricultural Fund for Rural Development (EAFRD) for farmers who are entitled to compensation for restrictions or incentives if they implement voluntary measures.

Measure 1: Conduct an analysis of the risk of pesticide use on biological diversity in areas of the NATURA 2000 ecological network and determine the sensitive species and habitat types, i.e. NATURA 2000 areas that require adjusted use.

Measure 2: Define possible restrictions to the use of pesticides in specific areas through protected area and NATURA 2000 area management plans and by incorporating nature protection measures and conditions in natural resource management plans.

Measure 3: Secure funding from the European Agricultural Fund for Rural Development (EAFRD) for farmers entitled to compensation for restricted use of pesticides or incentives if they implement voluntary measures.

Measure 4: Special emphasis shall be placed on preserving biological diversity through the training of professional users of pesticides engaged in agricultural production in NATURA 2000 areas.

Figure 2: Proposed Natura 2000 ecological network. *Source: SINP*

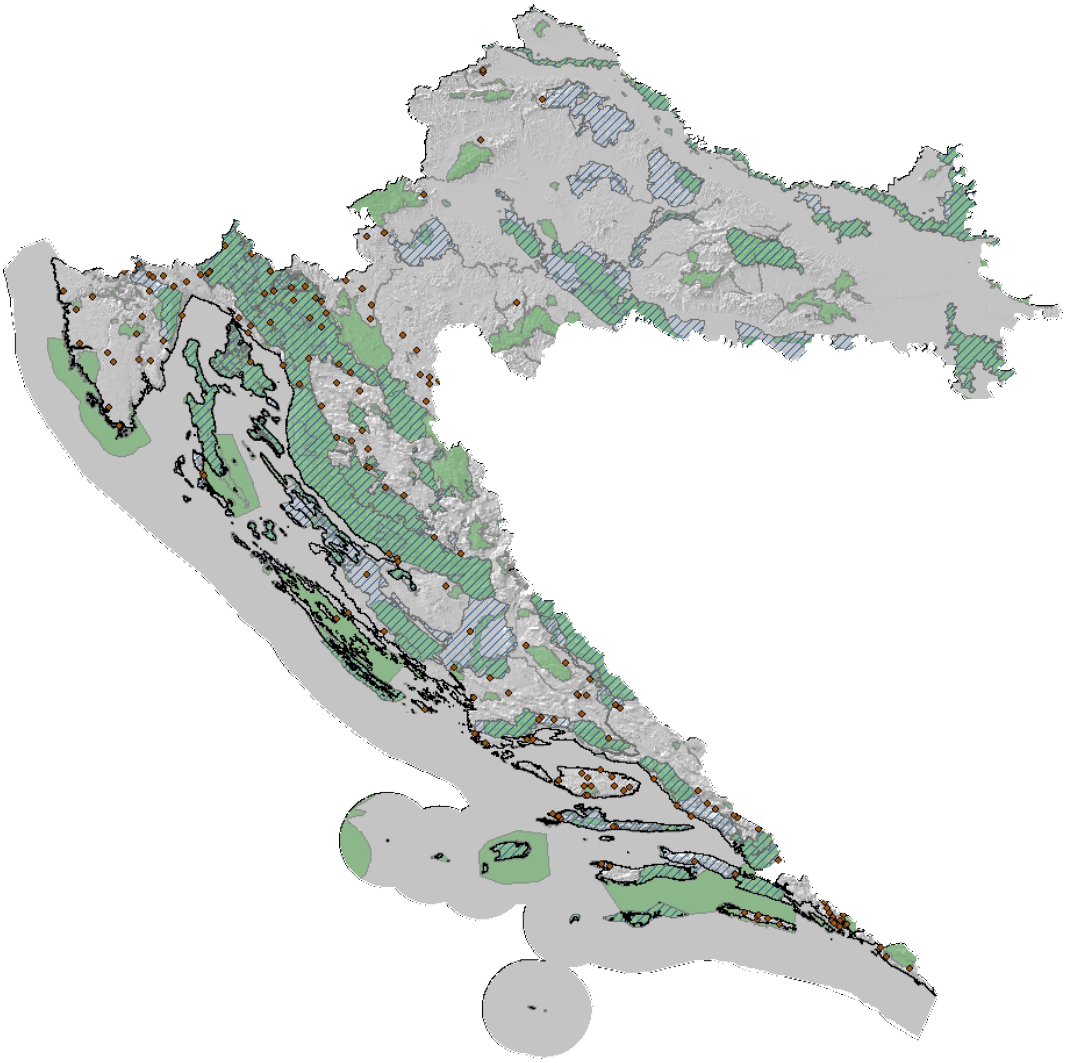


Table 6: *Proposed Natura 2000 network—data on surface areas – Source: SINP*

	Croatian land surface (km2)	% of Croatian land	Croatian territorial waters surface (km2)	% of Croatian territorial waters RH	Total surface area in Croatia (km2)	% of total surface area in Croatia	Number of Natura 2000 areas
pSCI	16,203.12	28.63	4,947.78	15.64	21,150.90	23.98	756
SPA	17,138.49	30.28	1,047.65	3.31	18,186.14	20.61	38
Natura 2000	20,897.32	36.92	5,249.25	16.60	26,146.57	29.64	794

Environmental protection

Protection of the aquatic environment and drinking water

a) Sanitary protection zones

Sanitary protection zones are protected areas, or areas of special water protection, where additional protection measures need to be implemented in order to protect waters and the aquatic environment. In line with the Waters Act,[9] areas or springs or other water deposits that are used or are reserved for the public water supply, as well as areas where water is captured from rivers, lakes, reservoirs or the like for the same purpose, must be protected from intentional or accidental pollution and from other impacts that could negatively affect the health suitability of the water or its abundance (hereinafter: sanitary protection zones).

Pursuant to the Waters Act[9], the Ordinance on the conditions for determining sanitary protection zones for springs[10] in prescribes the conditions for determining the sanitary protection zones for springs that are used for public water supply and measures and restrictions that apply within them.

The sanitary protection zones are determined according to the type of aquifer:

1) springs that capture groundwater, i.e.:
   a) from an aquifer with intergrain porosity,
   b) from an aquifer with fracture and fracture-cavern porosity.
2) spring that capture of surface waters, i.e.:
   a) from reservoirs and lakes,
   b) from open watercourses.

1a) Sanitary protection zones for springs that capture groundwater from aquifers with intergrain porosity are:

– restriction and control zone – zone III,

– strict restriction and control zone – zone II, and

– strict protection and control regime zone – zone I.

1b) Sanitary protection zones for springs that capture groundwater from aquifers with fracture and fracture-cavern porosity are:

- restriction zones– zone IV,

– restriction and control zones – zone III,

– strict restriction and control zones – zone II, and

– strict protection and control regime zones – zone I.

In zone I sanitary protection zones of springs that capture groundwater from aquifers with intergrain porosity and aquifers with fracture and fracture-cavern porosity, agricultural production is prohibited. In zone II, only ecological (organic) production is permitted, with the application of the permitted fertilisers and plant protection compounds in line with separate regulations.

2a) Sanitary protection zones for springs capturing surface waters from reservoirs and lakes are:

– restriction and control zones – zone III,

– strict restriction and control zones – zone II, and

– strict protection and control regime zones – zone I.

In zone I sanitary protection zones of springs that capture surface waters from reservoirs and lakes, agricultural production is prohibited. In zone II, only organic production is permitted, with the application of the permitted fertilisers and plant protection compounds in line with separate regulations.

2b) For the capture of surface waters from open watercourses, only zone I sanitary protection zones are determined, in which the use of fertilisers and plant protection products, among other things, is prohibited.

The protection of springs by sanitary protection zones is performed in line with the decision on the protection of the spring. The decision on protection of the spring is made by the following, with the prior consent of Croatian Waters:

1. representative body of the local self-government unit, if the zone is the territory of a local self-government unit,
2. representative body of the regional self-government unit, if the zone extends over the territory of multiple local self-government units within the same regional self-government unit,
3. by agreement, the representative bodies of regional self-government units, if the zone extends over the territory of multiple regional self-government units.

If the stated bodies do not pass the decision on the protection of springs within the stipulated deadline, the same will be passed by the minister, and it shall remain in effect until the passing of the decision on the protection of springs.

Passive and active protection measures are implemented in the sanitary protection zones of springs.

Passive protection measures are prohibitions as defined by the Ordinance on the conditions for determining sanitary protection zones of springs[10] and must form an integral part of the Decision on the protection of springs, which may also prescribe other prohibitions and restrictions.

Active protection measures include monitoring water quality in the catchment area of the spring and undertaking activities to improve water condition, which in particular refers to the construction of water structures for public water supply and the drainage of wastewaters, the implementation of cleaner manufacturing, organising organic agricultural production, installation of reservoirs for hazardous matter and pollutants and other protection and other measures that improve water quality.

Exceptionally, certain interventions may be permitted in the area, i.e. certain activities in sanitary protection zones of subterranean aquifers that are otherwise prohibited in those zones if:

1. detailed water research works are performed to investigate the impacts on the area of the sanitary protection zone in which the intervention is planned to be executed or a certain activity performed (microzone) on the aquifer,
2. pursuant to the detailed water research works, a separate report is drafted for the purpose of proving the circumstances from the previous point (hereinafter: microzone report),
3. the microzone report envisages the appropriate measures for protection of the aquifer in the microzone.

The microzone report in the sanitary protection zone of the spring that captures ground waters from aquifers with intergrain porosity must prove that the intervention in the area of the microzone (hereinafter: intervention in the microzone) is not detrimental, or that performing the activity in the microzone is not detrimental, in the sense of the stipulated purpose of determining the zone by the Ordinance.[10]

The microzone report in the sanitary protection zone of the spring that captures groundwater from aquifers with fracture and fracture-cavern porosity must prove that the characteristics from points 1, 2 and 3 in the microzone are significantly different from the same pursuant to which is determinated the sanitary protection zone in which the microzone is situated.

If the circumstances from the above microzone reports can be proven, the conditions for the execution of the intervention in the microzone and the obligation to take protection measures will be determined, and the administrative body of the local or regional self-government unit as per the decision on the protection of the spring may, in agreement with Croatian Waters, pass an act that permits the performance of the said activities in the microzone.

The inspection control of the application of the Ordinance[10] on the conditions for determining sanitary protection zones for springs is performed by the state water management inspection.

Measure 1: Creating a register of protected areas and river basin management plan and increase inspections of sanitary protection zones of water

b) Monitoring of surface and groundwater

Supervision over the state of surface waters, including coastal waters and groundwater, is performed by the monitoring of the state of waters. In 2009, the national monitoring programme began to be aligned with the Water Framework Directive 2000/60/EC[3] of the European Parliament and of the Council, and in 2010, the new Waters Act[9] came into effect and provided a legislative framework for establishing aligned monitoring.

The Waters Act[9] prescribes the following monitoring objectives:

- establishing long-term changes (supervision monitoring),
- establishing changes due to the implementation of measures in areas confirmed to not be compliant with good water status (operative monitoring), and
- establishing unknown relations (research monitoring).

Furthermore, the Waters Act[9] prescribes monitoring which includes the necessary indicators to be established:

- volume, level, flow, speed, hydromorphological characteristics, ecological and chemical status, and ecological potential for surface waters,
- ecological and chemical status and ecological potential for coastal waters,
- chemical status for waters of the territorial sea, and
- quantity and chemical status of groundwater.

Pursuant to the Waters Act[9], Croatian Waters is the competent body for monitoring the state of surface waters, including coastal waters, and groundwater, for which an annual Monitoring Plan was adopted, with the prior approval of the Ministry of Agriculture. Monitoring the state of water includes ecological and chemical indicators for surface waters, and chemical and quantity indicators for groundwater.

Monitoring water quality is performed by the Head Water Management laboratory of Croatian Waters, and laboratories authorised by the Ministry of Agriculture. Croatian Waters are competent for interpreting the monitoring results, and are required to draft an annual report that is submitted to the Ministry of Agriculture and the Environmental Protection Agency.

Monitoring surface waters

The first monitoring of water quality began on the Danube River in 1958. Since the 1970s, monitoring has been carried out at the national level. Until 2009, monitoring was performed for the purpose of establishing the general ecological functions of water, monitoring of burdens from point and diffuse sources of pollution, monitoring water quality on water capture for drinking water and the like. In 2011, the plan for monitoring the quality of surface waters includes testing water quality at 310 measurement stations in watercourses, lakes and reservoirs, and at 75 measurement stations in coastal waters.

Supervision monitoring in 2011 was performed at 37 measurement stations on watercourses, and at 5 measurement stations on lakes. Due to the wide scope of the supervision monitoring, and limited capacities of the analytical laboratories, this was carried out in the period from 2009 to 2012. In 2011, the following priority compounds were measured at the supervision monitoring stations, in addition to other parameters:

- organochloride pesticides (*DDT, DDD, HCH, lindan, hexachlorobenzene-HCB, aldrin, dieldrin, endrin, heptachlor, endosulfan, isodrin*),
- triazine pesticides (*atrazin, simazin*),
- organophosphorous pesticides (*chlorphenvinphos and chlorpyriphos*),
- pesticides (*alaklor, diuron, isoproturon, pentachlorphenol*)

In Danube Basin, the chemical status including priority compounds was assessed at 104 measurement stations, of which 15 did not achieve good chemical status. In the Sava sub-catchment, in the majority of cases (at 4 measurement stations), the values of the pesticide *hexachlorcyclohexane* exceeded standard quality values, while in the area of the Drava and Danube sub-catchment, the values of mercury and its compounds exceeded quality levels.

In the Adriatic Basin, the chemical state of waters including the list of priority compounds was assessed at a total of 42 measurement stations, of which only one station did not achieve good chemical state (excess of pesticide *hexachlorocyclohexane*).

The chemical state of watercourses and lakes refers to their load of priority substances, for which environmental quality standards have been prescribed at the European Union level in Directive 2008/105/EC of the European Parliament and of the Council[11]. A total of 33 priority substances were determined, and among them were thirteen substances identified are priority hazardous substances due to their toxicity, non-biodegradability and bioaccumulation (e.g. *hexachlorbenzene*, e*ndosulphan*).

The water quality monitoring plan in 2011 envisaged the monitoring of sediment quality at 20 measurement stations in Croatia. This was performed in full, with the exception of the station on the Danube River near Ilok. There is no standard for assessing sediment quality, and therefore a comparison was made of the content of tested compounds between different watercourse, as well as a comparison with the state the previous year.

The organic compounds tested included the organochlorines (*lindan*, *hexachlorbenzene*, *DDT*, total *HCH*) and triazine pesticides (atrazin). The organochlorine pesticides and *atrazin* were not detected in a single sample, with the exception of the sediments of the Neretva River and Norin Spring. In comparison with previous years, the value of total *DDT* in the Neretva River was significantly lower.

An operative monitoring network for terrestrial surface waters is currently being developed. Measurement stations suitable for monitoring the state of watercourses for which it was determined that they did not achieve good ecological and chemical state of the water, and that there is a risk that they will not meet the ecological objectives, were singled out among the existing monitoring network. At those stations, which became candidates for operative monitoring, chemical indicators were defined according to the corresponding pressures as defined by the Regulation on the water quality standard[13] and the Ordinance on limit values for wastewater emissions[12]. Until the establishment of a comprehensive operative monitoring network, the testing of chemical indicators is performed at a reduced dynamic.

To assess the quality of surface waters intended for human consumption, the criteria from the Regulation on the water quality standard[13] were applied, i.e. the limit values of chemical indicators, priority compounds and other pollutants that correspond to the good state of terrestrial surface waters. In order to determine whether there has been deterioration from the previous year, the assessment at the same measurement stations for 2010 was also shown. The assessment of the chemical state of surface waters intended for human consumption is insufficiently reliable, as not all the pollutants upstream from the surface intervention that could have an impact on the state of water were identified, nor was monitoring performed for all pollutants, and the frequency of testing indicators was often less than that prescribed by the Regulation on water quality standard[13].

Monitoring groundwater

The monitoring of groundwater, pursuant to the Water Framework Directive[3] and the Waters Act[9], includes indicators necessary to determine the quality and chemical state of groundwater. The first systematic monitoring of the quality of groundwater captured at the springs in karst areas began in the 1980s. In 2000, systematic monitoring of groundwater at inflow areas of water pumping stations of the City of Zagreb began, while in 2006, systematic monitoring of groundwater began at the national level. Monitoring is performed for the purpose of establishing the chemical state of water, long-term changes of natural conditions,

changes caused by intensive anthropogenic activities and changes due to the implementation of measures in areas which do not meet the conditions for good status.

In 2011, the water monitoring plan in Croatia envisaged the testing of water quality at the springs, piezometers and wells of inflow area of water pumping stations in the Danube Basin in a total of 18 groundwater bodies – 13 in the Sava sub-catchment and 5 in the Drava and Danube sub-catchment, and captured springs and wells in the Adriatic Basin in 10 groundwater bodies.

In the area of the Sava catchment, groundwater quality was tested in the inflow areas at 12 pumping stations of the Zagreb aquifer, and 42 pumping stations and springs in the remainder of the catchment. Of these 42 pumping stations and springs, 34 are situated in the alluvial aquifer in eight waterbodies, and 8 springs in the karst area of the Sava basin. In the Drava and Danube catchment, ground water quality was tested in the inflow area of 30 pumping stations.

In the Adriatic Basin, ground water quality was tested in 26 captured springs and wells. In 2011, the following priority compounds were also tested at measurement stations:

- organochlorine pesticides (*DDT, DDE, DDD, HCH, lindan, hexachlorbenzene, aldrin, dieldrin, endrin, heptachlor, endosulfan*),
- triazine pesticides (*atrazin, simazin*),
- pesticides (*alaklor, pentachlorfenol*)

In 2011, a good chemical state was confirmed with regard to the pesticide active compounds at all measurement states in the Danube Basin – Sava catchment, with the exception of a measurement station in the Zagreb waterbody, situated at the Mala Mlaka water pumping station where poor chemical state was confirmed, due to a mean annual concentration of *atrazine* of 0.11 g/l. However, it should be emphasised that in the Zagreb waterbody, a linear declining trend of the mean annual values of *atrazine* concentrations has been confirmed.

In all groundwater bodies in the Danube Basin, Drava and Danube catchment, and in the Adriatic Basin assessed in 2011, good chemical status was determined concerning the above analysed pesticide active compounds.

All EU Member States, including Croatia after its accession to the EU, are obliged to gradually reduce their emission or stop emissions of priority hazardous matter, including pesticides in water. In that sense, it is necessary to improve monitoring in such a way that encompasses as many active compounds that are in actual use that can represent a risk for groundwater.

The inspection control over the implementation of monitoring of surface, including coastal waters and groundwater, including and laboratory tasks in the implementation of monitoring is performed by the state water management inspection service.

Measure 1: Increasing the number of pesticide active substances that are determined in waters, and give priority to monitoring active substances that are hazardous for water and aquatic organisms.

Measure 2: Accreditation of laboratories and accreditation and validation of analytical methods for determining pesticides.

c) Monitoring pesticides in drinking water

Two types of monitoring are performed under the competence of the Ministry of Health pursuant to the Ordinance on the health compliance of drinking water (OG 47/2008):

1. Monitoring of springs for drinking water – financed by legal persons that manage water supply systems;
2. Monitoring drinking water from the distribution network – financed by counties.
   The analysis of pesticides is envisaged in the complete (C) analysis, for the following indicators:

Organochlorine pesticides: Total organochlorine pesticides, *HCB, HCH-alpha, HCH-beta, HCH-delta, lindan, DDT and metabolites, aldrin, dieldrin, endrin, heptachlor, heptachlor epoxide, dicophol, endosulfan, vinclozolin, diclofluanide, tolyfluanide, chlordane, metoxichlor, iprodion, captan, imazalil;*

Organophosphorous pesticides: total organophosphorous pesticides, *dichlorvos, mevinphos, forat, diazinon, metylparation, paration, malation, chlopirifos, etion, fenitrotion, thyometon, dimetoate, phosalone, fenchlorphos, fention, primiphos-methyl, chlormephos, bromophos-methyl, bromophos-ethyl, tetrachlorvinphos, azinphos-meti, azinphos-etil, coumaphos, fenamiphos, fonofos, chlorpyriphos-methyl, ometoate, pyrazophos, pirimphos-ethyl, thyabendazol, metidation, demeton-S-methyl, demeton S, demeton S-methyl sulfon, tolklophos-methyl, isofenphos, oxydemeton-methyl,*

Triazines **(***atrazin, simazin*).

This monitoring is performed by the Croatian National Institute of Public Health (CNPH), in cooperation with the 19 CNPH county offices. The survey results are analysed by the CNPH and the results of monitoring conducted are forwarded once a year to the Ministry of Health.

The Monitoring plan for springs for 2013 envisages the taking of 383 samples for C analysis.

Pursuant to the Ordinance on the health compliance of drinking water, samples are taken on the following basis:

1. For all water pumping stations that supply more than 1,000,000 m^3 of water into the system, sampling for complete C analysis according to Table 1 of the Ordinance, four times per year, meaning 4 analyses for pesticides from this type of water pumping station per year;
2. for all water pumping stations that supply less than 1,000,000 m^3, a minimum of one C analysis once a year by spring according to Table 1 from the Ordinance, meaning one analysis for pesticides from this type of water pumping station per year.

In the Monitoring of springs for drinking water in 2011, the taking of samples for C and B analysis was envisaged according to the following bases. As the monitoring plan for springs is performed at about 62% of the envisaged scope (240 samples of raw water from springs were analysed in 2011), a similar number of analyses for pesticides is expected this year. All tested water samples contained lower values of the measured pesticides than the maximum permitted limits by the Ordinance. It is certainly worth noting that all values were below the limit of determination. These values were expected, primarily because these were samples of raw water taken from water pumping stations within the sanitary protection zone I, in which the use of pesticides is strictly prohibited.

The new Act on Water for Human Consumption is in the adoption process. This Act is fully aligned with Council Direction 1998/83/EC on the quality of water for human consumption.

The implementation of monitoring drinking water will be substantially amended in terms of the type and scope of analysis. With regard to pesticides, a significantly higher number of water samples will need to be tested from the distribution system, as well a substantially greater number of pesticides. In that sense, it is necessary to improve the monitoring in such a way that it encompasses as many of those active compounds that are in actual use, and that may represent a risk for drinking water.

Measure 1: Increase the number of pesticide active substances that are analysed in drinking water and give priority to monitoring those active substances in use in Croatia and which due to their properties can easily reach the water.

d) Safety distances from water surfaces

In the application of PPPs, aquatic organisms found in the surrounding waterbodies can be exposed to active substances found in the PPPs or their metabolites. Special protection measures for the aquatic environment are prescribed by the Ordinance establishingof an action framework for achieving the sustainable use of pesticides [7]. In order to reduce the exposure risk for aquatic organisms to pesticides, in some cases it is necessary to apply risk mitigation measures, i.e. to prescribe safety distances from the edge of the field to the water surface which must be abided by in the application of PPPs.

Safety distances to the water surface are determined at the time of authorization of a specific PPP. Safety distances are intended to protect aquatic organisms within waterbodies that can be found near arable surfaces. The size of the safety distance depends on the following factors:

- physical chemical properties of active substances contained within the PPP,
- toxicity of the PPP to aquatic organisms,
- crops to which the PPP is applied (for taller crops, application is greater, and therefore the safety distance will be larger),
- growth stage of the crop,
- number of applications (for greater number of applications, the envisaged concentrations in the environment are greater, and with that the protective zones),
- manner of treating crops.

In the calculation of safety distances, data on the acute and chronic toxicity of active substances, PPPs and metabolites to various groups of aquatic organisms (fish, aquatic invertebrates, algae and higher aquatic plants in the case of herbicides) are considered, and the predicted environmental concentration of active substances and metabolites in surface waters (PEC_{sw}).

The values of the toxicity and exposure relationship (TER values) are compared with the limit values prescribed by the Ordinance on the common principles for the assessment and authorization of plant protection products[14]. In the case that the TER values obtained are higher than the prescribed limit values, it is not necessary to apply additional risk mitigation

measures, instead a buffer zone of 1 to 3 metres is prescribed, depending on the height of the crop.

In the case the TER values obtained are lower, it is deemed that there is a risk for aquatic organisms with the proposed application of PPPs. Then a new calculation of the predicted environmental concentrations of active substances and metabolites in surface waters (PECsw) is made, with the use of the amended (reduced) drift values, which gives a greater buffer zone until the TER values are greater than the prescribed limit values.

With the use of various methods for reducing drift - aerial support for sprayers and atomisers, low drift nozzles reduce drift, which also reduced the safety distance to the water surface that should be abided by while applying plant protection products. This is particularly important when applying PPPs that contain active substances that are exceptionally toxic to aquatic organisms, and the prescribed protective zone to the aquatic surface is large, without the use of low drift nozzles.

At the time of authorization, the buffer zone is calculated using the drift values of Rautmann et al. Currently, only the predicted environmental concentrations in surface waters (PEC_{sw}) are calculated for PPP authorization purposes, with the use of nozzles without drift reduction, and it is not possible to make calculations of the safety distances using low drift nozzles. In the case of recognition of authorization towards individual Member States whose authorizations contain safety distances with and without the use of low drift nozzles, the proposal for authorization should also propose safety distances with and without the use of low drift nozzles.

In practice, it is necessary to stimulate the use of such nozzles, regardless of whether or not this is listed on the label, as this will reduce the entry of pesticides into the waterbodies from drift during application.

Measure 1: Raise awareness of pesticide users of the need to protect aquatic organisms and protect water by abiding by the prescribed protection zones and other risk mitigation measures.

Measure 2: Raise awareness of pesticide users on the importance of various methods for reducing drift, aerial support for sprayers and atomisers, low drift nozzles and increasing the use of the above methods as additional risk mitigation measures for the aquatic environment, and reducing the consumption of PPPs and the cofinancing of the same.

Measure 3: Raise awarness among pesticide users and owners of pesticide application equipment on the verification of complicance of pesticide application equipment, their calibration and replacement of spent parts in line with manufacturer instructions.

Measure 4: Stimulate the use of PPPs that have lower toxicity for the aquatic environment, and with that the prescribed safety zone to the water surface is smaller. This is particularly important for agricultural surfaces lying in the direct proximity of aquatic surfaces.

Measure 5: Preservation of coastal vegetation during regular works to maintain watercourses, especially with intensive cultivated agricultural surfaces and stimulating the raising of a green belt, particularly on agricultural surfaces lying in the direct proximity of surface waters and for cultures with a taller growing form, for the protection of surfaces waters and aquatic organisms.

Environmental protection with an emphasis on pesticide waste management

Among all the other aspects, the sustainable use of pesticides must be based on a comprehensive abidance of regulations from the field of environmental protection. Considering that water protection is addressed as a separate section, this section will address the matters of air protection and waste management.

With regard to air protection, it is important to take account of the comprehensive implementation of all measures for reducing risks in distribution, storage and application of pesticides as described in previous sections. It is fundamental in air protection to prevent drift by wind and to take account of the prescribed concentrations and doses of pesticides, other usage restrictions, taking into account all the necessary measures to reduce risks for environmental components and for human and animal health. The set objectives will be achieved by implementation of all the provisions from the Ordinance on establishing a framework for action to achieve the sustainable use of pesticides[7].

Furthermore, abidance of the said Ordinance[7] is the fundamental precondition for achieving the provisions of the Waste Act and its implementing regulations, and the proper management of pesticide waste, with an emphasis on packaging polluted with hazardous compounds after the application of pesticides. The protection of human and animal health is not possible without the abidance of special regulations on waste management by all entities in the distribution chain and the use of individual pesticides.

The Waste Act stipulates the responsibility of registered legal and natural persons or crafts in such a way that the same are possessors of waste packaging polluted by hazardous compounds, and as such are obliged to keep the prescribed log for each type and quantity of waste and ensure temporary storage in line with the stipulated conditions for a maximum of one year, and to hand the waste over with the filled out accompanying form to an authorised person holding a permit for the management of such waste.

When such waste is generated by unregistered persons, i.e. by citizens using pesticides and generating waste as hobby producers of agricultural crops, the waste management regulations in such cases envisages the responsibility of the local authorities, which assisted by the municipal company, have the obligation to install receptacles for the separate collection of all components of hazardous waste from municipal waste, and to ensure the management of such waste in line with the Waste Act and its implementing regulations.

The current handling of waste packaging of pesticides in Croatia does not meet the prescribed conditions, and in the forthcoming period, it is necessary to invest additional efforts in the implementation of these regulations.

A bright example of the management of PPP waste packaging was the launch of the CROCPA ECO MODEL project, initiated by the CROCPA Association in 2008 in cooperation with authorised persons for hazardous waste management, based on the model of the ECPA. Over the years, implementation of the project has developed and been supplemented, with the goal of achieving better results.

However, in order to achieve the desired results, it is necessary to invest more effects to include all pesticide distributors in the system, and the CROCPA Association should take on the responsibility of pesticide distributors and organise a system of collecting empty packaging throughout the country, in such a way that contracts would precisely define the roles and payment of the system costs such that the valuable properties of the waste are used, as this today has increasing significance for sustainable development and energy efficiency.

Measure 1: Through the system to educate professional pesticide users, distributors and advisors, place special emphasis on the expansion of knowledge on the implementing regulations in the management of waste packaging and PPP waste. The obligation of professional pesticide users, distributors and advisors will be outlined in the instructions to be drafted by the Ministry of Agriculture in conjunction with the Ministry of Environmental and Nature Protection.

Measure 2: Increase inspection control and if necessary increase coordinated inspections for PPP distributors on the Croatian market, particularly those who are not in a network or do not have contracted cooperation with a legal or natural person possessing a permit for hazardous waste management.

Multiple compliance measures

Multiple compliance measures are obligations for beneficiaries of direct payments and IACS measures for rural development for achieving rights to payment pursuant to Council Regulation (EC) No 73/2009 laying down the common rules for direct support programmes for farmers within the framework of the Common Agricultural Policy and specified support programmes for farmers.

Multiple compliance is divided into two groups of measures: good agricultural and environmental conditions (GAEC) and stimulated management requirements (SMR).

Measure pertaining to PPPs are the use of only registered PPPs and application pursuant to approved use, instructions, warnings, notifications and restrictions listed on the labels of individual PPPs, and the storage and use pursuant to the principles of good agricultural practice for the preservation of human and animal health and environment protection.

Pursuant to the accession agreement between Croatia and the EU, this requirement becomes an obligation for agricultural producers, beneficiaries of direct payments and IACS rural development measures on 1 January 2016.

Protection of non-target arthropods and bees

Bees (honey bees, solitary bees and bumble bees) and other non-target arthropods, are exceptionally important for the pollination of agricultural crops, and for that reason, it is imperative that the application of pesticides does not impact their populations. In order to protect bees in foliar application and in the sowing of treated seeds, measures and procedures to reduce risk have been prescribed by the Ordinance Ordinance on establishment a framework for action to achieve the sustainable use of pesticides [7]. According to the data of the Food and Agriculture Organisation (FAO), it is estimated that of the 100 plant species that produce 90% of the world's food, 71 plant species are pollinated by bees. The main crops grown in Croatia depend on pollination by bees and other pollinators. That said, pollination also has an immeasurable contribution for the conservation of biological diversity.

Honey bees (*Apis mellifera*) originally inhabited the areas of Europe, Africa and the Middle East. Under the influence of local, environmental and climate conditions, indigenous breeds emerged in certain areas. After the last ice age in part of Europe, (southeastern side of the Alps, entire Balkan Peninsula and Danube plains), the grey bee (*Apis mellifera carnica*) arose, which was adapted for the long and harsh winters and the hot summers. There are also

different ecotypes of grey bees, and in Croatia, it is possible to isolate the Pannonian, Mountain and Mediterranean ecotypes.

In recent years, bees and other pollinators have been increasingly threatened by the spread of diseases and pests, reductions of natural habitats and areas suitable for hives, environmental pollution, increased use of pesticides and a series of other factors. Furthermore, due to the specific manner of mating of bees, geographical breeds of bees are threatened by the introduction of other bee breeds into their native area. Therefore, due to the free mating of bees, the threats to the grey bee in Croatia have been increased.

Measure 1: Through the programme to educate professional pesticide users, above all agricultural producers using PPPs to protect crops from harmful organisms, there should be systematic awareness raising on the potential dangers of plant protection products to bees and non-target arthropods.

Measure 2: Stimulate cooperation between professional users of pesticides, especially agricultural producers, beekeeping societies, and other institutions included in the registration and placing on the market of PPPs, so as to reduce the risks to bees and other pollinators.

Measure 3: Increase controls of implementation of prescribed risk mitigation measures for bees and other non-target arthopods during application of PPPs and sowing of treated seeds. Introduce inspection controls of the application of PPPs in the field, with the aim of controling the implementation of risk mitigation measures for bees and other important usage restrictions stipulated for individual PPPs, for the purpose of protecting non-target organisms and the environment.

Measure 4: Establish a system to monitor the exposure of bees to pesticides in real conditions of use in Croatia, in order to research the adverse impacts of pesticides on bees and the overall bee colony.

Measure 5: Conduct revisions of existing procedures in the case of incidents, massive bee poisoning caused by accidental or intentional activities, and where necessary to adopt new protocols for action upon suspicion of bee poisoning with pesticides.

Measure 6: Establish a pollination stripes to ensure a habitat in which useful pollination insects can live and feed.

Measure 7: Strictly abide by the rules of good agricultural practice and good beekeeping practice and the use of PPPs in accordance with the instructions on the label of the individual PPP so as to reduce the risk to bees.

Use of pesticides in non-agricultural and public surfaces

In order to reduce the risk to human health, animals and the environment, the use of pesticides on non-agricultural surfaces, particularly on public green surfaces, should be reduced, restricted or, in some cases, prohibited. This particularly refers to public green areas and parks in the vicinity of residential buildings, schools, kindergartens, rest homes, hospitals and other health care facilities where it is difficult to prevent the entrance of people, particularly children, animals and pets into treated areas, or areas immediately after treatment. The use of pesticides should also be prohibited in cases when the professional user is not able to ensure the safe application of the pesticides, and there are alternative methods to control the harmful organisms on plants.

Maintaining plants in excellent condition in public green areas in conditions of exposure to a series of hindering factors is an additional challenge for companies that deal with the maintenance of public areas and plant health. For that reason, it is necessary to ensure excellent protection and preparation of plants in the nursery, and after replanting to apply agrotechnical measures such as soil preparation, irrigation, fertilisation, removal of leaves and infected parts of the plant from plantations and other mechanical measures that create better conditions for plant growth and development. These measures reduce the presence of diseases and pests, and allow for the least pesticide consumption with good results in maintaining green areas. Priority should always be given to PPPs with lower risk.

Measure 1: Priority will be given to non-chemical proteciton measures, such as mechanical, physical, biological and biotechnical, while chemical protection measures will include only low risk PPPs, with the mandatory implementation of preventative measures aimed at reducing the appearance of diseases and pests.

Measure 2: Compulsory implementation of risk mitigation measures, such as guards for reducing drift and other equipment that reduces drift, the application of pesticides in the night and early morning hours using devices with quiet motors to reduce noise.

Aerial application of pesticides

Pursuant to the Act on Plant Protection Products[5], the aerial application of PPPs is not permitted in Croatia. Due to the fragmentation of agricultural surfaces and settlements, it is not possible to ensure safe application without drift onto human housing, animal housing, other structures, the aquatic environment, neighbouring crops and/or plantations, and domesticated and wild animals, and therefore the risks in aerial application are considered unacceptable in these conditions.

The Act envisages exceptions from a full prohibition, and aerial application may be approved only under special circumstances when the requirements laid down in the Ordinance on the establishment of a framework for action to achieve the sustainable use of pesticides [7] are met. These requirements primarily pertain to situations in which there is no practical alternative for control of a certain plant pest or plant product pest, or when there is an advantage in the sense of reducing impacts on human health and the environment in comparison with the ground application of PPPs. PPPs used for aerial application must received special approval from the Ministry of Agriculture, and that approval will stipulated the risk mitigation measures, and special risk management measures. Furthermore, the operator implementing the measures must have the appropriate education, and aircraft must be equipped with the best available technology for reducing drift.

Measure 1: Prohibition of aerial application of f PPPs remains in force in Croatia. Agricultural producers and forest owners have to take appropriate measures of plant protection on time to control the population of harmful organisms below the economic adversity threshold.

Integrated pest management and organic plant protection

Integrated pest management is a method of pests and diseases control that employs all available methods that are justified from the economic, ecological and toxicological perspectives. It gives an advantage in the use of naturally limiting the factors for diseases, pests and weeds, and tolerance figures are used in assessing the status. In integrated pest management, all positive factors of the agro-ecological system are employed. If agrotechnical measures are not sufficient, then biological, biotechnical or chemical methods are employed. Measures applied must meet the following criteria:

1. ensure healthy plant development,
2. pest populations are kept beneath critical levels,
3. protect natural enemies,
4. reduce threats of appearance of resistance,
5. reduce use of PPPs,
6. reduce hazards for all those working with PPPs, and
7. reduce threats for humans and the environment.

Measures, methods and eradication times are determined only for commercially important plant diseases, pests or weeds, exclusively based on forecasts of the appearance and spread in plantations or crops. This approach today is called sustainable, and the production system is called sustainable production.

The integrated approach to plant protection enables food production with pesticide residue levels lower than the maximum residue levels. This is not the primary objective of this plant protection approach, instead the primary objective is to reduce numerous other negative ecological consequences of the application of PPPs. The integrated approach to plant protection is most widely represented worldwide today, as it allows for the commercially and ecologically most acceptable application of PPPs. This approach is best developed in fruit production in Croatia, and most widely used in apple production.

There are limiting factors in integrated production and in forecasting the appearance and spread of plant diseases, pests and weeds. Factors that limit accurate forecasting of appearances are:

1. assessment of damage threshold,
2. assessment of yield losses,
3. assessment of appearance and spread,
4. monitoring and modelling appearance and spread,
5. monitoring and modelling the development stages of host plants, and
6. monitoring and modelling environmental conditions.

Organic approach to plant protection

The organic approach to plant protection implies the application of ecologically acceptable plant protection measures. Those are those measures that, with proper application, are not hazardous for humans and useful organisms, that do not pollute the environment (or only with short-term pollution), which minimally set off the establish balance of organisms, and that have a minimum negative impact on biological diversity.

The organic approach is based on (1) preventative and (2) alternative protection measures. Preventative measures include all available measures and methods that impact the reduction of pest populations, while positively influencing the development of useful populations. The emphasis is placed on those measures that reduce the development of diseases, pests and weeds, such as the sowing or planting of resistant varieties, balanced fertilisation with

manure, green fertilizers, crop rotation, etc. There are various definitions that aim to explain all that the alternative measures of control of plant diseases, pests and weeds implies. This concept implies the use of live antagonistic microorganisms or their products, the use of all ecologically acceptable chemical PPPs that are not classified as fungicides, but which have fungicidal or fungistatic activity, and the use of plant defensive activators that induce plant defence mechanisms. The greatest successes have been achieved with the use of antagonistic microorganisms, the most significant of which are fungi and bacteria. For the implementation of alternative measures, a great deal more knowledge and experience is necessary in order to ensure the proper and timely protection. In addition to causative agents of plant diseases, pests or weeds, hosts and environmental conditions, for the implementation of those measures it is also necessary to know the organisms being applied.

The integrated and organic approaches are sustainable approaches to plant protection, and the control measures in sustainable protection are categories into 'green', 'yellow' and 'red'. 'Green' measures include agrotechnical, biological, biotechnical and physical measures (permitted in organic production). 'Yellow' measures include the use of plant protection measures only when 'green' measures cannot prevent the appearance of commercial damages (permitted in integrated pest management, only some are permitted in organic production). 'Red' measures include plant protection measures that are prohibited in sustainable plant protection (organic and integrated).

In Croatia, fruit production since the 1970s has applied the integrated production approach, though the establishment of integrated production systems at the national level started relatively late. In 2010, the legal framework for establishing an integrated plant production system was put in place. For each production sector, the Ministry of Agriculture prepares technological instructions. In 2011, there was a marked increase in interest for this system, with an increase in the area under integrated production and an increase in the number of agricultural producers. Due to shortcomings in the integrated production system and the implementation of inspection controls for agricultural producers, a large number of producers left the existing system of integrated production of agricultural products. The Ordinance on the establishment of a framework for action to achieve the sustainable use of pesticides [7] establishes the compulsory application of the general principles of integrated pest management as of 1 January 2014.

Table 8: *Integrated production of agricultural products in Croatia, 2010-2012. Source: Ministry of Agriculture*

year/area in hectares	fruit	vegetables	vineyards	farming	total	Number of producers
2010	152.28	0.00	18.50	0.00	170.78	23
2011	2,169.46	718.71	2,473.99	66,771.39	72,133.56	540
2012	202.71	5.26	570.21	7,161.06	7,939.25	120
TOTAL	2,524.46	723.97	3.,062.68	73,932.40	80,243.61	683

The legislative framework for establishing a organic production system for agricultural products and food was established in 2002, though this production system in Croatia is still in the early development stages. However, Croatia has great potential for this type of production, a high percentage of unused agricultural lands (36.6%) which have conditions for organic production, and a high percentage of protected areas where only organic agricultural production is permitted. Thanks to the above, the interest in this kind of production is significantly increasing.

Agricultural areas under organic agriculture and the number of producers is growing thanks to state subsidies, cofinancing of expert controls and certification by individual counties, efforts of the AAS in informing and training, and active work of organic associations. The share of organic production in the overall (conventional) agriculture was 2.46% in 2011. The organic products market is not organised, partially due to a lack of products, limited processing capacities, and a lack of consumer information. The price of organic products is 20-50% higher than conventional products, and organic products are primarily exported to the EU Member States.

Table 9: *Areas under organic production and number of producers per year. Source: Ministry of Agriculture*

Year/areas (ha)	2005	2006	2007	2008	2009	2010	2011	Year/number of producers	
Ploughfields	2,214	2,957.92	2,915.69	2,800	9,766	17,066	22,156	2003	130
Orchards	84	200.93	574.72	792	1,264	1,770	2,058	2004	189
Vineyards	30	31.93	74.84	212	191	400	614	2005	269
Olive groves	26	36.98	82.83	100	228	322	600	2006	342
Meadows and pastures	740	2,620.10	3,495.81	5,603	1,998	2,452	4.943	2007	477
Fallow	27	101.80	40.15	100	84	156	452	2008	632
Forests (uncultivated lands)	60	58.58	86.94	82	315	444	352	2009	817
Vegetables			92.17	95	68	284	143	2010	1125
Medicinal plants			214.14	226	279	388	718	2011	1494
TOTAL	**3,184**	**6,008.24**	**7,577.29**	**10,010**	**14,193**	**23,282**	**32,036**		

Measure 1: Ministry of Agriculture, in cooperation with AAS and other experts, prepares the annual tehcnological instructions for individual sectors of plant production.

Measures 2: The possibility of improving integrated pest management methods will be included in the preparatory measures for agro-environmental payments in the framework of the PRP 2014-2020.

Measures 3: Education on new techniques and measures of integrated and organic plant protection, through initial and additional education, and through the work of the AAS, other expert and scientific organisations.

Measures 4: In the drafting of the techological instructions for each individual production sector, the IOBC guidelines will be followed and the use of synthetic pyretroids in certain production sectors and non-selective, residual and persistence pesticides will be restricted and/or prohibited.

Measure 5: The Ministry of Agriculture will financially and otherwise support research, application of promotion of non-chemical plant protection measures.

Measure 6: Promotion oorganic production.

Measure 7: Informing consumers about reducing the use of pesticides in integrated and organic agricultural production.

Reporting and forecasting tasks (RFT)

Knowledge of the state and status, and control of harmful organisms in a country is an international obligation assumed by the International Convention on Plant Protection and other international agreements to which Croatia is a signatory. The implementation of RFT is one of the preconditions for the export of certain products. The Plant Health Act[18] prescribes the implementation of RFT in Croatia.

Reporting and forecasting tasks are the foundation of contemporary plant protection, and they are mutually closely related. Participants in their realisation and implementation are CCAFRA-IPP, AAS, State Hydrological and Meteorological Institute (SHMI), Ministry of Agriculture, scientific institutions, the PPP industry, media and agricultural producers.

The objective of reporting tasks is the monitoring and registration of dynamics of the appearance of, intensity of attacks and distribution of pest organisms, resulting damages, measures to control specific pests and negative consequences of treatment with PPPs.

The objective of forecasting tasks is to use data collected in the reporting tasks to forecast the intensity of outbreaks and to determine the optimal schedule and measures to control pest organisms so as to prevent or reduce damages in agricultural production caused by pest organisms. In controlling pest organisms, various measures are applied, with more expert application of PPPs and increased application of ecologically acceptable plant protection measures as the aim. In that way, this also contributes to a reduction of environmental pollution.

The benefits of implementing reporting and forecasting tasks in plant protection are:

- informing professional users of the optimal schedules for controlling pests,
- reducing use of PPPs,
- obtaining information on the appearance of plant pests in Croatia.

To date, forecasting tasks at the county level have been performed by the staff of the AAS through the 'Reporting-forecasting tasks' programme prepared and coordinated by the CCAFRA-IPP. Recommendations and information at the regional level are available to the public on the AAS website (http://www.savjetodavna.hr), and at the state level on the CCAFRA website (http://www.hcphs.hr). With the intent of making the recommendations accessible to a larger number of producers, the AAS prepares recommendations at the county level in the local media (radio and newspaper).

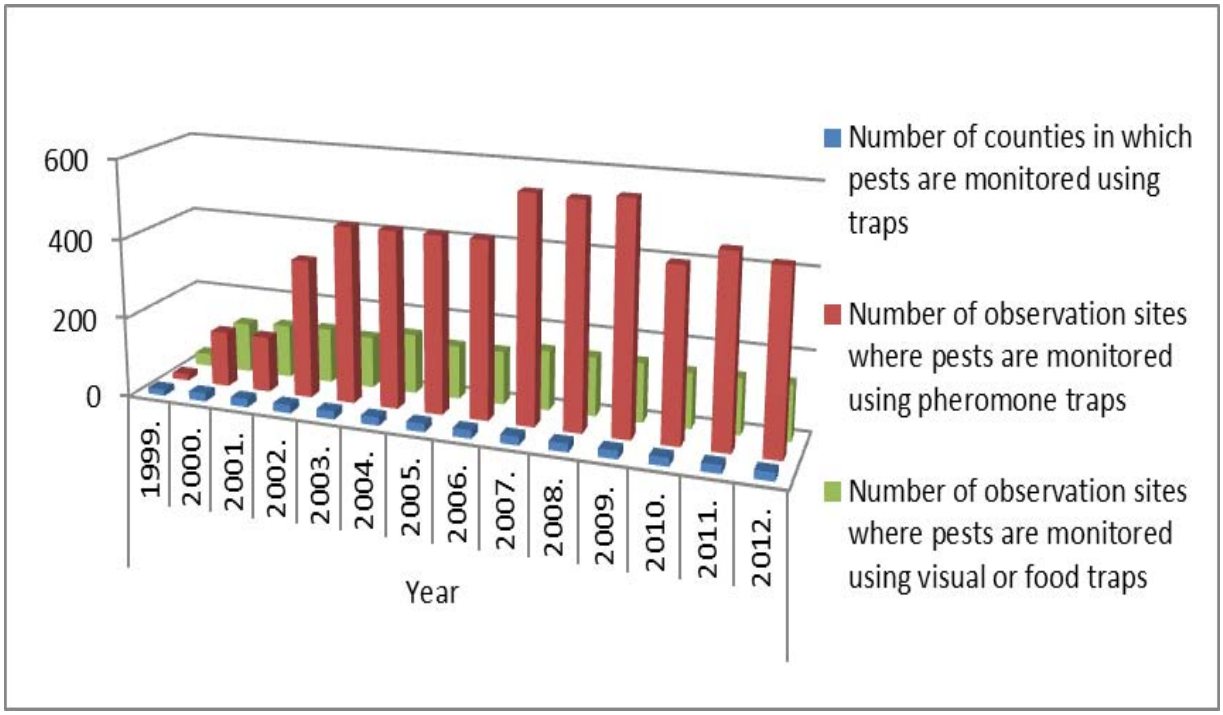
As part of the reporting tasks, the experts of the CCAFRA-IPP also record the dynamics of appearances, intensity of attacks and distribution, damages and measures to control certain pest organisms, and the negative consequences of treatment with plant protection products at the national level. On the basis of the data collected in the reporting tasks, the forecasting tasks then predict the intensity of the appearance and determine the optimal schedules and measures to control pest organisms.

Pursuant to the RFT objectives, experts of the CCAFRA-IPP hold educational lectures and workshops primarily for AAS experts, and occasionally for producers, they participate in various expert meetings on current topics, make field visits at the invitation of producers and AAS staff, where necessary visit permanent observation points, keep databases on the appearances of pests in Croatia, publish scientific and expert articles, draft forecasts at the national level and release them on radio and television and in some agricultural journals.

Plant protection specialists at the AAS spent part of their workday (30–60%) visiting localities to monitor agro-meteorological conditions suitable for the development and spread

of plant diseases, the appearance of pests and weeds, for the purpose of providing recommendations for plant protection. Recommendations for plant protection were released in 10 counties in 1999, in 17 counties in 2000, and in all counties since 2001. Notification on the appearance of the most significant diseases, pests and weeds, and recommendations for farmers have been broadcast on local TV stations, local radio stations, the AAS website, in the local newspapers, and expert articles on current issues have been published. They are also sent via e-mail to all those signed up for this service via the website. In 2012, the plant protection recommendations were received by 2520 users via the newsletter.

Graph 6: *Number of traps used to monitor pests, 1999-2013. Source: AAS*



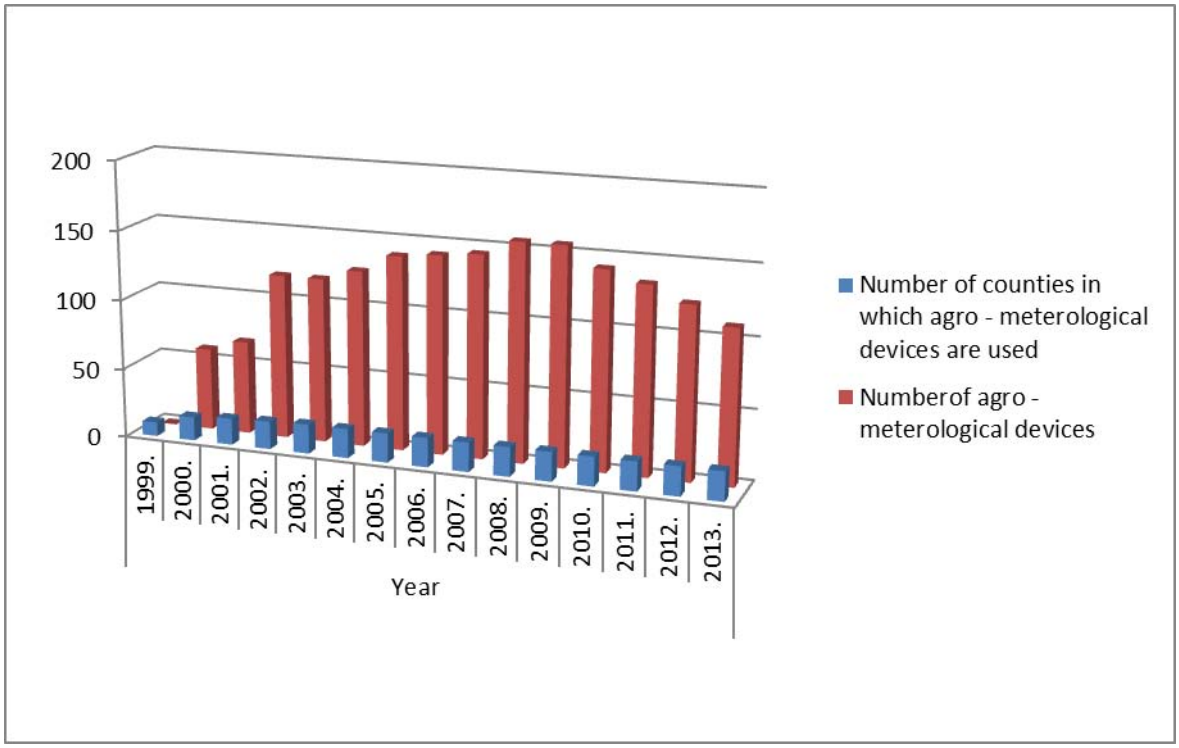
Agrometeorological conditions are monitored using agro-meteorological devices, such as Agra and Methos. The number of devices and the counties were they are used is shown in Graph 7.

Education of the AAS staff is one of the activities that contribute to the quality of work of specialists in the field, particularly on specific plant protection issues. From year to year, new problems arise that can only be resolved by educated specialists. Over the past 13 years, plant protection experts have participated in 117 educational workshops and seminars. Of that number, 94 workshops were organised by the AAS.

The AAS plant protection specialists held from 70–170 lectures each year for producers on protecting grape vines, and fruit, vegetable, flower and crop. From 1999 to 2013, the AAS staff prepared 15 flyers, 2 posters and 13 brochures on current topics.

In 2012, the experts of CCAFRA-IPP entered a total of 3311 reports into the information system for monitoring pests as part of the reporting tasks (http://ipp.hcphs.hr/), of which 1313 reports concerned the appearance of pests (insects, mites, nematodes, snails and rodents), 1084 concerning diseases and 914 concerning weeds. A total of 38 species of pests, 44 plant diseases and 52 species of weeds were recorded. The appearance of pests in fruit-growing and grape-growing is monitored using pheromones, olfactory (yellow, white, blue and red sticky plates) and feeding traps.

Graph 7: *Number of agro-meteorological devices 1999-2013. Source: AAS*



Measure 1: Improve the system of monitoring agro-meteorological conditions at a larger number of localities, and predicting the appearance of plant pests.

Measure 2: Ensure a sufficient number of traps for monitoring the appearance of pests.

Measure 3: Ensure a sufficient number of staff at AAS to work on forecasting tasks.

Measure 4: Ensure continued education of AAS staff.

Measure 5: Verify and adapt for the application of new forecast models in the local climatic conditions.

Measure 6: Co-financing AAS by the regional and local government.

Measure 7: Improve the ICT system to connect the CCAFRA-IPP and AAS for the purpose of supplementing the pest database.

Measure 8: Ensure GPRS equipment for CCAFRA-IPP and AAS experts for the purpose of faster and more efficient monitoring of the appearance of pests as part of RFT.

Measure 9: Implement and improve reporting and forecasting tasks at the national, regional and local levels.

Measure 10: Ministry of Agriculture to financially and otherwise support research concerning the economically justifiable, effective and environmentally acceptable use of PPPs, based on up-to-date scientific knowledge.

Measure 11: Stimulate and support research on the application of PPPs for the purpose of achieved more efficiency and economically and ecologically acceptabe protection of agricultural crops.

Informing the public and raising awareness

Up to the end of 2012, informing the public and raising awareness was not fully prescribed by the national regulations. However, various and numerous activities have been taken to inform key stakeholders, interest groups, interested parties, the public and individuals, and to give accurate and objective information on the authorized PPPs and potential risks that can arise from their use. In addition to the Ministry of Agriculture, other state bodies and institutions and organisations and associations participated in these measures. The Ordinance on the establishment of a framework for action to achieve the sustainable use of pesticides [7] established the obligation of informing and awareness raising concerning the use of pesticides and the obligation of PPP users to provide information upon request on the names of applied PPPs, the manner, date and time of treatment, quantity (dose/concentration) and treated areas.

Within the PIS, the Ministry of Agriculture built in an internet search engine of the authorized PPPs, via which all internet users can obtain information on the currently registered plant protection products in Croatia. The search engine is available on the homepage of the Ministry website (www.mps.hr) or at the following link http://fis.mps.hr/trazilicaszb/. All relevant information and measures taken by the Ministry of Agriculture, are published on the ministry website, and on the websites of other state bodies and institutions involved in tasks relating to PPPs and concerning pesticide residues.

In order to facilitate informing the public and providing access to information in one place, the Ministry of Agriculture is completing development of the Phytosanitary portal, where information and data concerning PPPs will be published. This includes publication of easy to understand information on PPPs available to the general public, particularly concerning the risks and possible acute and chronic effects on human health, animals, non-target organisms and on the environment.

A single national information system for monitoring cases of poisoning has not yet been developed in Croatia, and a project is under development that will unite the now fragmented collection of data on cases of poisoning that is performed by a handful of health care institutions. In addition to monitoring cases of poisonings treated in hospital, which is under the competence of the CNPH, for the time being, relevant data on the frequency of acute poisoning with pesticides can be found in the annual reports of the Centre for Poison Control of the IMI. Of the total cases of poisoning in 2011 (1559), only 6.9% (109 cases) concerned poisoning with pesticides. In monitoring the groups of pesticides, PPPs are included, as are rodenticide substances used in municipal hygiene, though general use compounds containing pesticides are not included. According to these records, the number of cases of pesticide poisonings in the past five years has declined (from 11.6% in 2007 to 6.9% in 2011), and this trend has been continuing for the past few decades. According to the available data, the share of pesticide poisonings in the period from 1985 to 2000 was approximately 28%, which was reduced to 16% in 2003. Another encouraging fact is that only in 5% of cases of pesticide poisoning were serious clinical cases, which were primarily intentional for the purpose of committing suicide. The seasonal appearance of the majority of cases from April to June indicates that there is an additional need for education in order to prevent excessive exposure during application, and cases of poisoning due to inadequate storage and keeping of PPPs.

Measure 1: Further improvement of the internet search engines of registered PPPs and publishing a larger number of data relating to the approved use and limitations, and measures to reduce risks during the use of PPPs.

Measure 2: Completion of the Phytosanitary portal, placing it into full operation and its regular maintenance. The Ministry of Agriculture will ensure the general public has full access to all relevant information concerning PPPs, and risks from their use, and the advantages and disadvantages of chemical and non-chemical protection measures in protecting plants from pests.

Measure 3: Publishing data on acute poisoning and chornic poisoning where available, in groups that are regularly exposed to pesticides, such as operators, agricultural workers or persons living near areas where pesticides are intensively used.

Measure 4: During the project to build a system to monitor cases of poisoning, which is envisaged to become operational in 2014, the Ministry of Health will ensure that cases of poisoning with plant protection products are adequately monitored, for the purpose of planning further education for users and for improving the health protection of people.

Measure 5: Upon request by interested parties, provision of information on PPPs that are applied, particularly near settlements, buildings in which people reside, animal housing, surface waters, public surfaces, parks, children's playgrounds, recreational and sports courts, schools, kindergartens, hospitals, other health institutions and the like.

Measure 6: Upon the request of citizens living in the direct proximity of surfaces being treated, the professional user is obliged to announced treatment no later than 24 hours prior to treatment and to provide information on the PPP to be used in the treatment, the date and time of treatment and the manner of treatment.

Introducing more acceptable and new methods and techniques in plant protection

In the forthcoming period, additional efforts will be invested in introducing non-chemical protection measures, such as:

- biological protection measures (use of natural enemies, i.e. predators and parasites);
- biotechnical protection measures (use of attractants, olfactory traps, pheromones, repellents, including confusion methods, mass hunting and 'attract and kill');
- sterile insect technique.

a) Confusion method

All multiyear crops represent monocultures, and their survival is threatened by an increasing number of causative agents of plant diseases and harmful organisms of animal origin.

A significant group of pests in orchards and vineyards are fruit pests (fruit moths), not only due to direct damages, but also due to the subsequent development of causative agents of diseases from the groups of brown rots (*Monilinia*) and moulds (*Botrytis*).

Numerous moths in Croatian plantations are such that the majority of the total number of applied insecticides is used to control these groups. The need and time periods of their use must be precisely determined, as application too early or too late does not give the expected results, instead pollute the environment and negative impact biological diversity in plantations.

The guidelines for integrated production in developed countries for the control of fruit pests in orchards and vineyards recommend the use of confusion methods. The knowledge that male insects can detect a female’s scent from great distances is used to monitor the appearance of

individual pests, and also for their control during the past thirty years. Chemical compounds that serve for the mutual attraction of the sexes of the same species for mating are called sexual pheromones.

These are aliphatic high-molecular compounds, usually alcohols, acetates or aldehydes with 9-18 carbon atoms. Their formulation into preparations that ensure even evaporation over the course of the season has allowed the use of sexual pheromones to monitor populations of pest species, and for their control using the confusion method. The confusion method is based on the distribution of a large number of sexual pheromones that are applied to plastic packaging of various form (e.g. capsules, dispensors, diffusors or evaporators, etc.), for the purpose of confusing the males and preventing copulation and fertilisation of the female. The confusion method is most commonly used against the coddling moth (*Cydia pomonella*), summer fruit tortix (*Adoxophyes orana*), peach moth (*Cydia molesta*), peach twig borer (*Anarsia linaetella*), plum fruit moth (*Cydia funebrana*), and grapevine moths (*Lobesia botrana, Eupoecilia ambiguella*).

The greatest advantage of introducing confusion methods is the abandonment of the use of chemical PPPs (synthetic insecticides), which are always potentially hazardous for the environment, and natural enemies. The shortcomings of confusion methods are reduced efficacy in years with a stronger appearance of pests, additional costs arising from monitoring and determining the necessary corrections with insecticides, and the size and shape of the plantation, i.e. the spatial isolation of surfaces with confusion methods from other parcels of land where this method is not employed. Despite this, multiple surveys have been performed on the success of confusion of harmful fruit moths, and today this method is widely used on larger plantations of fruit and grapes under integrated and organic production.

Considering that the confusion method does not envisage direct treatment of the pest, the following conditions must be met to ensure its success: (1) timely hanging of a sufficient number of capsules in the plantation, (2) appropriate density of capsules, and the proper and sufficient distribution of capsules in the plantation, (3) satisfactory spatial isolation from nearby plantations where confusion is not applied, (4) monitoring of the appearance of harmful moths and the percentage of attacked fruit, in order to forecast possible correction with the application of insecticides in plantations where confusions methods are applied.

The capsules should be hung in plantations immediately prior to the start of, or at the start of flight of fruit pests. The fact that males appear prior to females (protandria) or the abidance of limit temperatures for the sexual activity of insects allows for the hanging of capsules after the start of flight of fruit pests. The number of capsules per unit area depends on the type of packaging (quantity, stability and duration of pheromone release), on the assessed pest population size, and on the threshold of threat and possible correction using insecticides. Usually, 200-1000 capsules/ha are hung. In order to reduce costs of confusion methods per unit area, in recent years, certain manufacturers have been reducing the quantity of pheromone per capsule, and adding compounds that increase their activity (e.g. RAK 1+2E). Mating is avoided only in cases when the distance between individuals is sufficiently large, i.e. under low pest population sizes, as in proximity, the natural scent of the female is stronger than the scent of the pheromone.

In the period 1998–2003, in cooperation with the Faculty of Agronomy of the University of Zagreb (Agricultural Zoology Department) and the AAS in Medjimurje County, the efficacy of confusion methods was verified in grapevine plantations (RAK 1+2) and apple plantations (RAK 3, Shin-Etsu Isomate) for the control of dangerous populations of coddling moths and vine moths.

The experience obtained in Međimurje County with the experimental application of confusion methods indicated that it is possible to have a successful grape-growing season without the application of synthetic insectides to control vine moths. In apple plantations, due to the need for corrective control of summer fruit tortrix, peach moth and second generation corn moths, the application of insectides in the annual programme to control coddling moth was reduced by 60%. This ecologically most acceptable method of controling fruit pests becomes particularly effective if the majority or all of the grape or fruit growers in an area use this method.

Measure 1: Authorization of pheromones for the confusion method.

Measure 2: Education for oagricultural producers, associations, cooperatives, local government about the advantages of this method.

Measure 3: Launch of the pilot projects to use the confusion method for the control of fruit pests.
Measure 4: Co-financing for the confusion method by regional and local governments.

Measure 5: Informing consumers about the benefits of non-chemical methods of pest control.

b) Sterile Insect Technique (SIT)

In Europe and globally, the sterile insect technique is routines used or researched for the control of a large number of insect pest species, and in medicinal purposes for controling the vectors of human diseases (mosquitoes as vectors for various diseases – tiger mosquito *Aedes albopictus* as the vector for West Nile disease, *Anopheles arabiensis* as the vector for malaria, Tsetse fly as the vector of the African tripanosomosis disease), parasitic diseases of warmblooded animals (screw worm fly *Cochliomyia hominivorax*), and in agricultural production for the control of commercially important pests of agricultural crops (coddling moth– *Cydia pomonella*, pink bollworm - *Pectinophora gossypiella*, red palm weevil - *Rhynchophorus ferrugineus* in dates and palms, Mediterranean fruit fly – *Ceratitis capitata* etc.).

The SIT technique, as the ecologically most acceptable, highly effective and selective method, is compatible with the use of other biotechnical and biological methods to control secondary pests. The Mediterranean fruit fly *Ceratitis capitata* is successfully controlled using SIT, which implies the laboratory breeding of a large number of sterile males that are then released into nature. The number of sterile males is twice the number of wild males. When a fertile female copulates with a sterile male, fertilization cannot occur, and reproduction in nature is interrupted. The control of the Mediterranean fruit fly using the SIT method in the coastal areas of Croatia represents an opportunity to replace the conventional, chemical control methods that have a series of negative impacts. Pursuant to the results of special monitoring programmes in recent years, it has been established that the pests spread into new, previously unaffected areas. In that sense, it is important to continue regular monitoring of pest organisms in affected areas, and to determine the presence of the pests in new, previously unaffected areas, in order to ensure timely measures are taken for their control and preventing their further spread.

During the implementation of the technical cooperation project with the FAO/IAEA CRO 5002 entitled “Feasibility Study for the Suppression of the Mediterranean Fly by Integrating Sterile Insect Technique on an Area-Wide Basis in the Neretva River Valley” in the period

2007–2008, a study was carried out and showed that the B/C factor of application of the SIT method under conditions of increased production had a value of B/C=6 (1 invested, 6 gained), in comparison to the application of pesticides where the B/C value was B/C = 0.9 (1 invested, 0.90 gained). It is particularly important to emphasise the importance of conserving the protected areas in the Neretva value, which cover a total area of 1600 ha.

During 2010 and 2011, as part of the technical cooperation project with the FAO/IAEA RER 5014 entitled "Suppressing the Mediterranean Fruit Fly by Integrating the Sterile Insect technique on an Area-Wide Basis in Neretva Valley", for the period 2009–2011, a pilot programme to control the Mediterranean fruit fly using SIT methods was employed for the first time in Croatia and in the region on an area of 650 ha at the Vidrica locality in the Neretva Valley, with an additional 250 ha buffer zone. The research conducted by CCAFRA-IPP in the Neretva Valley during 2010 and 2011 confirmed the high efficacy of the control method, and a reduction in the pest population in comparison to other affected areas. In 2012, the control area for the Mediterranean fruit fly was expanded from the existing pilot area to a total of 4100 ha of orchards in the area from Opuzen to the mouth of the Neretva River. Through the technical cooperation project with the FAO/IAEA TCP RER 5018 entitled "Supporting Fruit Fly Pest Prevention and Management in The Balkans and Eastern Mediterranean", for the period 2012–2013, a total of 320 million cocoons of sterile males of *ceratitis capitata*, strain V8 were imported. All activities for the procurement of additional equipment, reception, packaging and release of sterile males, observation of ponds in the Neretva Valley area and quality control were improved with the introduction of additional quality control tests. The assessment of the efficacy of the SIT method is conducted by sampling fruits and the control of the ratio of caught sterile and natural individuals in the treated area. The results of the efficacy assessment indicated that fruit infestations, measured as the number of larvae per kilogram of fruit, was reduced by 73.9% during the peach maturation period, by 92.4% in figs and by 96.8% in mandarins. With the introduction of this method for the entire region of the Neretva Valley, the need for PPP use to control these pests would be eliminated. Considering that mandarin exports in 2012 totalled about 40,000 tonnes, and that certain consignments exported to the EU were returned due to the presence of pesticide residues, and from the border crossings from the EU towards Belarus, Russia and the Ukraine for quarantine reasons, the application of this method through the entire Neretva Valley region is justified.

Measure 1 : Continue the implementation of special programs of the control of the Mediterranean fruit fly *Ceratitis capitata* and administrative support to the Ministry of Agriculture in the next cycle of Projects of technical cooperation with the IAEA and in making proposals and decisions .

Measure 2 : Continued procurement of equipment and materials, and training of experts and staff in the program .

Measure 3 : Continue the implementation of the Decree on taking measures to prevent the spread and eradicate the Mediterranean fruit fly *Ceratitis capitata* through a standalone program , and to ensure the sufficient financial resources for the provision of expert and scientific support from the experts from CCAFRA - PPI - and during implementation of the program focusing on the development, introduction and implementation of phytosanitary measures , methods and studies that allow unhindered export .

Measure 4 : Auditof the Study : Economic and technical study on the application of SIT techniques for the control of the the Mediterranean fruit fly in the Neretva valley , (IAEA 2007) , with special emphasis on the protection of ichthyological and ornithological areas in the valley, on the economic impact and compliance with specific condition for export .

Measure 5 : Inform and educate end users on conducting SIT techniques , and the transition to funding programs by agricultural producers , buyers and local governments , creating the winning model of partnership between the user and the Ministry of Agriculture .

RISK INDICATORS

In order to measure the progress and achievements in reducing the risks of pesticides for human health, animals and the environment, it is necessary to establish uniform risk indicators. Uniform risk indicators are used to monitor progress in achieving the general and specific objectives of the NAP, to manage risks at the national level, and for the needs of data processing and reporting.

On the basis of the measures for achieving the general and specific objectives of the NAP, the application of the following risk indicators is proposed:

1. Quantity of plant protection products sold to end users

Quantities sold can be monitored for establishing certain groups of active substances, with regard to their properties and greater risk for the environment and human and animal health. Particularly for those substances considered candidates for substitution pursuant to Regulation (EC) No 1107/2009[1].

2. Quantity of active compounds in kg/ha

The applied quantity of active substances is an exceptionally important indicator, based on which certain measures can be planned to reduce risks to human health, animals and the environment, and measures to reduce resistance of certain detrimental organisms to certain groups of pesticides.

3. Frequency of use of plant protection products (UU-index)

Expresses the data as to how many times per year a given agricultural area may be treated with the sold quantity of a given PPP, under the assumption that the PPP is used in compliance with the prescribed dosage/concentration.

Formula:

$$\text{UU-index} = \sum_{\text{all active substances}} (SQ_{a.c.}/SD_{\text{plant species}}) / SPA_{\text{plant species}}$$

- $SQ_{a.c.}$: Sold quantity of the given active substance in one year
- $SD_{\text{plant species}}$: Standard dose/concentration for each active substance in each culture
- $SPA_{\text{plant species}}$: Size of production area for a certain culture

4. Number of professional pesticide users who have completed the training programme pursuant to the requirements of the Ordinance on the establishment a framework for action to achieve the sustainable use of pesticides [7],

5. Number of distributors and advisors who have completed the training programme pursuant to the requirements of the Ordinance on the establishment of a framework for action to achieve the sustainable use of pesticides [7],

6. Number of professional pesticide users who have completed the training programme on multiple compliance conditions,

7. Number of devices for the application of pesticides examined pursuant to the requirements of the Ordinance on the establishment of a framework for action to achieve the sustainable use of pesticides [7],

8. Number of new devices for the application of pesticides and the average age of devices in use,

9. Number of sold low drift nozzles (injet nozzles, devices with aerial support, etc),

10. Percentage of food samples in which pesticide residues exceeding the MRLs for food have been determined,

11. Percentage of food samples in which pesticide residues have been determined. The data are monitored by the type of plant product.

12. Percentage of samples in the monitoring of groundwater that do not meet the requirements of the Water Framework Directive[3],

13. Percentage of samples in monitoring surface waters that do not meet the requirements of the Water Framework Directive[3],

14. Percentage of samples in the monitoring of drinking water that do not meet the requirements of regulations on drinking water,

15. Number/percentage of family farms and the size of areas under organic production,

16. Frequency of pesticide poisonings among operators and farm workers, other persons present or consumers due to improper storage, handling, application or via food,

17. Number of incidents of environmental pollution with pesticides, animal deaths, bee die-offs and other incidents caused by pesticides.

DATA EXCHANGE, COLLECTION AND PROCESSING, AND MEANS OF REPORTING

The Ministry of Agriculture will establish a working group in which experts will be appointed from different fields and institutions. The working group will be tasked with the collection of data and preparation of reports on the implementation of individual measures. Members of the working group are appointed from state administration bodies, institutions and organisations competent for the tasks relating to the envisaged measures. The working group will be appointed for a period of five years. The primary bodies for the activities are: Ministry of Agriculture, Ministry of Health, Ministry of Environmental and Nature Protection, CCAFRA-IPP, IMI, AAS, SINP. For the needs of monitoring implementation and execution of the envisaged measures of this NAP, the working group will also include other necessary stakeholders as necessary. On the basis of the data, information, reports and analysis, the members of the working group will propose amendments to the NAP at least once in the five-year period.

In the calculation of risk indicators, priority will be given to those active substances that arouse concern relating to the approved use on crops, certain areas and methods of use that demand particular attention so as to reduce risks and negative impacts of the use of pesticides on human health, animals and the environment.

Measure 1: Establish a working group for the collection of data and reporting on the implementation of measures for achieving the objectives of the NAP.

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1. Regulation (EC) No 1107/2009 of the European Parliament and of the Council. The provisions of this Regulation are not transposed into the national legislation. Direct application of the Regulation will be enabled through a new act.

2. PPPs containing active substances that are in the procedure of reassessment will not meet the benchmarks for approval as prescribed by Annex II, points 3.6, 3.7 and 3.8.

3. Water Framework Directive 2000/60/EC. The provisions of this Directive have been transposed into the Waters Act (OG 153/09, 130/11 and 56/13).

4. Council Directive 91/414/EEC concerning the placing of plant protection products on the market. The provisions of this Directive have been transposed into the Act on Plant Protection Products (OG 70/05) and subordinate legislation adopted pursuant to the Act.

5. The Act on Plant Protection Products (OG 70/05) has been aligned with the provisions of Directive 91/414/EEC.

6. The provisions of the Regulation (EC) No 396/2005 of the European Parliament and of the Council on maximum residue levels of pesticides in and on food and feed of plant and animal origin have been transposed into the Ordinance on the maximum residue levels of pesticides in and on food and feed of plant and animal origin (OG 148/08, 49/09, 118/09, 36/10, 26/11 and 111/12). As of the date of accession of Croatia into the EU, the said Ordinance will cease to have effect, and direct application of this Regulation will be permitted by a new Act.

7. The provisions of Directive 2009/128/EC of the European Parliament and of the Council establishing a framework for Community action to achieve sustainable pesticide use have been transposed into the Ordinance on the establishment of a framework for action to achieve sustainable pesticide use (OG 142/12).

8. The Act on Technical Requirements for Products and the Assessment of Compliance, and the Ordinance on the safety of machinery, have been aligned with the provisions of Directive 2009/127/EC of the European Parliament and of the Council and Directive 2006/42/EC of the European Parliament and of the Council in the sections pertaining to pesticide application equipment.

9. The Waters Act (OG 153/09, 130/11 and 56/13) has been aligned with the provisions of the Water Framework Directive 2000/60/EC.

10. Ordinance on the conditions for establishing sanitary protection zones for springs (OG 66/11 and 47/13).

11. The provisions of Directive 2008/105/EC of the European Parliament and of the Council have been transposed in the Regulation on drinking water standards (OG 89/10).

12. Ordinance on limit values for wastewater emissions (OG 87/10)

13. The Regulation on water quality standard (OG 89/10) has been aligned with the provisions of Directive 2008/105/EC of the European Parliament and of the Council.

14. Ordinance on the uniform principles for the assessment and authorization of plant protection compounds (OG 166/06 and 80/07). This Ordinance transposed the provisions of Annex VI of Directive 91/414/EEC.

15. Strategy and Action Plan for the Protection of Biological and Landscape Diversity of the Republic of Croatia (OG 143/08)

16. Nature Protection Act (OG 70/05, 139/08 and 57/11).

17. Act on Support to Agricultural and Rural Development (OG 120/12, 136/12). This Act has transposed the provisions of Council Regulation (EC) 73/2009.

18. Plant Health Act (OG 75/05, 55/11). This Act transposed the provisions of Council Directive 2000/29/EC.

19. Regulation (EC) No 1185/2009 of the European Parliament and of the Council concerning statistics on pesticides.

20. Implementing Regulation of the Commission relating to the coordinated multi-annual control programme adopted annually by the Union for a three-year period. The most recently released Regulation was Implementing Regulation of the Commission (EU) No 788/2012 that applies to the period 2013, 2014 and 2015.

List of abbreviations:

ABBREVIATION	MEANING
CROCPA	Association of producers and representatives of plant protection products in the Republic of Croatia
SHMI	State Hydrological and Meteorological Institute
CBS	Central Bureau of Statistics
SINP	State Institute for Nature Protection
ECPA	European Crop Protection Association
EFSA	European Food Safety Authority
EU	European Union
FAO	Food and Agriculture Organisation
PIS	Phytosanitary Information System
GAEC	Good Agricultural and Environmental Conditions
GC-MS	Gas Chromatography - Mass Spectrometry
CCAFRA-IPP	Croatian Centre for Agriculture, Food and Rural Areas – Plant Protection Institute
CNPH	Croatian National Institute of Public Health
IAEA	International Atomic Energy Agency
IACS	Integrated Administration and Control System
IMI	Institute for Medical Research and Occupational Medicine
MRL	Maximum residue level of pesticides
MA	Ministry of Agriculture
NAP	National Action Plan
PECsw	Predicted Environmental Concentration (Surface Water)
AAS	Agricultural Advisory Service
RC	Republic of Croatia
SIT	Sterile Insect Technique
SMR	Statutory Management Requirements
SSD	Standard Sampling Description
PPP	Plant Protection Products
TER	Toxicity Exposure Ratio