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REDUCTION OF POLLUTION RELEASES THROUGH AGRICULTURAL POLICY CHANGE AND DEMONSTRATIONS BY PILOT PROJECTS

Review of agrochemical inventories and recommendations for reducing the impact of agrochemicals

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PREFACE

The overall objective of this Project is to the reduction of pollution from agriculture.

Within this Project there are two key specific objectives:

> Agricultural Policy: Reduction of nutrients and other harmful substances from agricultural point and non-point sources through agricultural policy changes (referred to Output 1.2 in DRP's documentation); and,

> Pilot Project(s): Development and implementation of pilot projects on reduction of nutrients and other harmful substances from agricultural point and non-point sources (referred to as Output 1.3).

The work will build on earlier studies and will improve the linkages between key EU policy instruments including, Water Framework Directive, Nitrates Directive and the Common Agricultural Policy etc., within the basin.

This Project is a continuation of work began in Phase 1 of the DRP, and the outputs and outcomes from this initial phase will be utilized and further developed in the project.

The Project will assist the DRB countries (especially in the lower Danube basin) with the development of pilot programmes for agricultural pollution reduction and low-input agriculture, in line with existing and emerging (driven by EU Accession) national environmental legislation.

The project addresses two DRP Outputs:

> Agricultural Policy (DRP Output 1.2) and

> Pilot Projects (DRP Output 1.3)

The following Tasks are included in the Project relating to Agricultural Policy:

> Task 1: Analysis of Current Legislation and Enforcement

> Task 2: Review of Agrochemical Inventories

> Task 3: Best Agricultural Practice

> Task 4: Dissemination of new Agricultural Pollution Reduction Concepts

The following Tasks are included in the Project relating to Pilot Projects:

> Task 5: Preparing detailed work programme for Pilot Projects

> Task 6: Implementing Agreed Pilot Project

> Task 7: Pilot Project Training and Demonstration Workshops

This report addresses Task 2: Review of Agrochemical Inventories.

The purpose is to review the inventories from Phase 1 of the DRP and to formulate recommendations for the appropriate use of these agrochemicals to ensure a reduction of their environmental impact.

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ABBREVIATIONS

BAP	Best Agricultural Practice
daNUbs	Nutrient Management in the Danube Basin and its Impact on the Black Sea
DRB	Danube River Basin
DRP	Danube Regional Project
DRPC	Danube River Protection Convention
EG	Expert Group
EMIS EG	Expert Group on Emissions
EU	European Union
EU WFD	EU Water Framework Directive
FAO	Food and Agricultural Organisation
GAP	Good Agricultural Practice
GEF	Global Environment Facility
GIS ESG	Expert Sub-group on Cartography and GIS
GIS	Geographical Information System
GMO	Genetically Modified Organism
ICPDR	International Commission for the Protection of the Danube River
ICM	Integrated crop management
ICSU	International Council for Science
IPM	Integrated Pest Management
IPPC	Integrated Pollution Prevention and Control
MLIM EG	Expert Group on Monitoring, Laboratory and Information Management
MONERIS	Modelling Nutrient Emissions into River Systems
PoM	Programme of Measures
POP	Persistent Organic Pollutant
PPP	Plant Protection Products
RBM EG	Expert Group on River Basin Management
UNDP	United Nations Development Programme
RBMP	River Basin Management Plan
RR	Roof Report
TNMN Trans	National Monitoring Network
WFD	Water Framework Directive
WB	World Bank
WHO	World Health Organization

LIST OF EXPLANATIONS OF CENTRAL TECHNICAL TERMS

Integrated crop management (ICM)	Integrated crop management (ICM) is a method of farming that balances the requirements of running a profitable business with responsibility and sensitivity to the environment. It includes practices that avoid waste, enhance energy efficiency and minimize pollution.
Biological control	The use of living natural enemies of a pest like parasitoids, predators or pathogens to reduce a pest is called biological control.
Integrated Pest Management (IPM)	The use of all appropriate pest management options, that contribute to a reduction of pest incidence, including the judicious use of pesticides, is called Integrated Pest Management. Components of IPM are: • use of resistant varieties • crop rotation • cultural practices/ thorough soil cultivation/ optimum seed bed • use of healthy seed • use of action thresholds for spraying decision • judicious use of pesticides
Priority Pesticides	In accordance with Article 7 of the Danube River Protection Convention, Annex II, Part 2 B a list of priority pesticides for the DRP has been prepared in Phase I. The 25 pesticides and 5 inert ingredients on the priority list include herbicides like Atrazin, fungicides like Copper compounds, insecticides like Endosulfan and others.

1. PILOT PROJECT APPROACH FOR THE REDUCTION OF USE AND IMPACT OF AGROCHEMICALS

The Pilot Project focuses on minimising the loss of nutrients and pesticides from the pilot project farms seen as production units and includes the most relevant BAPs for achieving this target. The Pilot Project is based upon a combined farmer/environment approach, that sees the loss/overuse of nutrients and pesticides as a loss of valuable resources and detrimental to the farm economy.

The Review of agrochemicals (chemical fertilizers, pesticides) includes recommendations for the appropriate use of these agrochemicals in order to minimise their detrimental environmental impact and seeks to ensure their correct use. The Review is made by project's experts on the base of the country reviews from the partner organizations from the 7 lower Danube Countries.

During the whole process the Project is aiming at a very close dialogue with the Pilot Project farmers.

For further information on the Pilot Project see the Technical Reports of this Project:

- Detailed work programme for Pilot Project and

- Best Agricultural Practices – What is it and how can it be implemented in practice.

The implementation of Pilot Project includes the following general steps:

1. Identification of potential Pilot Project farms in cooperation with provincial Secretary of Agriculture in Vojvodina.
2. Visit to the Pilot Project farms, evaluation of present status.
3. Definition of the BAPs relevant to the Pilot Project farms.
4. Agreement with the Pilot Project farmers.
5. Implementation of the Pilot Project.

1.1. Nutrients management: Optimisation of the use of manure and chemical fertilisers

The Pilot Project approach on the optimisation of the use of nutrients (manure plus chemical fertilizers) focuses on the handling of manure to minimise the loss of nutrients during the handling in the stables and when bringing it out to the fields. As little water as possible should be added to the manure to reduce the needs for storage capacity and the cost of bringing the manure out on the fields.

The pilot project promotes the following elements of BAP relevant to nutrients:

Best Agricultural Practice No 1

There should on all farms above 5 ha and/or 5 livestock be calculated resource economy every year, latest 1 April for the preceding year, and covering at least the resource economy for N, P and pesticides.

There aren't direct environmental effects related with N, P or PPP, but clarification of the possibility for pollution reductions.

Best Agricultural Practice No 2

Every farm with at least 1 ha of arable crops should ensure soil sampling at least each 5 years.

There isn't direct environmental effect, but creates the basis for fertiliser planning.

Best Agricultural Practice No 3

Crop rotation and fertilizing plans should be prepared for all farms above 5 ha every year latest 31 March, for winter crops latest 1 August. Fertilizing plans shall be based on the expected yield level, the needs of the crops, and include both livestock manure and mineral fertilizer.

The direct environmental effect is significant amount of reduced N and P leaching.

Best Agricultural Practice No 4

Livestock should be fed with rations that are correct balanced with energy, protein and minerals in relation to the productivity.

This practice would reduce the content of N and P in the manure by 15%, but with 15% increased productivity the amounts of manure would be increased by 15% as well, therefore no effects.

Best Agricultural Practice No 5

Cleaning of stables with water should be avoided or reduced to a minimum.

There aren't direct effects, but pre-condition for use of the livestock manure as fertilizer for the crops.

Best Agricultural Practice No 6

Watering of the livestock should happen in a way that hinders spill of water.

There aren't direct effects, but pre-condition for use of the livestock manure as fertilizer for the crops.

Best Agricultural Practice No 7

There should maximally be livestock corresponding to a nitrogen content in the manure of 170 kg N per ha. Manure should be sold to other farms or distributed to fields of other farms in case of a higher livestock density.

The direct environmental effect is significant amount of reduced N and P leaching.

Best Agricultural Practice No 8

There should be storage capacity for at least 6 months production of livestock manure at the farm. Production systems which use a bedding material need storage capacity for both liquid and solid manure. Production systems with deep bedding can store the manure on the field for up to 6 months if the manure has a dry matter content of minimum 30%.

The direct environmental effect is significant amount of reduced N and P leaching.

Best Agricultural Practice No 9

It must be hindered that rain water can dilute the livestock manure.

Best Agricultural Practice No 10

Spreading of manure in the period from 15 October till 1 March should not take place, and in any case not on to frozen land or land with a slope of more than 7°.

Best Agricultural Practice No 11

Proper technology should be used for spreading of livestock manure. Liquid manure and slurry should be spread with band laying system or be injected into the soil.

Best Agricultural Practice No 12

Livestock manure should be incorporated into the soil within 6 hours.

The optimisation of the use of nutrients includes the following implementation steps in addition to the general ones mentioned above:

1. Agreement with the local extension service: Zrenjanin Agricultural Institute including on-the-job training of advisers in the following issues:
   - Nutrient balance calculations
   - Field and fertiliser planning
   - Milk recording and feeding planning for dairy cows
   - Organisation of farmers (machinery ring)
   - Manure storage design
   - Manure transport, handling and spreading machinery
2. An Architect/Buildings advisor elaborates technical documentation for the manure and slurry storing objects on pilot farms: land surveying, measuring, dimensioning and locating of manure and slurry storing objects. Calculating the needs and cost af material and labour.
3. Investigate support possibilities from state and regional funds: MAFWM Rural development grant scheme, MAFWM Investments in agriculture grant scheme, MAFWM Subsidised credit lines, Voivodina Secretariat rural development grant schemes in close dialogue with the farmers and the authorities.
4. Promote establishing of manure storage facilities.
5. Promote purchase of manure handling equipment.
6. Soil sampling and collection of information for field and fertiliser planning.
7. Excursion for the pilot farmers to visit another machinery ring in Serbia
8. Setting up a Computer program for nutrient balancing.
9. Establishing Crop rotation and fertilising plans. Fertilising plans is based on the expected yield level, the needs of the crops, and include both livestock manure and mineral fertiliser.
10. Seminar on nutrient balance calculations and fertiliser planning for the involved Pilot Project farmers and Zrenjanin Agricultural Institute.
11. Securing that proper technology is be used for spreading of livestock manure: Liquid manure and slurry should be spread with band laying system or be injected into the soil. This includes investigating and advising on the possibilities and advantages of establishing a joint machine pool.
12. Establishing a plan for timing and amount of manure and chemical fertiliser (taking into consideration the type of chemical fertiliser) on each field.
13. Ongoing contact and advice from advisers from Zrenjanin Agricultural Institute to Pilot Project farmers.

1.2. Pesticides

The pilot project promotes the following elements of BAP relevant to pesticides:

Best Agricultural Practice No 1

There should on all farms above 5 ha and/or 5 livestock be calculated resource economy every year, latest 1 April for the preceding year, and covering at least the resource economy for N, P and pesticides.

Best Agricultural Practice No 13

Spaying with pesticides should be done according to the needs, and the doses take into consideration the spraying time, the development stage of the crop, the climatic conditions.

Best Agricultural Practice No 14

The spraying equipment should function properly, and it shall be ensured that the nozzles are functioning well to ensure an even spraying.

Best Agricultural Practice No 15

Pesticides shall be kept in a locked store, where books are kept on the purchase and use of pesticides.

The Pilot Project approach on the loss of pesticides to the environment includes the following implementation steps in addition to the general ones mentioned above:

1. Agreement with the local extension service: Zrenjanin Agricultural Institute including on-the-job training of advisers in the following issues:
    - Plant protection.
    - Establishing locked store and books on Plant protection means.
2. Seminar of pesticide planning for the involved Pilot Project farmers and Zrenjanin Agricultural Institute, including test of field sprayers, personal protection and use of reduced doses.
3. Securing that spraying equipment function properly on the Pilot Project farms, and that the nozzels are functioning well to ensure an even spraying.
4. Establishing locked store and books on Plant protection means
5. Ongoing contact and advice from advisers from Zrenjanin Agricultural Institute to Pilot Project farmers.

2. LINK TO PHASE 1 DRP ACTIVITIES

This report builds on the achievements of Phase 1 of the Danube Regional Project, especially the reports:

- Inventory of Mineral Fertiliser Use in the Danube River Basin Countries with Reference to manure and Land Management Practices
- Inventory of Agricultural Pesticide Use in the Danube River Basin Countries
- Recommendations for Policy Reforms for the Introduction of Best Agricultural Practice (BAP) in the Central and Lower Danube River Basin Countries.
- Final Report for Danube Regional Project Outputs 1.2 & 1.3
- Inventory of Policies for Control of Water Pollution by Agriculture in the Central and Lower Danube River Countries

It uses the same definition of Best Agricultural Practice as in Phase 1 of the Danube Regional Project: "…the highest level of pollution control practice that any farmer can reasonably be expected to adopt when working within their own national, regional and/or local context in the Danube River Basin". The definition emphasises the understanding that BAP actually encompasses a broad spectrum or hierarchy of activities that must be interpreted according to local agronomic, environmental, social and economic context.

Focus in Phase 1 was on agrochemicals as a source of water pollution. This project considers the handling of manure as a central issue in BAP implementation in the lower Danube countries. The typical management practices for reducing the risk of diffuse pollution by nutrients from agriculture have been promoted in the Final Report Phase 1. Almost all of them are included in the pilot project as elements of BAP.

A very big problem associated with the use of pesticides was identified in the Final Report Phase 1 as the farmers 'bad practice' when applying pesticides, not considering the development stage of the crop and the climatic conditions when spraying, and not spraying according to needs. The solution of this problem is addressed in the pilot project as element of BAP.

In the ToR of this project it is stated that in Phase 2 the Consultant is expected to review these inventories and to formulate recommendations for the appropriate use of these agrochemicals to ensure a reduction of their environmental impact. This review and recommendation should cover all key issues, including substitution, elimination and further regulation of use.

3. COUNTRY INFORMATION AND STATEMENTS

The following section is based upon information from the partner organisations in the 7 lower Danube countries

1. Bosnia & Herzegovina: Agricultural Institute of Republic of Srpska, Department of Agrochemistry and Agroecology
2. Bulgaria, National Agricultural Advisory Service
3. Croatia, Regional Environmental Centre and EuroLex Consulting Ltd.
4. Moldova, National Farmers Federation of Moldova
5. Romania, Fundatia pentru Dezvoltare Rurala din Romania
6. Serbia, "Natura Balkanika" Nature Society
7. Ukraine, National Association of Agricultural Advisory Service of Ukraine.

Bosnia & Herzegovina

Bosnia and Herzegovina (BiH) covers about 51,000 km^2 and has currently about 3.3 million inhabitants. The country is largely made up of mountainous highlands in the South and the West, hilly lands in the middle and the North, and flat to undulating plains in the Northeast. Consequently, most of the continuous tracts of fertile agricultural lands are situated in the northeastern part. The agricultural activities in the other parts of the country are mainly limited to relative narrow alluvial valleys and to undulating and rolling hills.

Major crop areas sawn in B&H (Data source 2005, Agency for Statistic of B&H)

Crops	Area sawn in ha 2003/2004	Area sawn in ha 2004/2005	Index 2003/04 2004/05
Wheat	86.986	81.409	93,59
Rye	3.425	3.355	97,96
Barley	21.714	20.269	93,35
Oats	21.338	18.476	86,59
Maize	193.563	195.636	101,07
Sunflower	239	215	89,96
Rape seed	141	520	368,79
Soy-beans	3.390	5.383	158,79
Tobacco	2.759	2.906	105,33
Potatoes	43.216	41.512	96,06
Field vegetables (beans, cabbages, onions etc.)	38.779	37.942	98,51
Forage grass, clover, lucerne	117.383	132.940	93,71
Maize for fodder	12.446	15.137	121,62
Forage beet	1.890	1.759	93,07

Nevertheless agriculture has played an important role in BiH. Before the civil war some forty percent of the population was full or part time employed in the agricultural sector. The civil war between 1990 and 1995 had a devastating effect on agriculture and food production. At the end of the war nearly eighty percent of the population depended on imported food. Since then, several bilateral and multilateral assistance programs have provided for essential farm inputs.

Most of the agricultural land is planted to maize and wheat, followed by potatoes and field vegetable crops. Maize is used for human consumption and as animal feed. Life-stock production includes poultry, cattle, pigs and sheep.

Total number of livestock in B&H in 2004 (Data source 2004, Agency for Statistic of B&H)

	TOTAL NUMBER OF LIVESTOCK
CATTLE	452.895
Cows and heifers in calf	339.235
SHEEP	892.941
Ewes for breeding	653.194
PIGS	595.171
Sows and sows of first farrow	118.059
HORSES	27.639
POULTRY	9.475.735
Hens	3.178.000
BEEHIVES	240.723

Bulgaria

Bulgarian soils are characterized by relatively high natural fertility. Fifty-six percent of the soils have a relatively favorable moisture – temperature regime, 24% have a restricting water regime and 20 % have a restricting temperature regime. There is a high diversity of soil types. Around 48% of Bulgaria is mountainous area and soil erosion is big problem.

Today there are more that 600 000 farms in Bulgaria with an average size of 1,32 ha of arable land. The main agricultural crops are wheat, barley, sunflower, maize, tomatoes, potatoes, apple, peach and vineyards.

A farm survey in 2003 showed that only 528 Bulgarian farms have special facilities for manure storage, while 484 836 farms have none.

The Code of Good Agricultural Practice (Code of GAP) has been approved by the Minister of Agriculture and Forest with Ordinance № RD 09-431/22.08.2005. The Code of GAP was developed for carrying out the requirements of Regulation № 2/16.10.2000 on the protection of waters against pollution caused by nitrates from agricultural sources, issued by the Minister of Environment and Water, the Minister of Agriculture and Forest and the Minister of Health and promulgated by State gazette № 87 from 2000. Regulation № 2 transposes the requirements from Directive 91/676/EEC on protection of waters against pollution caused by nitrates from agricultural sources (named Nitrates Directive). The Codes of CAP give the instructions for the correct utilization of organic and mineral manure.

The Codes of GAP have to be implemented by farmers in the protected areas around water sources and facilities for drinking water supply and around water sources of mineral water used for therapeutic, preventive, drinking and hygienic purposes.

For farmers, whose areas are located in the territories identified as vulnerable areas (areas where running and leaking waters are polluted by nitrates from agricultural sources), implementation of the Code of GAP is obligatory as a first program for reduction and elimination of pollution in vulnerable areas. The program for reduction and elimination of pollution in vulnerable areas was prepared and came in force in 2006 and will be updated after 4 years. For farmers, whose areas are not in vulnerable areas, the observation of Code of GAP is voluntary. A wide information campaign is initiated to present GAP and to motivate farmers to implement it on their farms.

The use of mineral fertilizers (NPK) has drastically decreased between 1997 and 2003. In 2004 the fertilised agricultural area in Bulgaria was (% of the total arable area)

- 34.68% for Nitrogen
- 1.37% for Phosphorus
- 0.57% for Potassium.

In the period from 1997 to 2003 more nitrogen was removed from the fields than was applied as chemical fertiliser resulting in a negative N-balance in most fields. As virtually no phosphorous is applied to the fields, crop production relies totally on the available phosphorus in the soil. As a consequence of the reduction of nitrogen fertiliser the average yields of the major crops have gone down.

Average crop yields between 1986 and 2004 in t/ha

Crops	1986-90	1996	2004
Wheat	4,2	1,9	2,4
Barley	3,9	1,7	1,9
Maize-corn	3,8	2,3	2,8
Sunflower	1,6	1,1	1,2

With regard to pesticide use in Bulgaria there are no reliable data available on the exact quantities and kinds used. It is however known that most pesticides are used in the regions where cereal crops are cultivated. The total number of active substances legalized in Bulgaria is 193, the total number of authorized priority pesticides is eight.

Examples of 'bad practice' contributing to the risk of pollution from pesticides in Bulgaria are:

- Unauthorized use of pesticides on crops they are not registered for
- Spray tank washing nearby water courses
- Old equipment used for spraying of pesticides and drift of pesticides
- Lack of knowledge about protection of water courses and other areas
- Poor timing of pesticides application
- Poor storage conditions.

The following policy instruments for effective pollution control of pesticides have been identified as appropriate for Bulgarian conditions:

- Introduction of Integrated Pest Management Standards as a condition for agricultural subsidies
- Compulsory training of both, farmers and advisers (license)
- Licensing of spraying equipment
- Subsidies for changing practices
- Pesticide use reporting
- Sales reporting
- Data improvement
- Targeted monitoring.

The following recommendations for the reduction of the use of agrochemicals have been formulated:

- Reform of agricultural pollution control policy for agrochemicals
- Use of EU basic regulations for prevention of pollution of the environment from agriculture (agro-environmental measures)
- Use of EU co-financed schemes that offer grant–aided investment, agro-environment schemes
- Training for 'organic farming'
- Introduction of 'Verifiable Standards of Good Farming Practice', that all farmers receiving payments from agro-environment and less-favoured area schemes must comply with.

Croatia

Croatia can be divided into three geographic and climatic zones: the lowland zone in the north of the country, which has a continental climate, the Mediterranean coastal zone in the south, and the mountainous zone stretching across the central part of the country generate 8.1% of Croatian GDP.

Land use in Croatia 2004

	Statistical Yearbook	Agricultural census	Difference (%)
Agricultural land	3.143.000	1.391.622	126
Arable land	1.462.000	802.093	82
Utilized arable land	1.096.601	802.093	37
Fallow land	363.215	102.423	255
Meadows	399.000	149.790	166
Pastures	1.156.000	60.561	1.809
Vineyards	58.000	27.688	109
Orchards	68.000	31.163	118

Various types of climate, relief and soil are favorable for the production of a wide range of agricultural products, from field and industrial crops to vineyards, continental and Mediterranean fruits and vegetables. Of a total of 3.15 million hectares of agricultural land 63% is cultivated and the rest is pasture land. Eighty-three percent of the cultivated land is privately owned. The Agricultural Land Act regulates concessions for the exploitation of agricultural land owned by the state.

At present, there are two official sources of data in Croatia related to the agricultural sector: the Agricultural Census and the Statistical Yearbook of the Republic of Croatia which are not fully harmonized.

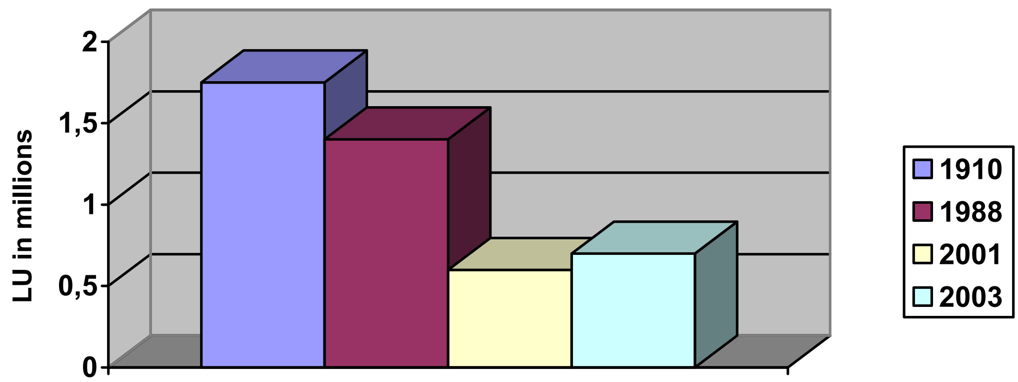
Two parallel agro-production systems are present in Croatia: family agricultural production units and agri-businesses. Private farming constitutes the core of the agricultural sector in Croatia since it occupies 80% of the total utilized agricultural land and 75% of the arable land, owns 82% of the livestock and 99% of all tractors, and accounts for approx. 95% of the total workforce in agriculture. The average family farm in Croatia is 1.9 hectares in size. Farms are very fragmented as the result of the previous administrative practice. Almost 3/4 of all Croatian family farms are smaller that 3 hectares and they farm only 21% of all utilized agricultural land owned by private sector. 75% of all private farms have three cows or less. In comparison, the average size of the agricultural companies is 159 hectares.

Farm size structure

	Farm households		**Agricultural companies**		**Total**	
ha	Number	ha	Number	ha	Number	ha
0-1	227.434	50.759	327	71	227.761	50.830
1-2	71.933	67.103	51	77	71.984	67.180
2-3	40.129	65.330	45	108	40.174	65.438
>3	109.036	670.004	941	216.952	109.977	886.956
Total	448.532	863.196	1.364	217.208	449.896	1.070.404

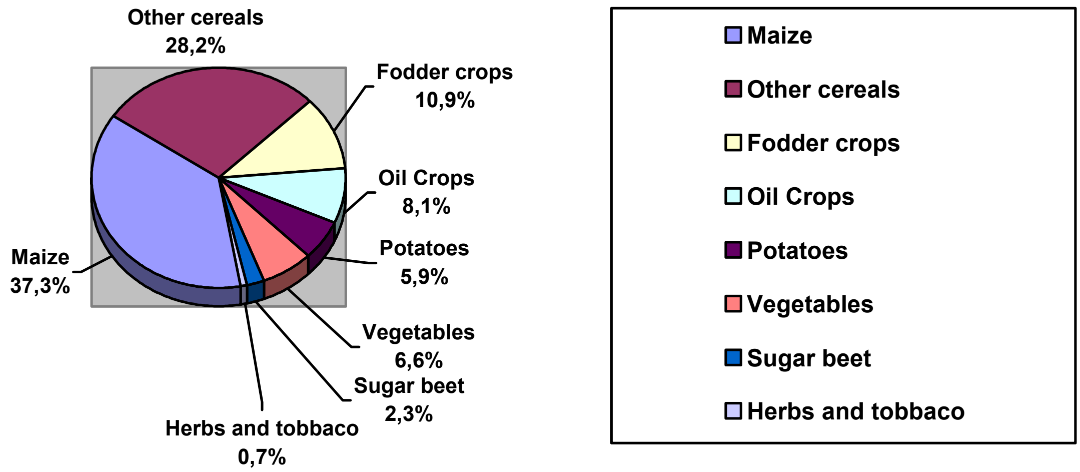
Private farming in Croatia is mostly characterized by small resources and income, restricted investments, combined sources of income meaning that private farming doesn't ensure appropriate full family income, lack of workforce, unfavorable age of rural population consisting of middle age and elderly people who have very poor education. Machinery is outdated and inappropriate for the implementation of modern agricultural approach principles. Ninety-eight percent of all farmers do not have any agricultural education and they significantly lack modern management practice and equipment. Their yields are significantly lower compared to those of agricultural companies.

The livestock numbers show a significant decrease within the last decade due to the losses caused by war, but also due to the generally unfavorable situation within the agricultural sector. The number of cattle today represents only 52% of the pool of 1989 (today approx. 450.000), the number of horses only 30% (today approx. 13.000), the number of sheep only 68% (today approx. 500.000), the number of poultry only 66% (today approx. 11.000.000), and the number of pigs only 74% (today approx. 1.400.000) of the status in late 1980s.



Livestock in Croatia (after UPR, 2002, VRH, 2003 and DZS, 2003a).

Crop production in Croatia is represented by corn, other cereals (mainly wheat, some barley, oats and rye in small amounts). Oil crops are produced on 90.000 hectares, while soy bean is produced on 40.000 hectares. 30.000 hectares are being used for sugar beet production. Tobacco is cultivated on 7.500 hectares. Using of pastures and meadows as well as fodder production shows a significant decreasing trend.



Crop production in Croatia

Moldova

The economy of the Republic of Moldova relies to a great extent on agriculture. Its population draws most of its income and means for sustenance from the land, other sources of income being very unreliable due to the deep economic crisis of the country. Currently, the agriculture and the food sector in the Republic of Moldova accounts for 30% of GDP, active labor force for 42% and exports for 65%.

The total land resources of the Republic of Moldova amount to 3.384.400 hectares. The agricultural lands amount to 2.556.600 hectares or 75,5% of the total, including arable land of 1.809.00 hectares or 53,5%, orchards and vineyards of 370.700 hectares (10,9%), and grassland of 376.000 hectares (11,1%). The surface under forests, groves and bushes amounts to 422.900 hectares or 12,5%. The main degradation factor for soils is soil erosion by water.

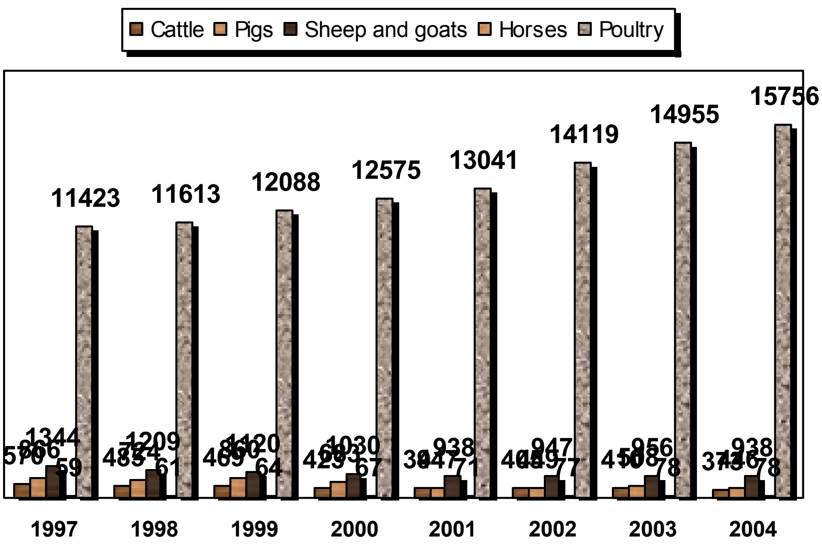
Although each family grows a number of crops, true diversification of crops in agriculture does not exist due to the subsistence form of farming. Farmers need to grow fodder for a few cattle and most foodstuffs for the family since there is no hope for cash income to purchase them. The extra produce is sold spontaneously in the local markets.

As of July 1, 2005 there were over 300,000 private farms registered by authorities in Moldova. On the average, the farm surface is 1.8 hectares.

Main crops with respective average yields, dynamics of animal production of recent years are presented in the following table and figure.

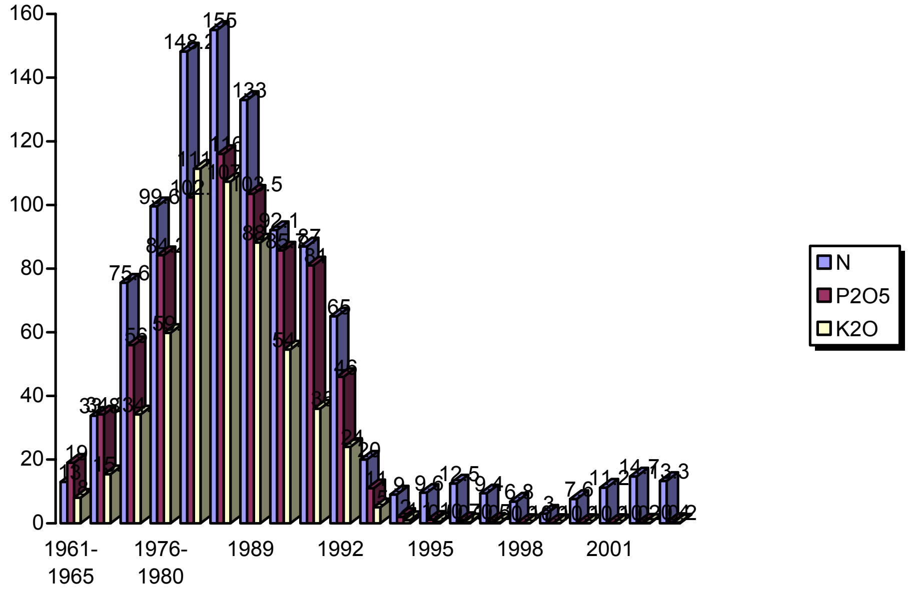
Crop production in Moldova (data for 2003)

Crop	Average yield (t/ha)
Winter wheat	0,6 t
Maize	1.7 t
Barley	0,8 t
Sugar beet	17,8 t
Soya	1,0 t
Sunflower	1,1 t
Tobacco	1,3 t
Potatoes	7,4 t
Vegetables	6,4 t
Grapes	4,1 t



Dynamics of livestock and poultry in all categories of producer (1000 capita)

Although Moldova is an agricultural country, during the planned economy the livestock wastes were seen as a nuisance and not as a very efficient resource. The amount of mineral fertilizer used on agricultural land was highest during the planned economy and decreased drastically after the political change. Manure from life-stock production is used only marginally as fertilizer. A big portion of liquid and solid manure is thrown into gullies or deposited in unauthorized places and thereby contributes to the pollution of the environment.



Dynamic of mineral fertilizer utilization (1000 t active matter)

Over the two decades between 1970-1990 over 800.000 tons of pesticides were used in the agriculture of the Republic of Moldova, the greatest amounts having been used during 1980-1990. The average pesticide pressure on soil has been 19.7 kg/ha (active substance), which exceeded several times the average amount used in the former USSR. As opposed to the 80ies the amount of pesticides used has declined significantly over the last 10-12 years.

There are estimated to be about 1.712 tons of obsolete and prohibited pesticides in the warehouses of the Republic of Moldova. A part of the pesticides were taken out of the warehouse and used by the population without knowing their origin, specifications and rules for the application. Pesticides can be found in most of the localities of the country, including in households.

Over the period 1976-1990 the pollution of the environment with pesticide residuals took place with concentrations dangerous for human health. Thus, in 1984 the average contents of Atrazine in the arable layer in the Northern zone of the country was exceeding the maximal admissible concentration (MAC) five times, in the Southern zone it was two times in excess, while in the Central zone the MAC was exceeded 50 times.

The Priority Pesticides identified in Phase 1 of the DRP are utilized for the pest and disease control in the following farm crops:

- 2,4-D – cereals, buckwheat, hetero-oil bearing/producing plants
- Chlorpyrifos – sugar beet, alfalfa, apple
- Copper sulphate (basic) - potato, tomato, onion, cucumber, melon, water melon, sugar beet, vineyards, quince, gooseberry, apple, apricot, cherry, peach, plum, pear trees
- Copper hydroxide – vineyards and apple
- Copper oxychloride – potato, tomato, onion, cucumber, sugar beet, hops, apple, apricot, cherry, peach, plum, pear trees
- Malathion – apple, cherry trees, tomato, cabbage

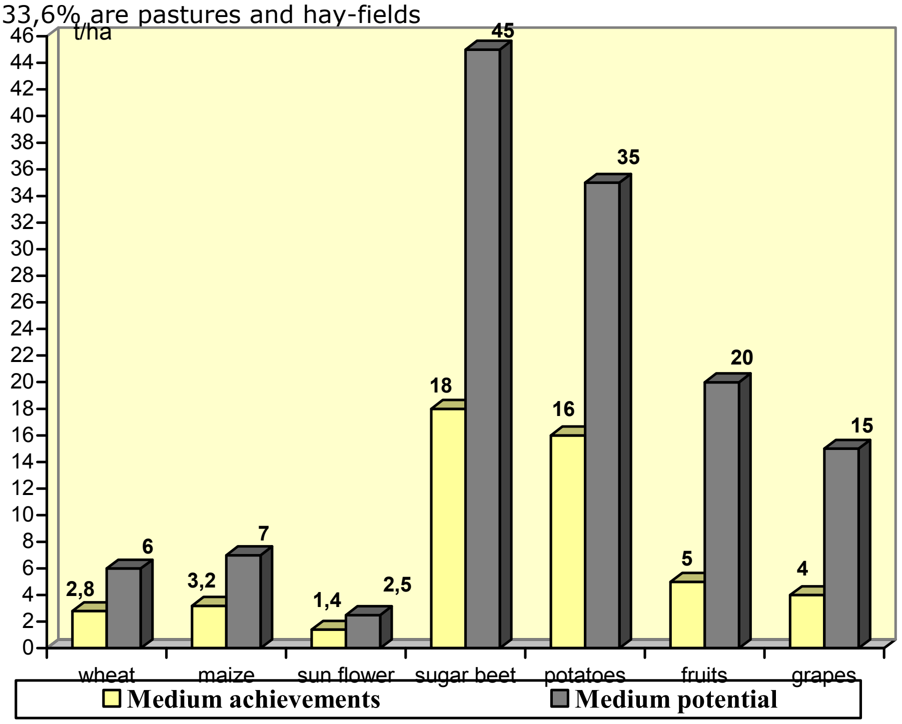
- Trifluralin – sunflower, cabbage, soy, tomato, tobacco.

Within the rural space the problem of pollution from chemicals remaining from the period of intensive agriculture is exacerbated by a low ecological awareness of the population.

Romania

Romania has conditions favorable to agriculture:

- The agricultural surface is 14,8 million ha, i.e. 0,65 ha per inhabitant
- 63,2% of this surface is arable land
- 3,2% is vineyards and orchards
- 33,6% are pastures and hay-fields



Medium potential of agricultural crops in Romania

The use of pesticides in Romania and the problems generated by their use:

- Pesticides are detected in surface and ground water in the DRB catchments area
- Use of unauthorised pesticides
- Uncontrolled and illegal trade of pesticides
- High use of pesticides in certain areas
- ‘Bad practices’ increase the risk of pollution

Serbia

After fifty years of planned economy, ten years of international isolation and the last few years of uncertainty whilst the nation debated in which direction it wished to go next, Serbia is once again moving forward, and its agriculture is about to embark on a transformation. This transformation will involve three major elements:

- completing the transition from centralized planned economy to the full market one

- integration with and ultimately accession to the European Union

- radical restructuring and modernization of the whole agricultural sector.

Agriculture accounts for about 25 percent of Serbia's GDP and, as such, is the largest sector of the economy.

The total agricultural land of Serbia can be seen in following table:

Agricultural land (in thousand ha)							
Region	Total	Arable	Orchards	Vineyards	Forage	Meadow	Pasture
Republic of Serbia	**5 673**	**3 656**	**255**	**82**	**528**	**672**	**1 008**
Central part	3 334	1 779	227	61	404	551	716
Voivodina	1 763	1 586	17	12	88	34	114
Kosovo (territory under UN interim administration)	576	291	11	9	36	87	178
Republic of Montenegro	**518**	**47**	**10**	**4**	**8**	**129**	**328**
Total	***6 191***	***3 703***	***265***	***86***	***536***	***801***	***1 336***
(Statistical Yearbook of Republic of Serbia, 2003)							

On the other hand, 27% of Serbian territory is forested. 5% of Serbian territory is protected. There are 5 National Parks, 120 Nature Reservations, 20 Nature Parks and more than 400 Nature Monuments.

The livestock population in Serbia is slightly declining.

Livestock population (1000 animals, FAO-STAT)											
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Cattle	1.975	1.991	1.809	1.950	1.926	1.899	1.894	1.831	1.452	1.366	1.355
Pigs	3.844	4.092	3.693	4.192	4.446	4.216	4.150	4.372	4.087	3.634	3.608
Chickens	23.955	21.493	20.311	23.491	24.287	23.542	26.188	26.492	21.118	21.000	21.100
Sheep and Goat	2.955	3.014	2.914	3.004	2.966	2.859	2.714	2.521	2.158	2.021	1.917

The utilization of fertilizer in Yugoslavia equaled approximately 1.25 m tons per year during 1982-1991. During 1991-1998 it declined to only 0.41 m tons (State of the environment 2000, National Environmental Priorities 2002). When this quantity is divided with the total area of arable land, it becomes clear that the utilization of fertilizers declined from approx. 115 kg a.m. NPK/ha to only 40 kg a.m. NPK/ha during 1991-2000. This trend, however, is expected to be reversed as the economy of the country recovers.

The data of the Agriculture Sub Association of the Business Association of Serbia (Privredna komora R.Srbije) show that there was an increase in fertilizer production in Serbia in 2004 by about 50% compared to 2003. During 2004 around 650.000 tons of fertilizer were produced in Serbia and 300.000 tons were imported from abroad.

Ukraine

The land resources of Ukraine are described in the following table:

Land resources of Ukraine

	Area 1000 ha	In %of total area
Total land area (territory)	60.354,8	100
Agricultural area	43.008,9	71,3
Forest area	10.457,5	17,3
Builded over land	2.459,2	4,1
Lands under water	2.420,5	4,0
Swamped land	953,2	1,6
Other	1.055,2	1,7

The structure of the agricultural sector of Ukraine can in short be described as follows:

- Agriculture is one of the most important branches of Ukrainian economy and contributes with 20% to the Ukrainian GDP
- 25% of the world black earth quantity are found in Ukraine
- 30% of the Ukrainian population lives in rural areas
- 20 % of the population are employed in agriculture
- 13% of total export are from agricultural production.

Livestock production in Ukraine

	Number of heads in 1000 (1.1.2005)
Cattle	6.952,7
Pigs	6.466,1
Sheep and goats -	1.769,5
Poultry	152.800,0

Agricultural crop production in Ukraine

	Sown area of main agricultural crops (in 1000 ha)					
	Grain crops	Sugar beet	Sunflower	Potatos	Vegetables	Fodder crops
2004	15.434	732	3.521	1.556	476	4.243
2005	15.005	652	3.743	1.514	465	3.738

www.ukrstat.gov.ua

Bad practices in connection with pesticide use of farmers in Ukraine:

- Wrong timing of application due to poor education
- Poor storage conditions
- Overuse of Atrazine and Chlorpyrifos
- Drift of pesticides to adjacent areas due to old spraying equipment and poor knowledge
- Cleaning of spraying equipment close to surface or even in surface waters
- Uncontrolled trade

4. CHEMICAL FERTILISERS

4.1. Phase 1 conclusions and recommendations

The following information is based upon the DRP phase 1 report: "Inventory of Mineral Fertiliser Use in the Danube River Basin Countries with Reference to Manure and Land Management Practices" and is based on information from the National Experts in the 7 lower Danube countries.

The environmental impact of fertiliser use is closely related to:

a) the total amounts of mineral fertilisers applied to agricultural land,
b) the way in which farmers apply fertilisers to their crops,
c) the overall management of their farming system.

In particular, the changes in management practice required to optimise the use of mineral fertilisers and avoid their misuse are related to the application of manure and slurry to agricultural land, as well as other soil management practices such as cultivations.

Typical problems and "bad practice" identified in the Phase 1 include:

- There is a widespread ignorance of ideas such as "pollution" or environment" amongst farmers and no information on the importance of managing fertilisers and manures properly
- Farmers often consider manure as a "waste product" rather than a source of nutrients that should be used carefully to save money spent on fertilisers
- The agricultural workforce often consists of more elderly people familiar only with previous farming methods and who have little (if any) agricultural education and do not understand the importance of applying fertilisers and manures correctly to the soil
- Machinery used for spreading fertilisers is outdated and not appropriate for modern agricultural operations – consequently application is uneven and commonly results in areas of "under" and "over"-fertilisation. Farmers do not have the knowledge or experience to adjust/operate the equipment correctly
- Many cheaper mineral fertilisers are only "milled" and during storage become compacted again which makes uniform spreading very difficult
- Fertilisers and manures are commonly stored in unauthorised places where there is a risk of causing pollution
- There is a tendency in some areas for farmers to grow the same crop (or same simple rotation of crops) for many years without application of fertiliser or manures. This is leading to a serious decline in soil fertility and the risk of increasing soil erosion due to loss of soil organic matter
- Farmers do not consider the nutrient requirements of the crops they are applying fertilisers (and manures) to
- It is not very common for farmers to practice soil testing before deciding where to apply fertilisers and manures and in what quantities
- Farmers and agronomists do not sufficiently recognise the potential value of nutrients in livestock manure. Consequently the application rate of fertilisers is not adjusted and nutrients are wasted because they are surplus to the crop's requirement
- Bad timing of fertiliser application is a common problem, especially when applying large amounts of fertiliser to higher value crops such as vegetables and potatoes. There are many reasons for this including poor knowledge and no access to agronomic advice, but also lack of necessary equipment when needed
- Application of nitrogen to soil in autumn before planting a spring crop is common practice in some countries. It is not understood that the nitrogen can be lost over winter. Spreading fertiliser and manure to frozen and snow covered ground is also common in some countries
- Over-application of fertiliser N at the time of sowing a crop is a common problem

- Compound fertilisers are often applied with inappropriate balance of nutrients and there is tendency to under-fertilise with P and K
- Nitrate losses from agricultural land are associated with farming practice not just the rate of fertiliser or manure application – factors that continue to contribute to high levels of nitrate leaching are poor timing of application, regular cultivations and the ploughing of grassland, legumes and other crop residues
- Fertilisers (and manures) are spread too closely to surface waters – rivers, lakes, ponds, streams and springs
- Fertilisers (and manures) are spread on sloping land where there is the risk of surface run-off from heavy rain washing them into nearby rivers and streams
- Even though the number of farm animals has declined and the quantity of animal wastes produced is less, most farmers do not have good storage facilities for manure and slurry – therefore manures and slurries are being applied at inappropriate times (e.g. autumn and winter) when there is a high risk of leaching or run-off
- Because of simplified tax systems in many countries for households and private agricultural plots including small farms there is no official obligation for them to have a book-keeping system. As a result they do not keep records of their purchases or use of fertilisers, manures or other relevant information (e.g. crop yields or sales) and there is therefore no reliable information regarding application of fertilizers.

Presently all 7 lower Danube countries have in their own national legislation about fertilisers: quality requirements and prescribed labelling and instruction to user.

The situation regarding the restrictions in the use of fertilisers is: the quantity per ha for different crops are prescribed, though not always precisely, in the secondary legislation, buffer zones and the restrictions to watercourses and lakes are prescribed. Time periods of permission to spread fertiliser are prescribed entirely in Bulgaria, in primary legislation in Croatia and Serbia, through recommendation in Bosnia and Herzegovina and Romania and almost without limit in Ukraine and Moldova. The rules for vulnerable zones or areas (e.g. cast areas) are prescribed in Romania, Bulgaria, Ukraine and Moldova.

The restrictions in stocking and equipment for handling fertiliser are completed in Bulgaria and Ukraine, only in primary legislation in Croatia and Serbia and in recommendations in Romania. There are no restrictions in Bosnia and Herzegovina and Moldova.

4.2. Substitution and optimisation

Nitrogen and phosphorus are the most important mineral nutrients for plant growth. Agricultural production in the lower Danube River Basin countries during the centrally-planned economies heavily relied on using mineral fertilisers, replacing the traditional reliance upon crop rotation and animal manures. After the collapse of the centrally-planned economies the agricultural productivity has drastically declined partly due to insufficient or inappropriately applied mineral and organic fertiliser from livestock production. At the same time too much nitrogen from agriculture is polluting the DRB waters.

The main sources of nutrient pollution from agriculture area:

- inappropriate use of mineral fertiliser and
- poor handling of solid and liquid waste from raising livestock
- inadequate storing of manure and slurry.

Farmers apply the fertiliser, mineral as well as organic one, often at the wrong time of the year or on wrong areas, for example on frozen ground or close to surface waters. Some farmers are not aware that there is an optimum for the amount of fertiliser, after which the crop does not benefit much more of fertiliser.

Many farmers do not consider livestock manure as a valuable crop nutrient resource but rather as a waste product. Livestock farms are often producing more manure than can be used by any crop, meaning that livestock waste becomes pollution.

Pollution also arises from storing manure improperly, for example on grassy areas from where it is washed away, or from dumping manure into floods. Storing facilities are usually inadequate and spreading happens all year including winter, when crops do not need fertilisation and the loss of nitrate therefore is highest.

An obvious way to reduce pollution from both chemical fertiliser and livestock manure is to substitute chemical fertiliser by liquid or solid manure, at least partially. If livestock manure or slurry are used in a sensible way, they can partly substitute chemical fertiliser, thereby reducing pollution from both chemical fertiliser and animal waste. As the content, kind and plant availability of nutrients in mineral fertiliser are different from livestock manure, mineral fertilisers cannot be substituted in a proportion of one: one. Farmers have to understand the differences between chemical and organic fertiliser and learn how to optimise their use. The optimisation of the use of both, mineral fertiliser and livestock manure, is a very important step to reduce pollution from nutrients. Not only is this expected to have a strong impact on pollution reduction, but it will at the same time increase farmers' income due to improved resource economy.

To minimize nutrient leaching from agriculture into the DRP waters and to efficiently use livestock manure as substitute for mineral fertiliser the following should be considered:

- Adaptation of fertiliser quantity to results of soil samples
- Adaptation of quantity to soil texture
- Adaptation of quantity and timing to crop requirements
- Proper application technique
- Regard for weather conditions
- Improvement of storage
- Fertiliser economy
- Integrated crop management.

Fertiliser quantity in relation to results of soil samples and to crop requirements

Nutrient inputs should be carefully balanced in respect of individual crop requirements and soil residues of nutrients and residues from previous crop. Application of fertiliser should always follow the results of soil samples and should also take into consideration the long-term release of nutrients from organic manure. In order to estimate the amount of manure needed for crop growth it is important to know the nutrient content of the applied manure. The quantity of fertiliser should also depend on the expected yield and kind of crop to which it is applied.

Long-term application of manure and slurry increases the total amount of total soil nitrogen and phosphorus and therefore slowly increases the supply of these nutrients to the crops. The rates of manure and slurry needed for optimum crop yields might therefore decrease over time, while the risk for over-fertilisation and leaching increases. Regular soil analysis is therefore strongly recommended.

Fertiliser quantity in relation to soil texture

Diffuse fertiliser losses from agriculture are greatly influenced by soil type. For example is the risk for nutrient leaching much higher on sandy soils than on loamy ones. Fertiliser quantities should therefore be adjusted to soil type.

In areas where the overlying soil is thin and/or where the underlying bedrock has cracks or is fissured or karstic in nature, there is a danger of polluting ground water. In such situations great care is needed when applying animal waste.

Fertiliser timing in relation to crop requirements

Fertiliser, both mineral fertiliser and livestock manure, should be applied to agricultural land at a time when the nutrients they contain can be used by the growing crop. Nutrients from fertilisers that cannot be used by the crops are subject to leaching or denitrification and release into the air, thereby contributing to water pollution and to the loss of valuable nutrients. The optimum time for application of slurry to cereal crops is not only limited by the risk of nitrogen leaching losses, but the growth stage is also of great importance. The most effective time for applying slurry to winter cereals, for example, is before the beginning of tillering, shortly before the time of the crops main nutrient requirement.

The application of slurry and solid manure should be carried out as early as practicable in the season in order to maximise the uptake of nutrients by crops and to minimise pollution risks. This is especially important for liquid manures like slurry with a high content of ammonium nitrogen, which is converted to nitrate in a relatively short period and then is prone to leaching. The application of slurry and other concentrated organic fertiliser should be avoided during the non-growing season, typically from October to April, when crops are not growing. In timing the application of manure, the relatively slow release of organic nutrients has to be considered.

Improvement of application technique

Ideally solid manure and slurry should be immediately cultivated into the soil using methods like ploughing, discing or through the use rotary cultivator. Cultivation into the soil is important to avoid the loss of nitrogen into the air.

Accurate calibration of fertiliser spreading equipment is important to minimise the risk of excessive application, both of mineral or organic fertiliser.

The use of modern technology for targeting fertiliser inputs in cereal production through the use of so-called ‘precision farming techniques’ offer a considerable opportunity to improve the efficiency and profitability of fertiliser use, and further reduce nutrient losses. The technology, however, is very capital intensive and beyond the reach of most farmers. One way to make them available also for smaller farmers is through the organisation of machinery rings.

Weather conditions and fertilisation

Application of fertiliser should generally be avoided in periods with strong rain or saturation of the soil with water. In addition to damaging the soil structure by the farm machinery, the risk for leaching is very high under such weather conditions. Also very warm weather in the period after manure or slurry application can cause high nutrient losses and contribute to pollution.

Improvement of storage

To minimize leaching of nutrients into the environment and to efficiently use manure and slurry as substitute for mineral fertiliser, storage has to be optimized. One of the major causes for nutrient pollution in the Danube River Basin is the lack of adequate storage facilities for livestock waste. Storage facilities have to reflect the size of the livestock producing farms. It is important that all waste material is collected and stored in appropriate storing facilities, both liquid and solid. The capacity of the storage facilities has to be large enough to make it possible to store all waste material during the winter period, when application of manure and slurry is not appropriate.

Fertiliser economy

In order for the farmers of the Danube River Basin to understand that livestock manure and slurry are valuable farm inputs that can substitute costly chemical fertiliser, it is important to make fertiliser economy transparent. Keeping records of fertiliser use and economy is a valuable tool in this process.

Records of fertiliser use and economy should include:

- how many fertiliser applications per crop
- application date/growth stage of crop
- total amount of fertiliser/organic fertiliser used
- spraying volume
- costs of application (costs of mineral fertiliser, fuel for tractor).

Integrated crop management

Integrated crop management (ICM) is a method of farming that balances the requirements of running a profitable business with responsibility and sensitivity to the environment. It includes practices that avoid waste, enhance energy efficiency and minimize pollution. ICM combines the best of modern technology with some basic principles of good farming practice and is a whole farm long term strategy. One of the main objectives of ICM is the reduction or substitution of external farm inputs, such as chemical fertilisers, pesticides and fuel, by means of farm produced substitutes and better management of inputs. This would then lead to reduced production cost and less environmental pollution. The principals and practices of ICM are:

- Crop rotation
- Soil protection
- Balanced crop nutrition
- Integrated pest management
- Enhancement of biodiversity
- Energy efficiency

The principles of ICM are complementary to the measures described as BAP. Their application will further contribute to the reduction of nutrient and pesticide pollution form agriculture and to the optimisation of the farm economy.

4.3. Elimination

Agricultural productivity depends largely on soil fertility. To maintain and enhance soil fertility and to support profitable crop production it is necessary to fertilise soils. The two most important plant nutrients applied as main fertilisers are nitrogen and phosphorus. Both are essential for crop growth and occur naturally in the soil. Agriculture however cannot rely on mineralization from the soil, as it does not meet the nutrient requirements needed in the current production and would rather deplete the soils. A total elimination of chemical fertilisers without substitution would therefore lead to a decrease of agricultural productivity and to a deterioration of the soils.

Agricultural fertiliser can be chemical or organic. Organic fertiliser can come from livestock production or from green manure. Moreover, adding nutrients to the soil can be done by nitrogen fixing plants that can bind air nitrogen or by deep-rooted plants elevating nutrients from deep soil layers to the root zone of agricultural crops. Organic farming is exclusively using organic fertiliser from livestock or green manure, sometimes supplemented by grinded minerals. Using the holistic production approach of organic farming makes it possible to produce crops with a relatively high yield without using chemical fertiliser. Leaching of nutrients from organic fertiliser, however, cannot be avoided also in organic agriculture, because the mineralization of nutrients from organic fertilisers is a continuous process that does not always coincide with the nutrient requirements of the crop.

4.4. Related projects

The UNDP/GEF Danube Regional Project has in 2006 launched a second round of a granting programme, where 62 non-governmental organisations were awarded small grants to reduce nutrient and toxic pollution in Danube waters. The project includes 11 Danube River Basin countries: Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Hungary, Moldova, Romania, Serbia, Slovakia, Slovenia and Ukraine. Projects are expected to run until January 2007.

At the regional level, five multi-country projects will include building bridges between stakeholders near the Hernad River in Hungary and the Sebes-Koros River in Romania. Public participation will be increased in managing the Sava River Basin. Best agricultural practices will be promoted to reduce pollution from farming in lower Danube countries.

At the national level 57 projects are being supported. They include: reducing pollution from Danube rivers, such as the Sava, Drina, Ipoly, Prut, Zitova and Maramures; campaigning for and promoting organic agriculture in Vukovar, Croatia, in the Morava River Basin in the Czech Republic, in Subotica, Serbia, and in Moldova; promoting best agricultural practices to eliminate nutrients and toxics in Croatia, Hungary, and Serbia.

This second round of DRP grants builds on the DRP's first round of 65 similar grants, which started in 2004.

The ongoing Serbia Danube River Enterprise Pollution Reduction Project (DREPR) of the World Bank aims at increasing the prevalence of environmentally friendly practices among polluting enterprises in the Danube Basin of the Republic of Serbia. In particular, the project targets nutrient pollution from livestock farms and slaughterhouses.

4.5. Agricultural extension service

Farmers are often neither aware of the environmental problems they cause, nor of how to solve them. It is important to raise their awareness about the issue of pollution from nutrients. It is necessary from the very beginning to change the common farmer's opinion that manure is a "waste product" rather than a natural source of nutrients. Also, it is necessary to improve agricultural education in order to emphasise the importance of applying manure correctly into the soil, with good timing, in compliance with the nutrient requirements of the crops and the results of soil testing. The existence of good storage facilities for manure and slurry and good manure production are further provisions for reducing pollution from nutrients. Recommendations on how to change polluting practices are described in the 15 BAPs defined for the pilot projects.

To successfully change farmers' habits they need to be involved. If farmers can be convinced that a better fertiliser management, both chemical and organic, will be economically and ecologically beneficial, they are more willing to change their practice. They need therefore to have access to training and advice by the advisory service.

The increasing complexity of considerations that farmers have to take when adopting Best Agricultural Practices requires a very strong advisory service.

4.6. Further regulation of use

As stated in the report 'Inventory of Mineral Fertiliser Use in the Danube River Basin Countries' of Phase 1 many of the main agricultural pollution issues regarding nutrients and pesticides are addressed by existing regulatory instruments in the DRB countries. However, existing instruments tend to be rather general with relatively few specific regulatory instruments.

Despite the relatively low levels of mineral fertiliser and manure currently applied to agricultural land in the lower DRB region compared to many EU Member States, national governments should take seriously the risk of diffuse pollution from fertiliser and manure application. The main sources of nutrient pollution from agriculture are:

- Inappropriate use of mineral fertiliser
- Poor handling of solid and liquid waste from raising livestock
- Inadequate storing of manure and slurry

Changing farmers' management practices is playing a key role in reducing nutrient pollution from agriculture. Regulatory issues to address nutrient pollution could include the following:

- Regulation of the maximum number of lifestock per unit of agricultural land
- Requirements for capacity of slurry tanks and manure storage facilities
- Time of field application of manure and slurry
- Incentive schemes for farmer investment in appropriate manure and slurry application and storage facilities
- Development of a strong and competent advisory service
- Provision and recommendations for Best Agricultural Practice for storing and spreading of manure and agrochemicals (dates and maximum amounts)
- Economic instruments to promote proper use and handling of chemical fertilisers and manure or slurry
- Systematic training of civil servants, extension services, farmers and employers in the agricultural sector.

5. PESTICIDES

5.1. Phase 1 conclusions and recommendations

Conclusions and recommendations from Phase 1 which are related to the pesticides:

- reduce the levels of harmful active substances used for crop protection by prohibiting and/or substituting the most dangerous priority pesticides with safer (including non-chemical) alternatives,
- improve controls on the use and distribution of pesticides,
- encourage the proper use of pesticides by farmers and other operators.

Reduce the levels of harmful active substances used for crop protection by prohibiting and/or substituting the most dangerous priority pesticides with safer (including non-chemical) alternatives:

Pesticide Ban - the use of Atrazine, Lindane, Diuron and Endosulfan need to be banned immediately.

Pesticide Phase-out - the use of all other priority pesticides, which are authorised should be reduced to a minimum, and their use should be phased out if possible and substituted by less-dangerous pesticides, including non-chemical alternatives.

Pesticide Cut-off Criteria - in order to prevent the replacement of the priority pesticides which are going to be banned or phased out with other hazardous pesticides, cut-off criteria for the approval of other pesticides need to be defined. Pesticides with distribution coefficients (K_{oc}) below 300g/l (low absorption to soil, prone to leaching and run-off) and a half life greater than 20 days need to be regulated (prohibition, taxes and transferable permits are possible policy tools). Persistent pesticides should not receive authorisation.

Improve controls on the use and distribution of pesticides:

Monitor Pesticide Trade - retailers, importers and distributor should be required to supply information on the amounts of all pesticide sold. Retail sellers need to keep records of their sales of pesticide products and to submit annual reports to national authorities

Control Pesticide Trade - all central and lower DRB countries must work towards stopping the uncontrolled and illegal trade of pesticides. The authorities on the borders should receive training on the issue of illegal pesticide trade. National legislation should enable authorities to effectively prosecute those selling illegal pesticides and to penalise them with high fines

Monitor Pesticide Use – effective monitoring of pesticide use at a farm level is an essential tool for improving the control of pesticide use and distribution, as well as assessing environmental risks, developing non-chemical alternatives etc. Uniform record keeping by farming is essential for a functioning pesticide monitoring system. National regulation must require that pesticide use records are a) **kept** by all pesticide applicators and b) **reported** to the relevant authorities

Elimination of Obsolete Pesticides – all effort must be made to immediately secure and remove stockpiles of obsolete pesticides.

Encourage the proper use of pesticides by farmers and other operators:

Raise Awareness about Pesticide Misuse – simple and easy to understand information materials, combined with well-targeted publicity campaigns, can be very effective at raising farmers' awareness of the dangers of improper pesticide use and the importance of key issues such as the safe storage, handling and disposal of pesticide products. Retail stores, extension services and other organisation working with farmers can serve as effective distributors of information material.

Develop National Codes of Good Practice for Pesticide Use – national authorities should agree upon clear and simple codes of good crop protection practice when using pesticides. There are numerous frameworks for such codes, but as a minimum they should provide guidance to farmers on:

- Basic elements of crop protection
- Choice of available chemicals for crop protection, including advice on not to use obsolete/illegal pesticides
- Integrated crop management and non-chemical alternatives for weed, pest and disease control
- Quantity and types of pesticide product to use
- Pesticide storage
- Use of spray equipment, including procedures for cleaning equipment
- Disposal of surplus pesticides and spray mixture (diluted pesticide)
- Disposal of empty pesticide containers
- Records of application
- Protective clothing and emergency procedures.

Mandatory Farmer Training on Pesticide Use - comprehensive training is the most important instrument to minimise losses and prevent pesticide pollution at a farm level. All farmers and other operators who wish to purchase and apply pesticides should be required to have a license confirming that they have participated in an approved training programme. As a minimum, training should highlight the possible adverse effects of pesticides and promote the National Code of Good Practice for the storage of pesticides, safe handling and application of pesticides, correct use of spraying equipment, disposal of unused pesticide and containers, and record keeping.

Presently all 7 lower Danube countries have in their own national legislation about pesticides: the positive list of approved pesticides, prescribed labelling and instruction to user and requirements for storing pesticides.

Training and education possibility is defined by national legislation in Croatia, Bosnia and Herzegovina, Bulgaria and Ukraine. There isn't information about current primary and secondary legislation about this matter in Romania. In Serbia and Moldova this issue is not defined by national legislation.

There is no requirement for spreading equipment (yearly control) in the 7 lower Danube countries.

The requirements to staff working with and spreading pesticides (e.g. certificate) are prescribed in Croatia, Bosnia and Herzegovina, Serbia, Ukraine and Moldova. There is no information about this matter in Romania. In Bulgaria this issue is not defined by national legislation.

Time restriction for use of pesticide, protected border zones to watercourse and lakes and rules for vulnerable areas are prescribed in all 7 lower Danube countries but not always with secondary legislation acts and concrete rules to promote implementation.

5.2. Substitution and reduction

In conventional agriculture pesticides are used to sustain yields. However, the excessive or inappropriate use of pesticides contributes to water pollution through leaching or run-off of pesticides. Pesticides are usually diluted with water and then sprayed on soil or crop. Excessive spraying can lead to soil toxicity and contaminated drinking water, because especially persistent pesticides are accumulating in the soils, from where they can leach into the ground water.

The disposal of unused spraying material is often problematic, because no special disposal systems are available to farmers. Sometimes pesticides are disposed by dumping on farm ground or into the sewerage system, thereby creating a severe risk for ground water contamination. Similarly, the washing of used equipment in open water bodies or on farm grounds without special waste water collection, is increasing the risk of water pollution.

On small family farms operating on a subsistence level the use of pesticides is regularly not economical, because the cost for pesticide application is usually higher than the benefit. On bigger farms, which operate more market orientated, like on strong family farms or agri-business farms it will be economically reasonable, however, to sustain yield and produce quality by applying pesticides.

Substitution is possible for some pesticides, when farmers can be offered alternative control methods. However, not for all pesticides alternatives are available. But in any case a number of measures can be taken to reduce the amount of pesticide used. Likewise is it possible by rather simple and inexpensive measures to reduce diffuse pollution from drift and from inadequate cleaning of spraying equipment or inadequate storage of pesticides.

Possibilities to substitute or reduce pesticides include:

Substitution

- substitute priority pesticides as defined in DRP Phase 1 with less harmful ones
- substitute pesticides with biological pest control
- substitute with mechanical methods
- substitute by genetically modified pest resistant crops.

Reduction

- by careful analysis of the actual needs
- by use of plant resistance
- by use of Integrated Pest Management (IPM)
- by optimisation of spraying technique
- by careful filling of spray tank, cleaning of sprayer, disposal of PPP
- by avoiding pesticide resistance
- by considering economy of pesticide use.

5.2.1. Substitution

Substitution of priority pesticides by less environmentally hazardous pesticides

In accordance with Article 7 of the Danube River Protection Convention, Annex II, Part 2 B a list of priority pesticides for the DRP has been prepared in Phase 1. The 25 pesticides and 5 inert ingredients on the priority list include herbicides like Atrazin, fungicides like Copper compounds, insecticides like Endosulfan and others. Most of these pesticides have been taken into use a long time ago, when requirements to their toxicity to the user and to the environment were not very high, and can be substituted by newer pesticides. The more recently developed pesticides are generally less toxic and more selective. They are very specifically toxic only for specific pests and less harmful to beneficial organisms like natural enemies of pests. Because of their selectiveness, however, these newer pesticides need to be applied at specific development stages of the pest to be fully effective. That means that the farmer has to be familiar with the critical stages of the pests to optimize the pesticide application.

Farmers may only use plant protection products that are officially registered in the country of use and are registered for use on the crop that is to be protected. A current list of all products that are approved for use should be made available to all advisors and farmers.

Biological control methods

To make use of living natural enemies of a pest like parasitoids, predators or pathogens to reduce the pest incidence is called biological control. Biological control includes the release of commercially reared natural enemies as well as the spray application of formulated microbial pesticides. Ready-to-use biological control methods do exist for a number of pests common in maize, vine and glass house crops. For many pests, however, biological control methods that are effective and economically competitive with chemical pesticides are not readily available.

Mechanical control methods

In almost all crops cultural control of weeds is possible at least partly as alternative to chemical control. Direct mechanical weed control methods include e.g. harrowing, rotary cultivation, hilling-up and hand weeding. Some of the mechanic methods need appropriate equipment. Successful cultural weed control does, however, not only depend on mechanical removal of weeds but also on preventive cultural measures like for example good seedbed preparation, good timing of nutrients and, very importantly, a cropping pattern that prevents the build-up of a one-sided weed population. In some crops like rape seed and potato cultural control of weeds can be highly competitive with chemical control. Also in plantation crops like vine or fruits mechanical control of weeds is possible and the pattern of rows and the row distances of newly planted plantations should be laid out in accordance to the equipment used for mechanical control.

Other mechanical control methods include pest mating disruption through pheromones or trapping of insects.

Genetically modified crops

Genetically modified crops with genes encoding resistance against insects have been grown widely in the USA and Canada since many years and have more recently also been approved for use in European countries. The most widely grown genetically modified pest resistant crop is B.t.-maize. While many experts claim that using genetically modified B.t.-maize reduces the amount of pesticides used in maize, the issue of environmental and food safety is still discussed and controversial.

5.2.2. Reduction

Plant resistance against pests

Crop varieties can differ widely with respect to susceptibility to pest attack and in their ability to compete with weeds. It is highly recommendable to use resistant and weed competitive varieties whenever possible. If resistant or competitive varieties are used instead of susceptible or less competitive ones, the number of pesticide applications can be reduced or pesticide application will not be necessary at all in some instances.

Reduction through IPM

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM uses current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. In contrast, organic farming applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals. IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practicing IPM, farmers who are aware of the potential for pest infestation employ several steps:

- use of resistant varieties
- crop rotation
- cultural practices/ thorough soil cultivation/ optimum seed bed
- use of healthy seed
- use of action thresholds for spraying decision.

Reduction of pesticides by optimization of spraying technique

If application of pesticides is necessary because action thresholds are reached, a number of measures should be taken to ensure that the application of the pesticide is as effective as possible. Only if a pesticide treatment has been effective it is possible to avoid the necessity of further pesticide applications or at least to reduce their number. If the number of pesticide applications can be reduced, the farmer is saving money and at the same time pollution of the environment is minimized. Measures to be considered are:

- use boom sprayers with nozzles that produce good and uniform droplets and spray cover
- check spraying quality of equipment /test field sprayer regularly
- spot treatment of perennial weeds
- spraying should take place at the right crop stage and susceptible pest stage
- adjust spraying volume to crop stage
- consider weather conditions when spraying (wind, sunshine, temperature, humidity)

Uniform spray cover. Except for spot treatment of perennial weeds and ultra-light volume applications early in the season, it is advised to use boom-sprayers, mounted on or towed by tractors. The nozzles of the boom sprayer should produce good and uniform droplets to ensure a spray cover as uniform as possible. To reduce drift and unwanted dispersal of pesticides, drift-preventing covers on the nozzles are advisable.

Regular test of field sprayers. The faultless functioning of the spraying equipment should be tested regularly, at least once a year. Testing criteria should include calibration to ensure accurate delivery of the required dosage of spray and size and quantity of spray droplets to ensure uniform spray coverage.

Spot treatment of annual weeds. Annual weeds are sometimes difficult to control by regular application of herbicides and often grow in clusters. Instead of treating the whole field they should be controlled either mechanically or by spot treatment with a higher dosage of herbicide. Spot treatment can be done by small spraying equipment or back-sprayers, but requires careful handling and protective clothing for the applying person.

Choosing the right pesticide and susceptible weed or pest stage. Most of the newer pesticides are rather specific not only regarding the pest species they do control, but also regarding the development stage of the pest. To get an optimum result of applying pesticides it is therefore very important to use the right pesticide and to apply it at the right development stage of the pest. The target species and the best stage for application should be indicated on the label. If pesticides are applied at the wrong development stage or are used against non-target pests, they are not effective. This means that the hazardous effects of pesticides on the environment in this instance are not counterbalanced by their effect of controlling agricultural pests.

Adjust spraying volume to crop stage. The quantity of spray mix should be calculated before spraying. Spraying volume of pesticides should be adjusted to crop stage, using lower volume for younger or smaller crops and higher volumes for older or taller crops. If spray volume cannot be adjusted at the spray equipment, volume regulation has to be done by application velocity.

Consider weather conditions when applying plant protection products. Spraying when it is windy, at low air humidity and at high temperatures should be avoided, because it will result in high losses of pesticide through drift and volatilization. The application of PPP will not be effective but contribute to the pollution of the environment.

Filling of spray tank/ Cleaning of sprayer and tank/ Disposal of PPP

A lot of care should be taken, when filling the tank with pesticide. Filling of the spray tank often is done at the same place on a farm. It is important that farmers are aware of, that even small amounts of spilled pesticides contribute to the pollution of the ground and surface water. Filling of the spray tank with concentrated pesticide should be done on a grass- or mulch covered place or a concrete floor from which spilled liquid is led into a separate tank or into the slurry tank.

After finishing spraying, the remaining spray residue in the tank should be diluted by 1:10 with clear water and sprayed preferably over a remaining untreated area. The spray solution between the tank and the nozzles cannot be diluted, care has therefore to be taken when applying the first meters as to avoid too high concentration of the pesticide. The outside of the sprayer and tank should be cleaned somewhere in the treated field. To be able to clean the spray equipment in the field, it is necessary to have a separate fresh water tank mounted on the spraying pesticide sprayer or on the tractor. Left over spray solution should never be disposed into the sewerage system, open water or onto the ground. Diluted spray solution could be led into the slurry tank.

Pesticide packing material should be disposed separately and treated as special garbage by the communal waste management system.

Avoiding pesticide resistance

Development of resistance to pesticides is a very real risk. Resistance development leads to yield loss in the treated crop as a first consequence, because the respective pesticide is not effective anymore. As a second consequence pesticide resistance leads to an increase in pesticide use, because farmers use higher concentrations to compensate for the reduced effectiveness of the pesticide or they treat more often. The development of pesticide resistance is therefore a threat not only to the individual farmer's economy but also to the environment. To avoid the development of resistance it is important to develop and follow appropriate guidelines. The main components of guidelines to avoid development of pesticide resistance are:

Apply the principles of IPM. If IPM is used the number of sprayings will be reduced. Resistance development is triggered by intensive pesticide use. The fewer the number of pesticide applications, the less is the risk for pesticide resistance development.

Alternate pesticides. An important rule for avoiding pesticide resistance is to avoid using a pesticide with a certain mode of action several times in one growing season. If more than one treatment in one season is necessary a pesticide with a different mode of action should be used for the second treatment. This recommended practice presumes that the farmers can choose between several registered pesticides for a given pest situation. It is also important that the farmer gets advice from the agricultural extension service, as the information about pesticides and their mode of action is very complex and rapidly changing.

Pesticide use and economy

Farmers should understand the relation between costs of pesticide use and the potential economic benefit through higher yield or better quality of produce. Not in all cases will the application of pesticides be economical. It will help to reduce pollution from pesticides if pesticide applications where the costs are higher than the benefit will be avoided. At the same time will this improve the farmers' net-income. To be able to make calculations on pesticide use and economy the farmers should keep records on the following data:

- how many sprayings per crop
- application date/growth stage of crop
- pesticide/active ingredients used
- spraying volume
- costs of spraying (costs of pesticide, fuel for tractor).

The records on pesticide use can also be used to follow a strategy to avoid development of pesticide resistance.

5.3. Elimination

The total elimination of pesticides will lead to reduced crop yields and reduce produce quality. The magnitude of the expected yield reduction will vary depending on the farming system and cropping pattern of a farm. Farms with a balanced cropping pattern will experience fewer losses than farms with a very narrow cropping pattern or growing special crops. In a farming system with a high percentage of cereal production increasing problems for example with grassy weeds would have to be expected. Potato crops would very likely suffer great losses through fungal diseases. Uncontrolled seed-borne diseases will rapidly permeate to most seed samples. Alternative control methods are available for some pests, but not for all. Some of the alternative control methods are economically not viable.

A provision for a total phase-out of pesticide use would lead to a substantial shift of farming systems, cropping patterns and cultural methods, as it is being practiced in organic farming. At present, the total replacement of external inputs only with natural resources and mechanisms to regulate pests is neither realistic, neither possible without substantial risks for food safety. According to country information from the 7 DRP countries the majority of rural inhabitants at present does not intend to shift their production to organic production.

5.4. Integrated pest management

Integrated Pest Management is the coordinated use of pest and environmental information along with available pest control methods, including cultural, biological and chemical methods, to prevent unacceptable levels of pest damage by the most economical means, and with the least possible hazard to people and the environment.

IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. As a first line of pest control, IPM programs target to prevent pests from becoming a threat. This may mean using cultural methods, such as selecting pest-resistant varieties, rotating between different crops, preparing optimum seed bed, and using healthy seed or planting material. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.

Before taking any pest control action, IPM first sets an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. Sighting a single pest does not always mean control is needed. The level at which pests will become an economic threat is critical to control decisions. It is important to monitor for pests in the field and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used

Once monitoring indicates that action thresholds are reached pest control is required. Effective, less hazardous pest control methods are chosen first, including mechanical or biological methods and targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort.

The following management activities are considered very important in IPM:

- use of resistant varieties
- crop rotation
- cultural practices/ thorough soil cultivation/ optimum seed bed
- use of healthy seed
- use of action thresholds for spraying decision.

Plant resistance. Crop varieties can differ widely with respect to susceptibility to pest attack. It is highly recommendable to use resistant varieties whenever possible. If resistant varieties are used instead of susceptible ones, the number of pesticide applications can be reduced or pesticide application will not be necessary at all in some instances**.**

Crop rotation. An increase in diversity of crop species reduces the disease and pest carry-over from crop to crop. Crop rotation sequences of farmers are, however, often more governed by considerations like marketability of the produce or access to irrigation than by phytosanitary aspects. Often the same fields are planted to the same crop for two or more years in a row. Diverse crop rotation systems are very important not only for soil structure and nutrient availability, but also for sanitary reasons. Soil-borne diseases and phytophagous nematodes can largely be avoided by using extensive and judicious crop rotation systems. Also the build-up of very uniform populations of problem weeds is being avoided by a varying cropping pattern. For example is it relatively easy to control grassy weeds, which are very problematic in maize, in a broad-leafed crop and vice versa.

Cultural practices / Soil cultivation / Optimum seed bed. Most cultural practices or soil cultivation activities have some influence on the agroecosystem in one way or another. Whether a field is autumn ploughed, spring ploughed or not ploughed at all will more or less disturb weed growth, soil-living pests and natural enemies of pests. Minimal cultural practices such as direct drilling, although they may reduce labour costs, also favour the survival of and build-up of pest populations in the soil. Crop debris in the fields and plant material discharged after harvesting or processing can serve as survival sites for pests and diseases. It is therefore important that growers are aware of the sanitary effect of composting or destruction of waste material. Generally a good seedbed preparation and optimum time of sowing gives the crop good growing conditions from the start will strengthen the competitiveness of the crop against weeds and will make the crop less susceptible to pest attack in the seedling stage.

Use of healthy seeds. Diseases that are seedborn or transmitted by infected planting material can be controlled by using healthy seeds or planting materials. Farmers have to be made aware, that it is important to use only healthy seeds or planting materials. Seed treatment with pesticides can in some cases result in fewer pesticide sprayings and therefore contribute to a reduced amount of pesticides used early in the season.

Action threshold for pest control. Before taking any pest control action it is important to set an action threshold. A low incidence of pest does not always mean that control is needed. An action threshold for pesticide treatment is the point at which pest populations or environmental conditions indicate that pest control action must be taken. The action threshold is defined as the critical point where the economic benefits from pest control in terms of higher yield or better produce quality are higher than the cost of pest control. In cases of low pest incidence pesticides should only be applied if the expected benefit from spraying in terms of higher yield, is higher than the cost of pesticide application. To determine the actual level of infestation it is necessary to regularly monitor pest incidence in the field and to have knowledge about the pests occurring in the field and the damage levels for different pests. Farmers and advisors have to be trained to recognise pests, know the damage levels for the most important pests and to learn, how to do pest monitoring. Monitoring and identification reduces the chances that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.

Reduction of active ingredients. Experience shows that the amount of active ingredients used per herbicide application can be reduced by up to 80% compared to the producers recommendations without any effect on crop yield or without any economical effect by considering the weed (species and stage), weather, timing and having adequate spraying equipment.

5.5. Genetically modified crops

Genetically modified crops with herbicide resistance genes or resistance against insects have been grown widely in the USA and Canada since many years and have more recently also been approved for use in European countries. The most widely grown genetically modified crops in Europe include insect resistant maize and herbicide resistant oilseed rape. Insect resistant maize possesses a bacterial gene coding for the production of an insect toxin. Insects eating plant tissue are at the same time consuming the insect toxin. Genetically modified herbicide resistant oilseed rape is resistant against the all-round herbicide Glyphosate. The general advantages of herbicide resistant crops seem to be connected with the fact that they enable farmers to employ a flexible and easy management strategy. And, in Glyphosate-resistant soybean, for example, costs in weed control programmes have decreased because of the reduced cost for herbicide applications.

While many experts agree that using genetically modified crops with insect resistance or herbicide resistance genes can reduce the amount of pesticides used in these crops, the issue of their long-term impact on the environment or on human health is still discussed and controversial. Especially in the case of herbicide resistant oilseed rape the discovery of a herbicide resistant weedy relative has confirmed the fear of environmentalist that uncontrollable 'superweeds' could be created by gene transfer from genetically modified crops to wild relatives.

Foodstuffs made of genetically modified crops that are currently available (mainly maize, soybean, and oilseed rape) have been judged safe to eat, and the methods used to test them have been deemed appropriate. These conclusions represent the consensus of the scientific evidence surveyed by the International Council for Science (ICSU) and are consistent with the views of the World Health Organization (WHO). However, the lack of evidence of negative effects does not mean that new genetically modified foods are without risk. The possibility of long-term effects from genetically modified plants cannot be excluded and must be examined on a case-by-case basis.

Genetically modified crops may have indirect environmental effects. It remains controversial whether the net effect of these changes will be positive or negative for the environment. For example, the use of genetically modified insect-resistant Bt crops may reduce the volume and frequency of insecticide use on maize and soybean. Yet the extensive use of herbicide and insect resistant crops could result in the emergence of resistant weeds and insects.

Several international agreements relate to the environmental aspects of genetically modified crops. The Convention on Biological Diversity is mainly concerned with the conservation and sustainable use of ecosystems but also with environmental effects of GMOs. A part of this convention is the Cartagena Protocol on Biosafety, which regulates the export and import of genetically modified crops.

5.6. Related projects

Problems of environmental pollution from pesticides are addressed by several on-going international projects in the Danube region.

The Food and Agriculture Organization of the United Nations (FAO) Italy started in 2003 funding a three-year regional project under FAO Trust Fund for Food Security to help seven countries in Central and Eastern Europe (Bulgaria, Hungary, Romania, Serbia, Bosnia and Herzegovina, Croatia and the Slovak Republic) to control the spread of a major maize pest in the region.
The project aims to enable farmers to monitor and control the pests in their fields, keeping the use of expensive and potentially damaging and dangerous chemical pesticides to an absolute minimum. This initiative aims to help national authorities to develop national IPM programmes, using participatory

The ongoing World Bank/GEF Project "Moldova: Persistent Organic Pollutants (POPs) Management and Destruction Project" supports investments for the environmentally safe management and disposal of obsolete POPs, including repackaging and centralized safe storage of obsolete pesticides in the agricultural sector, and PCBs in the energy sector, as well as their final destruction. research and training approaches. The project encompasses activities related to the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs) and performs inventories of sources and emissions of POPs, an assessment of stockpiles of POPs and of waste products contaminated with POPs, preparation of a POPs National Implementation Plan, assessment of public awareness of POPs, and preparation of a POPs communication strategy.

The organization "Citizens' Network" supported by USAID provides assistance with support to establishment of agricultural stores, seeds, pesticides, training in technology, etc. in Moldova.

The UNDP/GEF Danube Regional Project has in 2006 launched a second round of a granting programme, where 62 non-governmental organisations were awarded small grants to reduce nutrient and toxic pollution in Danube waters, The projects includes 11 Danube River Basin countries: Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Hungary, Moldova, Romania, Serbia, Slovakia, Slovenia and Ukraine. Projects are expected to run until January 2007.

At the regional level, five multi-country projects will include building bridges between stakeholders near the Hernad River in Hungary and the Sebes-Koros River in Romania. Public participation will be increased in managing the Sava River Basin. Best agricultural practices will be promoted to reduce pollution from farming in lower Danube countries.

At the national level 57 projects are being supported. They include: reducing pollution from Danube rivers, such as the Sava, Drina, Ipoly, Prut, Zitova and Maramures; campaigning for and promoting organic agriculture in Vukovar, Croatia, in the Morava River Basin in the Czech Republic, in Subotica, Serbia, and in Moldova; promoting best agricultural practices to eliminate nutrients and toxics in Croatia, Hungary, and Serbia. This second round of DRP grants builds on the DRP’s first round of 65 grants, which started in 2004.

5.7. Agricultural extension service

The transfer of knowledge and information to farmers via advisory/informative instruments can play a key role in changing the management practices of farmers and reducing agricultural pollution. The appropriate use of pesticides, application of principles of integrated pest management and strategy to avoid build-up of pesticide resistance is complex and needs strong and capable advisory service.

5.8. Further regulation of use

As stated in the report ‘Inventory of Mineral Fertiliser Use in the Danube River Basin Countries’ of Phase 1 many of the main agricultural pollution issues regarding pesticides are addressed by existing regulatory instruments in the DRB countries. However, existing instruments tend to be rather general with relatively few specific regulatory instruments.

Changing farmers’ management practice is playing a key role in reducing pesticide pollution from agriculture. As a starting point it is crucial to raise awareness among farmers about pesticide misuse by simple and easy to understand information materials, combined with well-targeted publicity campaigns. Key issues for awareness raising are the dangers of improper pesticide use and the importance of safe storage, handling and disposal of pesticide products. Retail stores, extension services and other organisation working with farmers can serve as effective distributors of information.

Regulatory issues to address pesticide pollution should include the following:

- Control on use of pesticides
- Control of trade and distribution of pesticides, control of black market
- Pesticide ban for the most toxic and persistent priority pesticides (Atrazine, Lindane, Diuron and Endosulfan)
- Pesticide phase-out of the other authorized priority pesticides
- Definition of cut-off criteria for registration approval of new pesticides. Persistent pesticides should not receive authorization.
- Encouragement of organic farming, development and implementation of special labels certifying organic products
- Encouragement of integrated pest management

- Encouragement of use and development of biological control products
- Registration procedures for microbiological control organisms to guarantee quality standard and ecotoxicological safety
- Development of a strong and competent advisory service, that can encourage and train farmers in the proper use of pesticides
- Implementation of BAP/Development of National Codes of Good Practice for pesticide use
- Regulation of storage of pesticides
- Mandatory training of farmers in proper use and storage of pesticides/Personal license for persons using agrochemicals for pest control
- Encouragement of proper use of pesticides by farmers and other operators through awareness raising.

6. ORGANIC AGRICULTURE

Organic farming refers to agricultural production systems used to produce food. Organic farming management relies on developing biological diversity in the field to disrupt habitat for pest organisms, and the purposeful maintenance and replenishment of soil fertility. Organic farmers are not allowed to use synthetic pesticides or fertilizers. All kinds of agricultural products are produced organically, including produce, grains, meat, dairy, eggs, and processed food products. Ideally the essential characteristics of organic systems include:

- design and implementation of an "organic system plan" that describes the practices used in producing crops and livestock products
- a detailed recordkeeping system that tracks all products from the field to point of sale
- maintenance of buffer zones to prevent inadvertent contamination by synthetic farm chemicals from adjacent conventional fields.

Certified organic refers to agricultural products that have been grown and processed according to uniform standards, verified by independent state or private organizations accredited by an authorized institution. All products sold as "organic" should be certified. Certification includes annual inspection of farm fields and processing facilities and ideally the submission of an organic system plan. Inspectors verify that organic practices such as long-term soil management, buffering between organic farms and neighboring conventional farms, and recordkeeping are being followed. Certified organic requires the rejection of synthetic agrochemicals, irradiation and genetically engineered crops.

The elimination of pesticide use is possible when the holistic concept of organic farming is used. Some pests or weeds can be difficult to control in organic farming resulting in yield losses or quality reduction. Organic production is therefore often connected with higher production costs as compared to conventional farming. It is therefore important for the organic producer that higher production costs for organic products can be compensated by higher market prices for organic products. This can be only achieved if organic products are certified and marketing as organic food is possible.

Organic agriculture is an important component of the efforts to reduce pollution from pesticides. It also contributes to the diversification of farming systems.

In order to support organic farming in the lower DRP countries, a number of issues have to be addressed:

- Development of a strategy to support organic and special quality agricultural production
- Building of national capacities for specific certification, production and research requirements
- Development of a certification system.
- Rules for conversion
- Rules for certification and control
- Strengthening of marketing possibilities
- Awareness for the nutritional and environmental benefits of organic farming has to be raised in farmers and consumers
- Establishment of a fund for promotion of Organic/Ecological farming aiming at subsidizing farmers during conversion.

- Systematic training of civil servants, extension services, farmers and employers in the agricultural sector on organic farming.

Like the first round also the second round of the UNDP/GEF Danube Regional Project granting programme is awarding small grants to non-governmental organisations in 11 Danube River Basin countries supporting the promotion of organic farming projects. Countries in which NGOs have received small grants include Croatia, the Czech Republic, Moldova, Romania, Serbia and Slovenia. Further support to the issue of organic agriculture was coming from an FAO project ‘Diversified Value-added Production and certification in Environment friendly Farming Systems’ in Croatia.

7. THE BLACK MARKED FOR AGROCHEMICALS

Institutions in charge of agrochemical inventories in countries of the DRP and also traders of agrochemicals assume that there is quite a substantial black market for agrochemicals. Products on the black market are either genuine or counterfeited and sold without any proper documentation or instructions for use. They are cheaper than regular products and often bought by poorer farmers. The capacities of the authorities of some of the DRP countries do currently not allow them to cope with the problem.

It is recommendable to make efforts to immediately secure and remove stockpiles of obsolete pesticides and to improve monitoring and controlling the pesticide trade and use and distribution of pesticides.

Retailers, importers and distributors should be required to supply information on the amounts of all pesticide sold. Retail sellers need to keep records of their sales of pesticide products and to submit annual reports to national authorities.

Effective monitoring of pesticide use at farm level is an essential tool for improving the control of pesticide use and distribution. Uniform record keeping by farming is essential for a functioning pesticide monitoring system.

All central and lower DRB countries must work towards stopping the uncontrolled and illegal trade of pesticides. The authorities on the borders should receive training on the issue of illegal pesticide trade. National legislation should enable authorities to effectively prosecute those selling illegal pesticides and to penalise them with high fines.

8. INFORMATION AVAILABLE

In order to make sensible decisions on further regulation of fertilizer and pesticide use, to design good advisory strategies and to control the use and distribution of agrochemicals and animal waste it is important to base decisions on sound information of the present situation in each of the DRB countries.

The following information should continuously be collected for each country:

- Lifestock production
- Standards for nutrient content of lifestock waste
- Crops grown, areas and kinds
- Fertilizer used, kind and quantity
- Pesticides used, kind and quantity
- Environmental monitoring on the amount of nutrients and pesticides in surface and groundwater (e.g. transport in rivers as result of agricultural activities).

When collecting information it is highly recommendable to discuss with the institutions in charge for data collection the purpose and further use of data. Quality assurance, accessibility of information to others and the flow of information between interested institutions are important topics to be addressed. Collection of the same information of different institutions should be avoided.

9. RECOMMENDATIONS FOR THE APPROPRIATE USE OF AGROCHEMICALS

9.1. Chemical fertilisers

The Project has in dialogue with the project partners elaborated recommendations on the appropriate use of chemical fertilisers including the use, handling and storage of manure and slurry from lifestock production in order to reduce the impact from fertiliser use on nutrient pollution. The recommendations are the basis for nutrient and pesticide management in the Pilot Project and are contained in the recommendations for BAP in the Lower DRB Countries and include the following:

- Adapt fertiliser N quantity to the crops' requirement depending on

  - kind of crop, crop variety, expected yield, expected crop quality

  - natural supply of N from the soil, including N released from soil organic matter, crop residues and applied manure or slurry

- Avoid applications of N fertilisers and Manure/slurry from autumn to early spring, when crop requirements for N are very low
- Limit the application of manure and slurry to a quantity that ensures that N supply does not exceed crop requirements; apply preferably in smaller quantities at regular intervals to match more closely the crops requirement for nutrients during the growing season
- Take special care when applying fertilisers and manure/slurry on fields where there is a risk of run-off to surface waters
- When applying fertilisers/manures, ensure that an adequate distance (a 'buffer zone') is kept away from surface waters to avoid the risk of direct pollution
- Ensure accurate calibration of fertiliser spreading equipment to minimise the risk of excessive application.
- Improve application technique for manure and slurry
- Improve storage facilities for manure and slurry
- Minimise the period when the soil is left bare and susceptible to nitrate leaching by increasing the area of sown winter crops, cover crops and grassland, whilst decreasing the areas sown to spring crops
- Sow winter crops early in autumn to increase nitrate uptake prior to the onset of the winter leaching period
- Regard weather conditions when applying fertiliser
- Adapt quantity of fertiliser to soil texture.

Generally it is important to get the agricultural community actively and positively involved in reducing the environmental impact of chemical and organic fertiliser by stressing the economic benefits of improving the use and handling of chemical and organic fertilisers for the farmers. Farmers need to understand that lifestock waste, if applied properly, can partly substitute chemical fertiliser. Proper use and handling of fertiliser will increase the efficiency and profitability of chemical as well as organic fertilisers, improve farm economy and reduce environmental impact of nutrient pollution. Systematic training of civil servants, extension services, farmers and employers in the agricultural sector is needed to support the changes.

9.2. Pesticides

The Project has in dialogue with the project partners elaborated recommendations on the appropriate use of pesticides including the handling and storage of pesticides in order to reduce the impact from pesticide use on water pollution. Recommendations on the appropriate use of pesticides include conclusions and recommendations from Phase 1 and emphasise the promotion of integrated pest management and other alternative crop protection measures. The recommendations are the basis for pesticide management in the Pilot Project and are contained in the recommendations for BAP in the Lower DRB Countries. They include the following:

- Encourage reduction of pesticide use by integrated pest management measures like
  - Use of resistant varieties
  - Use of crop rotation
  - Cultural practices/thorough soil cultivation/optimum seed bed
  - Use of healthy seed
  - Use of action thresholds for spraying decision
- Encourage substitution of priority pesticides by less harmful ones
- Encourage substitution of pesticides by biological or mechanical control methods
- Encouragement of organic farming
- Optimisation of spraying technique
- Careful filling of spray tank, cleaning of sprayer, disposal of PPP
- Development of strategies to avoid pesticide resistance
- Appropriate pesticide storage
- Consideration of pesticide use economy for plant protection decisions
- Mandatory farmer training on pesticide use/licensing of farmers
- Dissemination of appropriate knowledge on integrated pest management, organisational support and legal definitions
- Availability of a current list of all authorised products for all advisors
- Awareness raising about pesticide misuse
- Immediate pesticide ban for the most hazardous priority pesticides like Atrazine, Lindane, Diuron and Endosulfan need to be banned
- Pesticide phase-out of all other priority pesticides and substitution by less-dangerous pesticides, including non-chemical alternatives
- Definition of pesticide cut-off criteria for the approval of other pesticides, persistent pesticides should not receive authorisation
- Improve controls on the use and distribution of pesticides/control of black market.

WORKING FOR THE DANUBE AND ITS PEOPLE

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