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STATISTICS AND SUSTAINABLE DEVELOPMENT: THE CASE OF FERTILIZERS AND PESTICIDES PRODUCTS IN AGRICULTURE

Supporting paper submitted by ISTAT, Italy**

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1. Role of the agriculture and factors influencing the sustainable development

The agriculture is going through a complex phase of transformation and of redefinition of its social and economic role: today the final goal of the agricultural activity is not only the increasing of the production; other objectives are pursued still more in the recent years as the environmental protection, the sustainable or eco-sustainable agriculture, hydrogeological protection, the biodiversity, the quality of life, the human presence on the territory, etc.
The actual and future perspective of the agriculture will be still more oriented towards a form of sustainable, eco-compatible activity with a specific attention to the environment and the quality of life only if it will be able to rebalance the utilisation of the means of production and of the other practices impacting on the sustainable development such as:

- the decreasing of the biodiversity;
- the intensive and forced cultivation as well as the monoculture repeated on the same area for some years;
- the use of pesticides containing active principles dangerous for the human health, the water quality and the environmental protection of the land;
- the excessive consumption of the chemical fertilisers, in particular containing nitrogen because of the direct risks on the human health and the impact on the on the water-bearing strata pollution;
- the irrational use of the water in the irrigation practice;
- the increasing mechanisation of all the agronomic and zootecnical activities with a consequent reduction of the quality in the vegetal and animal productions.
- the use of complete or complementary feed to the animals as well as integrators;
- the reduction and the extinction of vegetable and animal species and races not economically profitable;
- the uncorrected management of the forest;
- the research of increasing of the quantity of the products instead of the quality;
- the uncorrected practices to carry off the by-products of the cultivation and of the fertilizer;
- the abandonment of the mountain and the depopulation of the rural areas
- the decreasing of the social and welfare services in the rural areas

On the other side it can be recognised a positive role of the agriculture on the sustainable development considering:

- the biological agriculture
- the biodinamic agriculture
- the integrated productions
- the quality production recognised and safeguarded as the DOP (Denomination of the Origin Protected), IGP (Geographic Indication Protected), AS (Affirmation of Specificity) products, the DOC (Denomination of Origin Controlled), the DOCG (Denomination of Origin Controlled and Guaranteed) and the IGT (Territorial Geographic Indication) wines and the other biological products certified;
- the keeping, the protection and the development of the biodiversity;
- the recovery and the revalorization of the vegetable and animal species and races in extinction;
- the good agricultural practices;
- the use of natural fertilizers;
- the use of natural or biological pesticides;
- the use of seeds genetically not modified;
- the use of feed of exclusively vegetable origin;
- the good management of the forest;
- the correct management of the water;
- the hydrogeological protection of the territory;
- the social function of the farmers as protectors of the environment;

- the agritourism, the rural tourism and the horse-tourism;
- the add value of the agriculture represented by the history, the culture, the tradition, the gastronomy;
- the social revalorization of the rural world.

2. The agricultural statistics in favour of the sustainable agriculture

In the context of the new role of the agriculture in the society, the agricultural statistics have a more and more fundamental task to furnish reliable and impartial information, elaboration and indicators to follow the evolution of the sustainable agriculture.

The objective is to develop official statistical system to monitor with accuracy, reliability and timeliness the factors of risk and the positive phenomena emerging in the present social-rural world.

In this optic a great opportunity is offered by the studies, the researches and the surveys carried out by FAO, OECD and European Union through Eurostat. In particular with the contribution of experts of the Member States, Eurostat has studied and elaborated 35 agro-environmental indicators to monitor, separately or together, the sustainable development, the environment state and the evolution of the agriculture in each Member State

In Italy, the National Statistical Institute (ISTAT) is already carrying out relevant surveys directly related with the sustainable agriculture; This far-sightedness is the consequence of a permanent attention of the Italian official statistic on the agriculture and the rural world since the end of the 19th century. Nowadays 12 surveys, included in the National Statistical Programme, collect direct information useful for specific indicators on the sustainable agriculture.

Especially, this paper wants to investigate:

- survey on the fertilizers and their active principles distribution and use, survey on fertilizers and their nutritious elements;
- use of fertilizers and pesticides in specific cultivation;
- evolution of distribution and use, to verify if the choices of the farmer correspond, more or less, to government, scientific and legislative policy of European Union;
- the contribution of statistics to measure the sustainability of agriculture to construct correct indicators about agro-alimentary;
- availability of statistics about nutritious elements to calculate the balance of nitrogen, phosphorus and potassium;
- use surveys to study the pollution of water and foodstuffs.

3. Survey on the fertiliser's distribution (fertilizers, compost, corrective)

3.1 – Survey

It is annual and complete survey on the enterprises distributing the fertilisers with the own trademark. The information is collected through a self-compilation of paper or electronic questionnaires.

The information collected for each fertilizer are:

- The titre and the content expressed in main nutritious elements (nitrogen, phosphorous, potassium), in meso-elements (calcium, magnesium, sulphur), in total micro-elemets and in organic matter;
- The national or foreign origin;

- The fluid or solid state;
- The provincial distribution of each fertilizer and of the nutritious elements included.

An estimation of the quantity of the nutritious element and of organic matter per hectare of fertilized area is calculated in base of the Agriculture Area Utilised.

Recently the field of observation of the survey has been enlarged to the organic fertilizers, he compost and the correctives in way to cover the whole phenomenon.

The considered classification, definition and nomenclature are still elaborated and updated in base of the national and public laws and sets of rules about fertilizers. In particularly they are classified in 62 groups.

Table 1 – Typology of fertilizers

FERTILIZERS	GROUPS *(Number)*
Mineral fertilizer	35
Organic-mineral fertilizer	8
Organic fertilizer	8
Compost	7
Corrective	4
Fertilizers	**62**

For the survey of this year (2003) it is in progress to collect specific information about fertilizers observed and usable of biological agriculture. These information will allow to follow the evolution in the years about their use, and so to measure carefully the choices of the farmers for sustainable agroalimentary productions, less polluting and more health.

3.2 – Evolution on the fertilisers distribution in the years 1991-2001

Analysing the statistics in the years 1991-2001 (tab.2,3,4) it is possible to underline this following phenomenon:

- a strong decrease of mineral fertilizer from 43,2 to 34,6 million of quintal (-8,6 million of quintal, equal to –19,9%);
- a substantial increase of organic-mineral fertilizer form to 1,1 to 3,9 million of quintal (+2,8 million of quintal, +254,5%);
- an increase of micro and macro elements of fertilizer that form, like corrective, a minimum part in the distribution of fertilizers;
- a great distribution of organic fertilizer that, in the 2001 compared to 1998, are grown of 0,7 million of quintals (+30,4%), reaching the amount of 3,0 million of quintals;
- a strong increase of compost , among 1998 and 2001, they passed from 2,7 million of quintals to 7,5 million of quintals (+4,8 million of quintal, +177,8%);
- an increase of percentage of contents in the principal nutritious elements (nitrogen, phosphorous and potassium), mineral fertilizer (+0,5%), organic fertilizer (+2,5%) compared to decrease of mineral-organic products (-2,4%) an composts (-6,2%);
- a total increase of nutritious elements contained in the fertilizers distributed, from 1999 to 2001, form 18,8 to 45,4 kilos per hectare of fertilized area.

The cause of this evolution of distribution of fertilizers is the particular choices of farmer, of manufacturing industries and of national and European authority; particularly is underlined:

- a total reduction of mineral products distributed;
- an increase of quantities of nutritious element and organic substances per hectare of fertilized area;
- a decrease of mineral fertilizing in favour of organic one;
- a strong increase in the use of organic substance contained in compost;

Table 2 – Ditribution of fertilizers per type – Years 1991-2001 *(quantity in million of quintal)*

FERTILIZER	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Mineral fertilizer	43,2	44,7	45,8	41,7	38,7	38,0	41,5	35,4	35,5	34,3	34,6
Simple	*24,8*	*25,6*	*26,5*	*25,9*	*23,9*	*22,0*	*25,3*	*20,0*	*20,4*	*20,1*	*20,5*
Complex	*18,4*	*19,1*	*19,3*	*15,8*	*14,8*	*16,0*	*16,2*	*15,4*	*15,1*	*14,2*	*14,1*
Ferilizer based on Meso and micro elements *(a)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	..	..	0,2	0,2
Mineral-organic Fertilizer	1,1	2,2	2,2	2,4	2,4	2,8	3,3	3,8	3,8	4,2	3,9
Organic fertilizer	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	2,3	2,6	2,6	3,0
Compost	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	2,7	3,3	4,9	7,5
Corrective	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	0,3	0,2	0,2	0,1
Fertilizers	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	**44,5**	**45,4**	**46,4**	**49,3**

(a) – In the 1998 was collected only microelements
(b) – Data not available

Table 3 – Nutritious Elements and organic substance contained in the fertlizer per type – Years 1991-2001 *(quantity in million of quintal)*

FERTILIZER	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Mineral fertilizer	17,4	18,3	19,0	16,9	15,5	15,3	16,7	14,7	14,7	14,0	14,0
Simple	*8,1*	*8,7*	*9,1*	*8,6*	*8,1*	*7,4*	*8,5*	*7,1*	*7,3*	*7,1*	*7,1*
Complex	*9,3*	*9,6*	*9,9*	*8,3*	*7,4*	*7,9*	*8,2*	*7,6*	*7,4*	*6,9*	*6,9*
Ferilizer based on Meso and micro elements *(a)*	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	..	..	..
Mineral-organic Fertilizer	0,3	0,6	0,7	0,7	0,7	0,8	1,0	1,1	1,1	1,2	1,1
Organic fertilizer	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	0,1	0,2	0,2	0,3
Compost	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	2,0	2,8	4,2
Corrective	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	0,1	0,1	0,1
Fertilizers	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	**18,1**	**18,3**	**19,7**

(a) – In the 1998 was collected only microelements
(b) – Data not available

Table 4 – Nutritious elements and organic substance contained in the fertlizer per hercate of fertilized area – Years 1991-2001 *(quantity in kilos) (a)*

NUTRITIOUS ELEMENTS ORGANIC SUBSTANCE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Nitrogen	64,4	70,0	74,7	66,6	54,2	75,9	82,3	73,8	74,6	86,5	89,4
Phosphoric anydride	46,7	48,3	50,5	46,3	33,8	53,6	54,0	45,6	44,4	46,1	45,0
Potassic oxid	28,8	30,9	30,9	26,5	22,1	32,9	33,2	29,9	30,6	33,9	32,5
Total of nutritious Elements	***139,9***	***149,2***	***156,1***	***139,4***	***110,1***	***162,4***	***169,5***	***149,3***	***149,6***	***166,5***	***166,9***
Organic substance	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	*(b)*	18,8	30,3	45,4

(a) – In the treated area are included field fit for seed and fruit trees

4. Survey on the pesticides distributed in the cultivation

4.1 – The survey

Also the survey on pesticides distributed in the cultivation is annual and complete; it regards the enterprises distributing the pesticides with their own trademarks and the enterprises distributing pesticides with foreign trademarks; the information are collected through a self-compilation of paper or electronic questionnaires.

The survey is about:

- distribution of pesticides, for group, class of toxicity and province, classified in fungicide, insecticide, herbicide, biological, and others;
- provincial distribution of 399 active principles currently used.

On the base of the Agriculture Area Utilised is calculated the quantity of active principles distinguished in fungicide, insecticide, herbicide and others distributed per hectare of treated area. The recently widening of field of observation to biological products and to trap allows to collect all the products and the active principles used for the defence of cultivation.

The classification, nomenclature and definitions adopted are elaborated and continually updated on the national and European laws and sets of rules about pesticides. In particular, are collected 36 groups that involved 399 active principles.

Table 5 - Tipology of pesticides

PESTICIDES	**GROUPS OF PESTICIDES** *(Number)*	**ACTIVE PRINCIPLES CONTAINED** *(Number)*
Fungicides	7	91
Insecticides	9	120
Herbicides	10	140
Others	4	35
Biological	3	13
Trap	3	-
Total of pesticides	**36**	**399**

4.2 – Evolution of distribution of pesticides during the years 1991-2000

The study about the statistics during the 90's (tab. 6,7,8) puts in evidence the following changing:

- a total decrease in the distribution of pesticides , decreased from 172,3 to 154,7 million of kilos (-17,6 million of kilos, -10,2%) due to reduction of fungicide ad other products, equal to respectively –6,7 and –12,3 million of kilos;
- a softly decrease of biological products and trap equal, in the 2000, to 0,1 million of kilos and to 0,6 million of units.
- a decrease of toxicity degree due to shrinkage of products very toxic and toxic , reduced from 21,6 million to 12,6 million of kilos (-9,0 million of kilos, equal to –41,7%) compared to growth of noxious one, increased from 8,9 million to 16,2 million of kilos (+7,3 million of kilos, +82,0%);
- a general increase of concentration, between 1996 and 2000, of active principles contained in the products, grown from 44,4 to 51,6% due to the increase of active principles contained in fungicide (+14,3%), in insecticide (+4,2%), in others (+2,0%) in comparison with decrease oh herbicide (-3,4%);
- a total increase of 1 kilo of active principles per hectare of treated area, grown from 7,6 to 8,6 kilos. This growth has regarded fungicides (+1,3 kilos per hectare) and insecticides (+0,3 kilos per hectare) in comparison with decrease of others (-0,6 kilos per hectare).

On the bases on data observed, it is possible to do the following consideration:

- a reduction of products distributed, in particular of products (very toxic and toxic);
- an increase of concentration of active principle contained in products distributed;
- A slight distribution of biological products and trap.

Table 6 - Pesticides and trap distribuited for use,for category and grade of toxicity Years 1991-2000 *(quantity in million of kilos,)*

TIPOLOGY GRADE OF TOXICITY	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fungicides	89,6	94,6	94,8	83,4	84,1	82,9	84,4	84,7	84,2	82,9
Insecticides	34,4	33,7	34,9	32,4	36,0	33,8	39,2	38,1	35,9	35,5
Herbicides	25,9	22,5	24,5	24,9	27,2	28,7	28,9	29,0	26,5	25,9
Others	22,4	19,4	17,5	17,3	18,3	19,4	14,6	13,4	11,5	10,1
Biological	*(a)*	*(a)*	*(a)*	*(a)*	*(a)*	*(a)*	*(a)*	*(a)*	0,1	0,1
Total of pesticides	**172,3**	**170,2**	**171,7**	**158,0**	**165,6**	**164,8**	**167,1**	**165,2**	**158,2**	**154,5**
Very toxic or toxic *(b)*	21,6	19,9	19,6	18,2	19,0	17,6	17,9	15,6	14,4	12,6
Noxious *(b)*	8,9	19,8	16,3	16,0	16,8	21,3	21,6	20,8	18,7	16,2
Not classifiable *(b)*	141,8	130,5	135,8	123,8	129,8	125,9	127,6	128,8	125,1	125,7
Trap *(c)*	*(a)*	*(a)*	*(a)*	*(a)*	*(a)*	*(a)*	*(a)*	*(a)*	0,6	0,6

(a) – Data not available
(b) - Data estimated for years1995 and 1996
(c) – In millioni of units

Table 7 – Active principles contained in pesticides for category – Years1996-2000
(quantity in million of kilos)

TIPOLOGY	1996	1997	1998	1999	2000
Fungicides	43,5	52,6	53,6	52,8	52,4
Insecticides	10,3	11,9	12,0	12,1	12,1
Herbicides	10,4	10,5	10,7	9,7	9,5
Others *(a)*	12,3	9,7	8,3	7,4	5,8
Total of active principles	**76,5**	**84,7**	**84,6**	**82,0**	**79,8**

(a) – data in 1999 and 2000 includes also bilogical active principles

Table 8 – Active principles contained in pesticides per hectare of treated area *(a)*
- Years 1996-2000 *(quantity in kilos)*

Tipology	1996	1997	1998	1999	2000
Fungicides	4,4	5,0	5,0	4,9	5,7
Insecticides	1,0	1,1	1,1	1,1	1,3
Herbicides	1,0	1,0	1,0	0,9	1,0
Others *(b)*	1,2	0,9	0,8	0,7	0,6
TOTAL	**7,6**	**8,0**	**7,9**	**7,6**	**8,6**

(a) - in the treated area are included filed fit for seed and fruit trees
(b) - in others are includedi bilogical active principles

5. Survey on pesticides used in the cultivation

5.1- The survey

Survey on pesticides used in the cultivation is born like an action TAPAS (Technical Action in the Agricultural Statistics) included from European Commission to improve the agricultural Statistics.

The role of the Commission is to provide financial support and afterwards the member States have the role to continue the researches.

It is an annual survey developed on a sample of agriculture enterprises through CATI (Computer Assisted Telephone Interviewing) system.

Every year is measured the use of single products and active principle and also the number of treatments made on area planted with a specific cultivation. So are obtained the national estimations of fungicide, insecticide, herbicide and others use, per hectare of treated area.

In the last years, 1999-2002, the cultivation investigated in the surveys were grapevine, olive tree, apple-tree and maize; next survey (2003) will collect data about the use of pesticides in the cereal productions (soft wheat, durum wheat, barley and oats).

Year after year it will possible to obtained a description of average quantity used, both pesticide products and active principles, and an average number of treatment made on the main vegetables species, per hectare of treated area. In this way it will possible to estimate, for every single cultivations, the quantity and the percentage of treated area in favour of the non-treated one.

These informations are essential to estimate the progress of the use of pesticides and to investigate the strategy of the UE and sustainable agriculture.

5.2 – Results

Analysing the results it is possible to see an extreme diversity from the single cultivation, in the number of treatment and the quantity of active principles used.

Table 9 – Treatments and active principles used for cultivation *(quantity in kilos)*

CULTIVATION	FUNGICIDES		INSECTICIDES		HERBICIDES		MIX	TOTAL	
	N.treat-ment	Quantity	N. treat-ment	Quantity	N. treat-Ment	Quantity	N. treat-ment	N. treat-ment	Quantity
Grapevine	6,3	23,3	0,3	0,8	-	-	0,2	6,8	24,1
Apple-tree	5,7	19,7	3,1	32,6	0,4	0,7	0,9	10,1	53,0
Olive-tree	0,4	4,9	0,4	1,0	..	..	0,1	0,9	5,9

On average, olive tree are treated with only one treatment against seven treatments used for the grapevine and ten for apple-tree. The average quantity of active principles used for olive trees is about 1/4 and 1/9 of the quantity used for olive and apple-tree. Moreover, while the 90,3% of planted area with apple-tree, for olive the same data decrease to 38,3%.

6. Survey on fertilizers and pesticides use in the main fruit tree

The survey on the structure and production ferilizers and pesticides use in the main fruit trees is a European survey executed every five years. The last edition (2002) carries out it on a sample of about 20.000 units through direct interviews. The survey collects information on the main fruit trees and on the use of fertilizers and pesticides by the following cultivation: apple-tree, pear, peach, nectarine, apricot, orange, lemon and small citrus.

Thus a complete estimation of the nutritious elements and of the active principles used, by species, per hectare of invested and treated area will be available; in particular:

- distribution of fertilizers classified in 62 groups;
- importance of non-fertilized area;
- measure of average quantity of nutritious elements contained in every kind of fertilizer used;
- quantity of pesticides distinct for kind and class of toxicity and number of trap distributed;
- importance of non-treated area;
- measure of average quantity contained in the different kind of pesticides used.

These data will be very useful to elaborate specific indicators on the nitrogen, phosphorous, potassium balance, on the fertilizers use and on the active principles used by class of toxicity.

7. Conclusions

In the last years the task of the agriculture in the western countries is changed. The constant increase of the productions is no longer the final goal of the Agricultural Policies because the aspects connected with the sustainable development, the environmental protection and the food security are earning more and more importance.

The agricultural activity determines risk factors and positive impacts on the territory and the rural society; these factors are numerous, related, interdependent with other elements influencing the agri-environmental system.

The task of the present and future official agricultural statistic is to monitor the evolution of the sustainable agriculture through the elaboration of data coming from specific surveys and the definition of proper indicators of sustainability.

ISTAT carries out many surveys directly related to this theme since many years, and helps Eurostat to build a set of 35 agro-enviromental indicators. The analysis of data about the distribution and use of fertilizers and pesticides puts in evidence a slow but strong positive evolution in favour of sustainable development.
