ISSN 1331-7768 (Print)
ISSN 1331-7776 (Online)
UDC 63

CROATIA

AGRICULTURAE CONSPECTUS SCIENTIFICUS

POLJOPRIVREDNA ZNANSTVENA SMOTRA

VOLUMEN 64 BROJ 1 1999

http://www.agr.hr/smotra/

Social and Economic Reasons for Changed Approach to the Use of Chemical Fertilizers in Hungary

Chemical Fertilizers Management Change in Hungary

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SUMMARY

The history of chemical fertilization in Hungary over the last three decades, could be divided into three periods: an extremely *fast increase* of consumption from the middle 60's to the middle 70's; a period of constancy till the 90's; permanent decrease, the phase of *new reckless exploitation* up to the present. The Hungarian nutrient-management has had a strongly negative nutrient-balance for the last 8 years. This fact is quite a problem for our country in meeting the expectations of EU member-states. Due to accumulation and consumption of nutritive materials in the soil, the income redistribution took place between the 80's and the 90's. Behind extreme soil utilization in planting practice, lie new environmental risks and negative economic effects. Although special conditions call for specific measures, these facts don't seem to be important either to legal administration or to the media. Therefore, the environment policy of not decreasing the nutrient content of soils any longer, is urgent.

KEY WORDS

fertilization, nutrient-balance, environment

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Received: November 2, 1998

Socijalni i gospodarski razlozi promjene mišljenja o upotrebi mineralnih gnojiva

Promjene u gospodarenju mineralnim gnojivima u Mađarskoj

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SAŽETAK

Povijest mineralne gnojidbe u Mađarskoj unatrag zadnje tri dekade može se podijeliti u tri razdoblja: ekstremno brzi rast upotrebe mineralnih gnojiva od sredine 60-tih do sredine 70-tih, nepromijenjeno stanje do 90-tih i konačno, stalni pad, faza bezobzirne eksploatacije, sve do danas. Gospodarenje hranjivim tvarima u tlu ostvaruje u zadnjih 8 godina naglašenu negativnu ravnotežu. Ova činjenica stavlja Mađarsku u poseban položaj spram zemalja članica EZ. Potrošnja hranjivih tvari akumuliranih u tlu tijekom 80-tih, rezultirala je preraspodjelom dohotka u 90-tim. Ekstremno iskorištavanje tla vodi ka novim rizicima po okoliš i negativnim gospodarskim učincima. Iako ovi posebni uvjeti zahtijevaju i posebne mjere taj problem nema odjeka u pravnim propisima i niti u medijima. Kako se razina hranjivih tvari u tlu ne bi smanjivala potrebno je donijeti mjere za očuvanje okoliša.

KLJUČNE RIJEČI

mineralna gnojidba, ravnoteža hranjivih tvari, okoliš

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Primljeno: 02. studenog 1998.

THE CHANGING CONSUMPTION OF FERTILIZERS IN HUNGARY

The history of chemical fertilization can be divided into four, definitely separable periods in Hungary after II. World War:

1. a *slow increase* until the middle of the 60's; afterwards
2. a decade of extremly *fast increase*;
3. from the middle of the 70's until the end of the 80's consumption *stagnated*;
4. and up to the present it has been *decreasing*.

We have pursued "reckless exploitation" in Hungary from the middle of the 60's (Győrffy, 1991), so we decreased nutrient content of the soil more than we restored it. The increasing consumption of chemical fertilizers stopped the "reckless exploitation" in the 60's. However, the extremly fast pace of increase could be explained by political and economy-political view-points in the first place, and by professional reasons only in the second place.

After the last and largest collectivization wave of Hungarian agriculture - the years of 1950-1960 - verification of "superiority" and fighting for life of co-operatives was a very important political problem. The traditional, in the previous period typical, agricultural model that hardly depended on external inputs, gave little chance for increasing production. Beside machines existing before the collectivization were not suitable for farming on large scale (Bethlendi, 1979; Sántha, 1996 *a* and *b*). In consequence of this situation agriculture trended towards motorization and the production started to use more industrial inputs. Industrialization produced an effect on agriculture depriving it of manpower and arable lands. In the beginning cheap industrial inputs made up for the loss. Previously Hungary became self-sufficient in food products; considerable food-export also gained ground and it is increasingly important considering the process of indebtedness that had started in our country.

Consumption of chemical fertilizers gained political colour (Buzás & Lánszki, 1992), increase of consumption turned into strategic challenge; specialists acted under political pressure many times. The central encouragement appeared not only as personal influence but as significant - 20-50 per cent of producer price - support in the prices of chemical fertilizers. Investment grants, production supports, export bounties and supported consumer prices of foods have urged consumption of chemical fertilizers indirectly - by increasing the production and promoting products to come into the market. Conscious goverment policy have formed agricultural and industrial price ratios that urged motorization, use of chemical materials and "industrialization" in agriculture from the first half of the 60's to the middle of the 70's (see Varga, 1987). The political intention that wanted to propagate the industrial production method, appeared in central development programs as well (see Sipos & Halmai, 1988).

Fast increase of chemical fertilizer consumption from the middle of the 60's to the middle of the 70's was only one - although determinable - element of agricultural industrialization. This process had doubtless positive effects: soils filled up with nutrients, average yields increased, agriculture produced for export. We have to mention the dark side of the increase also. "Until 1976 - writes Fekete (1992) - chemical fertilizer consumption was virtually independent of planned yields, nutrient content and capacity of soils." Expert advising, warehouse building and fertiliser spreading technology did not keep abreast with chemical fertilizer consumption. Therefore utilization level was low, storage loss was high (Dorogi et al., 1980). The expanding role of industrial raw materials and sector-focused technological development led to disorganization of in-farm connections between crop growth and husbandry, farmyard manure and straw were qualified as waste, organic material management of soils was bad (Sántha, 1990).

The specialists percieved disadvantages and limits of extensive growth in the 70's. Specialists analysed the term of 1960-79 and emphasized the decreasing self-support

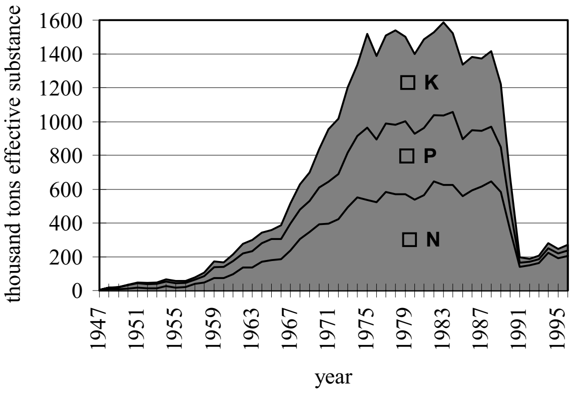

Chart 1. Changing sales of chemical fertilizers in Hungary
Source: Hungarian Central Statistical Office (KSH)

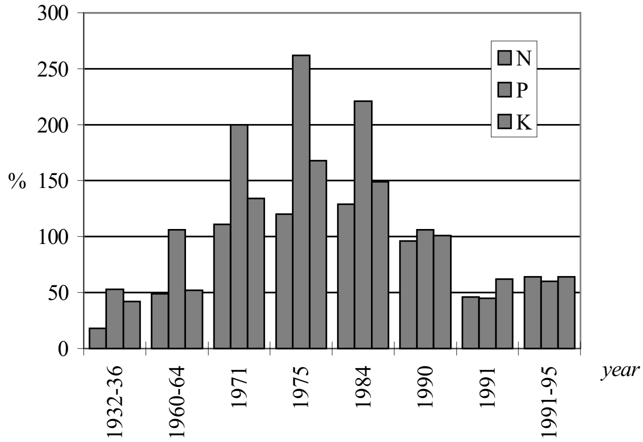

Chart 2. Intensity of nutrient compensation in Hungary (ratio of removed and restored effective substance quantity)
Source: CSATHÓ, 1994; DEBRECZENI, 1978, 1988; GYŐRFFY, 1965; KÁDÁR, 1979, 1987, 1997; ZUKKER, 1938

level of agriculture (Benet, 1979), on the other hand, they underlied that high level development was realized beside worsening effectivity (e.g. Burgerné & Szép, 1980; Mentényi, 1980; Vassné, 1984; Vági, 1978 *a* & *b*, 1980, 1984, 1985 *a* & *b*). The effectivity problem came ahead in the middle of the 70's when the sudden increase of world market energy prices reached Hungary as well. The sudden increase caused significant change in terms of trade index that touched food production closely. Moreover, the earlier, seemingly unlimited possibilities of export-increase narrowed in consequence of the agri-protectionism. The dynamical increase of agricultural export came to a sudden stop (see Németi, 1981). The Hungarian agriculture got into trouble owing to direct effects in terms of trade and the increasing energy prices; from this period the government supported it less and less, it had to pay more and more to the budget, agricultural workers' income decreased. From the middle of the 70's Hungarian economy was not in position to support agricultural development without improving its effectivity, and increasing the commodity standard, above all. From the second half of the 70's started processes that had an effect on agriculture and agriculture payed more to the budget than it received from it. From this time the role of agriculture in the national economy also changed fundamentally: the supported agriculture turned into "supporter".

It happened just when opposite processes started in the agriculture of developed West-European states. The sudden increase of oil price put the whole world economy into a new situation; Pálovicsné (1986) said: "a new period started for the agriculture all over the world in the middle of the 70's", that resulted in extending agri- protectionism. It was no longer the comparative advantages, that moved world trade, "but those artifical adventages that were created by financial and diplomatic means of certain states for their farmers". Hungarian agriculture met international circumstances where not only effectivity was important but the supporting policy of the states as well. To maintain its competitiveness Hungary would have to fulfil baseless improvement in effectivity that would compensate for the decreasing subventions and incomes.

Chemical fertilizer consumption after a rapid increase started to stagnate from the middle of thew 70's; this period would probably not have started in that time and not to such an extent without forced effectivity improvement. Chemical fertilization had new features in the stagnating period compared with earlier periods. The support price of chemical fertilizers remained in effect from the middle of the 70's but did not compensate for the significant rise in prices. Chemical fertilizer turned into an important cost element. This change fitted into the effectivity and material-saving efforts that were forced by - beside specialists' recognition and economic racionalism - deficit deriving from decrease of agricultural incomes.

The way of chemical fertilization turned into really more conscious and professional. The expert advisory system was organized on the basis of obligatory soil tests and the connecting laboratory network, information system. Nutrient management was based on expert advisory methods and principles elaborated by leading specialists; these methods and principles were criticized many times but their positive features gave professional background to chemical fertilizer consumption. The network of agro-chemical plants, that beside storage, dealt with liquid chemical fertilizer producing, spreading and other services, was built up. New technological solutions appeared and the most effective of these solutions was liquid chemical fertilizer use.

However, this awareness and competence - beside positive features - was pretty one-sided. The industrial crop growth technology based nutrient management unambigously on chemical fertilizers in the years of 1960-79 because of easier management, greater concentration, more controllable effective substance content, lower spreading cost, - and in the beginning - low price of chemical fertilizers. Outside these factors the industrial husbandry produced more and more hardly manageable, low concentrated slurry just as less and less farmyard manure. Sántha (1980, 1991) has studied minutely reasons and consequences of "depreciation" of farmyard manure. Sántha said that under circumstances of industrial production "*the essential problem was that consumption did not happen*". Approximately 80 per cent of farmyard manure and 30-40 per cent of slurry were used in this period.

Level of chemical fertilization was high in the stagnating period, and more and more people called attention to enviromental results of artifical fertilization in the end of 80's. Level of chemical fertilization fell to level of the beginning of the 60's, and the reasons were not enviroment-economic reasons. Until 1983 effects of decreasing income were compensated by increasing industrial, trade and services activities of large-scale agricultural enterprises; after 1983, however, the income of large-scale agricultural plants decreased gradually (see Németi, 1992). Decreasing profitability did not make supplementary investments possible in many cases, depreciation of fixed assets started. Saving activities became general in relation to every expenditure.

However, saving did not compensate rising prices. The price gap between agricultural and industrial products and payments to the budget created baseless requirements for agriculture concerning effectiveness that was unrealizable. Decreasing profitability indicated worsening self-financing ability. Rising price of industrial raw materials, human labour and energy caused that production demanded much more working capital and credit as well. More credit included increasing interests that was several times as high as the increase in incomes. Companies at first exhausted their future resources when kept investments back; later their present became endangered when surplus-cost of financing the production required several times as much resources as

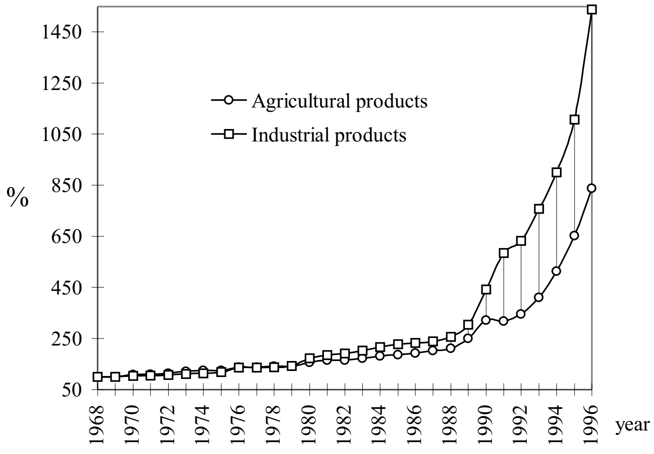

Chart 3. Price indices of agricultural and industrial products ("price gap") in Hungary (1986 = 100%)
Source: Hungarian Central Statistical Office (KSH)

the surplus-income generated. Liquidity problems were general and created additional saving compulsion.

In the second half of the 80's chemical fertilization diminished to a perceptibly lower level, although the change was not so large than at the end of that decade. The change of the political system that happened at the end of 80's, brought to the surface the erlier "hidden crisis" of agriculture (Sipos & Halmai, 1993). We have to mention four of many reasons:

- COMECON fell into decay; it was the biggest buyer's market for Hungarian grains and low processed products. Capacities that based on COMECON-export were not adequate for producing products that are marketable in other markets of high level,
- in consequence of decreasing living standards the buying power diminished and the internal market narrowed,
- assistance to agriculture decreased even more, while the price gap opened unexpectedly wide,
- slowly executed privatization resulted in unstable proprietorships, moreover, large-scale farming methods were usable only partially on the newly formed private farms. Old and new farms that were deficient in funds, did not get credit because of low profitability, risk of bankruptcy and lack of acceptable collateral.

Deficiency in founds led to forced saving and it seemed obvious that chemical fertilization have to be decreased, because soils had been filled up with nutrients in the previous decades. Chemical fertilization decreased strongly in the 90's and this decrease that was expected to be temporary, proved to be permanent. It was general that farmers stopped spreading of P- and K-fertilizers and used moderate levels of N-fertilization; this peculiar reckless exploitation resulted in negative nutrient-balances in the beginning of 90's (see Kádár, 1997).

Data of Chart 4 make it unambiguous that the strong decrease of livestock does not give hope for reducing the lack of nutrients by farmyard manures.

COMPARATIVE ANALYSIS OF CHEMICAL FERTILIZATION IN YEARS OF 1980-90

The level of chemical fertilization decrased at the end of 80's, furthermore, the advisory and information system that was based on obligatory soil-tests came to an end. It follows, that we encountered serious difficulties when we decided to analyse efficiency of chemical fertilization. Now we introduce some selected results of an analysis-series that is founded on data of crop production technology of Transdanubian agricultural enterprises. We wished to find connections in the first period of the analysis that partly give chance for us to compare chemical fertilizations of the 80's with of the 90's and are partly suitable to make calculations involving data of costs and prices in the second period. We made numerous (ca. 130) factor analyses and calculated numerous (ca. 220) functions with one and with multiple independent variables using data of wheat cultiva-

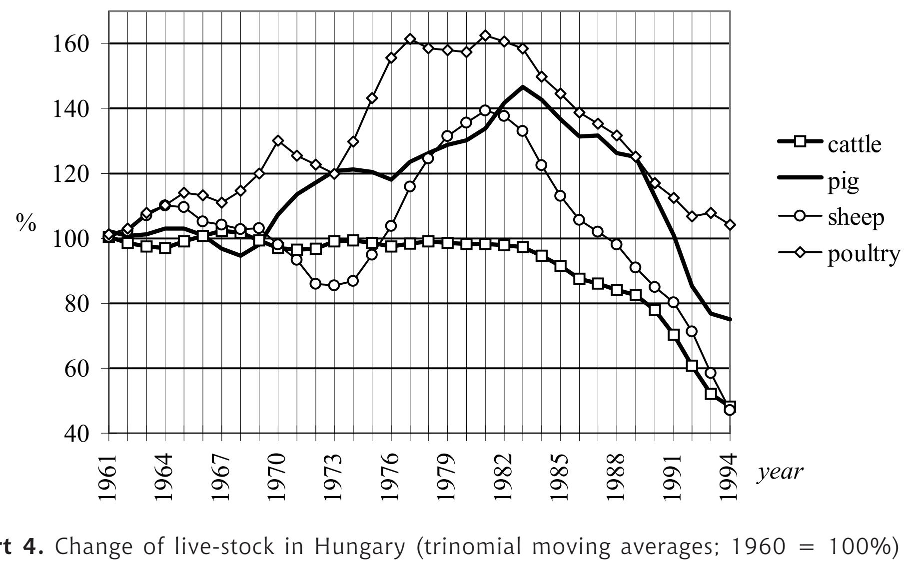

Chart 4. Change of live-stock in Hungary (trinomial moving averages; 1960 = 100%)
Source: Hungarian Central Statistical Office (KSH)

Table 1. The share of single factors in the variance of yield (%), (n= number of cases)

Name of Factors, variables closest to factor	**Datagroups 1986-1989 (n=402)**	**1991-1994 (n=214)**
Factor of reaction (pH, $CaCO_3$, Mn)	0	1
Humic content, soil structure (K_A, humus, Mg)	0	4
Factor of phosphorous content (P_2O_5, Zn)	1	0
Land quality factor (Ak/ha)	3	-
Factor of P and K fertilizers	1	**14**
Factor of N fertilizer	-	**35**

tion in the years of 80-90 in such a manner that calculations could be comparable. The dependent variables of the regression analyses were yields in every case, independent variables were changed. Every factor analysis had the following variable set:

1. soil quality (Ak/ha); **2**. average yield (t/ha); **3**. pH; **4**. soil-constraint (K_A); **5**. $CaCO_3$ (%); **6**. humus (%); **7**. NO_3+NO_2 (ppm); **8**. P_2O_5 (ppm); **9**. K_2O (ppm); **10**. Mg (ppm); **11**. Zn (ppm); **12**. Cu (ppm); **13**. Mn (ppm); **14**. N fertilizer (kg/ha); **15**. P fertilizer (kg/ha); **16**. K fertilizer (kg/ha).

For each of the factor analyses the principal component analysis (PCA) method was used, and in identifying the factors the factor loading matrix found after the varimax rotation process was the starting point. As it is generally used in the relevant literature, an observation variable was considered in our calculations in identifying a factor, if the factor loading was at least 0.7, that is, the share of that factor in the variance of the observed variable was nearly 50 %.

In the computation of the functions several single variable or multiple variable functions were tried out, but considering the calculations based on data of the 1990-ies, only a few functions of the form $y=a+bx+cx^2$, and with one independent variable (quadratric functions) gave reliable estimates, so the possibility of comparison with the years of 1980-ies and the 1990-ies was also limited to that function type. Another factor narrowing the possible range of comparison was that the lack of P and K fertilisation led to the impossibility of the function estimations for P and K.

In the second period of the analysis we wanted to answer the question how the typical nutrient management of the 80's could work under the price ratios of the 90's.

Analysis without prices

We found relative stability in the factor structure of factor analysis calculated by data of different periods but with the same variable set, and this made possible the comparison of results. While ratio of these relatively constantly combined factors in the total variance is fairly stable, ratio of some factors in variance of average yield indicates significant differencies before 1990 and after 1990. We found considerable changes in factors that include yield and NPK nutrients. It is typical before 1990 that yield becomes a specific factor. The cause of this result is that in this period variance of yield was determined by constituents that were omitted from analysis. Naturally, it does not mean that chemical fertilizers had no role in the change of yield; they were not critical factors, "bottleneck". The situation is different after 1990. Yield was not a specific factor by itslef and its' variance was determined by constituents including NPK fertilizers. Nitrogen has a leading role among all of them, as there was hardly any phosphorus and potassium fertilization on studied fields in the 1990-ies.

In Table 1 we show the mentioned changes in case of two data groups considered typical by ourselves - data of wheat cultivation before 1990 (1986-1989) and after 1990 (1991-1994). Both data groups come from wheat fields in county Fejér.

To create correct functions from data of enetrprises is not easy even if we have a database suitable for various classifications, and including many elements; ratio of successful calculation is very low. This is true in the case of data of the 80's, however, this is more true in the case of data of 90's, as we had little possibility to create homogeneous data groups because of the small number of elements, and of the fact that P and K fertilization was occasional in the years of 1990. It is not accidental that we were able to create only some effect functions using the data of the 90's. Two of them are compared to functions of the 1980-ies in Chart 5. The functions shown in the figure are computed from the data groups listed below:

- 1985 - wheat production data of four counties (Baranya, Fejér, Somogy & Tolna) in 1985 (number of cases: 3085)
- 1985-87 HN - wheat production data of three years of four counties; for fields having weak humic and $NO_{3+}NO_{2-}$ content (number of cases: 864)
- 1991-1994 - data from wheat fields in county Fejér for the given four years (number of cases: 214)
- 1991 - data from 63 wheat fields in county Fejér in 1991.

Curves representing the years of 80's reach their' maximum above 300 kg/ha N dosage. The relatively low level of the other factors did not limit the yield-increasing effect of nitrogen up to this point (see Chart 5). Maximum of functions showing the years of 90's is lower (difference is 1-1,5 tons) and N dosage related to these maximums is lower than half of the dosage in the ear-

Table 2. Change of maximum income of nitrogen effect functions calculated by data of the 80's and the 90's, with and without corrections according to nutrient balance, in version A

Naming		1985			1991-1994	
Maximum of income, Ft/ha		**1560**			**8444**	
Average yield of wheat at maximum income, t/ha		5,61			4,58	
	N	**P**	**K**	**N**	**P**	**K**
Nutrients removed by yield, kg effective substance/ha	152	62	101	125	50	83
Compensation, kg effective substance /ha	224	95	117	100	9	12
Balance: - kg/ha	+72	+33	+16	-25	-41	-71
- Ft/ha		+7.410			-7.045	
Income and nutrient balance together Ft/ha		**8970**			**1399**	

lier years. Curves representing the years of 90's bend down very quickly after the maximum, which strongly points towards the presence of other limiting factors.

Analysis including costs and prices

In the beginning of the second period we compared the technology of wheat and maize cultivation in the 80's and in the 90's. We stated that fundamental changes and changes concerning the whole technology did not happen in the studied enterprises in the last decade. "Industrial" technology of the 80's is ruling now as well; the only difference is, that level of nutrient compensation is lower and possibly the frequency of spreading is kept rarer (the change in the quality of seeds and crop protection was not identifyable by the available data). Accordingly, the essential question of analysis was what would happen if the technology of the 80's was realized at the price level of the 90's.

We made two versions of the following calculation using data of wheat cultivation, assuming costs and prices

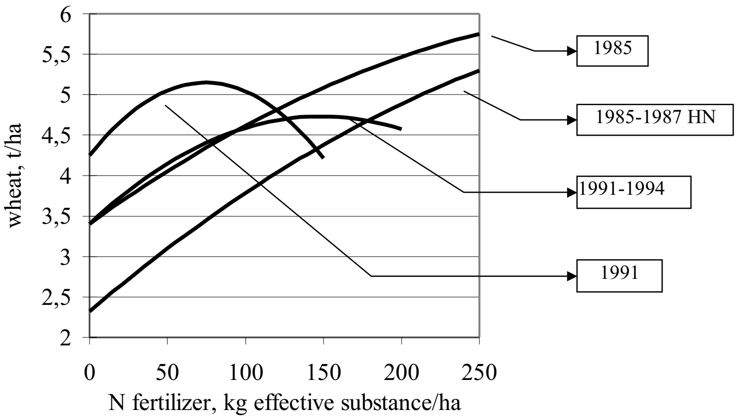

Chart 5. Nitrogen effect functions

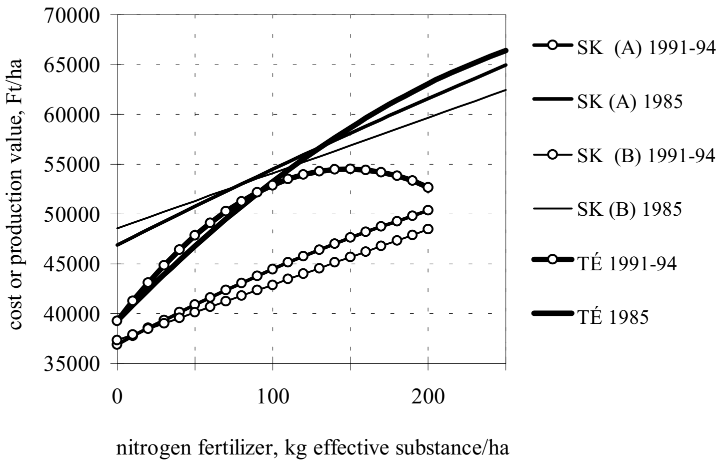

Chart 6. Value and cost of production according to version A and B, supposing price-ratio of 1995 and technology of the 80's and the 90's.

of the year 1995, starting fromt from effect functions with one and with multiple independent variables:

- in *version A* surplus costs of fertilization and harvesting, dosage of fertilizer and yield were regarded as variable costs;
- in version B price of chemical fertilizers was the only variable cost, costs of spreading and harvesting were fixed costs.

Optimal N dosage of the nitrogen effect function (Chart 6) calculated by data of 1985 and with prices and costs of 1995 was higher, its maximum income was lower both in version A and version B than - supposing the same prices and costs - in the case of the nitrogen effect function calculated by data of 1991-1994. Thus, the conclusion can be drawn, that current practice is good. Why should we fertilize when our income is higher without fertilization!? However, we think that this situation is not so bright. Maximum income from the function calculated by data of the 90's is higher because nutrient compensation does not reach the quantity of nutrients removed by yield. Lower maximum income from function calculated by data of the 80's could be explained by the fact that nutrient compensation was higher than quantity is required for nutrient balance. If question is how long nutrient content of the soil will be enough.

On Chart 7 we calculated fertilizer-yield effect functions using connection between yield and two independent variables (the same nutrient in the soil and in the chemical fertilizer) and we show this connection at different levels of nutrient content in the soil. (The calculations were done using data of 8960 wheat fields in four counties, for the years 1985-1987.) We attached production cost (calculated by price rates of different years, in wheat-equivalents) to effect functions. Cost lines on Chart 7 show how much wheat cover the production cost per hectare. Great increase of real costs in the first half of the 90's is striking. In the years of 1980 costs (calculated by typical nutrient compensation of the 80's) were covered at low levels of nutrient content of the soil as well; with price rates of 1995 cost lines were only below the effect curves calculated by good nutrient content. All these call attention to the "tight corner" where cultivation of corn - and generally the whole plant cultivation - fell in: soils having fewer and fewer nutrients in consequence of "reckless exploitation" allow the producer to cover fewer production cost, however, to cover increasing real costs the high nutrient content of

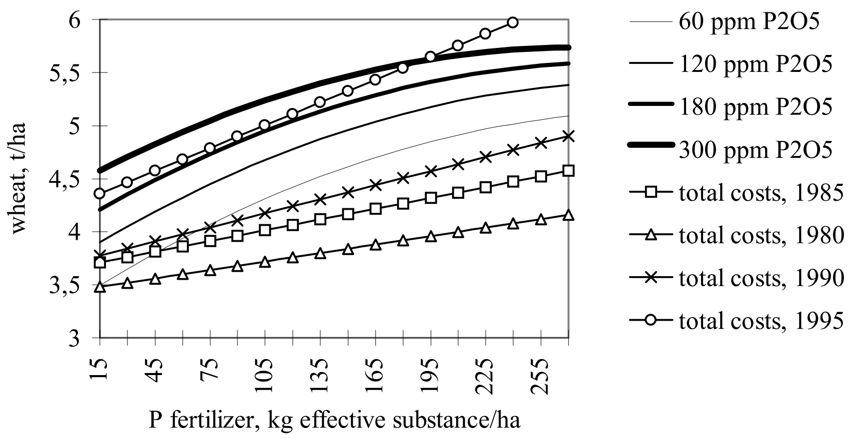

Chart 7. P effect functions calculated by data of 1985-87 at different nutrient content level of the soil; shows marginal costs (total costs) calculated by price rates of 1985-87, in wheat-equivalent

the amount, that covers costs of chemical fertilizer required for compensation of removed nutrients is substracted from maximum income of the function calculated by data of the 90's, and add the amount that spent on positive nutrient balance (to increase nutrients in the soil) to maximum income of the function calculated by data of the 80's, we get a different picture.

The income relation of functions calculated by data of the 80's and the 90's changed when the effect to the nutrient balance was considered (see Table 2). Much as the presented results are relative, it shows the fact that increase and decrease of nutrients in the soil caused income redistribution between the years of 1970-80 and the years of 1990; profitable cultivation of corn will be impossible without income redistribution nowadays. The the soil is needed; to create and maintain this state needs newer costs.This is a *vicious circle*, and solution depends on facts being outside our analysis.

DILEMMAS BEFORE YEAR 2000

A dominant farming aspect can be attached to every development period of Hungarian chemical fertilization. Fast increase in chemical fertilization levels coincided with the extensive period of industrialization of agriculture, the dominant quantitative viewpoint. Aspects of saving and efficiency were typical in the stagnating period (from the middle of the 70's to the end of the 80's); at that time chemical fertilization turned more conscious, professional, effective and economical than

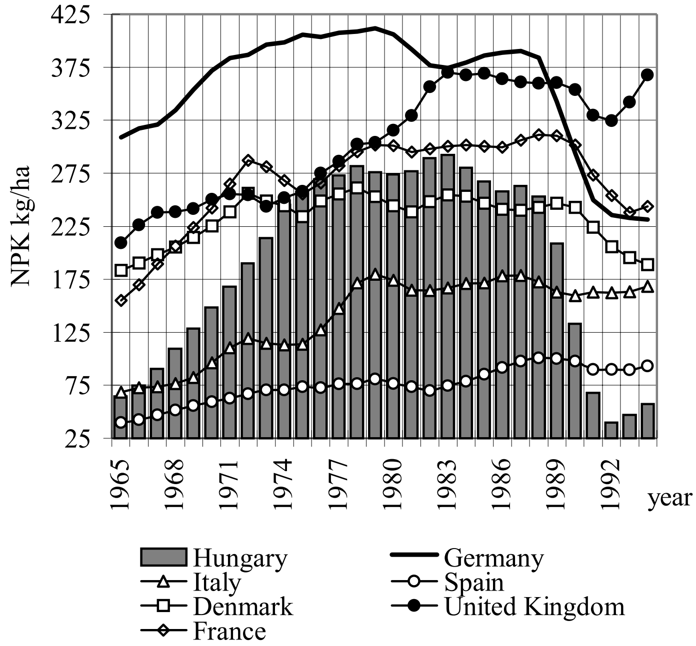

Chart 8. Trinomial moving averages of NPK effective substance consumption regarding one hectare arable land, garden, vineyard in a few European countries
Source: RÓZSA et al., 1983; FAO Fertilizer Yearbook 1990, 1996; FAO Production Yearbook 1975, 1976, 1977, 1978, 1979, 1986, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996

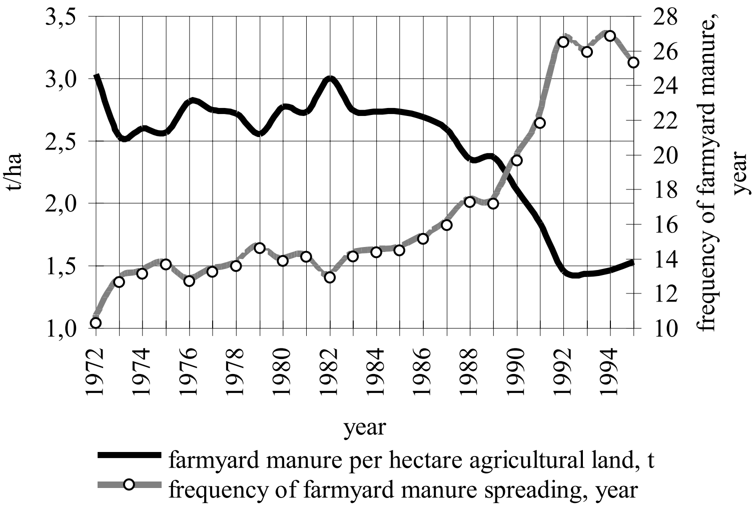

Chart 9. Trinomial moving average of farmyard manure spread on land of Hungarian co-operatives and companies
Source: Hungarian Central Statistical Office (KSH)

in the earlier periods. At the end of the 80's opinions were stronger which called attention to the enviromental effects of high-level artifical fertilization and long-lasting positive nutrient-balances indicating wasting of energy sources in some areas. Concentrated livestock farms producing slurry caused waste and pollution as well. In nutrient management an enviroment economical way of looking emerged, that urged the elimination of the above-mentioned negative effects.

The new way of looking was not general at the end of 80's, but it was stronger in the 90's when fertilization levels - independently of the pread of the new approach - decreased to the level that was typical at the beginning of the 60's. In this situation the *approach* or rather the *phraseology* moved away from *reality* and started an independent life. Enviromental effects of extreme fertilization are in the center of this way of looking and suggest changes that are not neccessary now. Changes happened in reality - nutrient content of soils decreased - involve *a new enviromental risk* that is not integrated into this new cast of mind. The current phraseology of enviroment-economical way of thinking in our opinion has an answer for not the real situation of nutrient-management in Hungary, but for something else (for an earlier Hungarian or West-European state). This is the main cause this phraseology why will be accepted with many difficulties among the people who are not professors, researchers and civil servants.

Decreasing fertilization and the "new reckless exploitation" are typical in a period when EU-joining is a real prospect for our country. Both our prospect to join and improvement of our position after the accession demand alignment with unmistakable tendencies of nutrient-management in EU countries. At the beginning of 90's many developed European countries initiated some restrictions - in our circumstances very strict restrictions - to decrease harmful accumulation of nutrients (see e.g. Kádár, 1992; Szolnokiné, 1994). In the last decade - especially after the publication of the European Nitrate Directive (97/676/EEC) - an increasing number of studies focused on probable economical effects of enviroment policy (see e.g. Berensten & Giesen, 1995; Kuhlmann & Brodersen, 1998). Both these studies and common sense demand that compliance of Hungarian agriculture could be free of problems - without harmful nutrient accomodation -, but we have to choose prudent means to serve the purpose and we have to take the current Hungarian circumstances as starting-point.

Chart 8 shows Hungary's special position compared with selected EU countries. In those countries which reached high - approx. 200 kg/ha - chemical fertilization levels earlier than Hungary, consumption of fertilizers deacreased in the 90's. This decreased level is still high (approx. 200-300 kg/ha). In the countries which started from a low fertilization level - similar to Hungary -, this tendency is not unambiguous, the level is rather stationary. There is no country where such powerful changes happened as in Hungary.

Chart 9 shows that farmyard manure did not lighten effects of decreased chemical fertilization - number of livestock decreased strongly - and will not do so in the future either. In 15 member-states of the EU the number per hectare of cattle is 4 times, pig 1.2 times, sheep approx. 4.5 times bigger than the Hungarian data in the middle of the 90's (Sántha, 1997). We can note that level of farmyard manure is lower in Hungary than in the EU, just like the chemical fertilization level.

On the basis of the above-mentioned facts we can declare that Hungarian nutrient-management is in a particular situation, so it needs particular methods of treatment. We should consider some economical means which do not increase reckless exploitation, control the local accumulation of nutrients and, as permanent features, are guarantees for EU member-states that our country does not want to get a short-term advantage at the expense of neglecting the enviroment.

Beside current consumption of chemical fertilizers and livestock density the regulation purpose could not be the general decrease of nitrogen-phosphorus-potassium (NPK) use in Hungary. This decrease is likely to happen after initiating the fertilizer input-tax used in Austria and Sweden. Simultaneously the risk of nutrient accumulation is not negligible at present (e.g. on livestock farms without lands), and this risk does not diminish after initiating the fertilizer input-tax. Input-tax could not turn to be right in my opinion.

The purpose is the reduction of nutrient waste and not the consumption of chemical fertilizers, so applicable methods have to take aim at the whole production and not only one element. Consequently, nutrient surplus-tax could be more successful instead of fertilizer input-tax and could be more acceptable for many farmers. However, nutrient surplus-tax has two preliminary conditions that would make more difficult the initiation.

First preliminary condition: creating a registering system to show nutrient surplus. It is important that the current registering systems would be slightly changed, limited work would be necessary for these changes, data of stocks contenting NPK would be calculated and would be verifiable in every phase of nutrient circulation. Both the need of minimal excess work and the possibility of verification demand that nutrient registering has to integrate into the current accounting system. We have examined this possibility and found that nutrient registering is possible after limited supplementing of the Hungarian accounting system.

Second preliminary condition: to know the NPK content of stocks (forage, livestocks, chemical fertilizers, farmyard manures, farm produces, etc.). This is not problem in case of some stocks (e.g. chemical fertilizers), but in case of certain stocks (e.g. farmyard manures) nutrient content has a wide range. However, there is some foreign precedent to solve this problem (see Breembroek et al., 1996), and there is some research work to study possibilities of nutrient surplus-tax - regarding to only nitrogen - in Hungary as well (see Podmaniczky, 1997).

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