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FOREWORD

Understanding the nature of the world food system has been a major objective of IIASA's Food and Agriculture Program (FAP), since it began in 1977.

Scholars from different nations have worked together in the FAP. The interactions of scholars from many different nations and perspectives sometimes reveal preconceptions regarding systems one is not fully familiar with. And often this provides interesting questions for fresh analysis.

This paper on efficiency of socialist cooperative agriculture is one such example of such analysis. The questions posed here were raised in discussions when a group of FAP scholars from different nations visited a cooperative farm in Hungary. In this paper the authors have advanced some hypotheses to explore the reality behind the apparent comparative inefficiency of socialist cooperative farming.

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Csaba Csaki, Kirit Parikh and Laszlo Zeold

Cooperative farms provide members of the cooperative with private (family) plots in a number of socialist countries in Eastern Europe. It is also generally believed that the value added from the private plots on a per hectare basis far exceeds the value added per hectare from the cooperatively cultivated land. For example, in Hungary a typical cooperative has about 700 members and operates around 5000-6000 hectares of land, of which 500-600 hectares are operated as household plots by the members, but about 25% of the total value of products comes from private operations. Even in the Soviet Union where such small holding agriculture is now being encouraged, similar differences in output per hectare between private and cooperative land are reported.

From this, the western economists have a tendency to conclude that private farming is much more efficient and that if only all farming were made private, socialist agriculture would produce much more. But to what extent is such a conclusion valid? Such a conclusion implies that the household's operations of the private plots and operation of the cooperatives are independent. However, in reality the two *sectors* operate in a complementary fashion. Moreover, when government control upon cooperatives is implemented by economic means the cooperative's management would try to and be able to maximize the welfare (income) of the members of the cooperative, which depends on the total income obtained from both the cooperatively operated land and the private operations. Thus allocation of products to exploit comparative advantages and transfer pricing to avoid taxes (just as in the case of a multi-national company with production plants in two countries) may be expected. Such a behavior could explain a large part of the *observed* differences in productivity.

Large scope exists for both profitable product specialization as well as for giving hidden subsidies through accounting practices such as the way in which overhead and charges for marketing, veterinary services, etc., are allocated. Private households concentrate on animal husbandry operations. This provides an opportunity for the cooperative to save on investments in buildings needed for livestock operations, particularly where many farmers have homes with some provision for keeping livestock. And of course, the livestock sector is particularly suited to provide hidden subsidies through provision of feed, veterinary services and marketing facilities. Moreover, the economies of scale are stronger in crop production than in livestock operations (once the buildings are taken care of) and this also suggests that the cooperatives concentrate on crop production. On the whole the household plots of the cooperative members can be regarded as an integral part of the large scale enterprise and the interrelations between the collective and household farms in the area of production

and sale are an extension of large-scale farms, e.g, production inputs, and animals for feeding are supplied to the small scale farms on a cost basis. Products are marketed by the cooperatives on a contract basis and extension service is supplied by the large scale farms.

It is our contention that for those centrally planned countries where the indirect type of government economic management is applied, and cooperative management is democratically elected (secret ballot) as well as where appropriate policies exist to motivate private households to seek additional incomes, such an explanation is closer to reality.

We propose to explore this issue through a set of programming models of a cooperative farm with household plots and agricultural activities. We will stipulate alternative objective functions and then examine the optimal solution to assess incomes per hectare accruing to the members of the cooperative from private holdings and from cooperative farming. We will also explore the range of incentives needed to ensure vigorous operation of private plots. For this purpose we take a typical cooperative farm in Hungary.

INSTITUTIONAL SET UP OF HUNGARIAN COOPERATIVES

Before we describe the model it would be useful to look at the institutional set-up of Hungarian cooperative farms. (In 1983 about 1300 cooperative farms were operating in the country). The cooperatives in Hungary are business enterprises and social institutions at the same time. Their independence is quite large in both areas. As enterprises the cooperatives have full decision making authority in their activities. Government control is implemented by indirect tools, operating mainly through incentives.

In general, for the Hungarian cooperatives quantitative targets of output are not prescribed by the central planners. Their performance is sought to be directed through indirect means of prices and taxes, and other policy instruments, such as interest and credit policy, subsidies, etc. The cooperatives cover their expenses from their returns and accumulate diverse funds. Formally the compensation fund for labour provided by members, which is the source of personal income was established as a residual after deducting costs of materials, taxes, and other obligations from returns. The residual was distributed according to the total of the so called "work units". At present the cooperatives pay guaranteed monthly wages which are set at about 80% of expected income. At the end of the year, an additional bonus amounting to 6-20% of the guaranteed sum of their wages is distributed among the workers. This share depends upon the financial performance of the enterprise.

The management of the cooperatives is based on the principles of so called "self management". The assembly of the members is the highest decision making authority. Both the Board of Directors and the President--the chief executive of the farm--are secretly elected from among members for a fixed term by the members.

Prices of outputs and inputs are set by the central price controlling authorities or for some commodities are determined by supply-demand relations. A cooperative is subject to the following taxes:

(a) **Land tax**

(b) **Income tax on "clear" income**: clear income is here defined as follows:

- Net Value Added = Gross Revenue - Current Inputs - Depreciation

- Clear Income (before tax) = Net Value Added - Wages

In order to promote investment the tax rate on clear income is a decreasing function of the investment/clear income ratio.

(c) **Tax on the increase in members' income from the cooperative**: to prevent avoidance of income tax through increasing wages and bonus and also to keep personal income increases under control, not only the income tax rate increases when average income from the cooperative increases compared to the previous year, but also an extra tax has to be paid when income increases exceed a certain specified level

(d) **Labour remuneration tax**: Paid according to wages as a contribution to social security expenditures

(e) **Production tax**: Levied on the value of the industrial and other non-agricultural activities performed by the farm.

In addition, the cooperatives pay contributions towards local municipal development. The clear income of the cooperative farm is allocated as per the decisions of the members. Various funds such as investment, social and cultural, reserve funds and funds for homes are formed and are influenced by the taxation system mentioned above. Private household income is also subject to income tax when income exceeds a certain level. However, in practice such tax is rarely paid, as the tax free allowance is relatively high. Such potential income from transfers of intermediate inputs provides scope for creative tax management by the cooperative through product specialization and cost allocations.

THE MODELS

The set of models we have used was developed on the basis of an LP model used for 5-year planning purposes at an existing Hungarian cooperative farm. The 5-year planning model with a detailed description of the farm and the results of the various model runs were published as an operation research case study in Hungary, Csaki and Meszaros (1981).

The cooperative farm under study is located in the North-Eastern region of Hungary. The farm operates on an area of 5881 hectares (3500 hectares of arable land, 40 hectares of orchard, 1820 hectares grassland and 521 hectares of forest), and has a membership of 677 persons The natural conditions at the farm are worse than the Hungarian average. Out of the 3500 hectares arable land, 464 hectares are used as the members so-called household plots.

Based on the actual Hungarian model, three models have been constructed for our investigation:

1. Model for the optimization of the large scale part of the cooperative farm: *Large Scale Model* (LSM):

For this model we have used two alternative versions of the objective function:

LSM/1: maximization of clear income after tax (gross revenue - current inputs - depreciation - taxes paid*)

LSM/2: maximization of net value added after tax, (clear income after tax plus wages**)

*Tax payments are calculated on a simplified basis

**On the Hungarian cooperative farms a certain payment for workers is guaranteed by the government. This is considered as labour costs in our case. Additional payments (bonus or income share) is also usual at the end of the year from the net income.

2. Model for the independent optimization of the local household and private agricultural activities: *Household Model* (HM)

The objective function here describes the maximization of gross value added (gross value of production minus production expenditures without labour costs)

3. Model for the joint optimization of the large scale and household agricultural activities at the farm: *Cooperative Model* (CM)

The objective function here is maximization of the sum of net value added after tax of the large scale and gross value added in the household sectors of the farm

The *Large Scale Model* includes:

- *106 variables*: 20 variables represent the options in field crop production, 16 variables are related to the utilization of grassland, orchards and forest. The animal husbandry is represented by 25 variables. One variable expresses the aggregated construction and non-agricultural activities of the farm. The rest of the variables are related to resource utilization (manual labour and machinery requirements) the planning of new investment in machinery and in buildings and the financial results of the farming.

- *121 constraints*: The first group of constraints of the LSM are related to the availability of physical resources and the patterns of their utilization. Another group of equations describes the feed balances and the internal relations of animal husbandry. The use of manual labour and the rules of crop rotation are also described.

The Household Model optimizes the structure of the private producing activities of the cooperative members on the basis of the 464 hectares land endowment. The household farming is treated in this model as a fully independent operation. As available labour force in this area, the non-working members and those employed in other sectors are also considered (618 persons with two hours per day). The HM consists of:

- *14 variables*: 10 various production activities (wheat, barley, corn, plum, dairy cattle, beef cattle, pig with sow, hog, poultry for meat and eggs) are included and the financial results are also expressed by independent variables.

- *21 constraints* which express building capacities and availability of labour and feed balances. The formation of financial results are also described here.

The Cooperative Model includes both HM and LSM for the joint optimization of the cooperative farm. In this case the largest possible support for household farming and the availability of the additional labour force are assumed. Goods and services supplied for household farms by the large scale farm are calculated on a cost basis, as is the practice in Hungary. The model consists of:

-*121 variables* - *142 constraints* with the structure described above.

THE RESULTS

Results of the various runs can be seen in Table 1.

As can be expected comparing columns 7 and 4 we see that the cooperative model CM yields a value added of 81.6 million H.Ft which is 26 percent higher than the value added of 64.8 million H.Ft under separate optimization. Moreover, total gross value of product at 230.8 million H.Ft under CM is larger by 24 percent than the 186.4 million H.Ft worth of gross value of product that can be realized when both large scale and household farms carry out separate optimization. What is, however, striking is that increase in the gross value of product as well as in value added for the household operations under the CM are both nearly 2.5 times their values under the HM. This income is mainly due to the enlarged feed availability offered by the large scale part of the farm. On the other hand, the gross production of the large scale part can also be increased due to enlarged labour availability.

The total income of the members of the cooperative would consist of three components; gross value added in the household operations, wages received from the cooperatively managed large scale operations and the bonus received from the after tax clear income. Even assuming that all after tax clear income is distributed as bonus, under joint optimization the total income of the members is 67.7 mHFt (13.3 + 27.3 + 27.1) compared to 55.7 mHFt under separate optimization, an increase of 21.5 percent. Of course, in practice, not all after tax clear income can be distributed as bonus because when bonus exceeds a certain amount it will be liable to additional taxes. Thus the gain in total income under joint optimization will be larger than the 21.5 percent increase calculated above.

It is also interesting to compare the gross value of product per hectare under different runs. As mentioned earlier, out of the total arable land area of 3500 hectares the cooperative manages 3036 hectares and the household plots add up to 464 hectares. The gross value of product per hectares under LSM 2 and HM are 55764 HFt for the cooperative and 36853 HFt for the household plots. These are somewhat comparable figures and in any case do not show that households are more productive. In fact they show the advantages of large scale crop production practiced by the cooperative. However, under CM, the gross value of product per hectares is 61732 HFt for the cooperative land and 90302 HFt for the household plots. Thus if one were to compare only these figures one would wrongly conclude that household agriculture is more productive than the cooperative large scale agriculture. In comparing the results of the various runs, changes in the structure of production have also to be taken into account. The enlarged feed supply available on a cost basis for the members shows the extension of poultry and beef production at the household sector; while in the HM run households could have purchased feed grains from the market at the substantially higher market prices. The changes in the cropping structure are a consequence of the different feed requirements due to changes in the structure of livestock production. At the large scale part of the farm the additional labour force makes it possible to enlarge animal husbandry (cattle and sheep operations).

The most striking change in the structure of production under joint optimization is the substantial increase in poultry for eggs in the households. Households in column 6 have 8000 layers compared to 190 in column 3. One may wonder why in egg productions, where economies of scale may be strong, production by households is preferred. The explanation lies in the fact that households do not make special investment in buildings for poultry (many may have spare space in their yards), and that they do not pay the same taxes as the

Table 1. Production Structure and Incomes of a Farming Cooperative with Household Operations Under Alternative Management Regimes

	Large scale with max. clear income LSM/1 (1)	Large scale with max. net value added LSM/2 (2)	Household alone HM (3)	Large scale and household together (2) + (3) (4)	Cooperative Model CM		
					Large-Scale (5)	Household (6)	Together (7)
1. Gross value of product in million H.Ft.	155.4	169.3	17.1	186.4	188.9	41.9	230.8
2. Direct Expenditures Without Labour Costs in million H.Ft.	98.8	109.9	11.5	120.9	125.1	28.6	153.7
3. Valued Added* in million H.Ft.	56.6	59.4	5.4	64.8	63.8	13.3	81.6
4. Wages Paid in million H.Ft.	21.8	24.3	-	24.3	27.3	-	27.3
5. Clear Income in million H.Ft.	34.8	35.1	-	35.1	36.5	-	36.5
6. Taxes Paid in million H.Ft.	5.7	9.1	-	9.1	9.4	-	9.4
7. Clear Income After Tax in million H.Ft.	29.1	26.0	-	26.0	27.1	-	27.1
PRODUCTION STRUCTURE							
1. Wheat-Barley(ha)	1225	1225	464	1689	761	193	954
2. Corn(ha)	1057	1261	-	1261	1593	271	1864
3. Sunflower(ha)	-	-	-	-	-	-	-
4. Hay-Green Feed(ha)	704	500	-	500	632	-	632
5. Rape(ha)	50	50	-	50	50	-	50
6. Grassland(ha)	1590	1813	-	1813	1820	-	1820
7. Orchard(ha)	40	40	10	50	40	10	50
8. Dairy Cattle(head)	120	120	160	280	350	18	368
9. Beef Cattle(head)	2540	2900	-	2900	3480	143	3623
10. Sheep(head)	1512	3150	-	3150	5000	-	5000
11. Pig-Sow(head)	-	-	90	90	-	90	90
12. Pig-Hog(head)	-	-	1500	1500	-	1500	1500
13. Poultry for Eggs(piece)	-	-	190	190	-	8000	8000
14. Poultry for Meat(piece)	-	-	10000	10000	-	10000	10000

*Net for cooperative and gross for household

cooperatives. By giving feed and day old chicks to the households the cooperative can expand production without additional investments, and can increase personal incomes without paying wage related taxes. These advantages compensate the losses of foregoing the benefits of economies of scale. This shows the advantages of integrated planning of the cooperative and household operations.

If the managers have authority upon the structure of production and are democratically elected they are likely to work to maximize the total income of the members of the cooperatives. When compulsory targets are given for production and managers are appointed by central authorities, their obligation would be to the planners. They would therefore be more likely to maximize their performance as it would be evaluated by the central planners, namely by maximizing clear income of the cooperative after tax. Column 1, gives the results of LSM/1 under such behavior. This gives the lowest gross value of product as also value added but indeed highest clear income after tax.

To conclude, we believe that these runs demonstrate one main contention:

> When members are given small household plots and when management has freedom in making farming decisions and is elected democratically socialist cooperative farms plan the operations on the cooperative land and household plots in a complementary fashion, and in their effort to maximize the welfare of their members an illusion may be created that household plots are more productive.

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