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HORTICULTURAL SURVEYS IN POLAND: SCOPE AND METHODS IMPROVING SURVEY METHODS

Central Statistical Department, Poland

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Improving survey methods

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1. Harvest estimates and evaluations are statistical surveys providing figures for calculating expected and actual output of particular crops. They are conducted by surveyors and local experts from the Central Statistical Department, depending on requirements and intensity of production, at the *gmina* (commune) or voevodship level, but also by valuation collectives, or are based on the warehouse records of State and cooperative farms. Information on forecast and actual intake and harvest of fruit from trees and bushes is an important element in efforts to determine the extent of market gardening in the country. Producing a correct estimate of the output of fruit and berries is a difficult task in Poland, requiring of the experts, besides professional skills, excellent local knowledge and considerable experience with such matters. The difficulties stem, first and foremost, from the fact that production is so widely scattered. Some 396,000 households in Poland engage in horticulture; of those, 350,000 cultivate under 1 hectare, and 15,000 cultivate plots of 1 to 2 hectares. There are only 1,500 households whose horticultural activities extended over more than 10 hectares. The absence of large horticultural ventures is the reason for the wide range of varieties and the differences in means of cultivation and intensity of production. An additional difficulty in assessing horticultural output is the fact that only 80 per cent of Poland's trees are grown in orchards and 20 per cent - the harvest from which also requires assessment - grow elsewhere, for example on allotments or in free plantations less than a tenth of a hectare in size. It is estimated that the orchards planted over the past five to seven years and cultivated in accordance with European trends - where the number of irrigated short-stock apple trees per hectare can reach 3,000 - 4,000 with a modern mix of varieties, represent only 20 per cent of the total area planted to orchard in Poland. The remaining 80 per cent are old orchards with between 800 and 1,000 trees per hectare and a mix of varieties that does not entirely match the demands of the European market.

2. A variety of factors have a decisive influence on the size and quality of the fruit crop. Thorough and painstaking observation of these factors enables one to make accurate forecasts and evaluations of output. Among the characteristics deserving special attention are:

(1) biological factors - cutting, species, tree age;

(2) pedological - soil quality, local relief, situation;

(3) climatic - temperature, frost, precipitation, sunshine:

(4) technological and mechanical - the cultivation techniques employed, and in particular, care of trees and bushes, manuring and irrigation;

(5) economic and organizational - the use made of means of production, a lively and committed workforce, prices, profitability, sales opportunities.

3. The growers' professional skills and ability to adapt output and operating principles to changing circumstances - the transition to a market economy, and the modernization of production potential to meet today's requirements: requirements imposed on horticulture in Poland not only by the external market but also by the constantly changing and increasingly demanding domestic one - are also of enormous importance.

4. All these factors have a direct bearing on horticultural output, while simultaneously confronting the horticultural statistician with additional demands for more detailed surveys covering a wider range of

information while changing from measuring the productivity of one fruit-bearing tree to measuring the productivity of a hectare of them.

5. Statistical surveys of horticultural output in Poland typically cover the following: area devoted to fruit trees, in total and divided into areas of fruit-bearing trees in and outside orchards; number of fruit-bearing trees; yield per tree and per hectare, harvest, and fruit quality. Estimates are produced for apples, pears, plums, sweet and sour cherries, and for apricots, peaches and walnuts together. For fruit bushes, data are collected on the area and total number of bushes, the yield per bush and per hectare of plantation, and the blackcurrant, white and red currant, gooseberry, choke-berry and bilberry crop. For strawberries and raspberries, the area under cultivation, the yield per unit area and the crop are recorded.

6. Since 85 per cent of the fruit grown on trees in Poland is apples, the apple surveys are more detailed, with additional questions on the mix of varieties by area, the total number of trees and the crop. They cover 20 of the most widely grown varieties of apple: Idared, Macintosh, Jonathan, Lobo, Cortland, Spartan, Bancroft, Starking, Velty, Golden, Delicious, Gloucester, Antonovka, Ligol, Champion, Jonagold, Melrose, Gala, Boscop, and Elstar - and all other varieties together.

7. No information is gathered on varieties for other species of tree or bush or for strawberry and raspberry plantations.

8. The surveys cover individual farms, but also State and cooperative ventures. It must be stressed that individual farms make up 93 per cent of the total area of orchards and gardens in Poland, and produce 97 per cent of the total fruit crop.

9. The methods used to produce estimates - some ancillary, biometric methods apart - rely on constant, systematic monitoring and assessment throughout the year of the state of the crop together with factors and phenomena directly affecting yields and crop size. Of especial significance are:

(a) the health of the trees as they emerge from their winter rest and the blossom buds set;

(b) overwintering conditions;

(c) atmospheric conditions in the early spring, at blossom time and while the fruit is setting;

(d) the vegetation process and growing conditions for the fruit.

10. The set of biometric estimation methods used to assess output provides a numerical definition of crop size based on observations, measurements and the relationships between morphological features at various stages of fruit growth. The times at which estimates, forecasts and evaluations are made are chosen to suit the various phenotypic stages of fruit trees and bushes since, as mentioned above, different morphological features develop at the successive stages of plant growth and these are correlated with crop size. Poland conducts the following estimates and evaluations of horticultural output:

(i) A spring estimate of plant condition, covering winter damage to trees and bushes, frost-related spring damage, and blossoming. Thus the spring estimate encompasses an estimate of potential yields based on observations of climatic conditions during the previous summer and autumn plus the time while the blossom buds are setting and the number of such buds. For currants and gooseberries, the foliage is monitored up to the end of the autumn since this gives a good indication of the number and quality of buds set. The estimate is made by experts in mid-May;

(ii) A preliminary estimate of yield and crop, made after the styles have withered. The field estimate is conducted in late June/early July;

(iii) A pre-harvest estimate, regarded as a correction to the preliminary estimate; it is the preliminary estimate of the year for drupes, strawberries, currants and raspberries. It is made in late August;

(iv) A final evaluation, made in late October/early November. In addition to an estimate of the area and quantity of trees and bushes, yield and crop, it includes an estimate of fruit quality.

11. Three main groups of methods are used in forecasting fruit output: (a) statistical; (b) intuitive; and (c)empirical.

12. The forecasting methods most commonly used in Poland are intuitive ones based on the knowledge, professional experience, insight and systematic observations of the territory by the person making the forecast. In practice, intuitive forecasting relies on familiarity with the factors that determine the course of events. The more thoroughly the person making an intuitive forecast knows his subject, the more accurate the forecast will be. Intuitive methods rely, as a rule, on:

(i) Systematic observation of phenomena related to the process of plant growth, and direct observation of how fruit trees and bushes develop;

(ii) An opinion survey of those actively concerned with horticulture;

(iii) Consultation of the opinions of experts highly skilled in various aspects of horticulture.

13. Statistical methods are also helpful to those making the forecasts. They begin with a determination of the current state of production. Analysis of former trends in output reveals rates of change and sizes of trends, and this is helpful in predicting how phenomena will develop in the future.

14. Empirical methods introduce an additional element that makes for more objective forecasts and evaluations, since they bring measurable quantities into forecasts of the yield and crop from fruit trees and bushes. Estimates by eye of fruit yields can be made more realistic if they take account of the quantity of fruit on a tree and measurements of the average mass of a single fruit. Empirical methods comprise measurements of two kinds: (i) meteorological conditions - this group of methods is based on weather indicators, but for horticultural purposes they can only play an ancillary role in producing an accurate estimate of output; (ii) biometric features of plants and their fruit.

15. Biometric measurements are used in the statistical description of morphological features. Yield levels are related to them. Research has shown that yields are correlated with:

the shape of the plant and its vegetative organs: e.g., crown, stem/trunk;
the reproductive organs, in the form of buds, flowers, ovaries and fruits.

16. To determine how powerful an influence these features have, measurements - of crown size, number and size of ovaries, in the case of fruit trees - are essential.

17. The measured morphological features of trees and their correlation with yields are shown in Table 1.

Table 1. Measured biometric features of trees and fruit correlated with yield

Vegetative and reproductive organs	Most important biometric features	Types of fruit and tree			
		Apples	**Pears**	**Plums**	**Cherries (sweet)**
Stem and crown	Cross-sectional area	+	+	+	+
Crown	Fruit-bearing area	+	+	-	-
	Crown volume, m^3	+	+	+	+
Shoots	Number	+	+	+	+
	Length of growth	+	+	+	+
Foliage	Abundance per ovary	+	+	+	+
Buds, blossoms, ovaries	Number of buds	+	+	+	+
	Number of blossoms	+	+	+	+
	Number of ovaries	+	+	+	+
Fruit measurements	Quantity of fruit on tree	+	+	+	+
	Fruit diameter	+	+	-	-
	Mass of single fruit	+	+	+	+
Fruit growth (daily, weekly, ten-daily, monthly) during the vegetative season	Increase in fruit mass	+	+	+	+

Legend: + indicates that the feature exists
- indicates that the feature is absent

18. Obviously, biometric measurements can be carried out on a small number of plants that are representative of the entire population whose yield is to be estimated. For estimating apple output, the biometric method of counting the fruit on a tree, or part of it, with special field binoculars, and measuring the fruit-bearing area of the crown (length and breadth) with a pole or measuring tape, makes the intuitive one more realistic.

19. The overall count - the product of the fruit-bearing area of the crown, the total number of fruit from fruit density samples on the tree, and the average mass of a single fruit - enables the yield from the apple tree to be forecast. Fruit density is measured after the styles wither in June, when the diameter of the ovaries reaches 50 mm. In practice, given conditions in Poland, biometric measurements of the early varieties are made around 30 June, and around 10 July for the autumn and winter varieties. They must not be made too early, for then the fruit are still too small and hard to spot. But they must not be made too late, either, because then the branches bend under the weight of the fruit and conceal part of the crop.

20. Measurements of the length and diameter of shoots and the quantity of foliage can be used as additional indicators in forecasting yield. It is assumed that in order to get a good yield from moderate-

growth and semi-dwarf trees, the ovaries should be spaced 16-20 cm apart, and there should be 30-40 leaves per ovary.

21. Measuring the morphological features of fruit is quite difficult, but careful, systematic annual observation and biometric monitoring supported by statistical estimates ensure an accurate assessment of fruit output from fruit trees and bushes.

22. Poland's Central Statistical Department will this year carry out a detailed survey of the production potential in Polish horticulture. This will encompass some 17,000 horticultural ventures. The sample population will be ventures that in 1996 - at the general farming census - had at least 1 hectare of fruit trees and bushes (overall, there were 39,000 of these). The survey will be conducted by questionnaire between 2 and 9 October. It is planned to conduct such large-scale sample surveys of horticulture every five years. The range of topics covered will be extensive. The questionnaire embraces:

(i) Information on the owner or user of the venture, i.e. age, level of education (including horticultural training);

(ii) The nature of the venture, taking into account total size, area of farmland, area of orchards/plantations, availability of tractors and specialist production equipment, sorting and packing equipment, availability of irrigation systems. There are also questions on availability of fruit stores and refrigerators;

(iii) The nature of the produce grown: area, number of trees, and the harvest of the main types of fruit from trees divided into four age groups and bushes divided into two age groups. The survey will also gather data on apple trees by age groups of dwarf, semi-dwarf and full-sized trees, and on the 21 varieties of apple most commonly grown in Poland;

(iv) The nature of the crop (for consumption or industrial), and method of sale and distribution.

23. This detailed analysis of production potential and crop will enable a review of Polish horticulture to take place. At the same time, it will help horticultural statisticians to address the tasks inherent in the unification of European statistics. Poland is among Europe's largest producers of some varieties of fruit. It is the leading producer of berries, raspberries and sour cherries. The rapid modernization of its apple orchards holds out hope that it will soon be back among the leading European producers of apples.