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VARIABILITY OF FRUIT PRODUCTION ACROSS REGIONS

ABSTRACT

An unstable fruit production leads to weak investment strategies of fruit farmers, impacting consumers on the medium and long term. The identification of factors affecting fruit production stability is very important as, at present, the fruit sector is facing competitiveness problems and the production is still far from meeting the population's consumption needs. The study targets the following issues: 1) the performance of the sector and different regions as regards the investigated fruit tree species production and yields and 2) the production instability degree and the factors responsible for this phenomenon. In the analysis we used statistical data series, simple and synthetic variation indicators, calculated as absolute or relative measures.

Key words: fruit, production, yields, stability.

JEL Classification: Q 10, Q 13.

1. INTRODUCTION

The fluctuations in fruit production have a significant impact upon prices, upon farmers' incomes stability and implicitly upon the commitments on future investment actions. Measuring the production stability and the analysis of trends in the fruit production variability is of great importance in understanding the nature of food and nutrition security. By identifying the factors contributing to fruit production variability, the study provides a framework for understanding the stability/instability of the fruit production system both at national and regional level.

2. STATE OF KNOWLEDGE

Production stability has a multi-dimensional character. The agricultural system productivity is strictly linked to the economic, social and environmental conditions. When there is a dynamic equilibrium between the environmental and management factors, stable yields can be obtained. From this perspective, one of the important objectives of sustainable agriculture is to obtain yields stabilization on the long term.

Measuring and forecasting the impact of climate changes upon agricultural production represents a topic of interest for the scientific community. Among the climate phenomena with direct negative effects upon agriculture, we can mention the following: the changes in the rainfall regime, the increase of the average global temperature and the increase of frequency and intensity of extreme phenomena. The impact of climate changes upon agriculture and food security can be firstly felt through the changes in the crop yields, water availability, diseases and pest infestation, animal health and other biophysical factors (FAO, 2012). More concretely, the impact of climate changes upon agriculture is materialized in the growth period diminution (Sarr B, 2012), in significant variations of yields across regions (Ray D.K., 2013), increase of arid areas (A El-Beltagy, 2012), spreading of pests and certain invasive species (Burgiel, S.W, 2010**)**, diminution of biodiversity (C. Bellard, 2012), which besides food production supplies a variety of ecological services including the recycling of nutritional substances, the regulation of the microclimate and local hydrological processes, the removal of undesired organisms and harmful chemical substances (Altieri M, 1999).

As most fruit-tree species are growing better on deep well drained clayish soils, with a pH of 6–7, with rare exceptions, climate is one of the strongest determinants of the success in fruit cultivation. In most studies, the climate change impact is approached from the perspective of annual average temperature increase. The scientific proofs show that the 30 years with higher temperatures since the end of the 20th century have affected the organisms phenology, the species range and distributions, as well as the composition and dynamics of communities (Walther G.R, 2002). The perennial crops are more affected by the outrunning of phenological phases, as the adaptation possibilities through the changing of the calendar of agricultural activities are lower than in the case of arable crops.

Numerous studies highlight that the distinct modifications of the air temperature in the late 1980s led to clear responses in the phenology of crops, in many parts of the world. Under the impact of the global average temperature increase, the phenophases of crops fluctuate, and the growth season is prolonged (Romanovskaja D., 2009). Certain studies indicate that in Europe, the average annual growth season was prolonged by 10.8 days as against the early 1960s, and these changes can be attributed to the modifications of the air temperature (Menzel A., 1999). In Germany, the phenological phases of natural vegetation, as well as of fruit-trees and crops obviously advanced in the last decade of the 20th century. The strongest change in plant development took place for the very early phases in spring. The changes in plant development have been still moderate so far, so that no strong impact upon yields could be noticed (Chmielewski et al., 2004).

As the variability of climate factors can produce significant damages in orchards, generating high production volatility, given both by the absence of fruit bearing and by alternate bearing in fruit tress, the investment in fruit-tree plantations should always be based on zoning studies of fruit tree species, based on climate information and on information regarding the pedological, biotic and economic factors.

The zoning studies of the fruit-tree species represent a necessary support for putting into value their biological, ecological, agro-technical and productive particularities, and on this basis, for the elaboration of modern technologies, differentiated by species, varieties, ecological areas, in order to obtain stable and quality harvests under high economic efficiency conditions. A stable agricultural eco-system can better cope with the stress factors induced by the climate changes. For this purpose, the identification of sectoral vulnerabilities is a first important step towards the development of climate change adaptation plans.

In the year 2014, in our country, Romania's agro-climate and pedological potential for fruit-tree species was evaluated within an interdisciplinary working group. The paper represents the first approach to zoning the main tree species, fruit berries and strawberries nationwide, establishing the spatial distribution of soil and weather suitability for these species. For the suitability interpretation, scores from 0 to 4 were given for each climate and pedological factor. The results show that there are few cases in which the less favourable score (1.5–2.5) was assigned, and most cases fall into the moderately favourable interval (2.5–3.5) for the fruit-trees crops. In very few situations the scores exceeded 3.5 (very favorable), out of different reasons, and in all cases the low level of environmental factors must be boosted by technological measures, with irrigation being one of the most important ones (Coman M, Chiţu E., 2014).

3. MATERIAL AND METHOD

The information on the sectoral organization modality comes from the Eurostat database, having as source the basic surveys, i.e. the General Agricultural Census (GAC), conducted every 10 years, and the intermediate structural surveys (ISS), based on sampling, three times between the basic surveys. For the fruit production, yields and number of trees we used NIS database, Tempo Online.

As the scientific community considers that the simple coefficient of variation in volatility measurement over estimates the instability level in time-series data, we opted for the utilization of Cuddy Della Valle variability index. The index represents a modification of the coefficient of variation [CV] with a flattening factor of trends, which usually are present in the economic time-series data, according to the formula:

$$\boldsymbol{I_x = CV(x)\sqrt{(1 - R^2)}}$$

Where:
I_x = instability index,
CV(x) = coefficient of variation,
R^2 =coefficient of determination.

As yield variability increase and agricultural production variability increase implicitly in connection with the climate changes of the last years are debated in numerous specialty studies, we followed the evolution of the variability index for two different periods, namely 1996–2005 (P1) and 2006–2015 (P2).

In order to identify the nature of instability in fruit production we took into consideration the instability level for yields and for the number of trees (because at regional level there are no data available regarding the areas under orchards by fruit-tree species).

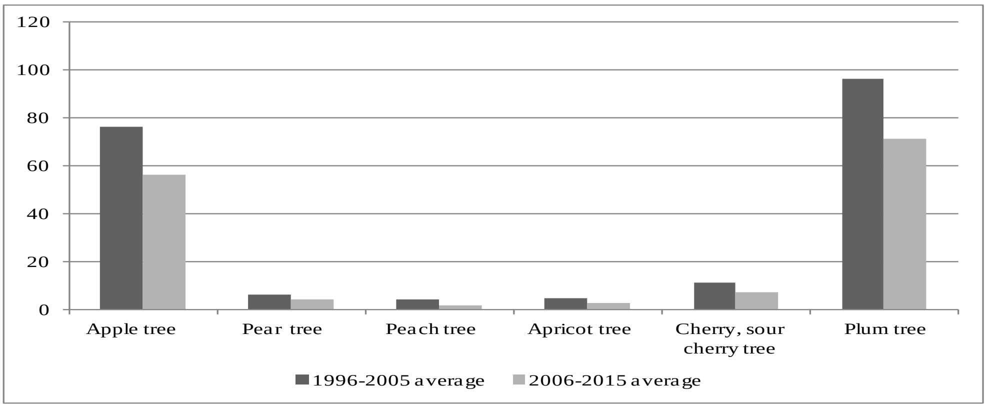
4. RESULTS AND DISCUSSIONS

4.1. EVOLUTION OF THE FRUIT FARMING SECTOR

In our country, fruit production is weakly diversified, the plum tree and the apple tree being the two species that cover over 80% of the area under fruit trees, with differentiations across regions.

One of the variables contributing to stable fruit productions is the area stability. If we refer to the two periods taken into consideration to assess the stability degree of fruit production, we can notice that the year 2006 represents a turning point when important areas were cleared (mainly in apple and plum trees). Out of this reason, the total area of orchards decreased by 28% as compared to the previous period average.

Since 2006, the area under orchards has continuously decreased, both overall and by development regions, except for Bucharest Ilfov. In relation to the regional area, the decrease of areas represents less than 1% in the regions South-East and South-West Oltenia and 1.4% in South Muntenia and North-East, 1.9% in the region Center and 3.7% in the region West (Figure 1).

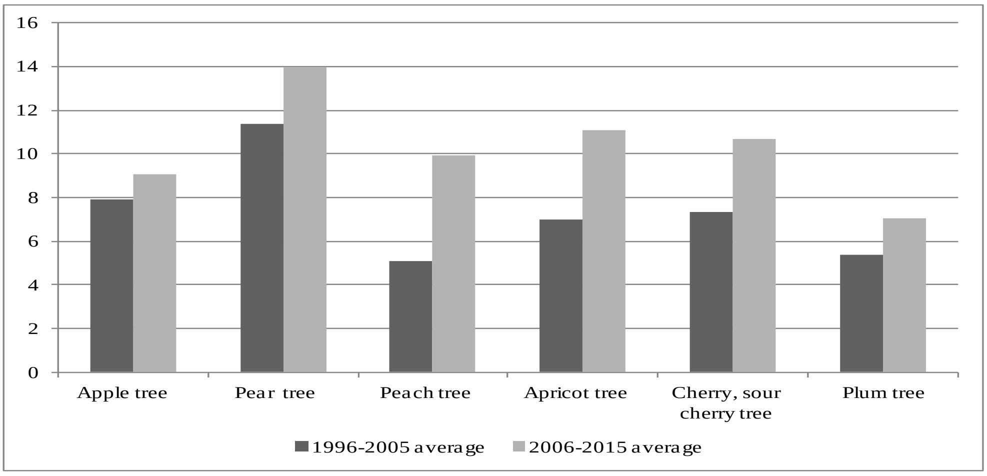


Source: Eurostat [apro_acs_h] [apro_acs_a]

Figure 1. Evolution of area under orchards by fruit tree species in the period 1996–2015, thousand hectares.

The total fruit production has been fluctuating, with years with peak productions and years with poor harvests. Production instability is largely due to the high variability of yields. Yields stability depends both on climate factors and structural factors (age of orchards). At the same time, the technological input must not be neglected either. Yields are unstable for all species of investigated fruit trees, with a great dispersion of their values, mainly in the period 1996–2005. After 2006 the variation intensity decreased.

The increase of yields could not fully offset the production losses produced under the background of the decreasing areas, so that in the period 2006–2015 the fruit production was smaller by 9% than the average of previous period.

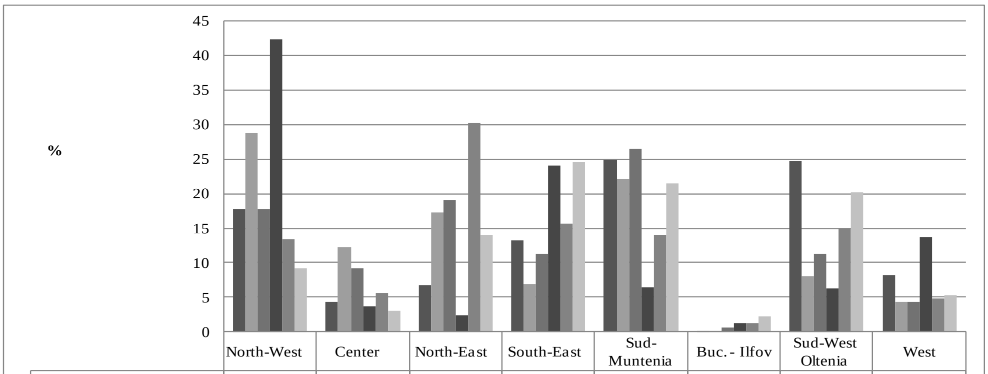


Source: author's calculations on the basis of Eurostat data [apro_acs_h] [apro_acs_a]

Figure 2. Evolution of yields on the fruit tree plantations in the period 1996–2015, tons/ha.

Across regions, all the investigated species are grown, yet the different fruit types have different shares in total fruit production. For instance, the North-West region is an important producer of peaches and apples, the North-East region stands out for the cherry/sour cherry production, and the region South-East Oltenia for the plum production (Figure 3).

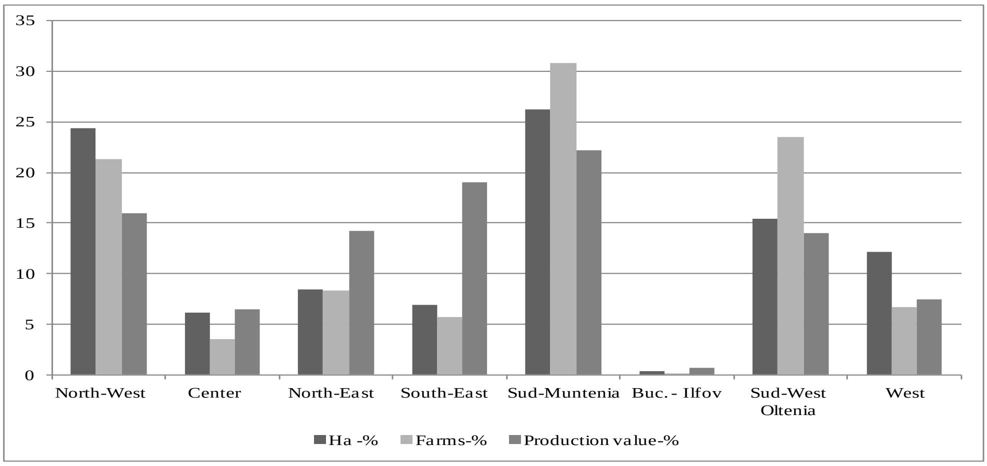
In the year 2012, the fruit production value totalled 989.46 million euro. The region South-Muntenia, which has the most important area under orchards, accounted for 22% of the fruit production value. Although the South-East region accounts for only 7% of the area under orchards, it accounts for 19% of the fruit production value (Figure 4).



	North-West	Center	North-East	South-East	Sud-Muntenia	Buc. - Ilfov	Sud-West Oltenia	West
Plums	18	4	7	13	25	0	25	8
Apples	29	12	17	7	22	0	8	4
Pears	18	9	19	11	27	1	11	4
Peaches	42	4	2	24	6	1	6	14
Cherries and sour cherries	13	6	30	16	14	1	15	5
Apricots	9	3	14	25	21	2	20	5

Source: author's calculations based on NIS data, Tempo Online

Figure 3. Share of regional production in total fruits, by species, in the year 2015, %.

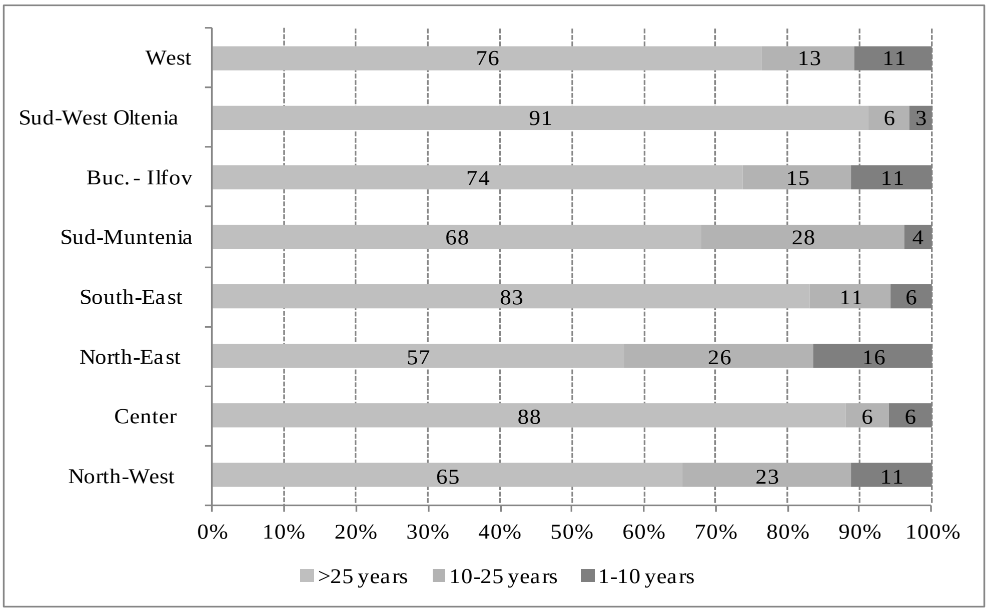


Source: Author's calculations based on Eurostat data [ef_oluecsreg],[ef_popermreg], [agr_r_accts]

Figure 4. Regional distribution of areas, farms and fruit production value, in % of total.

4.2. PRODUCTIVE POTENTIAL OF ORCHARDS ACROSS REGIONS

The increase of fruit productions at the level of natural (ecological) soil potential, as well as obtaining stable harvests largely depend on the productive potential of orchards. This is mainly measured by two indicators: age and density of fruit tree plantations. The first indicator is of interest for fruit production stability. This indicates that 74% of the fruit tree orchards in our country are old-aged (over 25 years old), almost 19% are 10–25 years old, and the young orchards occupy over 7% of the total area under fruit trees. The areas by regions have great structural deficits and stagnated in time in the regions South-West Oltenia and Center. The North-East region stands out by a more balanced structure between the age categories, being the region with the best investment dynamics in new plantations, followed by North-West. In the South-Muntenia region, which has the largest area under orchards, the share of old-aged orchards is under the national average, but lately the dynamics has been weak. In the regions West and Bucharest–Ilfov, the young orchards account for 11% of the area (Figure 5).



Source: author's calculations based on Coman Mihail, Chițu Emil – Coord. Zoning of fruit tree species by Romania's pedo-climatic and socio-economic conditions

Figure 5. Distributions of areas under fruit trees across regions by age categories.

4.3. FRUIT PRODUCTION STABILITY

In the first period (1996–2005), the total fruit production had a medium variability level that was largely due to the variability of yields. Across regions, the fruit production had a medium variability level in three regions: North-West, North-East and Bucharest–Ilfov; in the other regions, the fruit production featured high variability, mainly in South-West Oltenia, a region where the yield variability was also extremely high (Table 1).

Table 1

Variability of total fruit production, of yields and tree number per total and by regions

Region	P1 index (1996–2005)			P2 index (2006–2015)		
	Production	Yield	No. of trees	Production	Yield	No. of trees
Total	0.26	0.28	0.01	0.11	0.14	0.10
North-West	0.26	0.26	0.05	0.19	0.22	0.07
Center	0.34	0.33	0.03	0.25	0.22	0.05
North-East	0.21	0.24	0.04	0.20	0.14	0.07
South-East	0.34	0.36	0.04	0.16	0.14	0.04
South-Muntenia	0.37	0.39	0.04	0.16	0.26	0.37
Bucharest–Ilfov	0.19	0.29	0.08	0.39	0.23	0.22
South-West Oltenia	0.38	0.43	0.01	0.11	0.16	0.17
West	0.35	0.34	0.02	0.17	0.14	0.13

Source: author's calculations based on NIS data, Tempo Online

In time, fruit production became more stable due to yield variability diminution. It is worth mentioning that in P2 the variability index for the tree number increased, which means that the restructurings of areas under orchards had a positive effect on yield stabilization. As in the region Bucharest Ilfov the instability of fruit production increased, we can appreciate that this dynamics did not aim at sectoral restructuring.

From the perspective of the investigated species, in the first period (P1), the total fruit production had a medium variability level for three out of the six species, namely: pears, peaches, cherries/sour cherries, while the production of plums, apples and apricots had a high variability. Yields featured high variability, except for the pear yields. In the period 2006–2015 (P2) we can notice a positive evolution from the perspective of production stability increase, mainly due to yield variability decrease (Table 2).

Table 2

Variability of the production, yield and tree number, per total and by species

Species	P1 index (1996–2005)			P2 index (2006–2015)		
	Production	Yield	No. of trees	Production	Yield	No. of trees
Total fruit	0.26	0.28	0.01	0.11	0.14	0.10
Plums	0.36	0.34	0.02	0.15	0.20	0.17
Apples	0.37	0.39	0.01	0.11	0.10	0.02
Pears	0.21	0.20	0.03	0.12	0.12	0.05
Peaches	0.25	0.38	0.05	0.19	0.24	0.09
Cherries and sour cherries	0.23	0.29	0.04	0.15	0.14	0.04
Apricots	0.33	0.37	0.10	0.18	0.13	0.08

Source: author's calculations based on NIS data, Tempo Online

Stability increase can be explained by the removal from production of declining orchards that manifested a strong phenomenon of alternate bearing in fruit trees and their partial replacing by new plantations, which can be also seen from the increase of the variability index value for the number of trees in P2 compared to P1.

5. CONCLUSIONS

Production stability has a multidimensional character. The productivity of agricultural systems is strictly linked to the economic and social conditions, and also to the weather factor. As it results from the conclusions of the specialty studies, the impact of the modifications of weather variables upon yields is different by species and region, so that it is quite difficult to understand the influence of annual inter-climate variations in relation to the yields of crops in different regions. When there is a dynamic equilibrium between the environmental and the management factors, stable yields can be obtained.

In the first investigated period (1996–2005), the total fruit production had a medium variability level, which was largely due to yields variability level. At regional level, the fruit production had a medium variability level in three regions: North-West, North-East and Bucharest–Ilfov; in the other regions the fruit production was characterized by strong variability, mainly in South-West Oltenia, a region in which yield variability was also extremely high.

In the period 2006–2015, a positive evolution was noticed from the perspective of production stability increase, mainly due to yield variability decrease. The increase of stability can be explained by the removal from production of declining orchards that manifested a strong alternate bearing in fruit trees and the partial replacement of these orchards by new plantations. In time, an increase of yields can be noticed, accompanied by their variability diminution.

At country level, the best production and yield stability is found in pear production.

The variability index diminution in time confirms the hypothesis that in the case of fruit trees plantations in our country, production stability is largely affected by the structural factors and partially by the climate factors. Although fruit production has become more stable, price instability has increased. This reveals the deficient organization of the food chain from the perspective of the low level of farmers' connection to the market.

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