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## **ORGANIZATION OF SUPPLY CHAINS IN THE FRUIT SECTOR IN POLAND**

Key words: logistics, agriculture, fruit industry, processed fruit

**ABSTRACT.** The aim of the study was to recognize the supply chains used in the marketing of fruit and their products, as well as the trends of changes in this sector. The object of the research was fruit production in the world and Poland. The study presents a diagram of the supply chain in agribusiness. A method of graphic presentation of the flow of raw materials and fruit products from producers of raw materials and means of production for agriculture to the final consumer was also used. Trends of changes in the production of fruit and their preserves are presented. The research used literature on the subject, available mass statistics data and data prepared by the Institute of Economics, Agriculture and Food Economy – the National Research Institute. Based on the research, it was found that the fruit logistics chain includes thousands of farmers, many agri-food processing units, wholesale and retail food trade. It must be very flexible, constantly adapting to the challenges of a changing, globalizing market. In conditions of dispersed fruit production, success is determined by the efficiency of chain management combined with solidarity and mutual trust of all participants in the flow of goods, information and financial resources.

### **INTRODUCTION**

Fruit production and processing is one of the most important agricultural sectors as well as agri-food processing in Poland and the world. The fruit sector is of great importance as a source of income for producers in farms located on good and medium soils and in the vicinity of large urban agglomerations or food processing plants. It also plays an important role in creating jobs in rural areas and small towns. Fruits are the basic raw material in the fruit and vegetable industry, both in the production of solid consumer products, such as jams and marmalades, as well as juices and other beverages. Waste from fruit processing is used as a component in the production of livestock feed.

The importance of production and the increasingly promising perspectives of using fruit for direct consumption as well as for processing as well as a relatively favorable profitability level of this activity compared to other plant and animal activities evokes farmer interest in fruit-growing. A considerable number of producers and other market participants results in the growing interest of farmers, management boards of processing enterprises and salesmen in the efficiency of purchase and movement of fruit and their products, that is the functioning of logistics chains.

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## THE LEVEL OF WORLD, EUROPEAN AND NATIONAL FRUIT PRODUCTION

On a global scale, the most important products of this group include apples, oranges, mandarins, peaches and grapes. The total harvest of fresh fruit in the world in 2014 was estimated at 689.9 million tonnes, with an upward trend<sup>1</sup>. Their leading producer is Asia, then Africa, South America, Europe and North and Central America. The main producer of fresh fruit is China (about 210 million tonnes in 2014, including watermelons – over 70 million tonnes)<sup>2</sup>. In 2014, the largest harvests were of watermelons (over 111 million tonnes), bananas (110.1 million tonnes), apples (84.6 million tonnes) and oranges (70.8 million tonnes). The production of grapes (over 74.4 million tonnes), mango and guava fruit (over 45.2 million tonnes), mandarins (29 million tonnes), pears and pineapples (25.5 million tonnes), peaches and nectarines were also important (22.8 million tonnes) or other tropical fruit (20.4 million tonnes).

In the European Union, the basic fruit plants are: apples, which in 2017 collected about 10 million tonnes, oranges (6.2 million tonnes), mandarins (3.0 million tonnes), peaches (2.9 million tonnes), pears (2.3 million t) and grapes (1.6 million t) [Nosecka 2018]. The main fruit producers in the European Union are Italy (6.7 million tonnes in 2017), Spain (5.3 million tonnes) and Poland (3.2 million tonnes), and only in the following positions: France (2.9 million tonnes t), Greece (1.9 million tonnes) and Romania (1.0 million tonnes).

The value of fruit production in Poland in 2017 amounted to PLN 6,093 million, that is 4.7% of Polish global production (from 2010 an increase of 0.6 percentage point – p.p.) and 5.2% of commodity production (an increase by 2.1 p.p.) [GUS 2018]. In plant production, this share constituted 10.9% of global production (increase by 2 p.p.) and trade 14.8% (2.9 p.p.), respectively.

In Poland, the area of land designated for the cultivation of fruit plants is quite stable and amounts to around 390 thousand ha (however, a downward trend, from 398.6 to 393.3 thousand ha in the period 2014-2018, an increase of 1.3%) [Nosecka 2018]. Fruit tree plantations and nuts dominate (246,500 ha in 2018, 3.9% less than in 2014), especially apple trees (176,000 ha, no surface changes). Among trees, an important position is still taken by cherries (29.5 thousand ha, with a decrease by 8.1%) and plums (14.5 thousand tonnes, a decrease by 12.1%). Plantations of berry plants in 2018 occupied 146.8 thousand ha, or 3.5% more than in 2014.

Despite the reduction of the plantation area, fruit crops generally showed an upward trend (from 4,188.3 to 4,978.0 thousand tonnes in 2014-2018, or 18.9%), which was

<sup>1</sup> Around 700 million tonnes of fruit are produced in the world [Gospodarz .pl 2017].

<sup>2</sup> In the years 2012-2014, the order of fruit producers in the world was as follows: China (23%), India (12%), Brazil (6%), the USA (4%) and Italy (2% of world production) [Bugala et al. 2017, p. 42-43].

mainly due to an increase in the apple harvest (from 3,625.0 to 4,392 thousand t, or 21.2%) [Nosecka 2018]. Also, increased harvest berries (up to 586 thousand tonnes in 2018, an increase of 4% compared to the state in 2014), including strawberries, harvested 195 thousand tonnes, currant 130 thousand tonnes, and raspberries 120 thousand tonnes. The harvest of less popular fruit such as chokeberry (up to 60,000 t, or 38%), or highbush blueberry (up to 20,000 t, an increase of 60% in four years), and “other blueberries” grew faster and faster. During this period harvest doubled (from 4 to 9 thousand tonnes).

Harvested fruit is distributed in various directions, such as direct consumption in households without or after minor processing, home processing by fruit producers or customers buying directly on the farm or marketplace, wholesale to retail stores, sales to food processing plants, collection by producer groups, sales for exporters of fruit and processed raw materials.

Fruit is a raw material for the production of many products and food beverages exclusively produced from them (jams, marmalades, juices, etc.), but also semi-finished products for many industries of food processing, especially confectionery, bakery or alcohol. They are also used in pharmaceutical and cosmetics industries.

A significant part of Polish fruit production is exported. For example, in 2017, 23.7 million tonnes of fresh fruit and 9.9 million tonnes of fruit products were exported. Fruit export, however, is a complex process, requiring many elements that combine it. At the same time, there are huge changes in transport, storage, inventory management, etc. [Kisielewski, Papek 2017].

The cultivation of fruit in Poland is spatially diversified, as the farms from Mazovia, the Lubelskie, Świętokrzyskie and Łódź provinces dominate here [Gołębiewski, Sobczak 2017]. It can be briefly stated that fruit plants are grown more widely in regions located on better soils, located near large urban agglomerations or agri-food processing plants using fruit as a raw material. The labor force is also important, because fruit production, despite ongoing mechanization, is still labor intensive, especially during the harvest period.

The factor complicating the turnover of fruit and their products is the very large fragmentation of producers and the multiple destiny of raw materials: from raw fruit consumption in the country and abroad, through various levels of processing, often at several stages (raw material, semi-finished products, next orders). The efficient functioning of the market for fruit and their preserves therefore requires well-developed but also flexible logistic chains.

## TYPICAL SUPPLY CHAIN IN AGRIBUSINESS

The logistics supply chain covers the subsequent stages of the flow of goods and services from the producer of raw materials to the final consumer. It can have different lengths and depths, so starts with primary raw material manufacturers such as, for example, oil, coal, etc., or a specific chain link. In any case, however, all operations as well as processes must be fully organizationally and financially coordinated.

The condition for consumer satisfaction is to ensure the highest and most desired product quality, hence every entity involved in the production, packaging, storage, transport, distribution and marketing of fresh fruit should do everything correctly in the whole chain:

from farm to customer [Hewett 2003]. The current trend is the transformation towards the optimization of supply chains and streamlining logistic processes to increase customer satisfaction and loyalty, achieve lower costs and a higher market share, as well as achieve high profitability of the company. Nowadays, supply chain management (SCM) is a business process that involves the development of strategic alliances, the optimization of existing and created organizational structures, the development of human capital, a vision of the functioning of corporations, as well as activities for excellence. In the modern economy, including managing supply chains, it is also necessary to improve information technology instruments.

In particular, a lot of attention is devoted to the logistic organization of supply chains in countries dominating the world of fruit production, especially China [Wang et al. 2013]. Many studies focus on the development of simple, but close to an ideal model, supply chains, in which fruit is transported to the market immediately after harvest and simple packaging procedures. Fruit identification across the entire supply chain is becoming widespread, encompassing three systems: coding and identification, management of traceability information and related ancillary equipment.

In a typical logistics chain there are many processes in the field of production management, purchasing, inventory, demand and order fulfillment. It involves obtaining raw materials (e.g. extraction), supplies of raw materials and semi-finished products as well as the production and distribution of finished products. The logistics chain is a network that extends between supply and sales markets, producers, suppliers, commercial and logistic units, and final recipients<sup>3</sup>. It covers the flow of goods, information and financial resources.

The basic principles and organizational forms used in typical logistic chains are also valid in the flows of raw materials and food. An organizational chart that can be considered common for most of agribusiness chains is shown in Figure 1.

## FLOWS OF FRUIT AND FRUIT PROCESSING PRODUCTS

Within the framework of agribusiness there are many logistic chains. The most important ones are: cereal, milk, beef and pork, oilseeds, fruits and vegetables. Raw materials are mainly cereal grains, oil and legume plants, green fodder, roots and tubers of root crops, vegetables and fruits. In some products, agriculture is a producer and a consumer (self-seeding for fodder and for sowing), in others, especially fruit and vegetables, it is mainly a producer (own consumption is minimal).

Fruit can be consumed without processing and is a raw material for further production. The first group includes products obtained in orchards and perennial plantations consumed in a natural form. An important role is played by processed fruit, which is a raw material for the production of juices, compotes, jams, marmalades, etc., as well as for export. The importance of this product means that its movement and processing must take place in the operational links of many networks of connections [Klepacki 2000]. The main processes of the fruit supply chain and their links are presented in Figure 2.

<sup>3</sup> The problem is discussed in more detail in the paper: [Klepacki, Jarzębowski 2000].

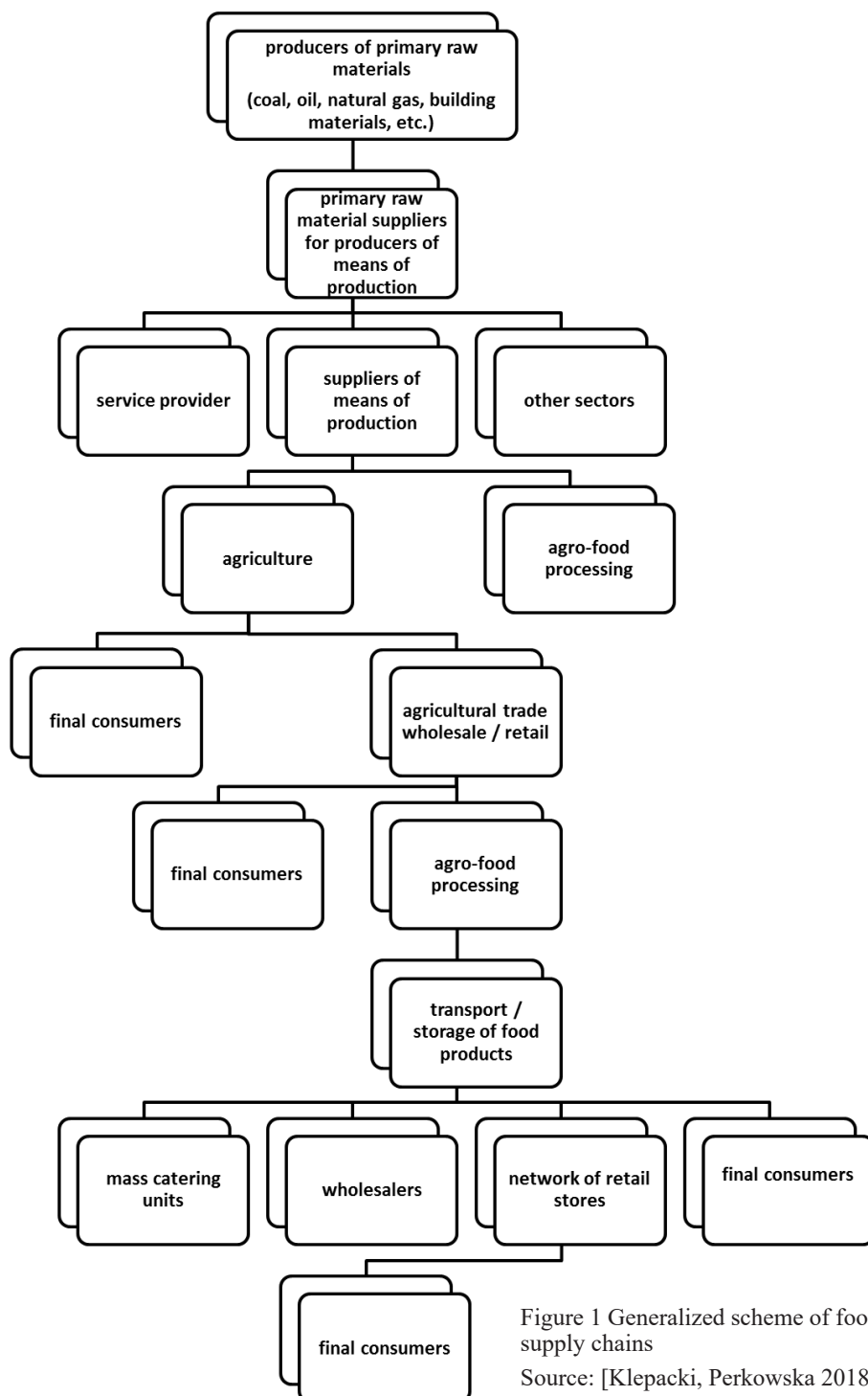


Figure 1 Generalized scheme of food supply chains

Source: [Klepacki, Perkowska 2018]

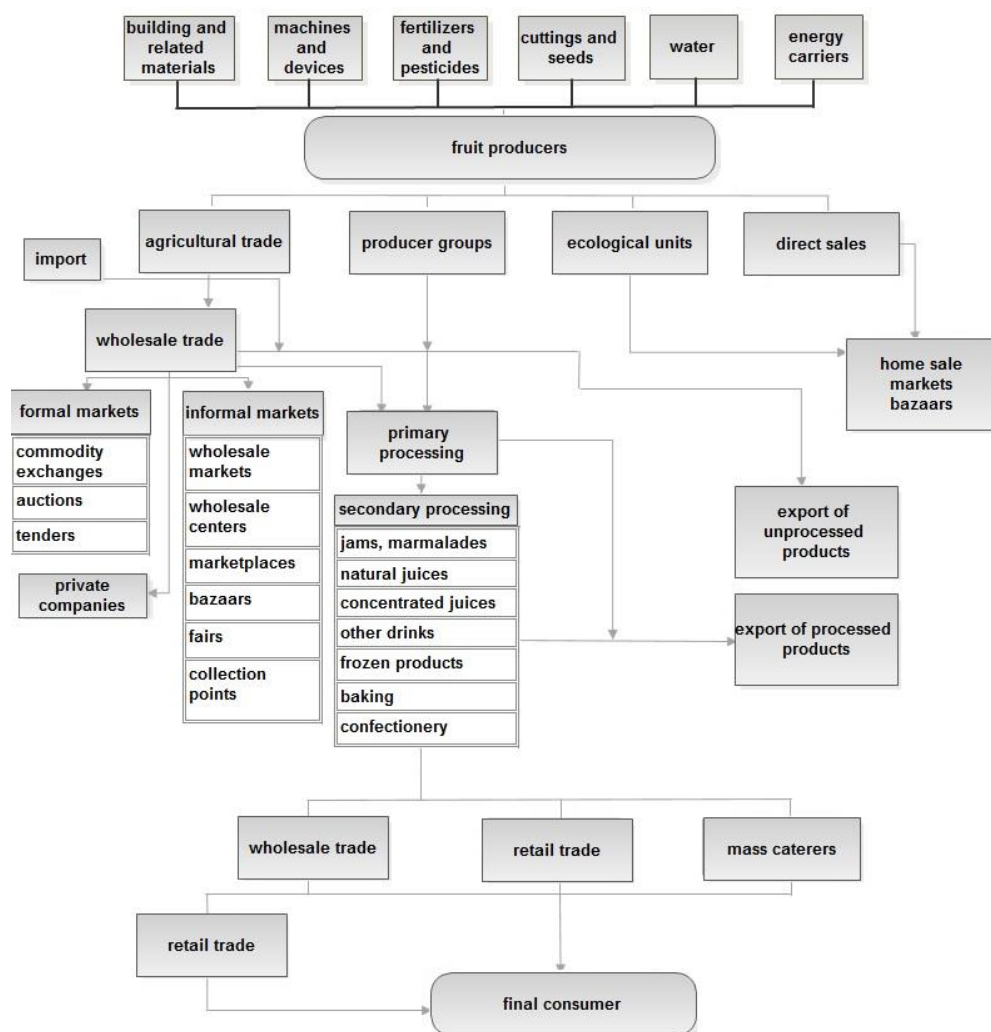


Figure 2. Diagram of the food supply chain of fruits and their preserves

Source: own study

The fruity supply chain begins with producers and suppliers of the means of production<sup>4</sup>, such as: machinery, equipment and tools, building materials, fuel, electricity, mineral fertilizers, pesticides, seed material, etc. The beginnings of agrobusiness supply chains

<sup>4</sup> In the presentation of logistics chains of agricultural raw materials and their preserves, the authors usually omit producers as well as suppliers of means of production for agriculture. This is an erroneous approach, because modern commodity farming, with a large scale of production depends on large quantity, high quality and timeliness of deliveries to a degree comparable to enterprises in other sectors of the economy.

go back to mines, machinery factories, chemical preparations and others. The agricultural and processing sector is a great recipient of industrial production and services.

The flow of fruit for processing takes place through many channels. The simplest relation is: producer – processor, that is an agricultural holding – plants of the fruit and vegetable industry, etc. This kind of connection is already present, but mainly concerns producers of large fruit batches or producer groups. Many farmers produce smaller amounts of fruit and use the services of intermediaries, such as commercial companies and private entities.

## DIRECTIONS OF CHANGES IN THE ORGANIZATION OF SUPPLY CHAINS FOR FRUIT AND THEIR PRESERVES

Intensive inclusion into the global economy has affected the Polish fruit sector in many aspects, both having a productive and structural nature. Several trends can be considered as crucial:

A relatively stable number of fruit producers and an increasing scale of production accompanied a declining number of farms in Poland. It can therefore be concluded that the fruit sector was better prepared than the whole of agriculture for the conditions of international competition.

The role and strength of direct relations between the processing industry and fruit producers has increased, which is reflected, among other things, in imposing production technologies on farmers (especially with regard to varieties produced), the number of intermediate links in the fruit chain decreased.

Producer groups are developed, especially among apple producers; they are used both for joint storage and the trade of fruit, as well as for wholesale purchases of revolving production means. These groups often displace commercial agents, taking over their tasks.

The processes of consolidation and reduction in the number of fruit trade units are followed, and local marketplace trade has been marginalized. Direct, home and roadside sales also play a marginal role in fruit trading. A significant role has been achieved by nationwide and international retail chains, which often determine fruit prices in their region.

The role of small processing units decreased, practically eliminating small fruit and vegetable processing plants for large plants.

Significant progress has been made in Poland in the field of transport infrastructure, especially warehouse infrastructure, which means that logistics costs related to fruit and losses in individual terms are decreasing. Food trade and storage is a very important part of logistics companies.

There is interest in traditional varieties of fruit plants, especially apple trees, but its scale is small, with no effect on significant commodity turnover, which is related to the creation of separate supply chains.



## CONCLUSIONS

1. The fruit sector is one of the most important in Polish agribusiness, and its functioning is an important factor determining the economic situation of many economic entities in agriculture and elsewhere.
2. The logistics chain for the supply of fruit and their preserves is very extensive, it includes thousands of fruit and growers, agri-food processing units, agricultural trade, wholesale and retail food trade. It must be flexible, adapt to new challenges related to the technological and organizational progress and changes taking place in the agribusiness environment and among clients.
3. In conditions of dispersed fruit production, the success of producers, processors and traders is determined by the efficiency of chain management combined with solidarity and mutual trust of all participants in the flow of goods, information and financial resources.

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## ORGANIZACJA ŁAŃCUCHÓW DOSTAW W SEKTORZE OWOCÓW W POLSCE

Słowa kluczowe: logistyka, rolnictwo, przemysł owocowy, przetwory owocowe

## ABSTRAKT

Celem badań było rozpoznanie łańcuchów dostaw stosowanych w obrocie owocami i ich przetworami, jak również tendencji zmian w tym sektorze. Przedmiotem badań była produkcja owoców na świecie i w Polsce. Zaprezentowano schemat łańcucha dostaw w agrobiznesie. Zastosowano również metodę graficznej prezentacji przepływu surowców oraz przetworów owocowych od producentów surowców i środków produkcji dla rolnictwa do finalnego konsumenta. Przedstawiono tendencje zmian w produkcji owoców i ich przetworów. W badaniach wykorzystano literaturę przedmiotu, dostępne dane statystyki masowej oraz dane przygotowywane przez Instytut Ekonomiki, Rolnictwa i Gospodarki Żywnościowej – Państwowy Instytut Badawczy. Na podstawie badań stwierdzono, że owocowy łańcuch logistyczny obejmuje tysiące rolników, wiele jednostek przetwórstwa rolno-spożywczego, hurtowego i detalicznego handlu żywnością. Musi on być bardzo elastyczny, stale dostosowujący się do wyzwań zmiennego i globalizującego się rynku. W warunkach rozproszonej produkcji owoców o sukcesie decyduje sprawność zarządzania łańcuchami, w połączeniu z solidarnością oraz wzajemnym zaufaniem do siebie wszystkich uczestników przepływu towarów, informacji i środków finansowych.

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