KAROL WAJSZCZUK

AN INVENTORY ANALYSIS IN THE VAST AREA AGRICULTURAL ENTERPRISES IN LOGISTICS ASPECT

From Department of Food Management Economics
of The August Cieszkowski Agricultural University of Poznań

ABSTRACT. The carried analysis out allowed to identify the logistics processes related to creation and maintenance of stockpile in the vast area agricultural enterprises. Besides, the level and structure of logistics costs generated in this sphere of activity of the enterprise were defined, too.

Key words: logistics, inventory processes, agricultural enterprises, logistics costs

Introduction

One of integral elements of the production process is the inventory creation issue. Traditionally, creation and maintenance of inventory was justified because of several circumstances (**Przybyłowski** et **al.** 1998):

– as a buffer of changing supply and demand, often caused by uncertainty in demand forecast,

– delivery of better services to certain customers, who wanted to receive them on every demand,

– promotion of efficiency production,

– protection against price rising by delivery,

– promotion of discount at purchase and transport of large batches,

– protection against unpredictable events (natural disasters, strikes).

Realization of the above-mentioned activities requires spending certain funds. In high developed countries the research showed, that index of share of inventory costs in total logistics costs was from 30 to 40% (**Skowronek** and **Sarjusz-Wolski** 1999). How high the costs are can be shown by their share in the inventory value, which level is around 25% (**Christopher** 2000).

In agricultural production, such features as: structure and length of production process – seasonality, diversity of inventory materials, organization of production process, natural and economic risk, also high quality for agricultural products, stress the impor-

tance of inventory processes in agricultural enterprises (**Wajszczuk** 1994, **Wielicki** 1983, **Wolszczan** 1988). At the same time must be underlined that majority of managers do not realize the real level of inventory costs, because some of the costs are of hidden nature.

Taking into account the above-mentioned considerations, the logistics analysis of inventory processes of chosen agricultural products, in particular the logistics cost analysis was the aim of the research.

Material and methods

The research was conducted in a vast area agricultural enterprise of approximately 3495 ha. Taking into account the organizational structure aspect this enterprise consists of six separate but strongly connected units-farms with typical agricultural production. Besides, the enterprise deals with production of mixed concentrated feed and grain spirit based on its own raw materials. Taking into account the structure of the production and inventory infrastructure involved in the production process, the storage of cereals, rape and maize were the subjects of the analysis.

Generally, based on various references, the essence and range of inventory costs of logistics include: costs of inventory creation, costs of inventory maintenance and costs of running low of stocks (**Skowronek** and **Sarjusz-Wolski** 1999, **Ficoń** 2001, **Twaróg** 2003).

Taking into account a kind of enterprise, its specificity, every time we should make an identification and properly locate particular kinds of costs. In case of the investigated enterprise, following kinds of inventory costs of logistics were identified:

   I – costs of capital (C_c),
  II – costs of storage (C_s),
 III – costs of risk (C_r).

It is said often that cost of capital (C_c) is called cost of interest or cost of lost profits. This kind of cost shows us how much capital is frozen in the stocks. This cost expresses alternative profits which an enterprise could get if they have been invested to other than stockpiles economic manner.

Costs of storage (C_s) present an important component of costs of inventory maintenance. They are strongly connected with warehouse functions. They include costs of internal transport in a warehouse and costs of store such as: rent, heating, lighting and other costs of extra activities connected with storage of particular product (maintenance, cleaning, labelling). Besides, costs of storage include costs of information and decision processes which are generated in widely understood process of storage, i.e. from phase of creation inventory, through storage of inventory production until creation of distribution stocks. The range of costs storage depends on the specificity of the investigated enterprise. So, within this analysis it has taken the following costs:

   – drying costs,
   – cleaning and refreshing costs,
   – prevention costs,
   – pay costs,
   – costs of internal transport and other works,

– costs of depreciation,
– costs of warehouse leasing,
– costs of information and decision processes.

Costs of risk (C_r) connected with inventory process can reflect possibility of depreciation stock value because of factors lying outside the enterprise control – macro-economics sphere. It sometimes happens that stored goods can become stale morally. Very similar situation takes place in the case of fresh products where change of physical-chemical features causes decrease of their value. Within the costs of risk related to stock process can be also distinguished costs which are connected with damage or theft. The lost profits of ended stocks must be taken into consideration (**Coyle** et **al.** 2002, **Lambert** and **Stock** 1993).

Mainly, costs of risk were connected with going stale of products and small theft in the investigated enterprise. Based on the analysis of stock control, it has been noticed that index of natural lost masses during the inventory processes was running about 0.5% for products stored in flat warehouses and 0.2% for products stored in silo-towers.

Results

Based on the analysis of the inventory processes such products as cereals, rape and corn maize, it was noticed that in the investigated enterprise it was over 12 thous. t stored every year. Because of this, the index of stored products was about 3.71 t per 1 ha of arable land. However, the index of the capacity of cereal warehouses (both flat and silo-towers) was around 2.24 m^3 per 1 ha of arable land. The structure of the stored products was shown in Figure 1.
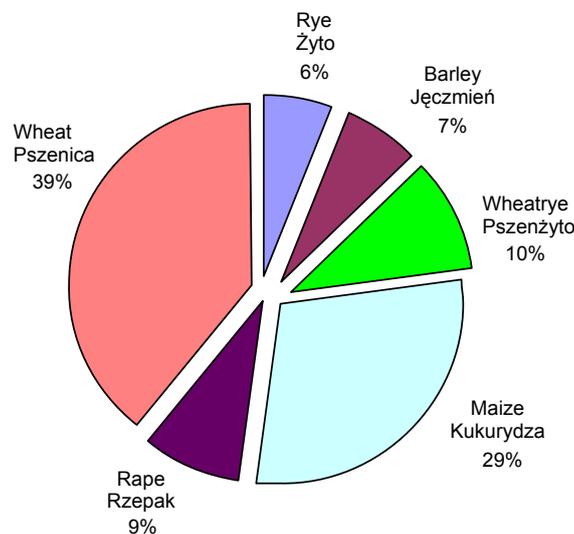

Fig. 1. The structure of stored grain
Ryc. 1. Struktura magazynowanego ziarna

A huge mass of grain must be received by warehouses in short time between July and October. The warehouses are used most intensively within this period. Seasonal of inventory process of chosen products is shown in Figure 2.
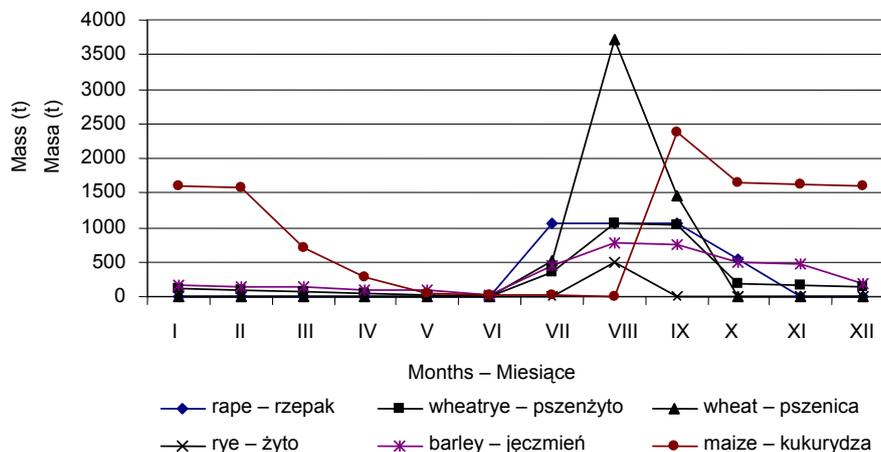

Fig. 2. Seasonality of inventory process of chosen products
Ryc. 2. Sezonowość procesu magazynowania wybranych produktów

During the inventory process of grain loss of grain mass takes place. There are some reasons of the loss occurrence which can be identified in the investigated enterprise:
   – change of physical and chemical features,
   – physical damages (caused by insects and diseases),
   – thefts and others.

The length of inventory period is an undoubted factor which influences the above--mentioned phenomenon of escalation. During the storage of cereals grain we should pay attention to humidity and temperature of raw materials. They are main factors influencing on the quality of stored grain. The humidity of storage grain should not exceed 14%. Increasing humidity of grain causes fast growth of temperature, enhanced bio-chemical conversions, development of fungus, yeast and boost of vital activity of insects, e.g. granary weevil. According to international data concerning loss of mass related with unsuitable storage of cereal grain can exceed even 30% (**Zawiślak** 1996). Mostly, it results from ignorance of principles of grain storage, unsuitable technological procedure and application of inappropriate methods of preservation. In the investigated enterprise the loss of cereal grain mass was 1.5%. That shows very well stock policy and proper application of grain storage principles in the enterprise. Figure 3 shows percentage loss of stored products.

Based on carried out analysis, the following elements of technological processes during the storage were identified and were shown in Figure 4. It can be noticed, that the occurrence of particular elements of the storage process depended on: degree of product humidity, impurities and the length of storage period.

Based on the carried out logistics costs analysis for whole enterprise two kinds of indexes describing the level of logistics costs were established. First, the share of logistics costs in relation to selling and services value – this index amounted to 29.72%.
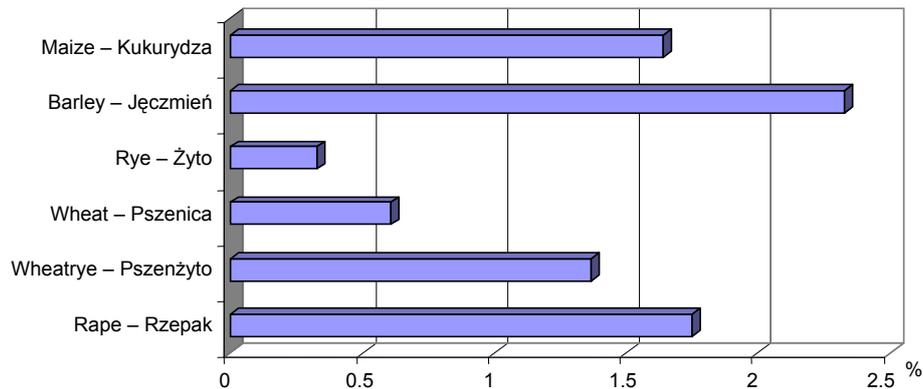
Fig. 3. Loss of mass of analysed products
Ryc. 3. Ubytek masy analizowanych produktów

The other one, shows the share of logistics costs in total costs of enterprise activity, was about 44.35% whereas around 37% is connected with costs of physical flow of material, around 7% was connected with inventory costs and merely 0.35% was connected with costs of information processes. The inventory logistics costs were particularly analysed in the investigated enterprise. The structure of this kind of logistics costs is as follows:
  – costs of capital – 28.34%,
  – costs of storage – 57.50%,
  – costs of risk – 14.16%.
  Within the particular stored products some diversification in the above mentioned logistics cost structure was noticed. The results are shown in the Figure 5.
  The highest share of cost capital in total logistics costs was noticed in the case of the products which were stored for the longest period: barley (44.9%), wheatrye (44.3%) and maize (30.5%). Similar dependences occurred in case of risk costs, which share was adequately 22.3%, 20.5% and 15.6%. The time factor was the main factor which determined the level of these kinds of costs. When we consider the costs of storage, such products as: rape (76.3%), wheat (68.2%) and (68.7%) were characterized by the highest share in total logistics costs. The costs of drying (rape and maize) and costs of labour (wheat and rye) dominated in this kind of costs.
  Besides, based on the carried out analysis of inventory logistics costs, some indexes of chosen products describing the level of costs per 1 t of stored product were established (Fig. 6). Based on results, three levels of the index can be distinguished. The highest level of this kind of cost was connected with maize (above 130 PLN/t). The second level was 80-90 PLN/t and was connected with products like rape, wheatrye and barley. The lowest level of the index (30-35 PLN/t) was connected with wheat and rye. The detailed analysis of the index made it possible to establish its level for all kinds of inventory logistics costs. In the kind of storage costs the highest level of the index was connected with rape and maize (adequately 68.6 and 70.2 PLN/t). Such a high level of the index for the products was the results of necessity of drying grain for proper inventory process (adequately 42.8 and 39.1 PLN/t). In the case of capital cost, the highest level of the index was connected with maize (about 40 PLN/t), wheatrye and barley (around 35 PLN/t). The main reasons of such a level were on the one hand the long period
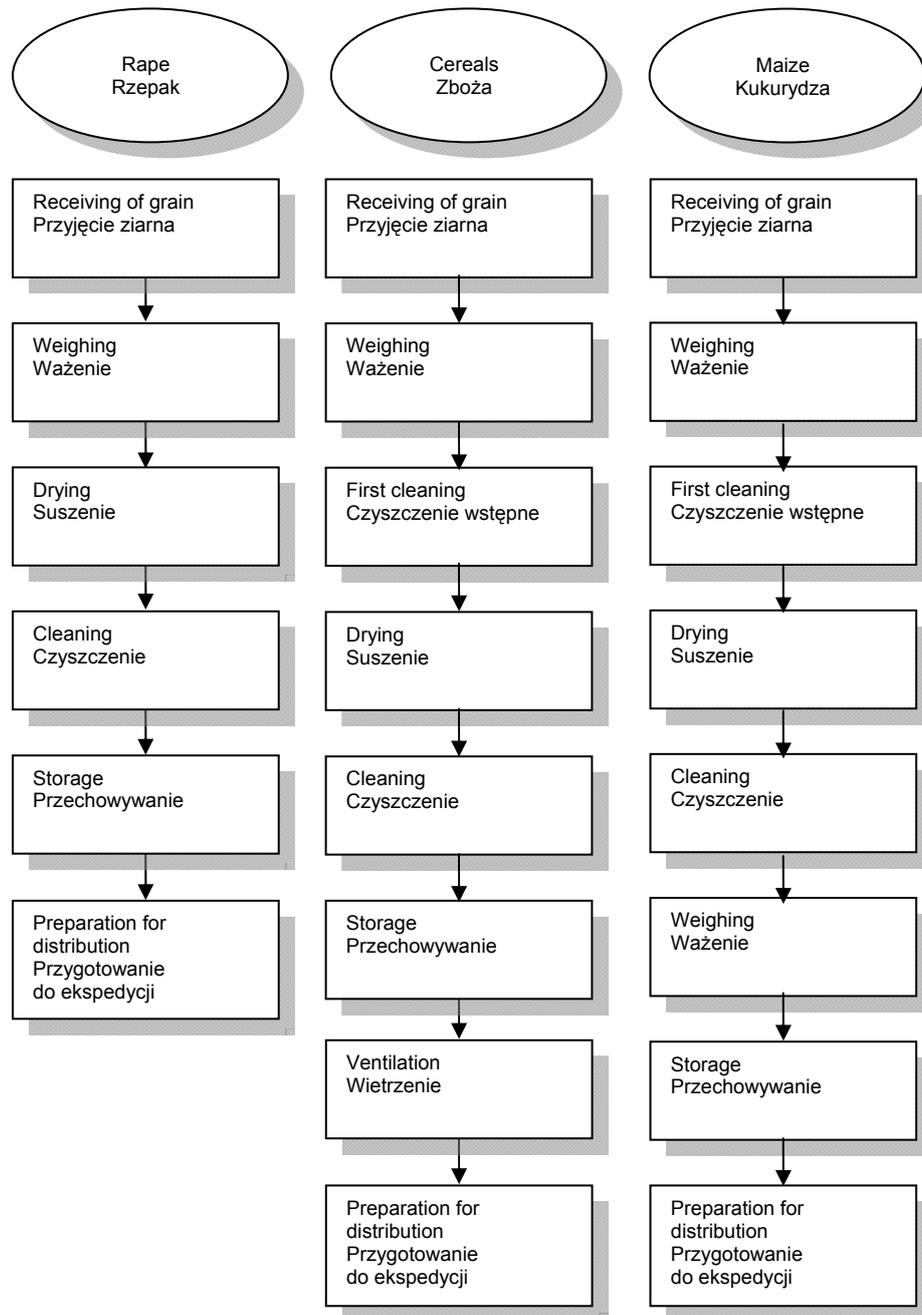
Fig. 4. Technological processes of storage of chosen products
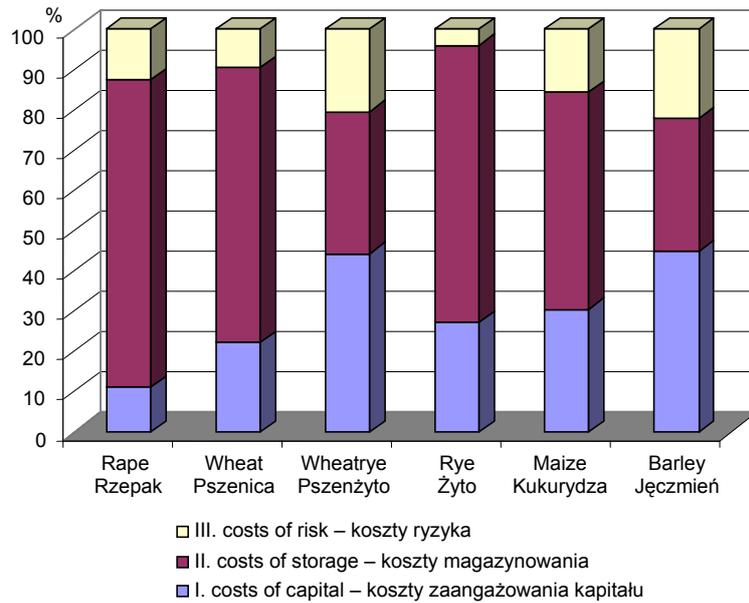Ryc. 4. Procesy technologiczne magazynowania wybranych produktów

Fig. 5. The structure of logistics costs of inventory of chosen products
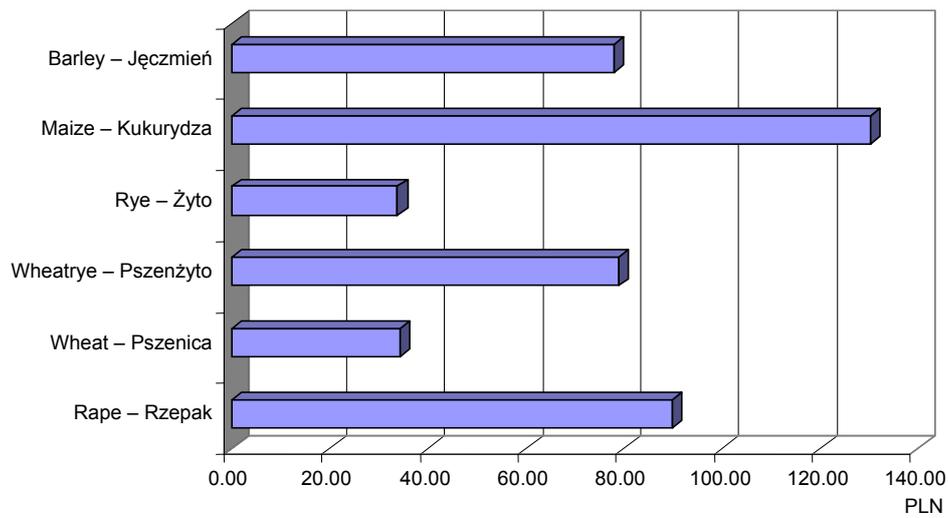Ryc. 5. Struktura kosztów logistyki zapasów wybranych produktów

Fig. 6. Logistics costs of inventory per 1 t of chosen products
Ryc. 6. Koszt logistyki zapasów 1 t wybranych produktów

of store and on the other the value of each stored product. Similar dependencies occurred in the case of risk cost analysis. Among the analysed products, the highest level of the cost index was connected with maize – 20.3 PLN/t, barley – 17.4 PLN/t and wheatrye – 16.2 PLN/t.

In the enterprise the storage costs dominated (near 60%) in the group of inventory cost of logistics. As shown in Figure 7, the structure of this kind of cost is differentiated very much. In the case of such products as rape and maize, drying costs are the main part of the storage costs (adequately 62.2% and 55.7%). A high degree of product humidity is the main factor creating such high share of this kind of logistics costs. For other products (rye, wheat, wheatrye), characterized by a middle degree humidity, this index was from 10 to 15%. There was one exception in the case of barley grain, where drying costs did not appear because of optimal grain humidity. The pay costs are the second main kind of cost in the analysed cost group. For some products, which required longer period of storing and various kinds of extra works (e.g. refreshing, internal transport, prevention and other works in the warehouses), the share of these costs is significant (from 40 to 50%).

costs of leasing – koszty dzierżawy
costs of depreciation – koszty amortyzacji
costs of information processes – koszty procesów informacyjnych
costs of prevention – koszty profilaktyki
costs of cleaning and refreshing of grain – koszty czyszczenia wraz z odświeżaniem ziarna
costs of internal transport and other works – koszty transportu wewnętrznego i manipulacji
pay costs – koszty wynagrodzeń
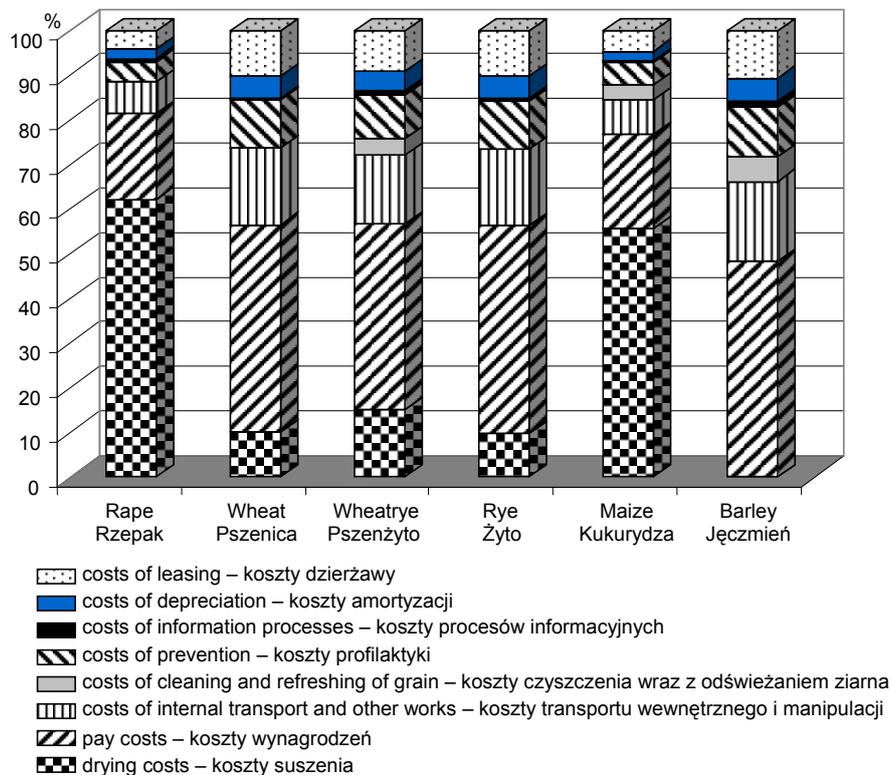drying costs – koszty suszenia

Fig. 7. The structure of storage costs of chosen products
Ryc. 7. Struktura kosztów magazynowania wybranych produktów

The carried analysis allowed to identify logistics processes related with creation and maintenance of stockpile in the vast area agricultural enterprises. Besides, a the level and structure of logistics costs generated in this sphere of activity of the enterprise were established, too. In spite of significant investment on modern warehouses in the analysed enterprise, occurrence of warehouses which did not meet the requirements of proper storage of products, was noticed. Besides of this, some warehouses have not

been used fully, but constant cost related with maintenance of the property should be pay permanently. Taking into account the above-mentioned, particularly a high share of logistics costs in agricultural enterprises in general, legitimacy of creation and putting into practice a proper permanent system of monitoring of such a kind of costs including inventory costs, is a necessity.

Conclusions

1. Carried analysis of inventory processes in the researched agricultural enterprise confirmed, that ownership of modern store infrastructure allows its competitiveness on the market increase.

2. Logistics costs of inventory are characterised by strong seasonal trend as a result of the specificity of plant production. The highest level of these costs occurs in months: July, September and October.

3. In the analysed enterprise the share of logistics costs in total costs of production is high – about 44.35%. However, the share of inventory costs in the total logistics costs is 15.8%.

4. Costs of storage are dominated in the inventory costs – 60%, whereas the capital costs are near 26% and costs of risk – 14%.

5. The drying costs dominated in the storage costs, and average share of these costs was 20%, in some cases – 60%. The second large group of cost was pay cost with the share 18.5%.

6. A comparative analysis of chosen products in the aspect of logistics inventory costs showed that the highest level of these costs was connected with storing of maize grain – 130 PLN/t. It depended on some factors such: the quantity of stored mass, the humidity of grain and the length of storing period.

Literature

Christopher M. (2000): Logistyka i zarządzanie łańcuchem dostaw. Polskie Centrum Doradztwa Logistycznego.

Coyle J., Bardi E., Langley C. Jr. (2002): Zarządzanie logistyczne. PWE, Warszawa.

Ficoń K. (2001): Procesy logistyczne w przedsiębiorstwie. Impuls Plus Consulting, Gdynia.

Lambert M.D., Stock J.R. (1993): Strategic logistic management. Irwin, Boston.

Przybyłowski K., Hartley S.W., Kerin R.A., Rudelius W. (1998): Marketing. Dom Wyd. ABC, Warszawa.

Skowronek C., Sarjusz-Wolski Z. (1999): Logistyka w przedsiębiorstwie. PWE, Warszawa.

Twaróg J. (2003): Koszty logistyki przedsiębiorstw. Instytut Logistyki i Magazynowania, Poznań.

Wajszczuk K. (1994): Transportochłonność produkcji roślinnej w wielkopolskich gospodarstwach indywidualnych. Probl. Inż. Roln. 1: 73-79.

Wielicki W. (1983): Transportochłonność produkcji rolniczej. Rocz. Nauk Roln. Ser. C 76, 1: 111-125.

Wolszczan J. (1988): Transportochłonność rolnictwa. Zesz. Probl. Post. Nauk Roln. 348: 35-41.

Zawiślak K. (1996): Magazynowanie nowych zasobów zbóż paszowych. Pasze Przem. 7/8: 17.

ANALIZA PROCESÓW MAGAZYNOWANIA
W WIELKOOBSZAROWYCH PRZEDSIĘBIORSTWACH ROLNICZYCH

S t r e s z c z e n i e

W pracy zidentyfikowano procesy logistyczne związane z tworzeniem i utrzymaniem zapasów w wielkoobszarowych przedsiębiorstwach rolniczych. Poza tym przeanalizowano wielkość i strukturę kosztów logistycznych w tego rodzaju przedsiębiorstwach. Zidentyfikowano trzy główne grupy kosztów logistycznych w sferze gospodarki zapasami. Dominującymi kosztami okazały się koszty magazynowania (60%), w następnej kolejności znalazły się koszty zaangażowanego kapitału (około 26%), a koszty ryzyka wyniosły 14% ogółu kosztów zapasów.