ACTA SCIENTIARUM POLONORUM *Oeconomia 12 (3) 2013, 17–28*

ORGANIZATION STRUCTURE IN RELATION TO THE SYSTEM OF INTEGRATED PRODUCTION IN FARMS

Maria Golinowska, Michał Kruszyński
University of Life Sciences in Wrocław

Abstract. The aim of the work is to present relation between the structure of farm organization, determined according to the economic system and the system of integrated production in a large-scale farm 2004–2011. The material for investigation originated from farm accounting data and from the charts of fields history. It was worked out with the use of vertical and horizontal analysis, as well as synthetic analysis 1st degree by B. Kopeć. Many-year-lasting analysis proved that the farm maintained animal breeding – plant production, namely rape – bee, highly intensive system, which is friendly to the environment. The rules of integrated production have been followed by that farm for more than 10 years and they involve: combination of pesticide treatments with mineral fertilization, appropriate crop rotation, which improves soil richness, application of liming and organic fertilization on the area of more than 25% of arable land. The economic system allows to apply integrated production.

Key words: organization structure, slant of the farm economy, directions of production, integrated production, intensity of organization

INTRODUCTION

Farm management system is most often defined as the management of agricultural production area regarding plant and animal production, as well as processing of their products, evaluated by ecological and economic criteria. Three systems of management can be distinguished in modern farming:
– conventional (intensive, industrial, classical, industrialized etc.),
– ecological (biological, organic, alternative, biological-organic, naturalized etc.),
– integrated (harmonized, sustainable, ecological-economic etc.).

The basis for distinguishing the systems mentioned above is the degree to which agriculture relies on industrial means of production, mainly mineral fertilizers and pesticides,

Corresponding authors: Institute of Economics and Social Sciences, University of Life Sciences in Wrocław, Pl. Grunwaldzki 24 A, 50-363 Wrocław, Poland, e-mail: maria.golinowska@up.wroc.pl, michal.kruszynski@up.wroc.pl

as well as its influence on the natural environment. Commonly accepted definitions of farming systems are as follows:

– conventional farming – management system timing at making maximum profit, obtained due to high efficiency of plant and animal production; that efficiency is achieved bin specialized farms, applying technologies of production based on considerable consumption of industrial means of production and very amount of labour;
– organic farming – management system which ensures permanent soil fertility, animals' health and high biological quality of farm products due to activation of natural mechanisms of production, which favour the use of natural, not technologically processed means;
– integrated farming – management system which enables achievement economic and ecological goals through purposeful application of modern technologies of production, systematic improvement in production techniques and implementation of different forms of the advancement in biological sciences to facilitate realization of its aims [Kuś 1995, Zimny 2007].

In economics of agriculture organization structure is defined with the use of management system which is a synthetic measure of farm organization. According to Kopeć [1968], organization structure involves sowing structure and livestock population, while organization structure involves the structure of sown area and land use, as well as the structure of the structure and population of livestock, while structure determinant is the management system, consisting of:

– slant, which means priority (dominance) of sectors, i.e. plant or animal production;
– direction of organization (production), which determines the dominance of production branch, within the frames of particular sector (cereals, root crop, forage crops and others – in plant production and cattle, swine, sheep and others – in animal production). To determine the position of a branch within the frames of a sector, B. Kopeć proposed the system of boundary indicators. Thus, cereals branch takes place when the share of cereals in sowing structure exceeds 66%, root crop – 25% and forage crop – 35% of arable land (sown areas and green areas). In animal production, the cattle branch requires exceeding 66% of livestock population in large units (SD), swine – 20% SD, sheep – 10% SD, and summary population should not be lower than 50 SD per 100 ha of arable land (AL);
– intensity of organization, while level is determined on the basis of appropriate coefficients, which cover amounts of labour and materials which are indispensible in the process of production.

B. Kopeć [1968] accepted, after Ernste Laure, as a basic unit the level of 1 ha cereals cultivation layout and determined its multiple for 1 ha of other crops, as well as for 1 SD of animals. Those coefficients were modified in the subsequent years, yet the rules have not been changed. Later, there was developed the formula for calculation of intensity of farm organization (I_g):

$$I_g = I_r + I_z \tag{1}$$

while:

$$I_r = \sum_{p=1}^{m} p \cdot s \quad \text{and} \quad I_z = \sum_{q=1}^{n} q \cdot t \tag{2}$$

where: I_r – intensity of plant production;
p – percentage of particular plants (groups of plants sown on cultivated areas – CA, or on arable land – AL);
s – cultivation intensity index;
I_z – intensity of animal production;
q – SD number of particular animal species per 100 ha AL (ground cultivation);
t – animal production intensity index.

Intensity level was determined in point ranges [Kopeć 1983]:
- extensive: 0–200,
- low intensive: 201–250,
- medium intensive: 251–300,
- medium high: 301–350,
- higher intensive 1: 351–400,
- higher intensive 2: 401–450,
- very high intensive 1: 451–500,
- very high intensive 2: 501–550,
- special high intensive: over 550.

Integrated production (IP) is the management system in which the producer carries out plant production with the use of sustainable technological and biological progress in cultivation, plant protection and fertilization, paying a special attention to protection of natural environment and people's health. Integrated production allows to obtain farm products of the highest biological and nutritive quality, safe to human health. In Poland, IP was introduced on the basis of law (principle) involving plant protection passed in 2003[1] and guidelines of detailed methodology of integrated production drew up for particular plants by Main Inspectorate of Plant Health and Seed Inspection[2].

Appropriately conducted plant cultivation, according to the principles of Good Practice in Plant Protection, constitutes the base for obtaining high yields of good quality, safe for the consumers. The basis to take the decision about plant protection in field cultivation should be the rules of integrated protection, i.e. the conception regarding plant protection which was developed at the end of 1950s [Stern, Smith and Van den Bosch 1959], and since 1976 this conception has been accepted as an official direction of research [Olszak et al. 2000].

Integrated plant protection (IPM) consists in purposeful application of combined biological, biotechnological, chemical, physical, cultivation and breeding methods in which the use of chemical plant protection is reduced to indispensable minimum and only applied to prevent excessive pest infestation, resulting in economic failure.

[1] Plant Protection Act from 18th December 2003 (Journal of Laws from 2008 No 133, Item 849).
[2] Web page of Państwowa Inspekcja Ochrony Roślin i Nasiennictwa – PIORiN http://piorin.gov.pl/index.php?pid=1477 (Last modification 25.04.2013).

The conception of integrated plant protection (IPM) has become the basis for elaboration of the assumptions and popularization of integrated production (IP) food crops and garden plants [Boller et al. 2004, Pruszyński, Zych and Nawrot 2004]. The principles of integrated plant protection are described in the Annex to III Directive 2009/128/WE[3]. There are 8 principles of plant protection [Golinowska 2012]. The basis for good elaboration of IPM program is gaining significant information, which are to be used in decisive process of production. The order of gaining information is as follows:

– identification of a plant pest,
– determination of its population,
– evaluation of damages and losses (economic approach),
– review of accessible methods of plant protection
– determination of the possibility of interaction: plant pests – other pests – useful organisms,
– analysis of local environmental and social-legal restrictions as well as assessment of interaction with other treatments,
– taking decision.

IPM conception has become the main direction of Food and Agriculture Organization (FAO) and World Health Organization (WHO) activity. Integration of methods is realized on different levels: pest – field – system of production. The most difficult to achieve is level three (system of production), since it deals with the relation between a pest and its control in different systems of cultivation.

The aim of the article was determination of the relation between farm organization structure and the system of integrated production.

MATERIAL AND METHODS

The material for examination was purposefully selected large-scale farm in Wielkopolskie Voivodeship. The farm has been run for about 15 years and it has introduced integrated production. The source material comes from farm accounting data and from the charts of fields history from 2004–2011. It has been elaborated with the use of the following methods:

– synthetic analysis 1st degree by Kopeć [1983],
– vertical and comparative analysis by Urban [1981] and descriptive method.

RESULTS

The examined farm is located in Wielkopolskie Voivodeship, in Gostyń County. The farm is Ltd company. In 2007 and 2011 the farm area was diminished to amount in the last year 1,518.6 ha (Table 1). Valuation ratio of agricultural production area (WWRPP)

[3] Directive of the European Parlament and of the Council of the 21st October 2009 establishing a framework for Community action to archieve the sustainable use of pesticides (Official Journal of the EU L 309/71).

for the region the farm is located in, according to Witek [1984], ranged 85.7 points, out of which 64.8 points refer to the soil quality and the remaining 20.9 points are connected with agro-climatic conditions. The farm employs from 1.8 to 2 persons per 100 ha AL. In 2006–2007 the grounds owned by the company accounted for 15.8% of total farm area, while in 2008–2009 the share of tenant farming decreased to 68.4% and in the subsequent years owned grounds ranged 56.8%. The organization structure of the company, determined according to Kopeć [1983], is shown in Table 3. In 2006 and 2007 the farm featured a plant slant and in the subsequent years the numbers of livestock increased to 52 SD per 100 ha AL and then the slant of the farm was changed to animal breeding – plant production. In plant production the main organization direction, in 2004–2012 was rape and white beets. In the structure of area under crop, cereals provided from 44.4 to 56.9% of arable land, rape share ranged from 25.3 to 38.2% and white beets occupied about 10% (Table 2).

Organization intensity, measured in points [Kopeć 1983], increased from 227.1 to 316.8 points. The examined farm changed its management system from crop rape – beet A, into breeding – crop rape – beet B1 (Table 3).

Table 1. Structure of land use in 2004–2011

Specification	2004	2005	2006	2007	2008	2009	2010	2011
Area GO [ha]	2381.4	2381,4	2381.4	1827.8	1827.8	1827.8	1827.8	1381.5
TUZ [ha]	105.5	105.5	105.5	105.5	100.7	100.7	100.7	100.6
including:								
– meadows	80.7	80.7	80.7	78.5	78.5	78.5	78.5	46.5
– pastures	24.8	24.8	24.8	22.2	22.2	22.2	22.1	18.0
Orchards [ha]	1.9	1.9	1.9	0.8	0.8	0.8	0.8	0.0
Total AL [ha]	2492.4	2492.4	2492.4	1929.3	1929.3	1929.3	1929.2	1446.0
Other land use [ha]	81.0	81.0	81.0	86.9	63.9	86.9	86.6	72.6
Total area [ha]	2573.4	2573.4	2573.4	2016.2	2016,2	2016.2	2015.8	1518.6
Share of tenant farming [%]	84.2	84.2	84.2	84.2	68.4	68.4	43.2	43.2

Source: Own research.

Table 2. Structure of area under crop in 2004–2011

Specification	2004	2005	2006	2007	2008	2009	2010	2011
Cereals [%]								
including:	50.7	51.1	52.7	56.9	56.9	51.7	50.6	44.7
– wheat	49.0	48.0	48.4	46.6	46.6	49.9	49.6	43.4
– maize	1.7	2.5	4.4	9.2	9.2	–	–	–
Rape [%]	27.1	20.6	25.3	28.6	28.6	26.9	32.0	38.2
White beet [%]	10.2	11.8	9.7	9.9	9.9	9.0	12.1	7.0
Fodder plants [ha]	10.0	8.2	11.1	4.6	4.6	12.4	5.3	6.9
Other [ha]	2.1	2.3	1.1	–	–	–	–	2.5
Total [ha]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Elaboration by the author.

Table 3. Organization structure in 2004–2011

Specification	2004	2005	2006	2007	2008	2009	2010	2011
Slant of the farm management	H-R	R-H	R	R	H-R	H-R	H-R	H-R
Direction of organization of plant production	rape-beet	rape-beet	rape-beet	rape-beet	rape-beet	rape -beet	rape-beet	rape
Livestock population [SD · 100 ha^{-1}]	52.5	45.8	34.0	34.3	57.0	52.0	52.0	52.0
Intensity of plant production [points]	168.0	167.4	15.9	164.7	165.7	161.0	177.0	178.8
Intensity of animal production [points]	120	88.4	89.2	62.4	151.0	138.0	138.0	138.0
Management system	H-R rape – beet B1	R-H rape – beet B1	R rape – beet A	R rape – beet A R	H-R rape – beet B1	H-R rape – beet B1	H-R rape – beet B1	H-R rape – beet B1

Source: Elaboration by the author.

The structure of area under crop in the analyzed farm has been maintained for many years as shown in Table 2. The trait of this structure is 50% share of cereals and high share of rape, ranging from 25.3 to 38.2% of arable land, as well as cultivation of fodder plants (mainly *Papilionaceae*). Such a structure of the area under crop ensures relatively proper crop rotation. Cultivation technology applied in the farm contains the elements of integrated production (Figs 1, 2 and 3), which consist in combination of pesticide treatments with fertilization and introduction of fertilization alone. A special attention should be paid to liming and organic fertilization with poultry dung. Nitrogen fertilizer and microelements fertilizer are applied as foliars with the use of Tecoma laser 5000 sprayer. In 2012 the cultivated plants in the farm were treated with the following amount of kg of NPK per ha and kg of SA (sactive substance) of pesticides: wheat: NPK – 95 – 76.5 – 65.7, SA – 2.28; rape: NPK – 257 – 76.5 – 135.7, SA – 2.46; white beet: NPK – 260 – 140 – 365, SA – 6.57.

Fifteen years ago the farm introduced the system of zero-tillage, using modern cultivation technology. The obtained financial result, measured by profit in 2004–2011, ranged from 694.1 to 4,122.2 zł per ha (Table 4). The profit made by the farm was the result of application of integrated production, high fields and efficiency of animal production. The share of production means directly connected with increased yielding in the years subjected to analysis was shown in Table 4. The basis of fertilization planning in the farm was the assessment of soil richness in nutrients, as well as soil reaction. Sustainable fertilization of plants, combining the use of mineral and organic fertilizers, ensures the best production output and it does not become the threat to the environment. The farm obtains much higher yields than average values for the country; in 2012 the yield of wheat

amounted 53 dt per ha, maize for grain – 120, peas – 30, rape – 26 and white beet – 960. Milk efficiency per one cow in that year ranged 9,560 l.

The prices obtained from agricultural products in 2006–2012 were considerably higher than average prices for Poland, published by Central Statistical Office, which proves high quality of the products and large, as well as homogenous type of goods. The farm has free choice in the most advantageous transactions involving the sale of farm crops. Appropriate crop rotation, plant fertilization and plant protection ensures advantageous yield size and profit. The farm cares about soil richness applying organic fertilizers such as manure and poultry dung. Manure is used for cultivation of white beet in the dose of 30 t per ha and poultry dung, in the dose of 9 t per ha, is applied on the remaining area under cultivation of white beet and maize. Poultry dung is used in the farm for cultivation of rape, in the dose of 9 t per ha and winter wheat, in the same dose. In 2006, the area of about 1,400 ha was fertilized with poultry dung and the area of about 400 ha was fertilized with manure. Liming was applied on the area of 1,000 ha. This technology of organic fertilization has been applied up till now. As far as operating costs of the farm are concerned, it is possible to notice that in 2004–2008 the share of mineral fertilizers purchase from 23.5 to 8.8% (Table 4) and, therefore, the share of mineral fertilizers was diminishing in favour of organic fertilizers. After that period there was recorded disadvantageous, from the environmental, as well as the farm point of view, increase in the share of purchase costs involving mineral fertilizers, which in 2011 provided for 28.4% in the structure of operating costs. In relation to base year 2004 the share of purchase costs of mineral fertilizers in operating costs increased in the examined period of eight years by 2.6%. It should be stressed that annual liming of soil is applied on the area of about 1,000 ha, destined for winter wheat cultivation. Decrease in mineral fertilization in favour of organic fertilization is one of the elements of integrated production (IP). The analyzed farm maintains the rules of appropriate crop rotation in the process of plant production.

In the case of wheat, technological process of integrated production consists of 12 elements (Fig. 1). Integrated production processes were applied in plant protection (fertilization was combined with pest control treatment and in the case of weed control, herbicide was combined with preparation against lodging), as well as foliar fertilization was combined with microelements nutrition.

Table 4. Costs of operating activities and profit in 2004–2011

Specification	2004	2005	2006	2007	2008	2009	2010	2011
Costs of operating activities [PLN · ha^{-1}]	5,382.2	5,838.0	5,292.7	6,947.5	9,303.8	9,275.2	8,886.3	11,909.8
Purchase of plant protection chemicals [%]	17.6	15.3	15.9	26.8	23.3	15.9	17.1	15.8
Purchase of fertilizers [%]	25.8	24.1	23.5	13.2	8.8	21.9	21.3	28.4
Gross profit per 1 ha AL [PLN]	1,201.0	695.1	941.0	2,477.4	422.1	1,528.6	2,587.8	4,122.2

Source: Elaboration by the author.

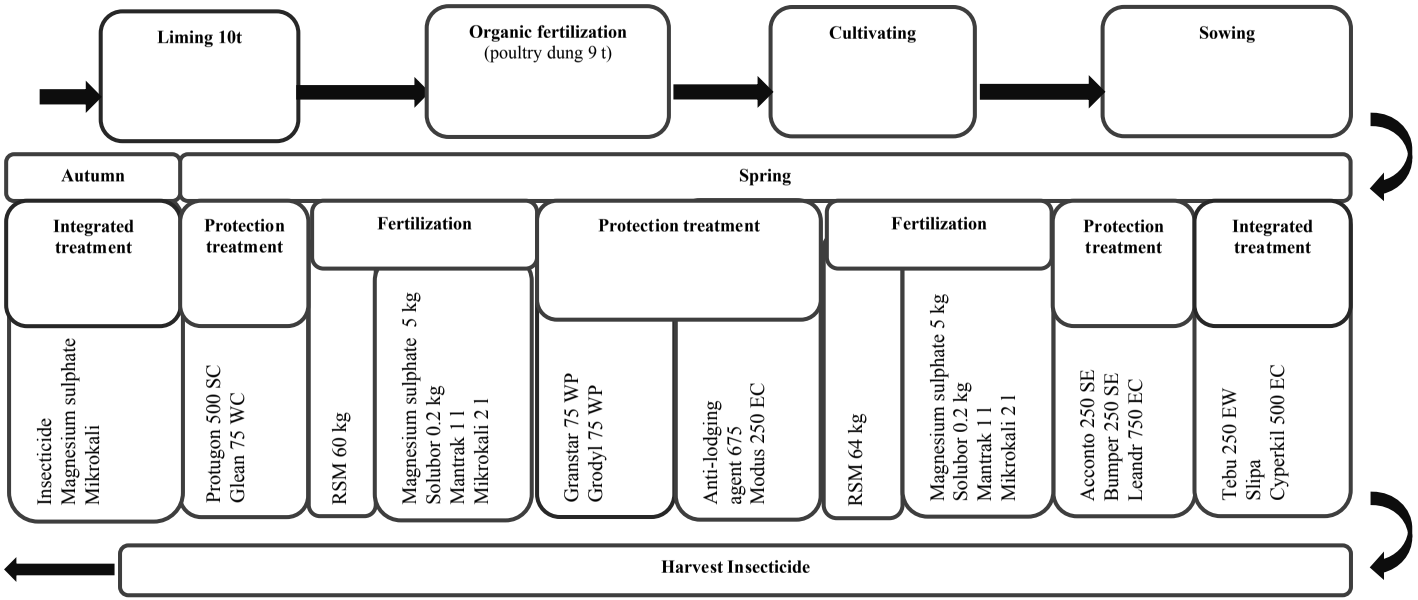

Fig. 1. Technology of wheat production and applied means of production

Source: Elaboration by the author.

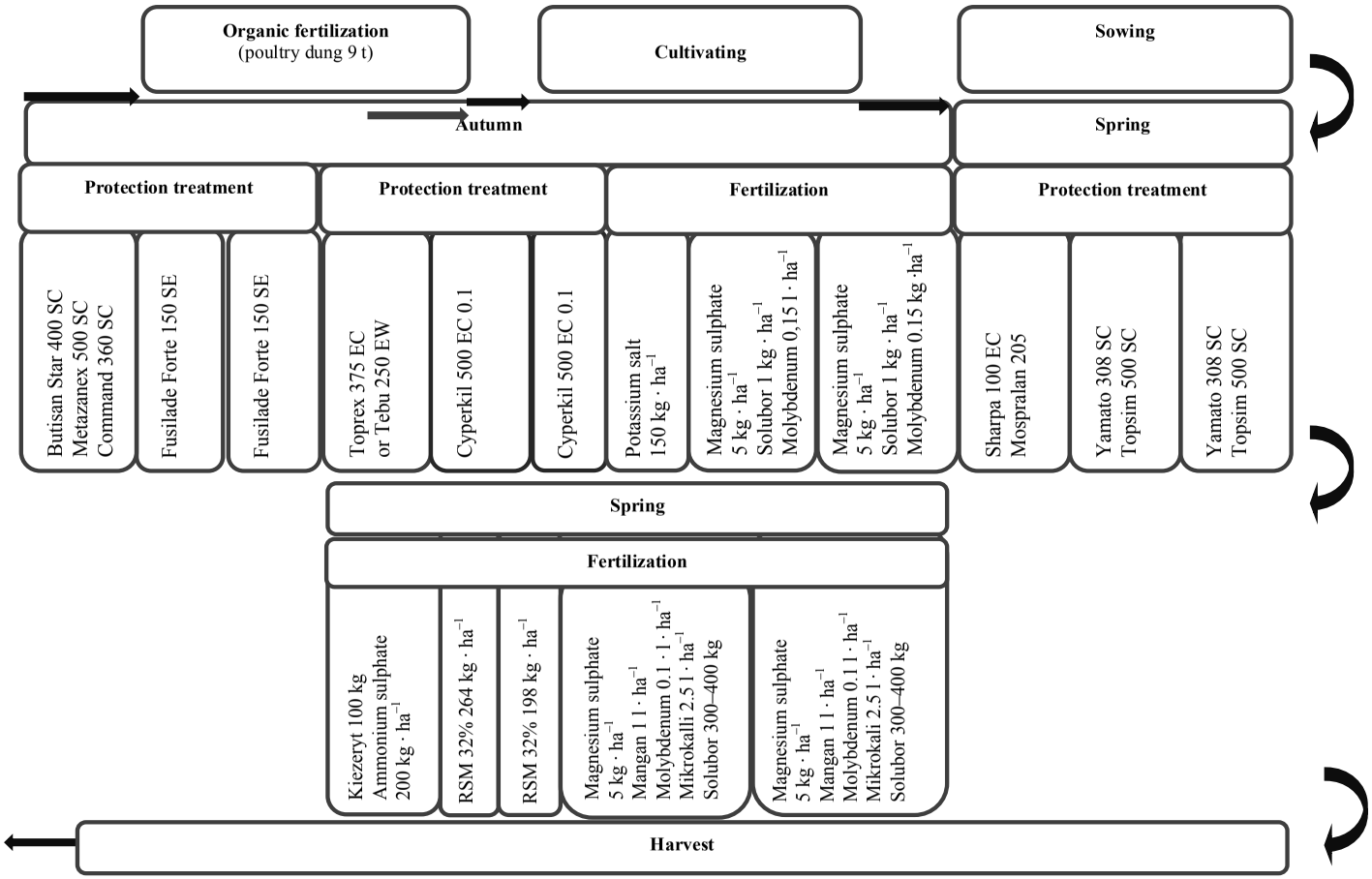

Fig. 2. Technology applied to oilseed rape and the means of production

Source: Elaboration by the author.

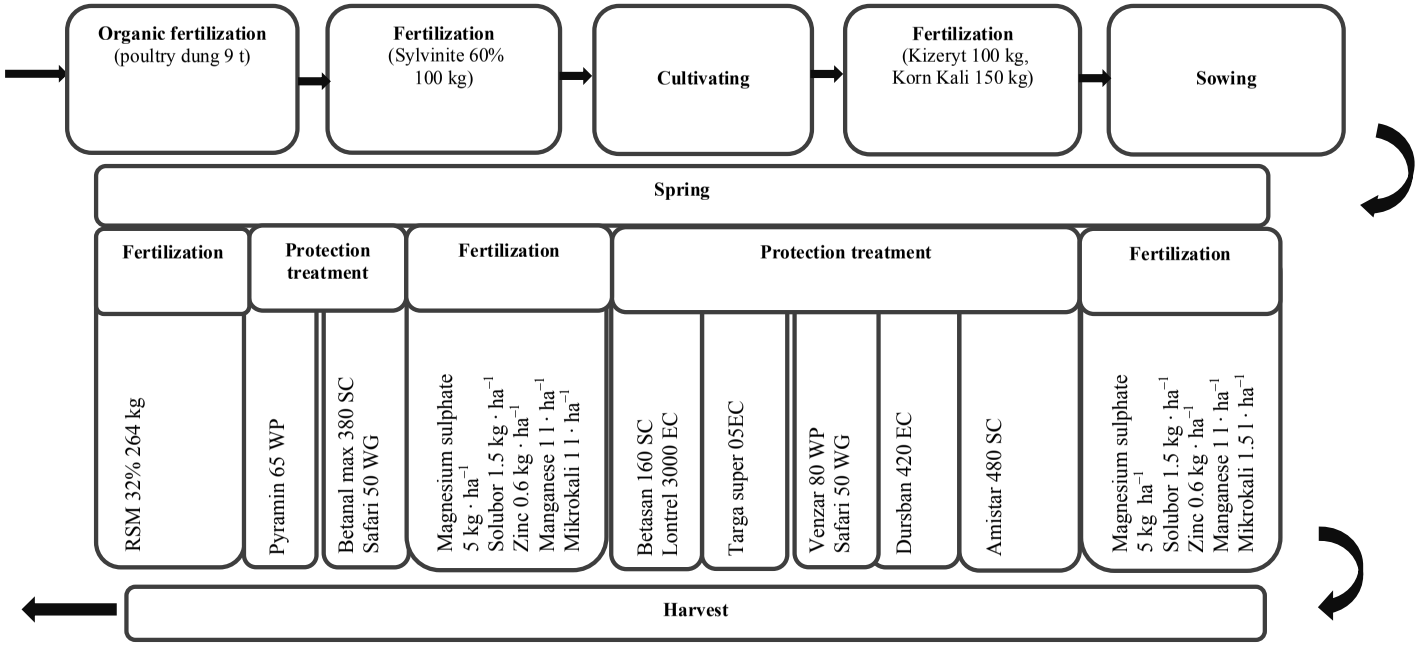

Fig. 3. Technology sugar beet and used the means of production

Source: Elaboration by the author.

CONCLUSIONS

1. The farm subjected to research follows the management system: breeding – plant production, rape – beet, high intensive B1.
2. The share of purchase costs of mineral fertilizers in operating costs of the farm increased merely by 2.6% in 2004–2011, which means that the farm introduces sustainable fertilization, consistent with the rules of integrated production, as well as meets cross-compliance.
3. The existing organization structure of the farm, whose management system, allows to apply the system of integrated production and imposes cross-compliance within the frames of direct payments, introduced in January 2011, as well as to obligatory guarantee, on existing legal provisions which will come into force in 2014, introduction of the rules of integrated plant protection.

REFERENCES

Boller E., Avilla J., Joerg E., Malavolta F., Esbjerg P., Wijnands F.G., 2004. Integrated Production. Principles and Technical Guidelines. 3rd ed. IOBC/WPRS Bulletin 27 (2).

Golinowska M., 2012. Koszty integrowanej ochrony roślin. Postępy w Ochronie Roślin (Progress in Plant Protection) 52 (3), 521–526.

Kopeć B., 1968. Systemy gospodarcze w rolnictwie polskim w latach 1955–1965. PWRiL, Warszawa, 539.

Kopeć B., 1983. Metodyka badań ekonomicznych w gospodarstwach rolnych (Wybrane zagadnienia). Skrypt AR we Wrocławiu 269.

Kuś J., 1995. Systemy gospodarowania w rolnictwie. Rolnictwo integrowane. Mat. Szkol. 42, IUNG Puławy, 38.

Olszak R., Pruszyński S., Lipa J.J., Dębowski Z.T., 2000. Rozwój koncepcji i strategii wykorzystania metod i środków ochrony roślin. Postępy w Ochronie Roślin (Progress in Plant Protection) 40 (1), 40–50.

Pruszyński S., Zych A., Nawrot J., 2004. Prawne i praktyczne aspekty integrowanych technologii produkcji upraw rolniczych w Polsce. Postępy w Ochronie Roślin (Progress in Plant Protection) 44, 300–305.

Stern V., Smith R., Van den Bosch R., 1959. The integrated control concept. Hilgardis 29 (2), 81–101.

Urban M., 1981. Ekonomika i organizacja gospodarstw rolnych. PWN, Warszawa, 71–77.

Witek T. red., 1993. Waloryzacja rolniczej przestrzeni produkcyjnej Polski według gmin. IUNG Puławy, Puławy.

Zimny L., 2007. Definicje i podziały systemów rolniczych. Acta Agrophys. 10, 507–518.

STRUKTURA ORGANIZACYJNA A INTEGROWANA PRODUKCJA

Streszczenie. Celem pracy jest zbadanie zależności między strukturą organizacji gospodarstwa, określoną za pomocą systemu gospodarczego, a systemem integrowanej produkcji w gospodarstwie wielkoobszarowym w latach 2004–2011. Materiał do badań pochodził z danych księgowych gospodarstwa oraz kart historii pól, a opracowano go, stosując metodę analizy pionowej i poziomej oraz analizy syntetycznej I stopnia B. Kopcia. Wieloletnia analiza wykazała, że gospodarstwo utrzymuje system gospodarczy hodowlano-roślinny,

rzepakowo-buraczany, wysokointensywny, który jest przyjazny środowisku. Zasady integrowanej produkcji badane gospodarstwo stosuje od ponad 10 lat, a są to: łączenie zabiegów pestycydowych z nawożeniem mineralnym, odpowiednie zmianowanie poprawiające żyzność gleby, stosowanie wapnowania i nawożenia organicznego ponad 25% gruntów ornych. System gospodarczy pozwala na stosowanie integrowanej produkcji.

Słowa kluczowe: struktura organizacji, nastawienie gospodarcze, kierunki produkcji, integrowana produkcja, intensywność organizacji

Accepted for print – Zaakceptowano do druku: 10.09.2013