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# OVERVIEW OF THE INDUSTRIAL MARKET IN ROMANIA. IMPLICATIONS FROM THE ORGANIZATIONAL CONSUMER PERSPECTIVE

Empirical study

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*Romanian industrial market*
*Organisational buyers*

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**Abstract**

Nowadays research in consumer behaviour has become really useful in understanding consumer needs regarding the use of products or services. Despite the tremendous work carried out in the field of consumer behaviour, few studies have concentrated on the organizational consumers as main buyers in the market. In this regard, considering the economic sectors of Romania, the main purpose of the article consists in characterizing the national industrial buyers taking into consideration the organizational consumer approach. Using an empirical study based on the macroeconomic indicators published by the Romanian National Institute of Statistics, we aimed to identify the components of the organizational market in Romania. In this regard, we selected several statistical indicators specific for the agriculture sector which can help us understand the behaviour of the organizations from this area considering the buying perspective. The results obtained demonstrate that although there are many macroeconomic indicators in the agriculture sector (43) few of them (19) provide significant information regarding the industrial buying behaviour among Romanian firms from this area.

## INTRODUCTION

As consumers, people tend to perceive easier the products and specific exchange processes from the consumer market. Despite this, most of the companies do not sell their goods only to individual buyers but also to organisations, the value of goods sold to companies being much higher than those sold to individual buyers.

Until now, when studying consumer behaviour, the literature from the field has focused both on individual and organizational / industrial buyer.

A review of the studies published so far shows that most of the knowledge acquired regarding the industrial buyer behaviour consists in systematic empirical research on the buying policies and practices of purchasing agents and other organizational buyers (Steth, 1973).

Considering the main purpose of our article, namely the characterization of industrial market in Romania, our article is organised as follows:

- The 1st part of the article consists in a short review of studies concerning the industrial market, organizational behaviour and the link between the two concepts from the literature point of view;
- The 2nd part of the study comprises a brief analysis of the main characteristics of organizational market;
- In the 3rd part we identified the types of organizational markets in Romania;
- In the 4th part of the article we analysed the main indicators of the organizational market in the agricultural sector in Romania and tried to identify whether the information provided is useful in understanding the organisational consumer behaviour;
- The 5th and final part of the article comprises remarks regarding the study carried out, conclusions on the article and several limits and perspective of the research.

## LITERATURE REVIEW

Industrial buying behaviour has been the focus of several researchers over the years.

Early studies published by Cardozo & Cagley (1971) and Steth (1973) have referred to industrial buying behaviour in terms of process in order to develop a descriptive model helpful in understanding the decisions of procurement managers.

This line of research was followed later by McQuiston (1989) which proposed a structural equation model in order to demonstrate that industrial purchase decisions are influenced by novelty, complexity and importance. The results obtained suggest that, from these three factors, novelty and importance can have the most significant impact in the industrial purchase behaviour.

Ellram (1991) aimed to identify the life-cycle pattern of an industrial buyer-seller partnership. After studying the industrial buyer-seller partnership in eight manufacturing firms, the authors findings suggest that there can be identified four specific stages: development, commitment, integration and dissolution, which are, basically, similar to the stages of the buying process of individual consumer.

A more comprehensive approach of all studies in the marketing research has been done by Olsen & Ellram (1997). After comparing the findings in the industrial buyer-supplier relationship in the marketing and purchasing literature, the authors consider that a closer cooperation between researchers in the purchasing and the marketing field can lead to an improved understanding of the nature and characteristics of industrial consumer behaviour.

With the development of international relations other researchers focused on the impact of cultural factors on the industrial buying behaviour. In this regard, Solberg (2002) focused on the understanding of buyer behaviour in Arab industrial markets. The results show that the Arab industrial buyer follows the same pattern as any western buyer, similar steps being followed in the purchasing process, the only differences being generated from the cultural heritage.

Further studies focused on the cross-cultural industrial buyer-seller relationships. Leonidou et al. (2008) conducted an analysis in 151 U.S. export manufacturers of industrial goods in order to determine the nature of their connection with foreign customers. Employing a structural equation model similar to the one used by McQuistion (1989) the authors results showed that "the exercise of power derived from coercive sources increases conflict and reduces satisfaction, while the exercise of non-coercive power sources leads to lower conflict but not significantly increasing satisfaction" (Leonidou et al., 2008).

Few years later, Schoenherr et al. (2012) have studied the research opportunities in purchasing and supply management in order to determine its impact on manufacturing firms. The authors consider that purchasing and supply management (PSM) have been crucial for the effectiveness and efficiency of operation conducted in these companies.

The brief review of literature concerning the organizational buyer process shows that authors from the field have different interest on the subject. The organizational / industrial buying behaviour has been studied in term of process, in relation to factors which influence the decisions in the acquisition process inside companies, in

conjunction with cultural influences and international market and, towards its impact on the specific activities conducted by companies.

## OVERVIEW OF ORGANISATIONAL MARKET

Most companies sell their products or services to other organizations in various forms. Usually, they are looking at both individual and organizational buyers by offering a wide range of products and services in the business market using complex methods to increase sales share. As a result, an important part of companies sell their products to wholesalers and retailers who offer them further to the final consumers.

Organizational buyers are represented by firms that purchase goods and services in order to produce other goods and services sold or rented to other buyers. Also, organizational buyers are retailers and wholesalers who buy products for resale, in order to obtain profit. They constitute the business market of every firm.

Organizational buying process represents the means through which organizational buyers determine the products and services necessary for their organizations, assesses all companies in those areas and choose one or more providers.

The business market is, from many points of view, similar to consumer market but there are several differences which make it unique:

a. *Business market comprises fewer buyers, but with a higher purchasing power.*

On the business market, buyers purchase greater quantities of products or services, which translate in substantial amounts of money.

Most of the goods and services on the market are intended to other companies which use them as production factors in order to make other products. Moreover, providers can offer similar products to businesses and individuals, acting both on the business and consumer market.

b. *Organizational customers are much more geographically concentrated.*

Since organizational buyers are fewer in comparison to individual buyers, their geographic distribution is more concentrated. Manufacturing companies often focus on a geographic area to provide quick access to the raw material, while wholesalers and retailers are focused on shopping areas.

c. *The market demand is more inelastic in the business market compared to the demand of the consumer market*, prices change not having a big impact on the changes of the demand.

d. *Business market demands derive from the demand in the consumer market.*

An increase in the business market prices does not directly influence customer demand. If this growth will automatically lead to rising prices in the consumer market, decreasing demand, this will result in decreasing orders of organizational buyers.

e. *Purchases made by companies engage more participants in decision-making*, often requiring specialized knowledge of the people involved.

f. *Decisions organizational buyers are much more complex, compared to the final consumer decisions.*

Business market purchases often involve a very large amount of money, with a substantial economic impact on the business buyer. Most times, corporate acquisitions are made in consultation with many specialists within the firm or with consultants from outside.

During the checkout process, they can get to know as well the products that the company wants to buy them and as well as the decision purchasing factors within the company.

In a corporate acquisition, the seller must communicate constantly with people involved in the buying decision. Most often, the seller helps the buyer to identify and to define its needs and proposes a solution. Then, the buyer is helped to maximize the solution proposed by the seller. Being very large sums of money, sellers generally adapts to the individual needs of clients.

g. *The number of acquisitions in the business is much smaller than the consumer market but have a greater value*.

After the brief analysis of organisational market, we can say that, in general terms, the organizational buyer behaviour is determined by:

- Buying in situations where there is a buyer organizational;
- Acquisition Centre (participants in the buying decision process);
- Factors affecting organizational buyers;
- Organizational buying process.

Depending on the market, the organisational buyer can act differently, a fact that imposes a more detailed analysis of each industrial buyer's behaviour. In the next section we identified the main types of organisational markets in Romania.

## TYPES OF ORGANISATIONAL MARKETS IN ROMANIA

In general, the organisational market is composed from all companies which buy products in order to use them as production factors or to resell them. In other words, the organisational market comprises all buyers which are not final buyers. This market is extremely large and includes all types of organisations like enterprises, banks, insurance companies, gross sellers, restaurants but also schools, hospital and governmental institutions.

When analysing organisational market Munteanu et al. (2011) distinguish three different components, namely:

- *Industrial market*, which is composed from firms which transform goods and services before selling them to other companies or final consumers.

- *Retailers market*, which comprises the companies which buy products just for reselling them to other enterprises or final buyers. Usually, this market is divided in two main parts, detail merchants and gross sellers. In terms of size, this type of companies usually varies from very small (family businesses) to very complex, multinationals, with impressive turnovers.

- *Governmental* or *Public goods market*, which includes all national and local state institutions who, in order to fulfil their goals, have to buy products and services to deliver to final consumers public goods and services.

For a better view of the components from the organisational market in Romania, Table 1 presents a specific structure considering the economic activity classification from the Romanian economy.

As we can notice from Table 1 the organisational market in Romania is divided in 4 main components:

- The industrial market;
- The merchants market;
- The governmental market;
- Other organisational clients.

From the 4 main components of the organisational market, the industrial one is the most developed, comprising 11 subcategories of economic sectors. Based on these aspects we selected further the most significant components of the industrial market in order to analyse the evolution of the main statistical indicators provided by the Romanian National Institute of Statistics between 2000 and 2015.

## RESEARCH METHODOLOGY

The first step in any research consists in establishing the methodological aspects of the study, namely the general purpose and specific objective, the population and the sample considered, as well as information regarding the space and time in which the analyse was conducted.

Considering the general purpose of our study, the characterization of national industrial buyers, the specific objectives are the following:

1. Identifying the most representative statistical indicators of industrial market in Romania;
2. Selecting data from the Romanian National Institute of Statistics;
3. Defining the period of time considered in the analysis;
4. Grouping statistical indicators in categories according to the subcomponents of the industrial market.

Concerning the space and time coordinates our studies took into consideration Romanian macroeconomic indicators calculated and published by the Romanian National Institute of Statistics (RNIS) during 1990-2014.

The data were collected from the Tempo Online of RNIS available at: http://statistici.insse.ro/shop/.

In this regard we mention that the access to these data involves user registration and, in some situations, a certain fee, depending on the information solicited by the researcher.

For every component of the industrial market, RNIS calculates several statistical indicators specific to the type of industry analysed. In order to select the most significant indicators for our analyse we reviewed first all indicators calculated for each component.

For each component of the industrial market the Romanian National Institute of Statistics calculates several indicators grouped on main domains as it follows:

- For agriculture there are 6 main domains for which the Romanian National Institute of Statistics calculates a total of 43 statistical indicators.
- In the silviculture component there are 7 statistical indicators calculated;
- The industry fields comprise 16 statistical indicators;
- For the energy sector there are 12 statistical indicators calculated;
- For the construction sector we identified only 8 statistical indicators;
- The services sector comprises 17 statistical indicators;
- The transport includes 6 domains with 42 statistical indicators;
- Post and telecommunications includes 15 statistical indicators.

In Table 2 we focused on the specific indicators for the agriculture sector. If we take a closer look at the structure of these statistical indicators calculated we can conclude that there aren't any specific statistical indicators which can inform us upon the value or the structure of goods or services purchased by firms.

However, there are several indicators which offer valuable information on the value of goods consumed by some companies. Based on these last findings we decided to select the most representative indicators for the agriculture domain of the industrial market.

The descriptive analysis of the indicators selected was carried out using the statistical software SPSS, the results obtained being presented as it follows.

## RESULTS AND DISCUSSIONS

The main statistical indicators related to consumption within companies from the agriculture sector of the industrial market of Romania selected for the descriptive analysis are:

- Park of tractors and of main agricultural machinery in agriculture (end of year) by ownership form, macroregions, development regions and counties, presented in Table 3;
- Quantity of chemical and natural fertilisers applied in agriculture by ownership form, macroregions, development regions and counties, presented in Table 4;
- Quantity of pesticides applied in the agriculture by ownership form, pesticide type, macroregions, development regions and counties, presented in Table 5.

In what concerns the analysis of the statistical indicators in the agriculture field the first one selected, the park of tractors and of main agricultural machinery, represents the number of tractors and main agricultural machinery at the end of the year. The period of time for which we had available data is 1990-2014, a detailed statistics of these data being available in Table 3.

The quantity of chemical and natural fertilisers applied in agriculture by ownership form, macroregions, development regions and counties refers to industrial products which can be separately nitrogenous, phosphate and potassium fertilisers or combined as complex fertilisers (active substance). The natural fertilizers are expressed as manure from all species of domestic animals and poultry (fresh or sour) and also the compost in liquid form, measured in brute weight. The period of time for which we had available data is 1990-2014, a detailed statistics of these data being available in Table 4.

The quantity of pesticides applied in the agriculture by ownership form, pesticide type, macroregions, development regions and counties refers to any substances or mixed substances, including the ingredients in their mixture, used in agriculture, silviculture, in storage spaces, as well as in other activities in order to prevent, reduce, remove or kill the insects, pathogenic agents, weeds and other forms of animal or vegetal life, including harmful viruses to plants and animals, insects and rodents bearing man-transmissible diseases and products regulating plant regrowth and their defoliation and splitting; they are reported in active substance. The period of time for which we had available data is 1990-2014, a detailed statistics of these data being available in Table 5.

The data available in Tables 3, 4 and 5 was processed in IBM SPSS Statistics 24. The purpose of the analysis conducted consisted in verifying the normal distribution of the indicators using Q-Q Plot normal and detrended. A number of 19 statistical indicators were analysed, using the normal and detrended Q-Q Plot as it follows:

For park of tractors and of main agricultural machinery in agriculture (end of year) by ownership form, macroregions, development regions and counties:

- Ploughs for tractors (Figure 1)
- Mechanical cultivators (Figure 2)
- Mechanical sowers (Figure 3)
- Chemical fertiliser spreaders (Figure 4)
- Mechanical sprayers and dusters (Figure 5)
- Self-propelled combines for cereal harvesting (Figure 6)
- Self-propelled combines for fodder harvesting (Figure 7)
- Combines and potato harvesters (Figure 8)
- Straw and hay packing presses (Figure 9)
- Windrovers for fodder harvesting (Figure 10)
- Physical agricultural tractors (Figure 11)

For quantity of chemical and natural fertilisers applied in agriculture by ownership form, macroregions, development regions and counties:

- Chemicals (Figure 12)
- Nitrogenous (Figure 13)
- Phosphates (Figure 14)
- Potassium (Figure 15)
- Natural fertiliser (Figure 16)

For quantity of pesticides applied in the agriculture by ownership form, pesticide type, macroregions, development regions and counties.

- Insecticides (Figure 17)
- Fungicides (Figure 18)
- Herbicides (Figure 19)

The Normal and Detrended Q-Q Plot analysis of all 19 indicators show similar results for all of the indicators taken into consideration. In the normal Q-Q plot we compared the observed data with those expected for each indicator. The linear tendency observed in all of the 19 cases can determine us to believe that the evolution of each variable was normal. For a better analysis of each variable we used the Detrended normal Q-Q Plot which shows the differences between the observed and expected values of a normal distribution. If the distribution is normal, the points should cluster in a horizontal band around zero with no pattern. The analysis of the Detrended normal Q-Q Plot has shown that none of the indicators analysed presents such a distribution, meaning that their evolution wasn't normal in the period of time taken into consideration (1990-2014).

## CONCLUSIONS, LIMITS AND RESEARCH PERSPECTIVES

All the 19 indicators analysed refer to the consumption or use of several goods in the agriculture sector in Romania. The descriptive analysis conducted using the normal and detrended Q-Q Plot in IBM SPSS 24 showed that the evolution of these consumption wasn't normal during 1990-2014. In other words, the consumption / use of products (pesticides, tractors, and

fertilisers) was either higher or lower during these years. As a result we can say that the organizational buyer from the agriculture sector has behaved different in the buying process of goods which allowed him to carry out its specific activities from the field.

Unfortunately, we can only speculate the most influential factors which lead to this behaviour considering that there are now macroeconomic statistics in this field regarding the organizational buying behaviour. However, in our opinion, an in-depth analysis of the organisational market of every sector is helpful in understanding the characteristics (volume, purchasing power, and capacity) of companies acting in those sectors.

As a consequence, the present analysis of the agriculture sector in Romania can be used as a starting point for developing a further study concerning the buying behaviour of organizational consumers from this market.

## REFERENCE LIST

[1] Cardozo, R. N., & Cagley, J. W. (1971). Experimental study of industrial buyer behavior. *Journal of Marketing Research*, 329-334.

[2] Ellram, L. M. (1991). Life-cycle patterns in industrial buyer-seller partnerships.*International Journal of Physical Distribution & Logistics Management*, *21*(9), 12-21.

[3] Leonidou, L. C., Talias, M. A., & Leonidou, C. N. (2008). Exercised power as a driver of trust and commitment in cross-border industrial buyer–seller relationships. *Industrial Marketing Management*, *37*(1), 92-103.

[4] McQuiston, D. H. (1989). Novelty, complexity, and importance as causal determinants of industrial buyer behavior. *The Journal of Marketing*, 66-79.

[5] Munteanu, C., Maxim, E., Sasu, C., Prutianu, Ș., Zaiț, A., Manolică, A., Jijie, T., Monoranu, A. (2011). *Marketing: principii, practici, orizonturi*. Iasi: Sedcom Libris.

[6] Olsen, R. F., & Ellram, L. M. (1997). Buyer-supplier relationships: alternative research approaches. *European Journal of Purchasing & Supply Management*,*3*(4), 221-231.

[7] Saleh, M. A., Ali, M. Y., & Julian, C. C. (2014). International buyer behaviour–commitment relationship: An investigation of the empirical link in importing.*International Business Review*, *23*(2), 329-342.

[8] Schoenherr, T., Modi, S. B., Benton, W. C., Carter, C. R., Choi, T. Y., Larson, P. D., ... & Wagner, S. M. (2012). Research opportunities in purchasing and supply management. *International Journal of Production Research*, *50*(16), 4556-4579.

[9] Sheth, J. N. (1973). A model of industrial buyer behavior. *The Journal of marketing*, 50-56.

[10] Solberg, C. A. (2002, September). Culture and industrial buyer behavior: The Arab experience. In *The 18th IMP Conference. Retrieved on September* (Vol. 9, p. 2010).

[11] http://statistici.insse.ro/shop/.

**Table 1. Components of organisational market considering the activity classification from the Romanian economy**

| *Number* | *Components* |
|---|---|
| ***I.*** | *Industrial market* |
| **A** | Agriculture |
| **B** | Silviculture |
| **C** | Aquaculture and fishing |
| **D** | Mining industry |
| **E** | Manufacturing industry |
| **F** | Electrical and thermal energy |
| **G** | Construction |
| **I** | Services |
| **J** | Transport |
| **K** | Post and telecommunications |
| **L** | Finance, banking and assurance |
| ***II*** | *Merchants market* |
| **H** | Wholesale and retail trade |
| **M** | Real estate |
| ***III*** | *Governmental market* |
| **N** | Public administration and defence |
| **O** | Education |
| **P** | Health and social care |
| ***IV*** | *Other organisational clients* |
| **R** | Other activities of collective, social and personal services |
| **T** | Activities of extraterritorial organizations and bodies |

*Source:* Munteanu et al. (2011, p. 100).

**Table 2. Overview of statistical indicators calculated by Romanian Institute of Statistic for components of industrial market**

| No | Components | Domains | Statistical indicators |
|---|---|---|---|
| ***I.*** | *Industrial market* | | |
| **A.** | Agriculture | 1. Total land fund | 1.1. Land fund area by usage, ownership form, macroregions, development region and counties<br>1.2. Land fund area by usage, counties and localities |
| | | 2. Material-technical resources of agriculture | 2.1. Park of tractors and of main agricultural machinery in agriculture (end of year) by ownership form, macroregions, development regions and counties |
| | | 3. Area and crop production | 3.1. Area cultivated with main crops by ownership form, macroregions, development regions and counties<br>3.2. Area cultivated with main crops by counties and localities<br>3.3. Crop production by main crop, ownership form, macroregions, development regions and counties<br>3.4. Crop production by main crop, by counties and localities<br>3.5. Average crop production per hectare by main crop, ownership form, macroregions, development regions and counties<br>3.6. Area of the vineyards in bearing by ownership form, macroregions, development regions and counties<br>3.7. Total production of grapes by ownership form, macroregions, development regions and counties<br>3.8. Total production of grapes by counties and localities<br>3.9. Average production of grapes per hectare, by ownership form, macroregions, development regions and counties<br>3.10. The number of fruit trees by ownership form, macroregions, development regions and counties<br>3.11. Fruit production by fruit species, ownership form, macroregions, development regions and counties<br>3.12. Fruit production by counties and localities<br>3.13. Average fruit production per fruit tree by fruit species, macroregions, development regions and counties |
| | | 4. Livestock and agriculture animal | 4.1. Livestock, by animal category, ownership form, macroregions, development regions and counties, at the end of year<br>4.2. Livestock, by main animal category, ownership form, counties and |

| No | Components | Domains | Statistical indicators |
|---|---|---|---|
| | | production | localities, at the end of year<br>4.3. Livestock per 100 ha of land, by main animal category, ownership form, macroregions, development regions and counties, at the end of year<br>4.4. Pig stock existent on 1 April, by weight group and economic purpose<br>4.5. Cattle livestock existent on 1 June, by age group and economic destination<br>4.6. Pig stock existent on 1 August, by weight group and economic purpose<br>4.7. Pig stock existent on 1 May, by weight group and economic purpose<br>4.8. Animal agricultural production by ownership form, macroregions, development regions and counties<br>4.9. Animal agricultural production by counties and localities<br>4.10. Average production per animal by ownership form, macroregions, development regions and counties |
| | | 5. Economic accounts for agriculture | 5.1. Production of the main agricultural products, per inhabitant<br>5.2. Value of agricultural production by sectors, ownership form, macroregions, development regions and counties<br>5.3. Indices of agricultural production by sectors, ownership form, macroregions, development regions and counties - base year = previous year<br>5.4. Agricultural branch production by sectors, ownership form, macroregions, development regions and counties - new series<br>5.5. Indices of the agricultural branch production by sectors, ownership form, macroregions, development regions and counties - base year = previous year - new series<br>5.6. Economic accounts for agriculture, current prices<br>5.7. Economic accounts for agriculture, prices for the preceding year<br>5.8.Unit value statistics, basic prices<br>5.9. Unit value statistics, producer prices<br>5.10. Unit value statistics - quantities<br>5.11.Volume of agricultural labour input |
| | | 6. Indicators of agriculture environment | 6.1. Area under irrigation command and agricultural area irrigated, by land use, macroregions, development regions and counties<br>6.2. Drainage area, open canals, by land use , macroregions, development regions and counties<br>6.3. Area reclaimed with soil erosion control works, by land use, macroregions, development regions and counties<br>6.4. Quantity of chemical and natural fertilisers applied in agriculture by ownership form, macroregions, development regions and counties<br>6.5. Area of the land where chemical and natural fertilisers were applied by ownership form, macroregions, development regions and counties<br>6.6. Quantity of pesticides applied in the agriculture by ownership form, pesticide type, macroregions, development regions and counties<br>6.7. Area of the land where pesticides were applied by ownership form, macroregions, development regions and counties |

*Source:* author's processing based on information retrieved from http://statistici.insse.ro/shop/.

**Table 3. Evolution of tractors and agricultural machinery in Romania between 1990 and 2014**

| | Categories of tractors and agricultural machinery | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Ploughs for tractors* | *Mechanical cultivators* | *Mechanical sowers* | *Chemical fertiliser spreaders* | *Mechanical sprayers and dusters* | *Self-propelled combines for cereal harvesting* | *Self-propelled combines for fodder harvesting* | *Combines and potato harvesters* | *Straw and hay packing presses* | *Windrovers for fodder harvesting* | *Physical agricultural tractors* |
| 1990 | 127065 | 73159 | 27339 | 35778 | 10810 | 14991 | 40695 | 5569 | 2998 | 21706 | 4981 |
| 1991 | 132761 | 73384 | 23868 | 34988 | 9871 | 14088 | 37614 | 5194 | 2345 | 20663 | 4805 |
| 1992 | 146790 | 80730 | 23223 | 37048 | 10563 | 13698 | 37392 | 5294 | 2459 | 21579 | 4712 |
| 1993 | 158126 | 95850 | 23632 | 43921 | 10694 | 12828 | 37309 | 4866 | 2356 | 19200 | 4491 |
| 1994 | 161223 | 103805 | 23446 | 47682 | 10498 | 12099 | 38381 | 4356 | 2605 | 18475 | 4062 |
| 1995 | 163370 | 107253 | 23376 | 50395 | 10259 | 11788 | 38121 | 4135 | 2611 | 16346 | 3764 |
| 1996 | 165281 | 113955 | 23899 | 51608 | 9981 | 10950 | 37711 | 3600 | 2937 | 14519 | 3446 |
| 1997 | 163016 | 114721 | 28369 | 53853 | 10061 | 9957 | 35705 | 3082 | 2956 | 12831 | 3093 |
| 1998 | 164756 | 121620 | 28057 | 55678 | 9912 | 9424 | 33076 | 2729 | 3232 | 11050 | 2779 |
| 1999 | 163883 | 122956 | 27988 | 56173 | 8940 | 8202 | 31268 | 2101 | 3376 | 8544 | 2153 |
| 2000 | 160053 | 123192 | 26212 | 57709 | 8635 | 7371 | 28084 | 1655 | 3498 | 6753 | 1780 |
| 2001 | 164221 | 126905 | 26037 | 59979 | 9250 | 6898 | 25784 | 1267 | 3650 | 5575 | 1661 |
| 2002 | 169240 | 131252 | 27433 | 62061 | 9656 | 7191 | 25315 | 1091 | 3791 | 4921 | 1512 |
| 2003 | 169177 | 132142 | 27366 | 63149 | 9525 | 6814 | 25048 | 910 | 4213 | 4730 | 1408 |
| 2004 | 171811 | 136100 | 28596 | 65346 | 9803 | 6573 | 24653 | 899 | 4562 | 5121 | 1373 |
| 2005 | 173043 | 137018 | 27143 | 66732 | - | 5679 | 25055 | 724 | 3856 | 5028 | 1224 |
| 2006 | 174563 | 138594 | 26317 | 67761 | - | 6425 | 24975 | 752 | 3870 | 5200 | 1250 |
| 2007 | 174003 | 139782 | 27262 | 67674 | - | 5876 | 24656 | 761 | 3765 | 5399 | 1269 |
| 2008 | 174790 | 141512 | 27522 | 68308 | - | 5876 | 24769 | 795 | 4100 | 5783 | 1232 |
| 2009 | 176841 | 142519 | 27675 | 68916 | - | 5865 | 24900 | 779 | 4284 | 6362 | 1263 |
| 2010 | 180433 | 142671 | 27795 | 69337 | - | 5680 | 25285 | 797 | 4583 | 7181 | 1233 |
| 2011 | 183064 | 146386 | 28926 | 71554 | - | 6053 | 25418 | 777 | 5060 | 9018 | 1201 |
| 2012 | 184446 | 147471 | 29173 | 73519 | - | 5459 | 25626 | 752 | 5165 | 9087 | 1817 |
| 2013 | 191301 | 152031 | 29565 | 74805 | - | 5293 | 26454 | 826 | 5348 | 10225 | 1221 |
| 2014 | 193120 | 156964 | 29562 | 76301 | - | 5315 | 25694 | 868 | 5122 | 10871 | 1217 |

*Source:* author's processing based on information retrieved from http://statistici.insse.ro/shop/.

**Table 4. Evolution of fertiliser used in agriculture in Romania between 1990 and 2014 (in tonnes 100% active substance)**

| Fertiliser category | | | | | |
|---|---|---|---|---|---|
| ***Year*** | ***Chemicals*** | ***Nitrogenous*** | ***Phosphatic*** | ***Potassic*** | ***Natural*** |
| **1990** | 1103075 | 656094 | 313108 | 133873 | 24790872 |
| **1991** | 463704 | 274936 | 145155 | 43613 | 16910213 |
| **1992** | 421452 | 257759 | 133086 | 30607 | 15791523 |
| **1993** | 537721 | 345647 | 164548 | 27526 | 17124549 |
| **1994** | 479227 | 313035 | 148770 | 17422 | 16944900 |
| **1995** | 470137 | 305877 | 149597 | 14663 | 17422695 |
| **1996** | 434730 | 267835 | 152511 | 14384 | 17870978 |
| **1997** | 404432 | 262141 | 128737 | 13554 | 16513098 |
| **1998** | 383224 | 253732 | 114645 | 14847 | 15841903 |
| **1999** | 330581 | 225186 | 92648 | 12747 | 16685312 |
| **2000** | 342174 | 239279 | 88258 | 14637 | 15812625 |
| **2001** | 369417 | 268469 | 86492 | 14456 | 15326901 |
| **2002** | 326123 | 239071 | 72996 | 14056 | 15746498 |
| **2003** | 362260 | 252139 | 95070 | 15051 | 17261643 |
| **2004** | 380004 | 270131 | 94073 | 15800 | 17748826 |
| **2005** | 461392 | 299195 | 138137 | 24060 | 16569808 |
| **2006** | 362984 | 252201 | 93946 | 16837 | 14900020 |
| **2007** | 387216 | 265487 | 103324 | 18405 | 13497929 |
| **2008** | 397965 | 279886 | 102418 | 15661 | 11748140 |
| **2009** | 426207 | 296055 | 100546 | 29606 | 13748307 |
| **2010** | 480586 | 305757 | 123331 | 51500 | 15231715 |
| **2011** | 486944 | 313333 | 126249 | 47362 | 14510194 |
| **2012** | 437972 | 289963 | 113035 | 34974 | 13292617 |
| **2013** | 491831 | 344468 | 113823 | 33540 | 13580267 |
| **2014** | 452239 | 303562 | 118574 | 30103 | 16261702 |

*Source:* author's processing based on information retrieved from http://statistici.insse.ro/shop/.

**Table 5. Evolution of pesticides in Romania between 1990 and 2014 (in kilograms active substance)**

| Pesticide categories | | | |
|---|---|---|---|
| ***Year*** | ***Insecticides*** | ***Fungicides*** | ***Herbicides*** |
| **1990** | 18597861 | 16454706 | 16451091 |
| **1991** | 6358413 | 9611663 | 9167849 |
| **1992** | 5077660 | 9356908 | 9817142 |
| **1993** | 3934650 | 8967092 | 8908669 |
| **1994** | 3624098 | 8341822 | 8146662 |
| **1995** | 3194228 | 7301099 | 6929506 |
| **1996** | 2816018 | 6683254 | 5850194 |
| **1997** | 2063314 | 6472320 | 5444265 |
| **1998** | 1445930 | 5340473 | 4493767 |
| **1999** | 1239321 | 4318211 | 3869290 |
| **2000** | 1109721 | 2801549 | 3959907 |
| **2001** | 1057753 | 2279181 | 4538718 |
| **2002** | 1031711 | 2237513 | 3658948 |
| **2003** | 876320 | 2130875 | 3770988 |
| **2004** | 1136190 | 2640625 | 3788871 |
| **2005** | 855620 | 1844233 | 4033418 |
| **2006** | 863108 | 1683848 | 3767126 |
| **2007** | 847580 | 2440697 | 3905442 |
| **2008** | 1046317 | 2076329 | 3426087 |
| **2009** | 1327660 | 2232598 | 3688948 |
| **2010** | 993324 | 1989229 | 3600382 |
| **2011** | 832646 | 1907540 | 3678610 |
| **2012** | 850103 | 2194060 | 3903714 |
| **2013** | 635076 | 2293286 | 3795431 |

*Source:* author's processing based on information retrieved from http://statistici.insse.ro/shop/.

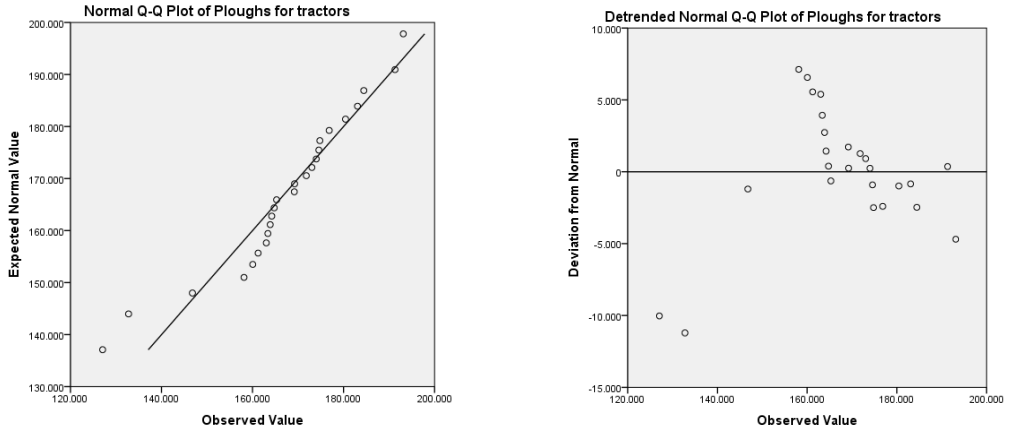


**Figure 1. Normal and detrended Q-Q Plot of ploughs for tractors**
*Source:* author's processing using IBM SPSS 24.

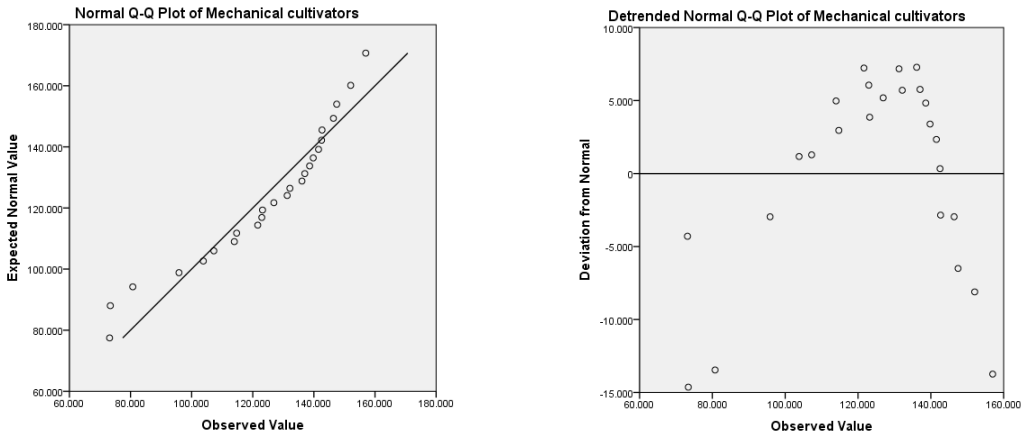


**Figure 2. Normal and detrended Q-Q Plot of mechanical cultivators**
*Source:* author's processing using IBM SPSS 24.

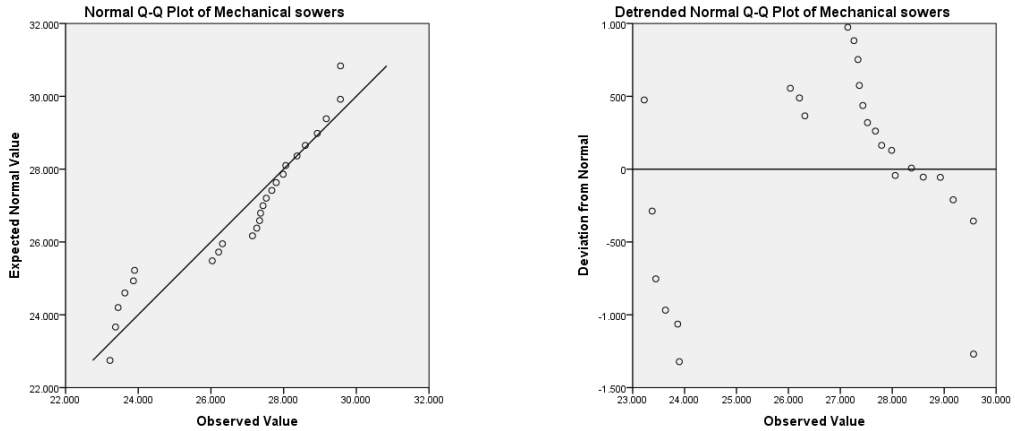


**Figure 3. Normal and detrended Q-Q Plot of mechanical sowers**
*Source:* author's processing using IBM SPSS 24.

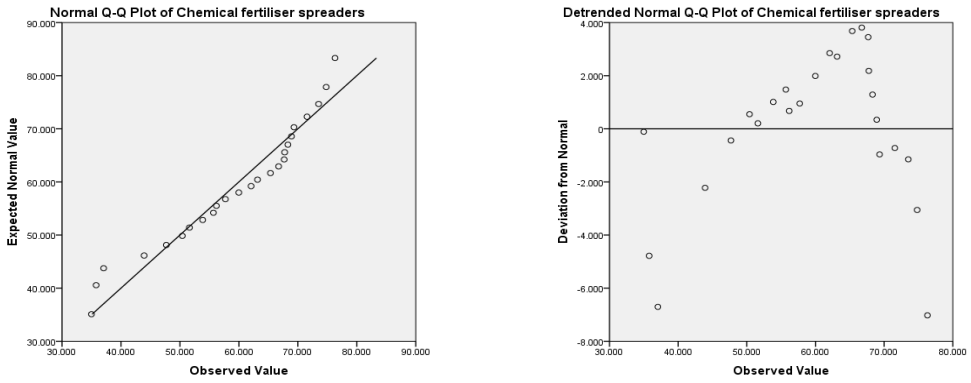


**Figure 4. Normal and detrended Q-Q Plot of chemical fertiliser spreaders**
*Source:* author's processing using IBM SPSS 24.

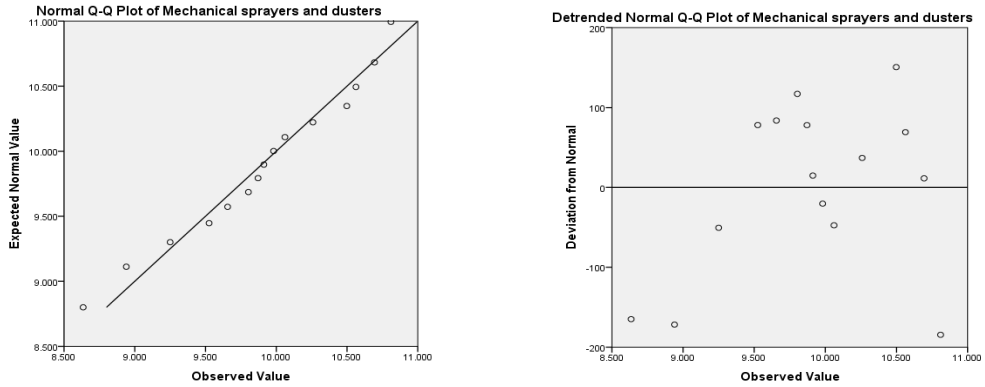


**Figure 5. Normal and detrended Q-Q Plot of mechanical sprayers and dusters**
*Source:* author's processing using IBM SPSS 24.

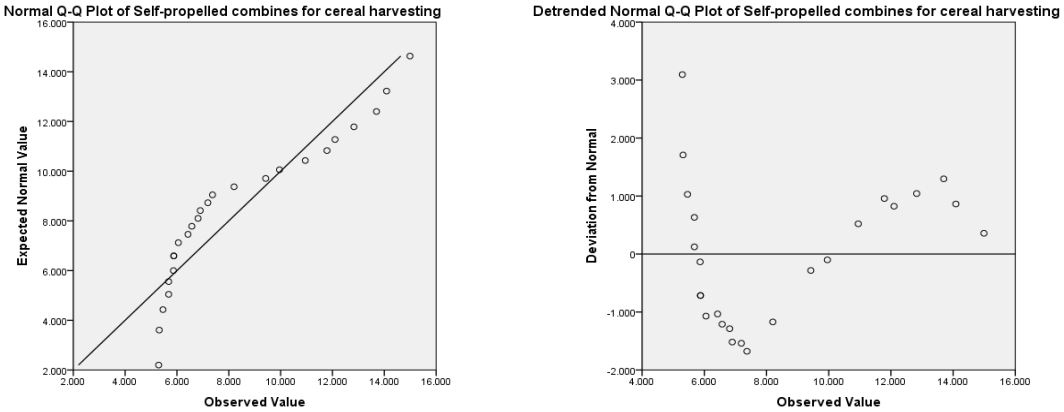


**Figure 6. Normal and detrended Q-Q Plot of self-propelled combines for cereal harvesting**
*Source:* author's processing using IBM SPSS 24.

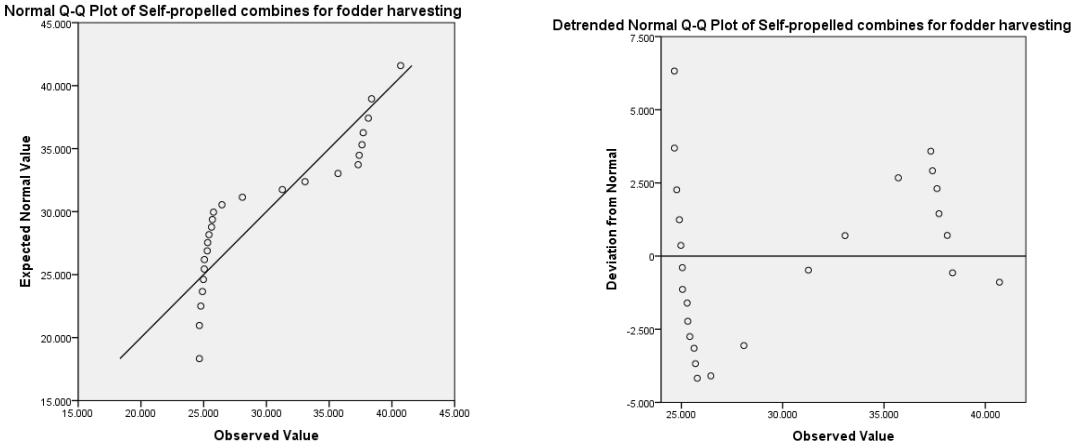


**Figure 7. Normal and detrended Q-Q Plot of fodder harvesting**
*Source:* author's processing using IBM SPSS 24.

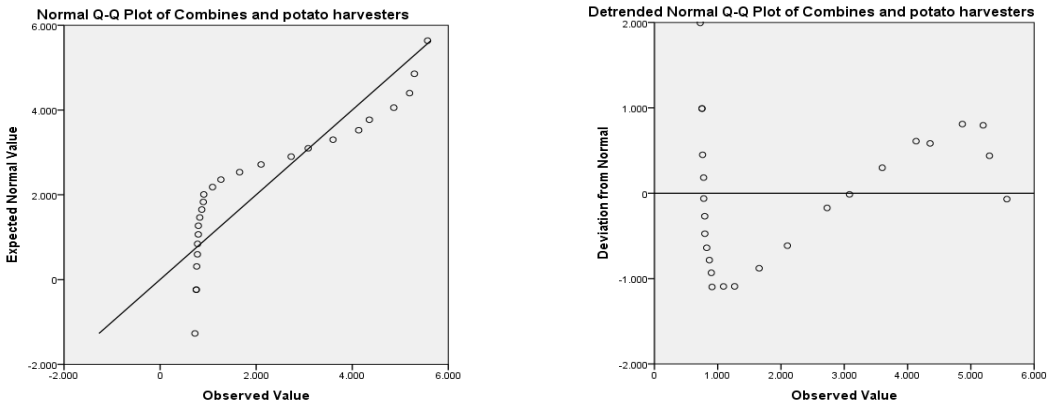


**Figure 8. Normal and detrended Q-Q Plot of potato harvesters**
*Source:* author's processing using IBM SPSS 24.

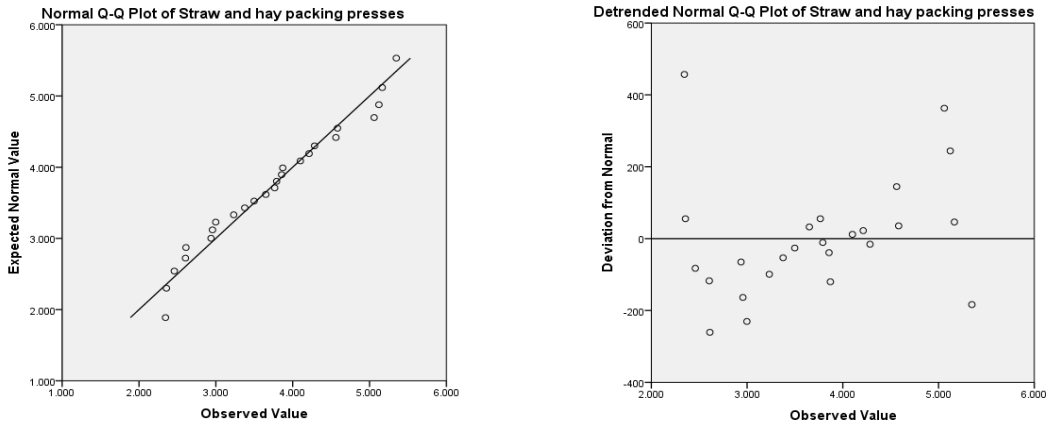


**Figure 9. Normal and detrended Q-Q Plot of straw and hay packing presses**
*Source:* author's processing using IBM SPSS 24.

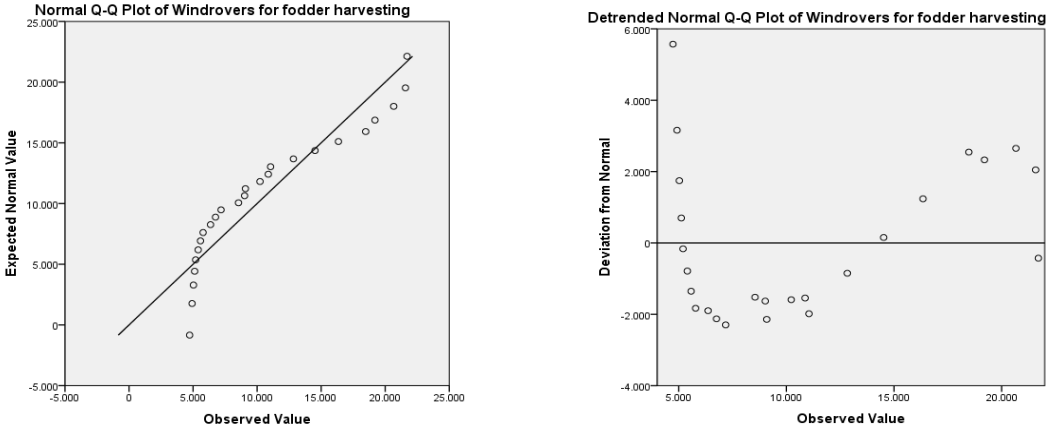


**Figure 10. Normal and detrended Q-Q Plot of fodder harvesting**
*Source:* author's processing using IBM SPSS 24.

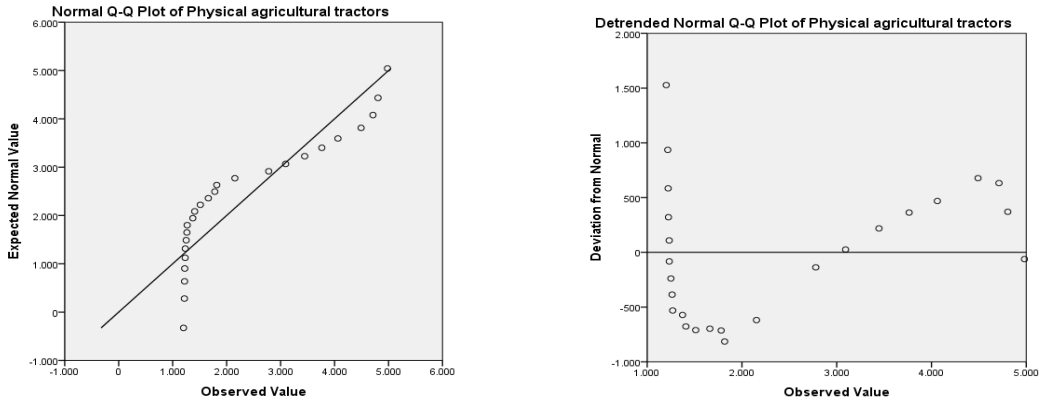


**Figure 11. Normal and detrended Q-Q Plot of agricultural tractors**
*Source:* author's processing using IBM SPSS 24.

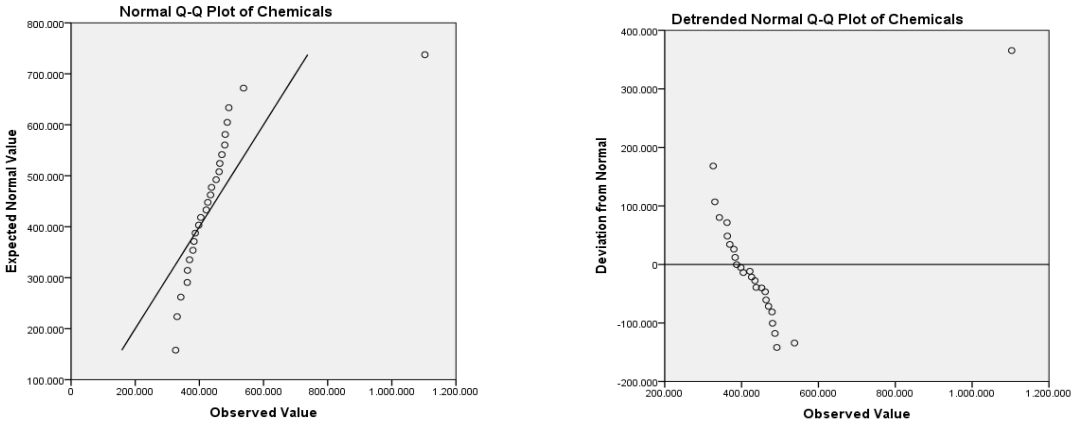


**Figure 12. Normal and detrended Q-Q Plot of chemicals**
*Source:* author's processing using IBM SPSS 24.

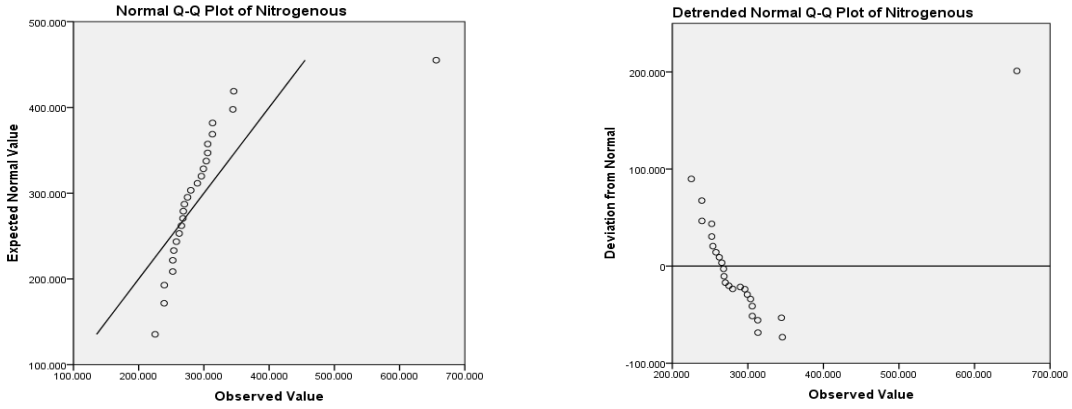


**Figure 13. Normal and detrended Q-Q Plot of nitrogenous**
*Source:* author's processing using IBM SPSS 24.

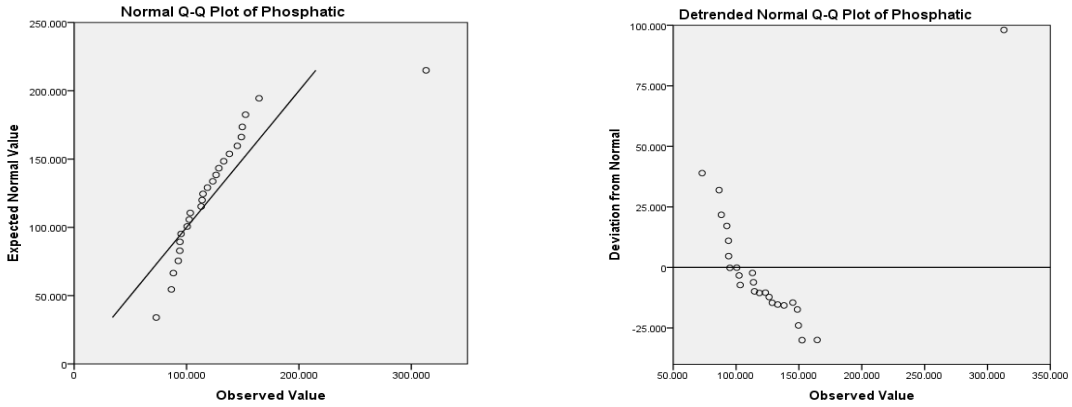


**Figure 14. Normal and detrended Q-Q Plot of phosphates**
*Source:* author's processing using IBM SPSS 24.

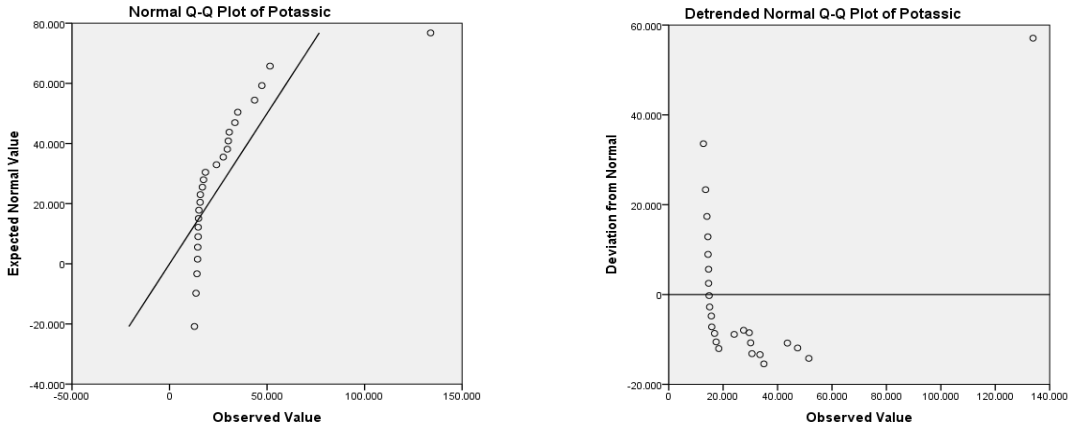


**Figure 15. Normal and detrended Q-Q Plot of potassium**
*Source:* author's processing using IBM SPSS 24.

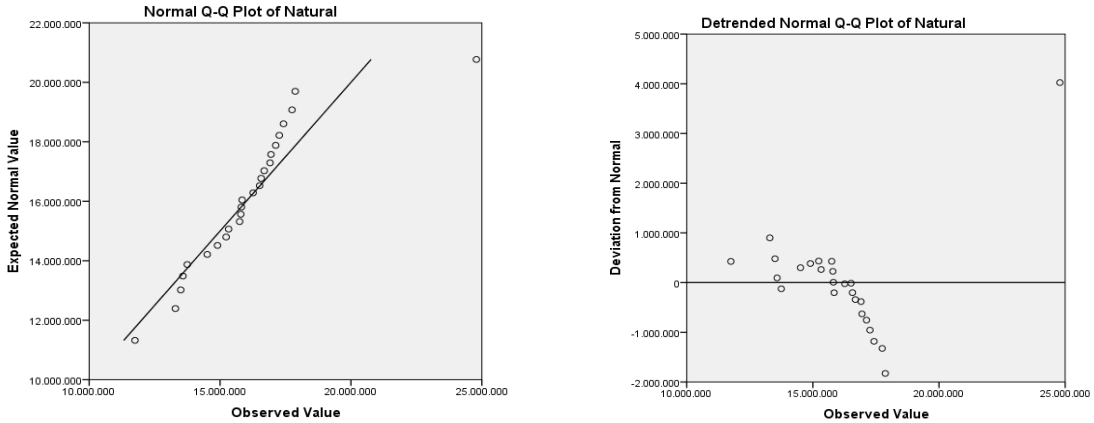


**Figure 16. Normal and detrended Q-Q Plot of natural fertiliser**
*Source:* author's processing using IBM SPSS 24.

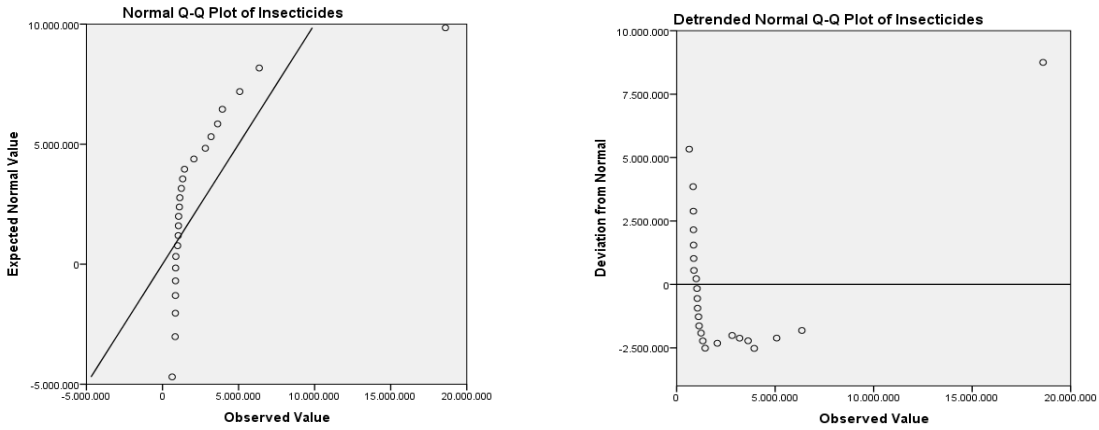


**Figure 17. Normal and detrended Q-Q Plot of insecticides**
*Source:* author's processing using IBM SPSS 24.

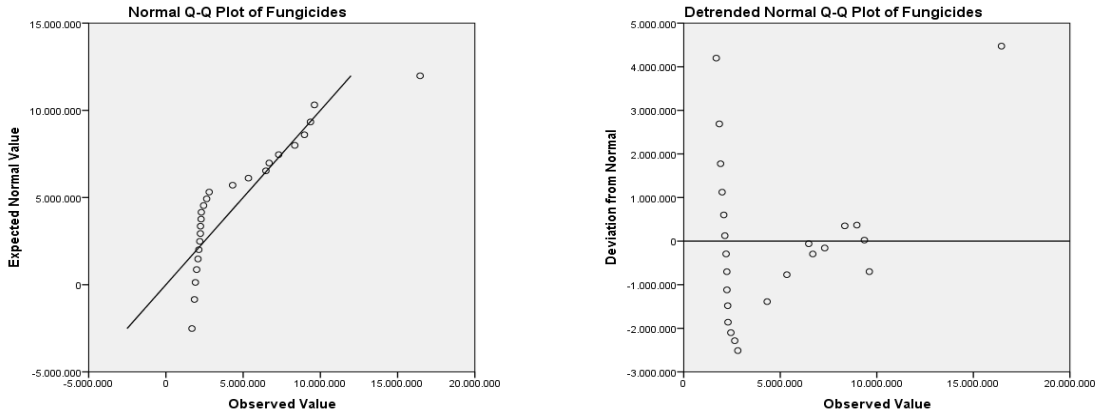


**Figure 18. Normal and detrended Q-Q Plot of fungicides**
*Source:* author's processing using IBM SPSS 24.

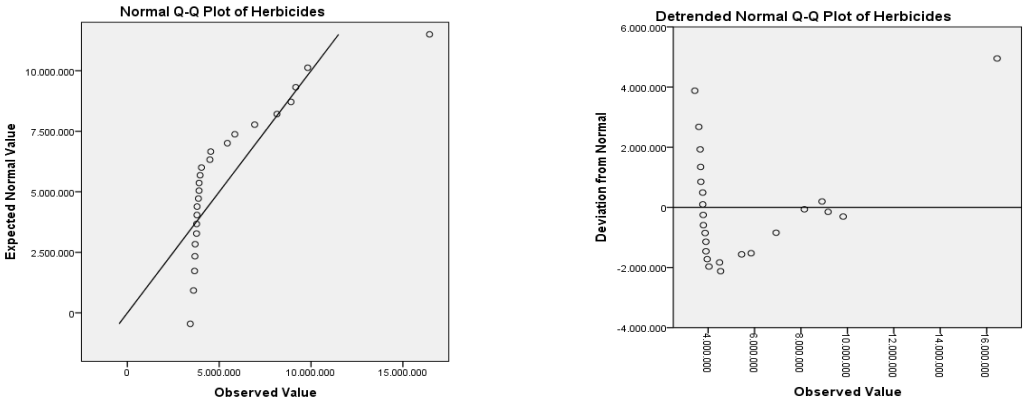


**Figure 19. Normal and detrended Q-Q Plot of herbicides**
*Source:* author's processing using IBM SPSS 24.