

## 4 Bulgaria

### 4.1 Introduction

The survey of Bulgarian phosphorus market was processed to investigate the situation concerning phosphate fertilizers in Republic of Bulgaria. The study describes the most important players on the market and can serve as source of the information for potential new actors who want to enter the recycled products market.

The Bulgarian phosphorus market structure was mapped in several steps. In first step the data about phosphorus import and export in country were collected. This data was obtained from Bulgarian Statistical Institute and processed for phosphorus containing fertilizers. This overview presents the first rough picture of the phosphorus flows across the country.

In second step the key actors relating to the phosphorus market were found and the situation in Bulgarian market was described. The actors were divided into several groups according to their role on the market (producer, importer, wholesaler, retailer). The information from key players was obtained through questionnaires and email communication. In last step the price ranges of TSP were investigated and analysed. The areas of phosphorus application were also studied next to these main steps.

Phosphorus is applied predominantly in the agricultural industry sector of in Bulgaria. Agriculture is an important element of national economy. Bulgaria has a long tradition in the cultivation of crops, especially cereals, vegetables and vines due to the favorable climate and fertile soil. Agriculture has average annual contribution 10% to the GDP

Bulgaria does not have any phosphorus resources and is dependent on imports. Recycled mineral phosphorus products are neither produced nor used in Bulgaria. Mineral phosphates fertilizers are imported or directly produced in Bulgaria. The prices of rock phosphates and its quality could be the main driving force for creation of the recycled phosphorus market branch. One plant in Varna run by Ecophos is capable of using secondary phosphorus-containing material and low quality rock to produce animal feed phosphate, fertilisers or high grade phosphates.

Currently there are several significant fertilizer producers in Bulgaria. These producers sell their products directly to the end-users but there is also a wide range of wholesalers and retailers in Bulgaria. The big competition among the most important actors is typical for Bulgaria. This was the reason of lack of information about the production of individual companies. All data is divided into several sections – Import of phosphate fertilizers, export of phosphate fertilizers and stakeholders overview.

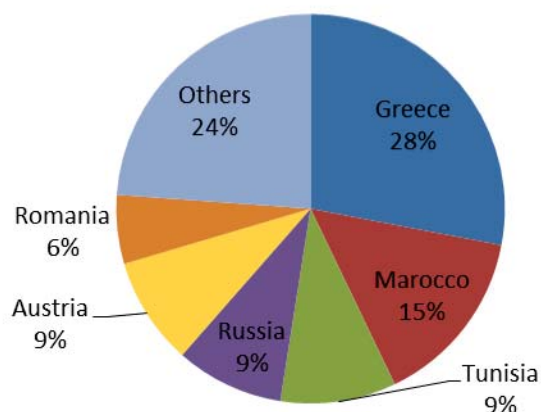
### 4.2 Import of phosphate fertilizers

The Republic of Bulgaria is dependent on phosphorus imports. Data from the Bulgarian statistical institute were used to gain information about imports, production and application of phosphate fertilizers.

Fertilizers are divided based on the nutrient content in the material.

- One component fertilizers, only containing phosphorus
- Complex fertilizers containing more nutrients, can be divided into:
  - Two – component fertilizers (NP, PK)
  - Three component fertilizers (NPK)

Many fertilizers are imported to Bulgaria. The major supplier is Greece, followed by Morocco (Figure 14).



**Figure 14: Fertilizers import into Bulgaria in t/a (Bulgarian Statistical Institute, 2011)**

NP fertilizers represent over 34% and NPK fertilizers over 30 % of total phosphate fertilizer imports (Table 14; details in Annex A). The imports of NP fertilizers corresponds to 11 kg of NP fertilizer /inhabitant/a or 16 kg/ha of agricultural land/a. The total imported amount of phosphate fertilizers are 240'000 t/a (33 kg/inhabitant or 47 kg/ha of agricultural land/a). Overall, complex fertilizers make up 91% of the imports.

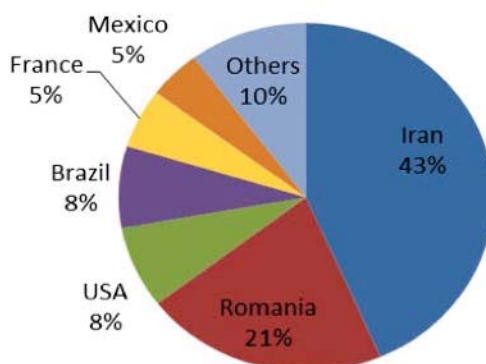
**Table 14: Amount of fertilizers imported into Bulgaria annually (t/a) (Bulgarian Statistical Institute, 2011)**

| Fertilizer type |                      | Share of total (%) | Relative volume (kg/ habitant/a)* | Relative volume (kg/ ha of agricultural land/a)** |
|-----------------|----------------------|--------------------|-----------------------------------|---|
| P fertilizers   |                      | 9.2                | 3.0                               | 4.3   |
| NPK fertilizers |                      | 30.4               | 10.0                              | 14.3  |
| NP fertilizers  | DAP                  | 16.4               | 5.4                               | 7.7   |
|                 | MAP                  | 9.2                | 3.0                               | 4.3   |
|                 | other NP fertilizers | 34.1               | 11.3                              | 16.0  |
| PK fertilizers  |                      | 0.8                | 0.25                              | 0.35  |

\*Bulgarian population: 7'262'675 inhabitants;\*\* Agricultural land: 5'101'000 ha

### 4.3 Export of the phosphate fertilizers

Bulgaria exports a great amount of phosphate fertilizers. These amounts are higher than the amount of imported fertilizers. The exported fertilizer is mainly one component fertilizers (superphosphates), which is sold to Iran (43%) and Romania (21 %) (Figure 15). Details can be found in Annex B



**Figure 15: Fertilizers export from Bulgaria in t/a (Bulgarian Statistical Institute, 2011)**

The total imported amount of phosphate fertilizers is 241'000 t/a. The relative volume of total fertilizers export was 73.9 kg/inhabitant/a or 105.2 kg/ha of agricultural land/a in 2012 (Table 15).

**Table 15: Amount of fertilizers exported from Bulgaria annually (t/a) (Bulgarian Statistical Institute, 2011).**

| Fertilizer type             |                      | Share of total (%) | Relative volume (kg/ habitant/a)* | Relative volume (kg/ ha of agricultural land/a)** |
|-----------------------------|----------------------|--------------------|-----------------------------------|---|
| One - component fertilizers |                      | 34.9               | 25.8                              | 36.7  |
| Multi-component fertilizers |                      | 32.6               | 24.1                              | 34.3  |
| NPK fertilizers             |                      | 0.6                | 0.43                              | 0.61  |
| NP fertilizers              | DAP                  | 6.8                | 5.1                               | 7.2   |
|                             | MAP                  | 8.9                | 6.55                              | 9.32  |
|                             | other NP fertilizers | 16.3               | 12.04                             | 17.14   |
| PK fertilizers              |                      | 0                  | 0.003                             | 0   |

\*Bulgarian population: 7 262 675 inhabitants; \*\* Agriculture land: 5 101 000 ha

The annual production of phosphate fertilizers is not known. The average phosphorus consumption in Bulgaria in the last 10 years is described in Table 16 in kg of phosphorus per ha of agriculture land.

**Table 16: Development of annual P consumption in kg/ha in the Republic of Bulgaria in the last 10 years (Eurostat, 2013)**

| <b>Year</b> | <b>P average consumption [kg/ha]</b> |
|-------------|--------------------------------------|
| <b>2002</b> | 1.86                                 |
| <b>2003</b> | 2.10                                 |
| <b>2004</b> | 2.55                                 |
| <b>2005</b> | 2.20                                 |
| <b>2006</b> | 2.20                                 |
| <b>2007</b> | 2.55                                 |
| <b>2008</b> | 2.65                                 |
| <b>2009</b> | 2.65                                 |
| <b>2010</b> | 3.33                                 |
| <b>2011</b> | 2.55                                 |
| <b>2012</b> | 4.11                                 |

#### 4.4 Summary

The total export of fertilizers containing phosphorus is higher than the total imports (Table 17). In 2011 the export of one-component fertilizer was more than eight times higher than the import. This shows that an important volume of one-component phosphorus fertilizer is produced in Bulgaria. In other categories

except DAP the import was higher compare to export.

The difference between import and export including also the fertilizers produced in the Republic of Bulgaria shows the consumption of fertilizers in Bulgaria.

**Table 17: Phosphate fertilizers import and export Republic of Bulgaria (Bulgarian Statistical Institute, 2011).**

| <b>Fertilizer type</b>             |                             | <b>Imported amount (t/a)</b> | <b>Exported amount (t/a)</b> |
|------------------------------------|-----------------------------|------------------------------|------------------------------|
| <b>One – component fertilizers</b> |                             | 22'000                       | 187'000                      |
| <b>NPK fertilizers</b>             |                             | 73'000                       | 3'100                        |
| <b>NP fertilizers</b>              | <b>DAP</b>                  | 37'000                       | 39'000                       |
|                                    | <b>MAP</b>                  | 48'000                       | 22'000                       |
|                                    | <b>other NP fertilizers</b> | 87'000                       | 82'000                       |
| <b>PK fertilizers</b>              |                             | 1' 800                       | 20                           |

## 4.5 Agriculture Stakeholders

The main actors on the phosphorus market are phosphorus importers and producers, wholesalers, retailers, farmer coops and individual farmers.

Two fertilizer producers, Neochim PLC, and Agropolychim JSC dominate the Bulgarian fertilizer market. They act as wholesalers and retailers (Table 18). There are four other important wholesalers and many other smaller ones. A lot of wholesalers import part of their products from abroad, but Neochim PLC and Agropolychim JSC sell only their own products. The network of retailers is quite large but no retailer provides data about their fertilizer sales.

**Table 18: List of contacted companies in Bulgaria**

| Company          | Importer | P-Producer | Fertilizer Producer complex | Fertilizer Producer blend | Wholesaler | Retailer | Farmers coop | Farmer |
|------------------|----------|------------|-----------------------------|---------------------------|------------|----------|--------------|--------|
| Neochim PLC      |          |            |                             |                           |            |          |              |        |
| Agropolychim JSC |          |            |                             |                           |            |          |              |        |
| Agricola         |          |            |                             |                           |            |          |              |        |
| Kompaktpak Ltd   |          |            |                             |                           |            |          |              |        |
| Bulagro AD       |          |            |                             |                           |            |          |              |        |
| A-Agro Ltd       |          |            |                             |                           |            |          |              |        |

## 4.6 Role of individual participants of the market

Importers import raw phosphorus materials or fertilizers from different countries to Bulgaria. In general, only the fertilizer producers import phosphorus raw material. Importers of the final fertilizers are mainly wholesalers, who also offer their products directly to the end users.

Fertilizer producers process the raw phosphorus materials to the different kinds of fertilizers. They provide products to the market (wholesalers, retailers).

In the past there were four important fertilizers producers in Bulgaria. Two of them, Agrobiochim and Chimco, have already stopped their production (Agrobiochim in 1999 and Chimco in 2004). Agropolychim and Neochim belong to the most significant ones. Currently they are producing the most significant amount of fertilizers. They also act as distributors to the end users. They play an important role in the wholesale and retail step, but the market also counts of many other companies. Wholesalers and retailers were contacted, but none of them wanted to share information about their production.

The companies were afraid to share any information concerning their production and position on the market due to the hard competition on the Bulgarian market. Retailers buy different kinds of fertilizers from the wholesaler or producer and pass them to the farmer coops and farmers. The retailers were not able to provide any relevant information. A short introduction of each company is presented in Annex B.

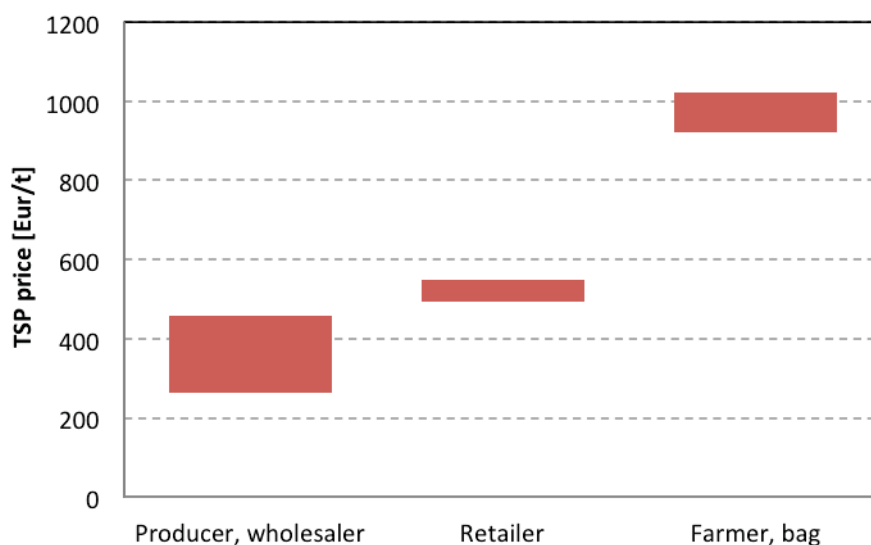
#### 4.6.1 Farmer cooperations, farmers

Some farmers use the recycled products in the form of biofertilizers (manure, sewage sludge – application of sewage sludge is possible in Bulgaria).

The total amount of dewatered sludge (dry substance) was 51'000 t/a from all Bulgarian communal wastewater treatment plants in 2011.

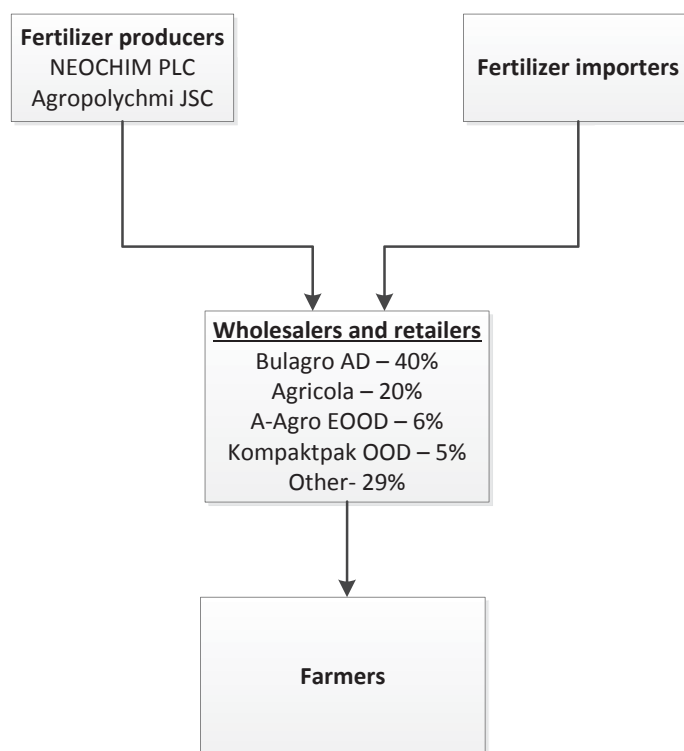
The farmers suppose that they will not use recycled phosphorus products in the near future they are afraid of recycling products. They do not trust the technologies to re from the waste). The main driver would be the new regulations.

The prices for triplesuperphosphate (TSP) are shown in Figure 16. High price difference between products from wholesaler and retailer can be observed. The prices represent only the agricultural market.



**Figure 16: TSP price paid by actors along the value chain in the Bulgarian fertilizer market (Bulgarian Statistical Institute, 2011)(Interviews, 2013)**

The most important actors on the fertilizer market were categorized according to their position on the market. Their share on the market was also added. Data were collected from individual companies.



**Figure 17: Overview of the different parts in the value chain in the Bulgarian fertilizer market**

The sector map in Figure 17 shows the dominance of the two major players in the Bulgarian fertilizer industry. Neochim and Agropolychim hold together about 90% of the total market shares. There are two larger wholesalers, Bulagro and Agricola, and several smaller companies which create all together over 40 % of the market. Fertilizers are used especially in agriculture sector. Only approximately 3 % of fertilizers are processed for application in hobby and sport facilities sector (Table 19).

**Table 19: Sector map of the phosphorus in the Bulgarian fertilizer market**

|                               |  |               |               |                    |            |
|-------------------------------|--|---------------|---------------|--------------------|------------|
| <b>Importer/<br/>producer</b> | NEOCHIM PLC; AGROPOLYCHIM JSC; both together create around 90 % of fertilizer market |               |               |                    |            |
| <b>Wholesaler</b>             | Bulagro 40 %   | Agricola 20 % | A-AGROEOOD 6% | Kompaktpak OOD 5 % | Others 29% |
| <b>Retailer</b>               | Many smaller companies with not significant share on the market                      |               |               |                    |            |
| <b>End-users</b>              | Agriculture 97%  |               |               |                    | Hobby 3 %  |

Knowledge about the information flows between the different actors of the value chain was collected.

Table 20 gives an overview of the requests of the different parts.

**Table 20: Information flow in value chain (data from company interviews)**

|                              |                               |                        |
|------------------------------|-------------------------------|------------------------|
| <b>Importer<br/>Producer</b> | <b>Wholesale<br/>Retailer</b> | <b>Farmer<br/>Coop</b> |
|------------------------------|-------------------------------|------------------------|

|   |                    |                   |
|---|--------------------|-------------------|
| Price   | Price              | Price             |
| Quality of the material   | Availability       | P-content         |
| Contaminant content (Cd, (50 g Cd/t P)),<br>purity of the product | Quality            | Verified supplier |
| Verified supplier   | Phosphorus content | Quality           |
| Delivery speed  | Delivery speed     |                   |
|   | Package size       |                   |

#### 4.7 Other Markets (except of agriculture)

Hobby market and fertilizers for sport facilities make up 2-3 % of the phosphate fertilizer market volume. These products are more expensive than agricultural ones.

#### 4.8 New market created for recycling?

There is no market for recycled mineral fertilizer products in Bulgaria yet.

#### 4.9 Conclusions

The market structure for phosphorus fertilizers and materials was examined in the Republic of Bulgaria. Data about phosphorus fertilizers export and import were obtained from the Bulgarian statistical institute. The total volume of P-containing fertilizers imported to Bulgaria is annually more than 240'000 t/a while exports are over 361'000 t/a.

A market survey revealed that there are only a few companies on the phosphate fertilizer market. The market is made up of two significant fertilizer producers (Neochim PLC, Agropolychim JSC) which also act as main wholesalers and distribute their products to the farmers and act as retailers as well. There are four other important wholesalers and many other smaller ones. A lot of wholesalers import their products also from abroad (except Neochim PLC and Agropolychim JSC which sell their own products). Additionally there is the Ecophos site in Varna, which is capable of producing 100'000 t of DCP/MCP each year. This production site used low-grade material and would also be capable of using ashes (Ecophos, 2014).

No company interviewed is currently using recycled phosphorus materials and these companies are not interested in the topic of phosphorus recycling. Data about recycled products are not known to the companies.



## 5 Czech Republic

### 5.1 Introduction

As many other countries in Europe the Czech Republic does not have any mineral phosphorus resources. The Czech Republic is totally depended on phosphorus import. Phosphorus is used especially in the area of agriculture (crops production and livestock) and food industry. The greater amount of phosphorus is applied in agriculture as fertilizers to guarantee a high yield. Fertilizers containing phosphorus are mostly imported and to some extent produced from imported phosphorus materials.

Recycled mineral phosphorus products are neither processed nor used in the Czech Republic. The whole phosphorus market consists of importing and processing of phosphorus-containing rock phosphate materials and fertilizers which are used in different agricultural and industrial fields. Our brief review is therefore focused on natural non – recycled mineral materials.

The net nutrient consumption of agricultural land supplied by mineral fertilizers was 93.1 kg/ha. This implies an overall consumption of 394'000 t/a fertilizers. Phosphorus consumption was 4.5 kg/ha referring to the agricultural land. That implies an overall phosphorus consumption of 19'000 t/a. Direct sludge application or via recultivation was 42'000 t/a.

At the 1<sup>st</sup> January 2011 1 923 fertilizers and additional soil conditioners were registered. The percentage ratio between national and imported fertilizers is 45/55. Furthermore, there are several EU fertilizers that are not necessary to register or label (ca. 25 - 30 % of all fertilizers).

Nitrogen fertilizers represent over 70% of the total fertilizer volume in the Czech Republic. Phosphorus fertilizers always were a minor product. Their market share decreased further the last years, due to the increasing prices of phosphates on the world market. For instance, one of the largest fertilizer producers stopped producing phosphate fertilizers in 2012.

The same methodology as for Republic of Bulgaria was used in the Czech Republic to investigate the Czech phosphorus market. The phosphorus market structure was mapped in several steps. In first step the data about phosphorus import and export in country were collected. This data was obtained from Czech Statistical Institute and processed both for raw phosphorus materials and phosphorus containing fertilizers.

In second step the key actors relating to the phosphorus market were found. The actors were divided into several groups according to their role on the market (producer, importer, wholesaler, retailer, farmer). The information from key players was obtained through questionnaires, email communication and interviews. In last step the price ranges of TSP were investigated and analysed.

There are several significant fertilizer producers and wholesalers in the Czech Republic. The most important wholesalers are grouped in AGROFERT holding. Some companies and their production will be described in the following text.

### 5.2 Import of the P-rich materials and products

As mentioned above, the Czech Republic is entirely depended on phosphorus imports. In the overview the total amount of imported phosphorus is divided into two groups raw phosphorus import and fertilizers import.

### 5.2.1 Raw phosphorus materials import

Rock phosphate rock reserves are concentrated in a small number of countries all over the world. The major players are currently China, US, Morocco + Western Sahara and Russia. The most important EU suppliers are Russia, Morocco, Tunisia, Finland and Syria.

Raw phosphorus is imported into Czech Republic mostly from Finland, Lithuania, Belgium, Russia, Netherlands, Kazakhstan, Germany, China and Italy. This shows that in most cases phosphorus is not directly imported into the Czech Republic from the country, where it was mined. The imported volumes vary depending on the different raw material categories.

Data from the Czech Statistical Institute (CSI) were processed for several categories of imported raw materials, which are used to produce fertilizers:

- Phosphoric acid –  $H_3PO_4$  is used for phosphate fertilizers production (i.e. superphosphate production)
- Calcium phosphate (in the category of chemical substances)
- Natural calcium phosphates (apatites, phosphorites) are grouped together with natural aluminum calcium phosphates and phosphatic chalk in the statistics. They represent the natural sources of phosphorus for further processing and fertilizers production

The total amount of raw phosphorus materials imported annually into the Czech Republic is about 23'000 tons. The largest share comes from Lithuania (31%), Finland (21%) and the Netherlands (16%). Calcium phosphate dominates in the imported volume (72%) and is followed by  $H_3PO_4$  (27 %; Figure 18; Annex B).

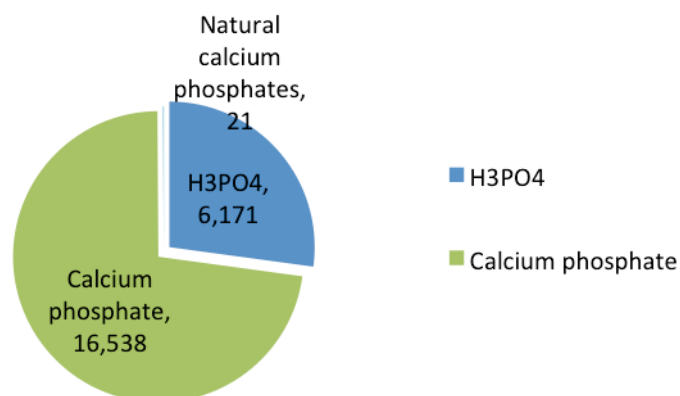


Figure 18: Import of various phosphorus rich material into the Czech Republic (Czech Statistical Institute, 2012)

### 5.2.2 Phosphate fertilizers import

Fertilizers can be divided into basic groups, based on the content of nutrients in the material.

- One component fertilizers: only containing phosphorus
- Complex fertilizers: containing several nutrients
  - Two – component fertilizers (NP, PK)
  - Three component fertilizers (NPK)

The majority of the fertilizers are, mainly imported from European countries (Poland – 31%, Austria – 16%, Lithuania – 12% and Russia – 16%; Annex B). About 85% of the imports are complex fertilizers. NP fertilizers represent 42% and NPK fertilizers 40% of total phosphate fertilizer imports (Table 21)

which corresponds to 5.8 kg of NPK fertilizer/inhabitant/a or 17.5 kg/ha of agricultural land/a. The total imported amount of phosphate fertilizers is 14.3 kg/inhabitant/a or 42.8 kg/ha of agricultural land/y.

**Table 21: Amount of fertilizers imported into the Czech Republic annually overview (Czech Statistical Institute, 2012)**

| Fertilizer type                      |                             | Share of total (%) | Relative volume (kg/ inhabitant)* | Relative volume (kg/ ha of agricultural land/a)** |
|--------------------------------------|-----------------------------|--------------------|-----------------------------------|---|
| <b>One component fertilizers (P)</b> |                             | 15                 | 2.2                               | 6.6   |
| <b>NPK fertilizers</b>               |                             | 41                 | 5.8                               | 17.5  |
| <b>NP fertilizers</b>                | <b>DAP</b>                  | 4.3                | 0.62                              | 1.8   |
|                                      | <b>MAP</b>                  | 21                 | 3.0                               | 9.1   |
|                                      | <b>other NP fertilizers</b> | 17                 | 2.4                               | 7.3   |
| <b>PK fertilizers</b>                |                             | 1.3                | 0.18                              | 0.54  |

\*Czech population: 10 516 000 inhabitants\*\*Agricultural land: 3 507 646 ha

Figure 19 gives an overview of phosphorus containing materials and fertilizers imports into the Czech Republic. Both the total imported amount and the percentage share are given. The total phosphate fertilizers import in 2012 was 150'000 t/a while raw phosphorus materials import only reached 23'000 t/a (less than one fifth of the fertilizers import).

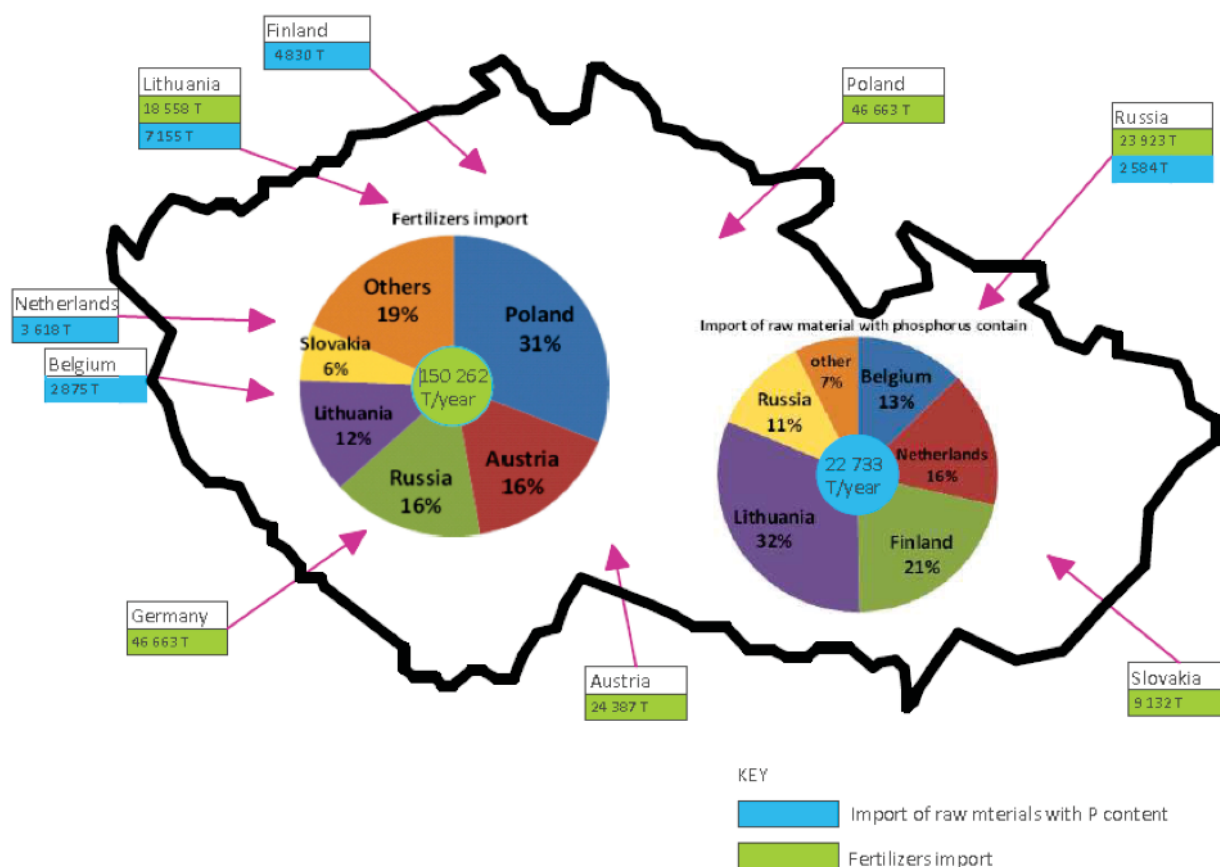


Figure 19: Import into the Czech Republic (fertilizers – left, raw material containing P – right) in overview (Czech Statistical Institute, 2012)

## 5.3 Export of the P-rich materials and products

### 5.3.1 Raw phosphorus export

In 2012 the total amount of exported raw phosphorus material was 34'000 t/y. Over 99% of the volume is phosphoric acid (Annex C). 65% of the material is exported to Germany, followed by Austria (10%). Less significant are Poland (5%), Hungary (4%) or Slovenia (4%) (Annex C).

### 5.3.2 Phosphate fertilizers export

A large amount of phosphate fertilizers are exported. The following data were obtained from CSI for the year 2012. The situation changed dramatically in 2013 as Lovochemie stopped producing and exporting phosphorus fertilizers.

The most significant volumes of P fertilizers were exported to Germany (56%) and Slovenia (33%) followed by Austria (7%) in 2012. The exported volume of NPK (11'000 ) represented 88% of total exported fertilizers amount (13'000 ) (Annex C).

Values for different types of fertilizers were processed separately with relative numbers. The relative volume of total fertilizers export was 1.21 kg/inhabitant/a or 3.6 kg/(ha of agricultural land\*a) in 2012 (Table 22)

**Table 22: Relative amount of fertilizers exported into the Czech Republic annually overview (Czech Statistical Institute, 2012)**

| Fertilizer type               |                      | Share (%) | Relative volume (kg/ inhabitant/a)* | Relative volume (kg/ ha of agricultural land/a)** |
|-------------------------------|----------------------|-----------|-------------------------------------|---|
| One component fertilizers (P) |                      | 2.2       | 0.03                                | 0.08  |
| NPK fertilizers               |                      | 88.4      | 1.07                                | 3.22  |
| NP fertilizers                | DAP                  | 0         | 0                                   | 0   |
|                               | MAP                  | 0.5       | 0.01                                | 0.02  |
|                               | other NP fertilizers | 8.9       | 0.11                                | 0.32  |
| PK fertilizers                |                      | 0.02      | 0                                   | 0   |

\*Czech population: 10 516 000 inhabitants \*\*Agricultural land: 3 507 646 ha

## 5.4 Summary

The exported volumes of phosphorus- containing raw materials exceeded the imported volumes in 2012 (Table 23). Especially the exported volume of  $H_3PO_4$  was more than five times higher than the imported volume. The reason for this phenomenon is the production of  $H_3PO_4$  in the Czech Republic which is only partly used for fertilizer production (e.g. triple superphosphate) or is further distributed abroad. Calcium phosphate is also used to produce  $H_3PO_4$ . The significant volume of this product is exported and it is also the reason of prevailed export of phosphorus materials.

**Table 23: Phosphorus materials import and export Czech Republic (Czech Statistical Institute, 2012)**

| Phosphorus source | Imported volume (t/a) | Exported volume (t/a) |
|-------------------|-----------------------|-----------------------|
| $H_3PO_4$         | 6'171                 | 33'817                |
| Calcium phosphate | 16'538                | 73                    |

Comparing imported and exported volumes of phosphate fertilizers (Table 24), the total import volume is much higher than the exported volume (over 11 times higher). However, the volume of exported MAP and other NP fertilizers is higher than import volume. The data are from the year 2012 when the important Czech fertilizer producer (Lovochemie) still produced and distributed NPK and NP fertilizers.

**Table 24: Phosphate fertilizers import and export Czech Republic (Czech Statistical Institute, 2012)**

| Fertilizer type                      |                             | Imported amount (t/a) | Exported amount (t/a) |
|--------------------------------------|-----------------------------|-----------------------|-----------------------|
| <b>One component fertilizers (P)</b> |                             | 23'000                | 300                   |
| <b>NPK fertilizers</b>               |                             | 61'000                | 11'300                |
| <b>NP fertilizers</b>                | <b>DAP</b>                  | 6'500                 | 0                     |
|                                      | <b>MAP</b>                  | 32'000                | 67'600                |
|                                      | <b>other NP fertilizers</b> | 26'000                | 1'100                 |
| <b>PK fertilizers</b>                |                             | 1'900                 | 2.2                   |

It is possible to calculate the amount of fertilizers consumed per year in the Czech Republic by subtracting the exported fertilizer from the imported fertilizer and adding the fertilizers produced in the Czech Republic. However, the fertilizer production in the Czech Republic is not statistically recorded. The total annual consumption in the Czech Republic has remained fairly constant the last ten years excepting a lower consumption following the price increases in 2009 (Table 25).

**Table 25: Development of annual phosphorus consumption in kg/ha of arable land in the Czech Republic in the last 10 years (Ministry of Agriculture, Czech Republic, 2012)**

| Year | Average consumption<br>(kg phosphorus/ha) |
|------|---|
| 2002 | 5.4                                       |
| 2003 | 5.1                                       |
| 2004 | 6.0                                       |
| 2005 | 5.1                                       |
| 2006 | 5.1                                       |
| 2007 | 6.7                                       |
| 2008 | 6.0                                       |
| 2009 | 1.9                                       |
| 2010 | 3.9                                       |
| 2011 | 4.9                                       |
| 2012 | 5.3                                       |

## 5.5 Agriculture – Stakeholders

The main stakeholders on the phosphorus market are importers and producers, wholesalers, retailers, farmer coops and individual farmers. A survey of the Czech phosphorus market revealed a large number of wholesaler and retailer representatives and several representatives of fertilizer producer groups. All important companies were chosen but only a few of them provide data about their phosphate business. The companies were chosen according to their importance on the market, regarding their annual turnover and type of production. Companies with annual turnover higher than 1'000'000 CZK (1EUR = 27 CZK) were considered as large. Several randomly selected companies with lower turnover were also taken into account. Some retailers and farmers were addressed to develop farmer's requirements for phosphorus fertilizers quality. Table 26 gives an overview of the companies as well as their field of work.

Nineteen companies were contacted during the survey. Three of them – Lovochemie, Fosfa and Silvamix are phosphate fertilizer compounders. Two of the addressed companies represent farmer coops (Patria Kobyly, BONAGRO). All others (14 companies) act on the market as wholesalers, retailers or fertilizer blenders.

An important holding in the Czech Republic agriculture sector is AGROFERT. This holding gathers important companies from many branches of the agricultural sector, including fertilizer wholesalers (ZZN Pelhřimov, ZZN Polabí, Agropodnik Domažlice, CEREAL, NAVOS, Primagra, AGRO ZZN, a.s., Agrona, a.s.) and the fertilizer producer Lovochemie. The AGROFERT holding as a whole did not provide information, but data were obtained from individual members.

### 5.5.1 Importer

Importers import raw phosphorus materials or fertilizers from different countries. In the case of raw material with P content, the importer is also the manufacturer of phosphate fertilizers (in the Czech Republic). Importers of the final fertilizers are very often wholesalers, which offer those products directly to the end users.

### 5.5.2 Phosphorus compounder

The producer processes the raw phosphorus materials to different kinds of fertilizers. Provides those products to the market (wholesalers, retailers).

In the Czech Republic 205 national and 235 international fertilizer producers are registered. Furthermore, another 35 national and 15 international fertilizer producers apply notification systems and 15 international producers utilized mutual fertilizer agreement between EU members.

The most important phosphate fertilizer producer in the Czech Republic was Lovochemie, which clearly dominated the Czech market. However, Lovochemie stopped the phosphate fertilizer production in 2012 (after 44 years) because of the interruption of phosphorus flow into the Czech Republic. Since 2012 the import of phosphate fertilizers began to dominate the market. Other less significant producers of phosphate fertilizers are FOSFA and Ecolab (Silvamix). The important fertilizer producer Yara Agri (Norway) imports its phosphate products to the Czech market (through its subsidiary Yara Agri Czech Republic).

**Table 26: List of contacted companies in the Czech Republic**

| Company                    | Importer | P-compound producer | Fertilizer compounder | Fertilizer blender | Wholesaler | Retailer | Farmers coop | Farmer |
|----------------------------|----------|---------------------|-----------------------|--------------------|------------|----------|--------------|--------|
| Lovochemie                 |          |                     |                       |                    |            |          |              |        |
| Fosfa                      |          |                     |                       |                    |            |          |              |        |
| Silvamix                   |          |                     |                       |                    |            |          |              |        |
| YaraAgri                   |          |                     |                       |                    |            |          |              |        |
| AGRO CS                    |          |                     |                       |                    |            |          |              |        |
| ZZN Pelhřimov              |          |                     |                       |                    |            |          |              |        |
| ZZN Polabí                 |          |                     |                       |                    |            |          |              |        |
| Agropodnik Domažlice       |          |                     |                       |                    |            |          |              |        |
| CEREA                      |          |                     |                       |                    |            |          |              |        |
| NAVOS                      |          |                     |                       |                    |            |          |              |        |
| Primagra*                  |          |                     |                       |                    |            |          |              |        |
| AGR OZZN, a.s.*            |          |                     |                       |                    |            |          |              |        |
| Agrona, a.s.*              |          |                     |                       |                    |            |          |              |        |
| HOKR, spol.s.r.o.*         |          |                     |                       |                    |            |          |              |        |
| ACHP Slavkov *             |          |                     |                       |                    |            |          |              |        |
| Agropodnik a.s. Jičín*     |          |                     |                       |                    |            |          |              |        |
| Agropodnik Hradec Králové* |          |                     |                       |                    |            |          |              |        |
| Patria Kobyly              |          |                     |                       |                    |            |          |              |        |
| BONAGRO                    |          |                     |                       |                    |            |          |              |        |

– \* Lack of data about production

### 5.5.3 Wholesaler

In general, there are a lot of small and medium size wholesalers in the Czech Republic. Three medium size (annual turnover is more than 2'500'000 CZK) companies – NAVOS (for Moravia), ZZN Polabí and ZZN Pelhřimov (for Bohemia) are the most important. There are also at least 30 smaller companies (with annual turnover less than 500'000 CZK) that focus on import of fertilizers. Some wholesalers are grouped



together or owned by a larger organization. The important ones are AGROFERT Holding and ZZN companies which includes 12 agricultural companies. Wholesalers also often act as retailers in Czech Republic and sell their products directly to the farmers or farmer coops.

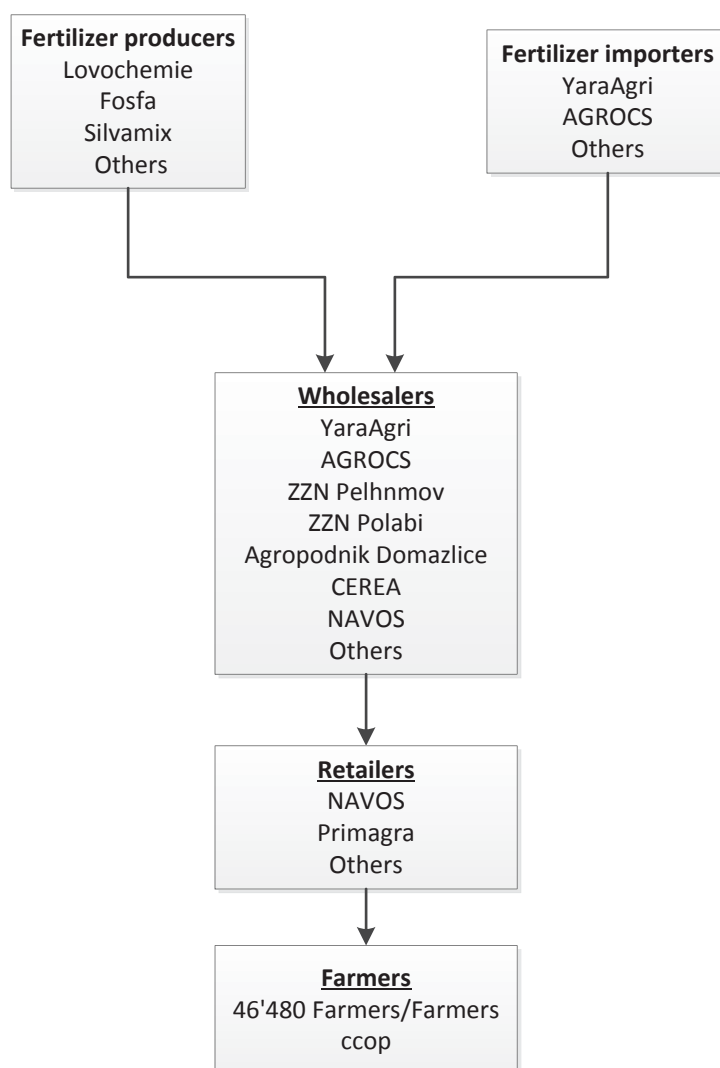
#### 5.5.4 Retailer

A retailer is the participant of the market who buys different kinds of fertilizers from the wholesaler or producer and sells it to the farmer coops and farmers. None of the contacted retailers were able to provide data. Some wholesalers sell their products directly to the farmers and act also as retailers in the Czech Republic.

#### 5.5.5 Farmer coops, farmers

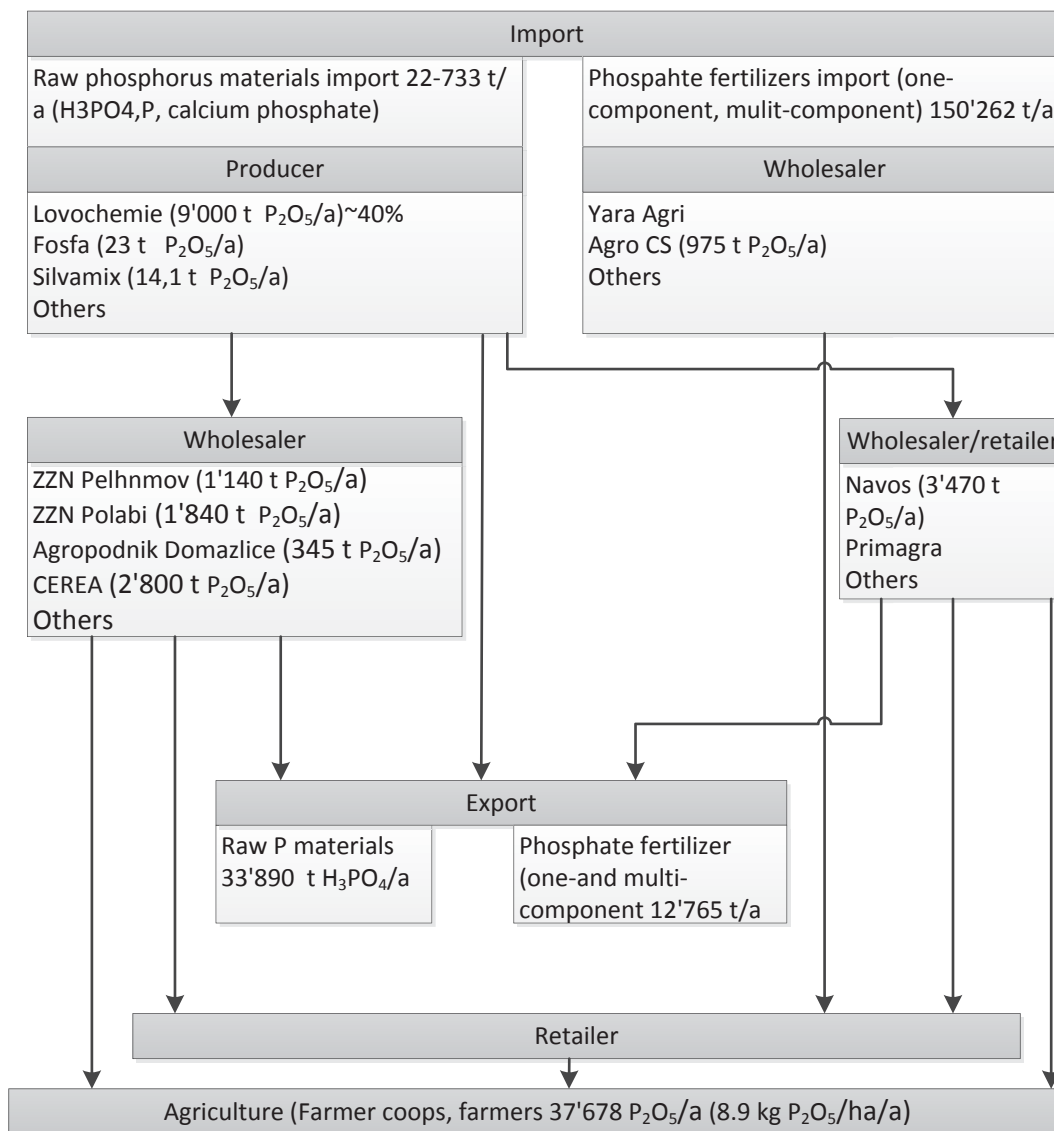
There are 46'000 farmers and agricultural companies that control 3'507'000 ha of agricultural land, of which 2'532'000 ha is arable.

This study also approached farmers in order to understand important parameters and requirements from an end-users point of view. Some farmers recycle phosphorus in the form of organic materials such as manure or sewage sludge. Application of sewage sludge is possible in the Czech Republic (Ordinance 382/2001 Sb). Using recycled phosphorus products in the near future does not seem to be likely from a farmer's point of view. These answers were reinforced by farmers around Brno and south Moravia.



**Figure 20: Overview of stakeholders on Czech fertilizer market (based on data from questionnaires, 2012)**

The various steps of the value chain are shown in Figure 20. The products from fertilizer producers and importers are shifted directly to the wholesalers and retailers. Retailers sell their goods to the farmers (or farmer coops). Some companies are listed in several groups because they fulfill several roles in the value chain. The listed companies were willing to answer questions about their role on the market. They represent only a part of the phosphate fertilizer market which counts many actors. Information from this chapter and the phosphorus flows on the Czech market were summarized (Figure 21).

**Figure 21: P flow in Czech fertilizer market (Czech Statistical Institute, 2012)(questionnaires, 2012) – amount expressed as  $P_2O_5$  volumes**

A sector map of phosphorus in the Czech fertilizer market was prepared (Figure 22). The share of individual companies is not listed. The Czech phosphorus fertilizer market consists of many actors who were not able to provide data about their market share because it is not known to them. Many companies responded that the market is still changing and companies are merging, etc. In general, the companies do not have information about the production volume of their competitors.

|                               |   |                                 |                                    |   |
|-------------------------------|---|---------------------------------|------------------------------------|---|
| <b>Importer/<br/>producer</b> | LOVOCHEMIE, YaraAgri, FOSFA, SILVAMIX, share of individual products: LOVOCHEMIE 0%<br>(stopped production last year, others: do not provide this information) |                                 |                                    |   |
| <b>Wholesaler</b>             | NAVOS leader in<br>Moravia  | ZZN POLABÍ<br>leader in Bohemia | ZZN Pelhřimov leader in<br>Bohemia | Others at least 30 smaller<br>companies |
| <b>Retailer</b>               | Many companies, each without significant share on the market  |                                 |                                    |   |
| <b>End-users</b>              | Agriculture 95 - 97 %   |                                 |                                    | Hobby 3-5 %                             |

**Figure 22: Sector map of the phosphorus in the Czech fertilizer market.**

Information about flows between each step in the value chain was processed (Table 27). Different actors in the value chain (importers, producers, wholesalers, retailers and farmers) were asked what they need to know from the step before and after which is summarized in one table.

**Table 27: Information flow in value chain (data from company interviews)**

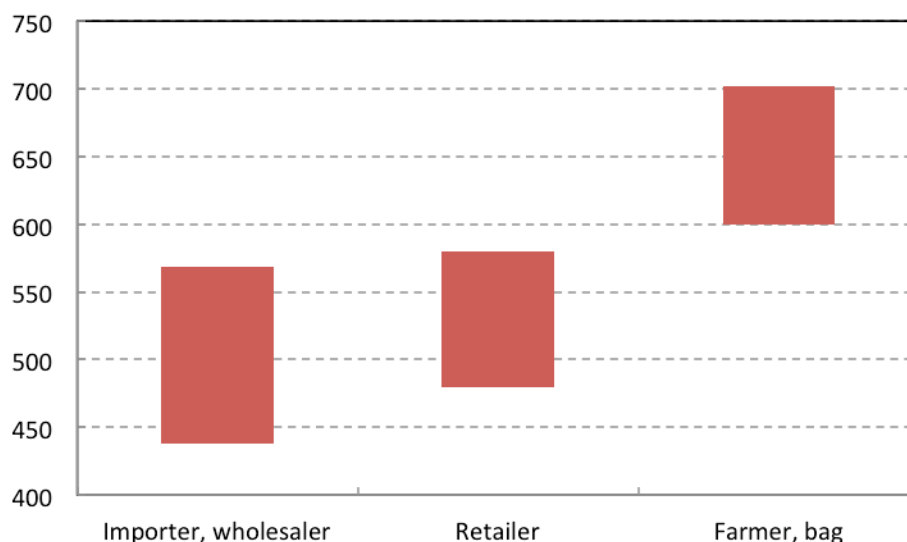
| <b>Importer<br/>Producer</b>            | <b>Wholesaler<br/>Retailer</b> | <b>Farmer<br/>Farmers Coop</b> |
|---|--------------------------------|--------------------------------|
| Price                                   | Price                          | Price                          |
| P- content                              | Availability                   | P-content                      |
| Quality                                 | Package size                   | Verified supplier              |
| Contaminant content (Cd, (50 g Cd/t P)) | Delivery speed                 | Quality                        |
| Verified supplier                       | Quality                        |                                |
| Package size                            |                                |                                |
| Delivery speed                          |                                |                                |

## 5.6 Fertilizer companies in Czech Republic

An overview of the collected information from the companies is given in the charts in the Annex D. Prices of TSP (Triple superphosphate) paid by stakeholders along the market chain were evaluated, considering data from CSI and individual stakeholders (wholesalers, retailers). Presented prices are presented for agricultural fertilizers (Figure 23).

## 5.7 Other Markets (except agriculture)

Hobby market and fertilizers for sport facilities represent about 3 – 5 % of phosphate fertilizer sales volume. These products are more expensive than agricultural ones. The reason is especially the packaging of small volumes (3 – 25 kg), which increases the price. This kind of fertilizers is predominantly imported to the Czech Republic.



**Figure 23: TSP price paid by stakeholders along the value chain in the Czech Republic (Czech Statistical Institute, 2012) (Individual stakeholders)**

## 5.8 Conclusions

The market structure of the phosphorus- containing fertilizers and materials were examined in the Czech Republic. Data about phosphorus fertilizers export and import were obtained from Czech statistical institute and processed. The total volume of fertilizers containing P imported into the Czech Republic is more than 150'000 t/y while the exported amount is over 12'000 t/y. The average annual phosphorus fertilizer consumption was 5.3 kg phosphorus/ha in 2012.

Producers, wholesalers and several farmers were contacted. The market survey revealed several important actors on the phosphate fertilizer market, although data were provided only by some of the contacted companies. The data showed that LOVOCHEMIE was the dominant fertilizers producer and wholesaler, but they have now stopped producing phosphate fertilizers. Currently the market is supplied by many smaller fertilizer producers (fertilizer compounders and blenders) and especially fertilizer importers.

No company is using recycled mineral phosphorus materials and only few of them are interested in phosphorus recycling. The greatest interest is coming from the fertilizer producers. But they find the recycled phosphorus products too expensive and think that the production in the Czech Republic cannot cover their consumption. The reasons for the low interest in phosphorus recycling is for instance the lack of information about this topic, social barriers and no pressure to use of this products. The introduction of the recycled product on the market will be associated with many obstacles. Customers are expected to be suspicious of recycled products as in the case of every newly implemented technology and good marketing with successful case studies will be key factor to enter market with recycled fertilizers. Actors will see more risks than benefits and they may be right because none of the products being evaluated in P-REX can offer real benefits to the end user – at best recycled products will be as effective as conventional fertilizers and recycled phosphates are not expected to increase the crop yields. A successful entrance of recycled products into the market is tightly connected with implementation of novel legislation.

## 6 Germany

### 6.1 Fertiliser Producers in Germany

Fertiliser production capacities in Germany have been in continuous decline since production and sales peaked in the seventies and eighties of the last century. However, relevant nitrogen and potassium capacities exist and may be conserved at the current production levels.

YARA, BASF (in cooperation with EuroChem Agro) and SKW Piesteritz are world scale producers of nitrogen fertiliser, YARA and BASF based on ammonium and SKW based on urea. K+S AG is a world scale producer of potassium fertilisers, produced from potassium ore mined in Germany. ICL, in turn, is a vertically integrated, world scale producer of phosphate and potassium fertilisers but its manufacturing capacities in Germany are confined to phosphate fertilisers and they are relatively small (Figure 24).

In Germany, no primary phosphate resources exist. All rock phosphate concentrates must be imported and thus no natural incentives exist to set-up relevant phosphate fertiliser capacities in Germany.



Figure 24: N and P fertiliser production in Germany locations and capacities

#### 6.1.1 Phosphate fertiliser Producers

Each year ICL Fertilizers (

Table 28) produces approximately 5 million tonnes of potash at Dead Sea Works, Israel; Iberpotash, Spain; and at Cleveland Potash, UK. The 4 million tonnes of rock phosphate mined at the Zin, Arad and Oron mines in Israel are used for the production of 1.7 million tonnes of granular fertilizers and 550,000 tonnes P<sub>2</sub>O<sub>5</sub> of phosphoric acid. ICL Fertilizers' phosphate mining operations in Israel, along with its fertilizer production facilities at Rotem, Israel, ICL Fertilizers Deutschland GmbH and at ICL Fertilizers Europe C.V., creates a wide array of phosphate fertilizers.

**Table 28: Phosphate fertiliser companies and capacities in Germany**

| Company  | Location   | Capacity in 1000 t product |
|--|--|----------------------------|
| ICL Fertilisers Deutschland GmbH   | ICL Fertilisers Deutschland GmbH<br>Giulinistr. 2<br>67065 Ludwigshafen/Rh<br>www.iclfertilizers.com | 275                        |
| Total  |  | 275                        |
| <p>Range of products: a complete range of mainly solid P, PK and NPK fertilisers from own fully or partly digested rocks and own potash mines in different countries.</p> <p>Remarks: ICL keeps its doors wide open for cooperation with producers of recovered phosphates and intends to install an ash feeding facility in its Amsterdam facilities. However, tests performed in cooperation with Technical University Darmstadt and published in the PhD Thesis of Sebastian Petzet exhibit relevant drawbacks if secondary sources with high iron concentrations, such as most sewage sludge ashes, are used as raw material (Petzet, 2012).</p> |  |                            |

“ICL Fertilizers Europe handles the entire operation of ICL Fertilizers group in Europe, including the production, logistics and trade. ICL Fertilizers Europe is in charge of all European facilities, which include the potash production sites of CPL in the UK and of Iberpotash in Spain, as well as of the fertilizers production sites of ICL Fertilizers Europe C.V. in Amsterdam and Ludwigshafen” (ICL Europe, 2014).

ICL Fertilizers Deutschland provides German customers with a broad selection of quality fertilizers for agriculture, in multiple grades and formulations, and animal feed.

ICL is participating in most of the European phosphate recycling initiatives and a legitimate spokesman has declared that the Ludwigshafen plant would accept and test minearal, preferably ash-based, secondary phosphate products. Other secondary products could be studied case by case but high levels of organic compounds are currently refused. Thus, ICL could be easily addressed with mineral recycled products.

This explicit invitation to recyclers is based on the limitations of the Negev mines with an estimated remaining lifetime of a few decades. To keep the European manufacturing plants operational, secondary resources should replace rock phosphate.

ICL feeds secondary phosphates to the rock phosphate concentrate, without heavy metal removal. As long as the admixture is for test purposes and represents a limited mass fraction, no negative impacts are expected on the product quality and the manufacturing process. Larger admixture rates of secondary phosphates derived from sewage sludge, for instance >10% may lead to relevant quality problems (lower water solubility because of Fe- and Al-phosphates from the reaction of Fe- and Al compounds in the sludge ash with sulphuric acid, used for acidulation in the fertiliser).

Nippon Phosphoric Acid Inc., as an example, is pursuing a similar approach to admix phosphate rich ash to the production line, feeding ash to rock phosphate before the mix reacts with sulphuric acid. After ex-

tensive tests Nippon Phosphoric Acid limits the admixture of ash to 1% of the total mass flow and does not see a potential for more than 3% of sewage sludge ash in the best of all possible scenarios. In addition, only ashes low in iron are acceptable which totally excludes ash from sewage works using iron precipitation.

Producers of secondary phosphates approaching ICL (or any other vertically integrated phosphate producer) should be aware that the market price of rock phosphate and the expenses for mining and beneficiation may be quite different. A vertically integrated phosphate producer as ICL would rather not base the purchasing price calculation on the market price but on his landed cost of rock phosphate. Discounts for lower phosphate concentration, impurities, more acid consumption, higher wear of the equipment, etc. will be applied so that sewage sludge incinerator operators should be aware of the limited potential of their ash to achieve a relevant positive market price.

An additional disadvantage of the simple “admixture” approach is that acids being necessary and used for making the product water soluble and easily available to crops not only mobilize the phosphates but also the heavy metals such as cadmium and lead.

Using ash for direct admixture to rock in conventional phosphate fertiliser plants clearly represents a dilution of pollutants being present in different concentrations in both starting materials. According to most waste management acts in Europe this may be considered as an illegal practice. Regulators need to determine to what extent such dilution is acceptable with regard to phosphate recycling.

### **6.1.2 Nitrogen Fertiliser Producers**

In contrast to only one P-fertiliser manufacturer, eight N-fertiliser producing companies from seven different industrial concerns (Yara is present with two manufacturing plants in Brunsbüttel and Rostock) are operating in Germany (Table 29). Only one of these companies, Yara, has (limited, producing about 300.000 t of  $P_2O_5$  per year) primary phosphate resources, to which the same rule as explained in the previous chapter would apply.



**Table 29: Nitrogen fertiliser companies and capacities in Germany (Industrieverband Agrar, 2012) modified**

| Company  | Coordinates   | Capacities in 1000 t product |
|--|---|------------------------------|
| ALZCHEM AG   | AlzChem AG<br>Dr.-Albert-Frank-Str.32<br>83308 Trostberg  | 145                          |
| <p>Products: Calcium cyanamide (“Kalkstickstoff”), N=20%, CaO=&gt;50%; special composition N fertiliser.</p> <p>Remark: Opportunity for P-recyclers, water soluble P carriers difficult to blend with calcium cyanamide because free acids contained in the acidic P-carrier (e.g. TSP) react with the N-carrier and reduce solubility.</p>  |   |                              |
| Company  | Coordinates   | Capacities in 1000 t product |
| EuroChem Agro (products manufactured by BASF and EuroChem Antwerp).  | EuroChem Agro GmbH<br>Reichskanzler-Müller-Straße<br>23<br>68165 Mannheim<br>www.eurochemagro.com | 975                          |
| <p>Products: Ammonium nitrate based N, N+S, NP and NPK as well as stabilised nitrogen fertilisers with and without trace elements.</p>   |   |                              |
| COMPO GmbH & CO. KG  | COMPO GmbH & Co. KG<br>Gildenstr. 38<br>48157 Münster<br>www.compo.com                            | 250                          |
| <p>Products: Solid and liquid NPK fertilisers for hobby and professional gardeners, golf green keepers and turf and public green keepers. About 50% of 400 MEUR sales to hobby and 50% to professional users. Innovative product line, nicely packed and all products sold under COMPO brand.</p>  |   |                              |
| DOMO CAPROLEUNA GmbH   | DOMO Caproleuna GmbH<br>Am Haupttor – Bau 3101<br>06234 Leuna<br>www.domochemicals.com            | 250                          |
| <p>Products: Solid and liquid ammonium-sulphate fertilisers (DOMOGRAN 45 N+S=21%+24% and DOMAMON 26 N+S=20%+6%) as a by-product from caprolactam production.</p> <p>Remark: Opportunity for P-recyclers because of intention to produce NP fertilisers in the future. Water soluble P-carriers are difficult to blend with ammonium-sulphate because free acids contained in the acidic P-carrier (e.g. TSP) react with the N-carrier and reduce solubility.</p> |   |                              |



| Company   | Coordinates  | Capacities in 1000 t product |
|---|--|------------------------------|
| INEOS Köln GmbH   | INEOS Köln GmbH<br>Alte Straße 201<br>50769 Köln<br>www.ineoskoeln.de  | 35                           |
| Products: Nitric acid and ammonium sulphate as petrochemical (by-)products from naphtha and natural gas processing.   |  |                              |
| SKW STICKSTOFFWERKE Piesteritz GmbH<br>(except technical, liquid, complex fertilisers)  | SKW Stickstoffwerke Piesteritz GmbH<br>Möllendorfer Straße 13<br>06886 Lutherstadt Wittenberg<br>www.skwp.de | 600                          |
| Products: Largely urea based solid and liquid N, N+S, NP and NPK as well as stabilised nitrogen fertilisers with and without trace elements. N fertilisers based on urea, ammonia and nitrate N.<br>Remark: Opportunity for P-recyclers, company aims at replacing rock phosphate by secondary phosphates for NP and NPK fertilisers. Water soluble, acid based fertilisers are very difficult to blend with urea based fertilisers because free acids contained in the acidic P-carrier (e.g. TSP) react with the N-carrier and reduce solubility. |  |                              |
| YARA Brunsbüttel GmbH (fertilisers and technical N)   | YARA Brunsbüttel GmbH<br>Holstendamm 2<br>25535 Brunsbüttel<br>www.yara.de                                   | 600                          |
| Yara Rostock (subsidiary of Yara GmbH & Co. KG))  | YARA GmbH & Co. KG<br>Werkstr. 98<br>18184 Poppendorf<br>www.yara.de   | 1.500                        |
| YARA GmbH & CO. KG (German headquarters of Yara)  | YARA GmbH & Co KG<br>Hanninghof 35<br>48249 Dülmen<br>www.yara.de  |                              |
| Products: Largely ammonia based solid N, N+S, NP and NPK as well as stabilised nitrogen fertilisers with and without trace elements.<br>Remark: Yara is committed to quality fertilisers. Sludge ash is not considered as a suitable feedstock for its ammonia based acidulation process. Ash from feedstock with fewer impurities (e.g. animal by-products) may be considered if available.  |  |                              |
| TOTAL   |  | 4.355                        |

Yara's development is rooted in that of Norwegian industrial firm Norsk Hydro, which dates back to 1905. That's when industrialists tapped into Norway's large hydro energy resources to produce the company's first important product: mineral nitrate fertilisers, which attracted attention from all over the world since it enabled farmers to boost their yields.

Almost a century later, after Norsk Hydro itself had expanded into a vast array of businesses from fertilizers to oil to metals, the division mostly devoted to agricultural products and co-products was spun off into its own stock listed entity. Yara International ASA debuted on the Oslo Stock Exchange in 2004 and since then has further expanded and acquired a number of other fertiliser businesses, among them Finnish Kemira GrowHow, owner and operator of the only European phosphate mine.

Today Yara is the world's largest manufacturer of mineral fertilisers with distribution networks in more than 150 countries, producing about 20 million tonnes of fertilisers with 8000 employees and 2012 sales of about 8.5 billion Euros.

Yara, however, will not accept sludge ash based recycled products because of too many impurities hampering the downstream acidulation process and reducing the product quality. If and when Yara could be a potential cooperation partner for other ash types (e.g. ash from chicken litter) is still under discussion.

BASF is a fertiliser manufacturer without an own marketing structure – the business operated by the company K+S Nitrogen GmbH was sold to the Russian integrated fertiliser and phosphate manufacturer EuroChem Agro. It is unlikely that BASF would accept any feedstock from third parties without approval of EuroChem Agro and if so, the material again would compete with rock phosphate mining and beneficiation costs and not with market prices. EuroChem Agro would be the counterpart to talk about cooperation in the field of secondary phosphates.

EuroChem is a leading global agrochemical company, producing primarily nitrogen and phosphate fertilizers, as well as certain organic synthesis products and iron ore. EuroChem is vertically integrated with activities spanning from mining and natural gas extraction to fertilizer production, logistics, and sales and marketing activities. The company is currently developing the Gremyachinskoe and Verkhnekamskoe greenfield potash projects in Russia, with planned capacities of 4.6 and 3.4 million tonnes per year respectively. Headquartered in Moscow, it operates production facilities in Russia and Western Europe and employs more than 20,000 employees globally.

Other German N producers, in turn, are potentially interested in cooperation with P-recyclers. Some of the nitrogen products have special characteristics and cannot be mixed with standard phosphate fertilisers, for instance urea, the main product of SKW Piesteritz.

SKW Stickstoffwerke Piesteritz GmbH was formed in 1993. As the largest producer of urea and ammonia in Germany, its current product portfolio covers a wide range of specialities for agro chemistry and industrial chemistry. SKW is one of 200 chemical, food and agricultural companies being controlled by Agrofert Holding A.S., the largest food group and the largest private employer in Czech and Slovak Republic with more than 20.000 employees.

Some of the N fertiliser suppliers produce fertilisers as a by-product such as DOMO Caproleuna (main product caprolactam), ALZCHEM and INEOS.

DOMO Caproleuna is part of the Belgian DOMO Chemicals Group, an integrated nylon 6 manufacturer active in the field of nylon intermediates, nylon resins, nylon engineering plastics and nylon fibres, fertilizers and polypropylene. DOMO is a mid-sized company with about 600 employees but a potential customer for recovered phosphates.

ALZCHEM is a multi-purpose speciality chemicals company with about 1.400 employees and produces, alongside with many chemical compounds for the food, the renewable energy, the metallurgy and the chemistry sectors calcium cyanamide, a nitrogen-lime compound with special, multipurpose fertilizer characteristics.

INEOS, in turn, is a global manufacturer of petrochemicals, speciality chemicals and oil products with about 15.000 employees and an annual turnover of €35 billion. It comprises 15 businesses each with a major chemical company heritage. Its production network spans 51 manufacturing facilities in 11 countries throughout the world.

ALZCHEM, DOMO and SKW Piesteritz consider extending their product range and cooperating with P-recyclers. There are, however, specific requirements sometimes difficult to achieve, for instance a high phosphate concentration as requested by SKW Piesteritz.

Both, DOMO and SKW have already allocated some funds to further investigate the potential of producing a NP fertiliser with secondary phosphates as P-carrier. It is, however, premature to talk about a real potential, too many decisions are still pending and the investments involved are still very small in comparison to the investment necessary for a secondary fertiliser plant.

Compo finally is the German market leader in the house and garden market with COMPO, among others, as a well-known brand and a large distribution network. The cornerstone of COMPO GmbH & Co. KG was laid in the city of Münster in 1956 with COMPO SANA, the first potting soil in user-friendly bags. In the following decades, the company was continuously expanded as a business division of BASF. The professional market was entered in 1971. Today the most important international brands are Blaukorn, NovaTec, Floranid and Hakaphos. COMPO now operates internationally and has a leading position in biological/technical branded specialty fertilizers for professional use. Compo may be a possible but very demanding cooperation partner for this specific market.

Recyclers intending to approach COMPO should, however, be aware that the company, although selling simple products at a much higher price to consumers than competitors to farmers will be translated into higher purchasing prices. The strength of COMPO is the brand names and these are reflected in an excellent presence in consumer markets. Still, these products are largely blended from single conventional fertiliser components that are bought at world market prices. Only speciality fertilisers may achieve higher prices when sold to COMPO and its, much less present, competitors.

### **6.1.3 Potash and Magnesium Fertiliser Producers**

The potash and magnesium fertiliser production in Germany is based on rich natural resources in central-east Germany. After Canada, Russia, Belarus and China, Germany is the fifth largest producer of potassium chloride in the world. In contrast to the producers of the other primary nutrients N and P, Germany based K+S Kali GmbH is one of the vertically integrated, global players on the potash market (Table 30).

**Table 30: Potash and magnesium fertiliser capacities in Germany (Industrieverband Agrar, 2012)**

| <b>Company</b>   | <b>Capacity in 1000 t product</b> |
|--|-----------------------------------|
| K+S KALI GmbH<br>Bertha-von-Suttner-Str.7<br>34131 Kassel<br>www.kali-gmbh.com     | 9.800                             |
| Plant Sigmundshall   | 1.100                             |
| Plant NeuhoF-Ellers  | 1.650                             |
| Plant Zielitz  | 2.500                             |
| Plant Werra  | 4.550                             |
| <b>Company</b>   | <b>Capacity in 1000 t product</b> |
| Deusa International GmbH<br>Nordhäuser Str. 2<br>99752 Bleicherode<br>www.deusa.de | 90                                |
| <b>TOTAL</b>   | <b>9.890</b>                      |

K+S was interested in introducing secondary phosphates to its fertilisers several years ago when it was still involved in manufacturing all types of NPK fertilisers. After withdrawing from K+S Nitrates (now EuroChem Agro) and COMPO (now independent) possibilities for cooperation are not evident. K+S had been following a strategy of concentrating on its core business and know-how-potash (Table 31).

**Table 31: Potash and magnesium fertiliser product range (Industrieverband Agrar, 2012)**

| <b>K+S KALI GmbH</b>   | <b>Potash and Magnesium Fertilizers</b> |     |    |    |
|--|---|-----|----|----|
|  | Nutrient levels in water soluble form   |     |    |    |
| Potash Fertilisers   | K <sub>2</sub> O                        | MgO | Na | S  |
| Korn-Kali® (Potash + magnesium 40 (+6+3+4))                                  | 40                                      | 6   | 3  | 4  |
| Magnesia-Kainit® (potash raw salt 11 (+5+20+4))                              | 11                                      | 5   | 20 | 4  |
| Patentkali® (potassium sulphate + magnesium 30 (+10+17))                     | 30                                      | 10  |    | 17 |
| 60er Kali® (potash 60)   | 60                                      |     |    |    |
| KALISOP® (potassium sulphate 50 (+18))                                       | 50                                      |     |    | 18 |
| HORTISUL® (potassium sulphate 52 (+18))                                      | 52                                      |     |    | 18 |
| Magnesium Fertilisers  |   |     |    |    |
| ESTA® Kieserit fine (kieserite 27+22)  |   | 27  |    | 22 |
| ESTA® Kieserit granular (kieserite 25+20)                                    |   | 25  |    | 20 |
| EPSO Top® (magnesium sulphate 16+13)   |   | 16  |    | 13 |
| EPSO Microtop® (magnesium sulphate + B + Mn 15+12)                           |   | 15  |    | 12 |
| EPSO Combitop® (magnesium sulphate + Mn + Zn 13+13)                          |   | 13  |    | 13 |
| Deusa International GmbH   | <b>Potash and Magnesium Fertilizers</b> |     |    |    |
|  | Nutrient levels in water soluble form   |     |    |    |
| Potash Fertilisers   | K <sub>2</sub> O                        | MgO | Na | S  |
| Potash (KCl), humid (86% KCl)  | 54%                                     |     |    |    |
| Magnesium Fertilisers  |   |     |    |    |
| Magnesium chloride flakes (bischofite) MgCl <sub>2</sub> * 6H <sub>2</sub> O |   | 20% |    |    |

Statistical data shows that despite having closed a large number of manufacturing facilities, Germany still is a relevant fertilizer producing country with a total nutrient capacity of about 15 million tonnes.

Some of the producers have expressed their interest for cooperation with P-recycling corporations, the only phosphate fertiliser producer ICL Germany and some of the nitrogen fertilizer producers: Alzchem AG, DOMO Caproleuna and SKW Piesteritz.

## 6.2 Fertiliser Distribution – Wholesalers and Retailers

### 6.2.1 Agricultural cooperatives

2'452 legally independent commodity and service cooperatives and thereof 6 central cooperatives operate on the basis of the principles set by Friedrich Wilhelm Raiffeisen. Almost all, in total 550'000 farmers, gardeners and winegrowers are members and co-owners of one or more rural cooperatives. In their role as market and service enterprises of the German agriculture, the Raiffeisen cooperatives supply their members with resources and equipment such as feed, fertiliser and machinery. They keep account of and process the entire spectrum of animal and plant products.

The umbrella co-operative in Germany is the “German Raiffeisen Association” Their founder – Friedrich Wilhelm Raiffeisen (1818 – 1888) started with the “Bread Union” (Brotverein) during the winter of famine 1846/47 in Weyerbusch (Westerwald, Germany) as an institution of welfare and mutual help. 1864 the “Bread Union” became the loan association of Heddersdorf. This was the first rural co-operative. The “Federation of Rural Co-operatives (Anwaltschaftsverband der ländlichen Genossenschaften) of 1877 was the origin of the large organization which has been living on since 1948 in the German Raiffeisen Federation (Deutscher Raiffeisenverband e.V.) with the support of numerous co-operative banks and enterprises of the network.

At the local - retail level the basic co-operative task – according to the statutes and law of 1889 – is directly expressed: Work and performance of co-operatives exclusively serve the members’ benefit. In the course of history, local and regional agricultural cooperatives were established to trade crops and agricultural supplies including machinery and equipment and fertilisers. These structures became large and very powerful enterprises. The large regional structures act as agricultural wholesalers and care for the volume purchasing. The local structures are in contact with the farmers and act as retailers. The initial system of each cooperative serving selected, mutually agreed regions is still visible but not everywhere in Germany – BAYWA and the different Raiffeisen Organisations compete in the federal states of former GDR. As of 2012, the organization counts approximately 1.8 million memberships including >550.000 farmers in the whole country.

Agricultural cooperatives have become an important economic factor and employer in rural areas. The turnover of Raiffeisen co-operatives grew from 3.5 billion Euros in 1950 to 17.5 billion Euros in 1970. In the year 2012, the Raiffeisen organisation achieved a total turnover of roughly 51 billion Euros. Currently, around 83’000 people are employed in cooperatives, including numerous specialists and highly qualified experts.

Estimations suggest that about 60% of the market is covered by cooperatives and 40% by non-cooperative businesses. Exact figures are not available, because neither the cooperatives, nor the private business Beiselen publish detailed sales figures for single sectors such as the fertiliser business.

The co-operatives are the market partners of German agriculture. Their activity is closely related to the structural change in rural economics, in their upstream and downstream areas and the developments on the domestic and foreign markets. Co-operatives adapt to the market movements in terms of size and structure, they add more value to their activities and they implement quality control systems to cultivation and processing of agricultural products.

The whole German Raiffeisen organization encompasses 2’531 commodity and service co-operatives (as of 31.12.2011), including:

- 6 main co-operatives including DRWZ (Deutsche Raiffeisen Warenzentrale GmbH)
- 2’374 rural commodity and service co-operatives (including 811 farming co-operatives)
- 151 multi-purpose co-operatives

Raiffeisen co-operatives supply production material, e.g. seeds, fertilizers, feed-stuffs, agricultural engineering and they offer a large range of services to their members. 1.600 Raiffeisen markets offer a wide, up-market product range for home and garden to the consumers. The Raiffeisen co-operatives are very popular in rural and suburban communities (Figure 25).

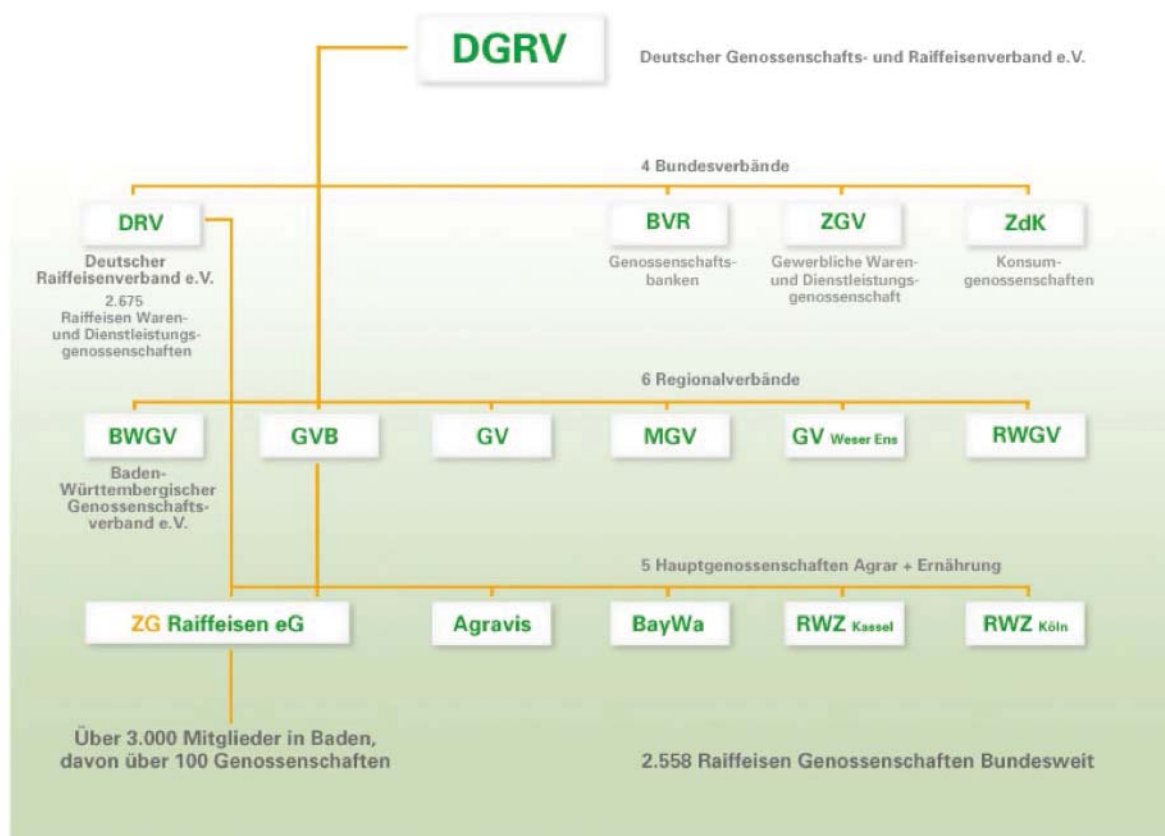


Figure 25: Structure of the German “Raiffeisen” co-operations

Compo GmbH & Co KG is manufacturer and wholesaler at the same time. The company sells to house and garden markets in Germany and across Europe. For detailed information please consult Annex E and Annex F.

### 6.2.2 Fertilizers for ecological farming

None of the recycled fertiliser types is approved for ecological farming in compliance of Regulations (EC) 834/2007 and (EC) 889/2008. Thus, the market for eco ecological farming is not an option in a foreseeable future.

In Germany, about 5.9% (2010) of crop- and woodland is cultivated by approximately 22,000 farmers according to the principles of eco-farming. The market share of phosphate fertilisers cannot be assessed but it can be assumed that only a tiny fraction of annually 7,000 tonnes “other phosphates” used in Germany is spread as rock phosphate to ecological farming cropland – if we use the 5.9% share we get some 400 tonnes (BOLW Bund Ökologische Lebensmittelwirtschaft 2011). However, if more effective products were approved, the market could grow significantly, as P is depleted on a significant part of cropland managed according to ecological farming principles.

Applications for approval of recycled products must be submitted by a government representative. Germany does not categorically object doing this but is aiming for support from ecological farming associations such as Bioland or Demeter. Bioland is seriously considering supporting approvals of new phosphate fertilisers but needs to go through an internal opinion-making process with all members and stakeholders. Farmers largely see the benefit of recovered phosphate products but are concerned about the



image of ecological farming, if the use of sewage sludge as a secondary resource becomes public. The process will take time. (Wiggert, 2012)

In principle, water insoluble phosphates such as struvite, phosphate slags or calcined phosphates may be in compliance with the rules of ecological farming. ASH DEC has performed tests and filed an application with the Austrian government.

### **6.2.3 Summary Fertiliser Distribution**

Agricultural and private fertiliser distributors do neither favour, nor refuse selling recycled phosphates. Recyclers producing large quantities must either deal with the companies of the fertiliser sector or develop an own marketing system. Recyclers producing small quantities can contact retailers directly and try to sell their products below the radar of the wholesale cooperations.

Wholesalers mainly care for financial and logistical issues – quality discussions are mainly reserved to the retailer level. Recyclers need qualified personnel to talk to wholesalers and retailers if they want to introduce their products at the fertiliser distribution level.

Selling to wholesalers and retailers requires product in full compliance with market requirements, supported by advertising and promotion by mass media and an educated sales force in the market. Expenses on sales and marketing are much higher in comparison to selling to manufacturers. This should be taken into consideration before opting for one or the other sales strategy.

## **6.3 German phosphate fertilisers**

### **6.3.1 Phosphate fertiliser types and their market penetration**

92% of all phosphate fertilisers are sold as multi-nutrient fertilisers. Straight phosphate fertilisers have a very small market share of less than 8%. If a recycling process produces straight P-fertilisers only, it is limited to a market of less than 20.000 tonnes per year in Germany. If, for instance, ASH DEC would implement a recycling plant with a capacity of 4 tonnes per hour (as planned and calculated economically viable) its production would exceed the German phosphate market volume by more than 50%. Thus, cooperation is recommendable with N (preferable) or K fertiliser manufacturers to produce a multi-nutrient fertiliser.

One of the drawbacks of many recycled fertilisers is the relatively low nutrient concentration, making it more difficult to produce high analysis multi-nutrient fertilisers. A number of options exist, however, meeting the market preferences.

Recyclers should be aware that it is much easier to manufacture a product being easily exchangeable with currently available products than to introduce a completely new product with – at least at a first glance – less favourable characteristics (Table 32).



**Table 32: Supply of phosphate-containing fertilisers to agriculture (t P<sub>2</sub>O<sub>5</sub>) (Statistisches Bundesamt, 2012)**

| Type                        | July-June<br>2010/11 | July-June<br>2011/12 | Change<br>2011/12 to 2010/11 |              |
|-----------------------------|----------------------|----------------------|------------------------------|--------------|
|                             |                      |                      | t nutrient                   | %            |
| Single nutrient fertilisers | 28'661               | 19'200               | -9.461                       | -33,0        |
| Superphosphates             | 19'569               | 11'870               | -7.699                       | -39,3        |
| Other Phosphate fertilisers | 9'092                | 7'330                | -1.762                       | -19,4        |
| Multi nutrient fertilisers  | 257'687              | 227'880              | -29.807                      | -11,6        |
| PK- fertiliser              | 29'026               | 19'358               | -9.668                       | -33,3        |
| NP- fertiliser              | 169'282              | 161'392              | -7.890                       | -4,7         |
| NPK-fertiliser              | 59'379               | 47'130               | -12.249                      | -20,6        |
| <b>Total</b>                | <b>286'348</b>       | <b>247'080</b>       | <b>-39.268</b>               | <b>-13,7</b> |

### 6.3.2 Chemical characteristics of popular phosphate fertilizers

Most phosphate fertilisers on the German market are high analysis phosphates with DAP and MAP as by far the most popular phosphate fertilisers, because of their high nutrient concentration of well over 60% (the remainder being ammonium) and their easy availability and their cheap price in terms of phosphate per tonne. In average, phosphate in DAP costs some 10% less than phosphate in Triple Superphosphate.

The PK fertiliser market has been in decline for decades with the consequence that K + S Kali GmbH has stopped production of the so called Thomasphosphate a fertiliser having been manufactured from converter slag (Thomas Slag) and potash. In the 90s, converter slag was replaced by dicalcium phosphate a phosphate compound mainly being produced as animal feed additive. At present, most PKs sold in Germany are produced by ICL (Table 33).

**Table 33: Nutrient forms and declarable solubilities of major phosphate containing fertilizer types (Industrieverband Agrar, 2012)**

| Fertiliser type  | Of which in %                       |   |  |   |  |
|--|-------------------------------------|---|--|---|--|
|  | Total-P <sub>2</sub> O <sub>5</sub> | Water soluble P <sub>2</sub> O <sub>5</sub> | P <sub>2</sub> O <sub>5</sub> soluble in 2% citric acid or alkaline ammonium citrate | P <sub>2</sub> O <sub>5</sub> soluble in neutral ammonium citrate | P <sub>2</sub> O <sub>5</sub> soluble in mineral acids |
| Single Superphosphate  | 18-19%                              | 16.7-18.0                                   |  | 2)  |  |
| Triple Superphosphates   | 45-46%                              | 42.7-44%                                    |  | 2)  |  |
| Soft ground rock phosphate   | 26-31%                              | 0   |  |   | 26-31 <sup>4)</sup>                                    |
| NPK-fertilisers  | Type dependent                      | 5)  |  | 2)  |  |
| NP-fertilisers   | Type dependent                      | 6)  |  | 2)  |  |
| Ammonium phosphate-fertilisers (MAP, DAP)                              | 46-52%                              | 42-47% <sup>3)</sup>                        |  | 2)  |  |
| PK-fertilisers (based on P-rich converter slag or dicalcium phosphate) | Type dependent                      |   | 2)   |   |  |
| PK-fertilisers based on (Super-phosphate)                              | Type dependent                      | 3)  |  | 2)  |  |
| PK-fertilisers (based on partial phosphate digestion)                  | Type dependent                      | 1)  |  |   | 2)   |
| PK-fertiliser (based on rock phosphate)                                | Type dependent                      |   |  |   | 2)   |

Average standard values 1) 50% from total P<sub>2</sub>O<sub>5</sub>; 2) 100% from total P<sub>2</sub>O<sub>5</sub>; 3) 90% from total P<sub>2</sub>O<sub>5</sub>; 4) 66% from total P<sub>2</sub>O<sub>5</sub> soluble in 2% formic acid; 5) 60-80% from total P<sub>2</sub>O<sub>5</sub>; 6) 65-75% from total P<sub>2</sub>O<sub>5</sub>

### 6.3.3 Mineral phosphate fertiliser flows to and from Germany

94% of phosphates supplied in Germany are imported and roughly half of this amount comes from Eastern Europe. It is not disclosed where the remaining 6% come from but one can guess that those are assigned to ICL's Ludwigshafen factory. The remaining hundred thousand tonnes P<sub>2</sub>O<sub>5</sub> produced in that plant are apparently exported, as we see in

Table 34.

The high share of imports from Eastern Europe indicates that large trading organizations and particularly the cooperative sectors import a lot from Eastern European, probably Russian phosphate fertiliser manufacturers. It is good to know that Russian phosphates are mainly produced from Kola-Apatite, a magmatic phosphate ore with low impurities and heavy metal concentrations. Consequently, there is no environmental issue related to the high share of imports from Eastern Europe, on the contrary.

**Table 34: Deliveries to agriculture and imports of phosphate fertilisers in 1.000 t P<sub>2</sub>O<sub>5</sub> (Statistisches Bundesamt, 2012)**

| Year    | Consumption | Imports |                     | Imports in % of consumption |                     |
|---------|-------------|---------|---------------------|-----------------------------|---------------------|
|         |             | Total   | From eastern Europe | Total                       | From eastern Europe |
| 2011/12 | 247         | 233 *   | 118 *               | 94                          | 48                  |

\*preliminary figures

As shown in Table 35, almost half of the imports come from the EU15, meaning that the phosphate containing fertilisers are manufactured within the EU15 – mainly in the Netherlands (ICL's Amsterdam facility).

**Table 35: Phosphate-fertiliser imports in 1.000 t P<sub>2</sub>O<sub>5</sub> (Statistisches Bundesamt, 2012)(modified)**

| Year      | EU 15 | Eastern Europe | Other countries | Total |
|-----------|-------|----------------|-----------------|-------|
| 2011/12 * | 98    | 118            | 17              | 233   |

\*preliminary figures

Table 36 shows that in total 330.000 tonnes P<sub>2</sub>O<sub>5</sub> are traded in Germany in the form of phosphate containing mineral fertilisers. Deducting 233.000 tonnes of imported phosphate fertiliser we get 97.000 tonnes of P<sub>2</sub>O<sub>5</sub> being produced in Germany –very much in line with ICL's production capacity of roughly 250'000 tonnes of product (containing 19-46% P<sub>2</sub>O<sub>5</sub>).

**Table 36: Foreign trade: phosphate fertilisers 1.000 t P<sub>2</sub>O<sub>5</sub> (Statistisches Bundesamt, 2012)**

| Year      | Imports ** | Exports ** | Consumption |
|-----------|------------|------------|-------------|
| 2011/12 * | 233        | 83         | 247         |

\*preliminary figures; \*\*excluding amounts for non-fertiliser purposes and transit, estimated

## 6.4 Total phosphate supply to German cropland

Phosphate supplies to the agricultural business in Germany have slightly recovered from its absolute low in the 2008/2009 season with only 174.000 tonnes of P<sub>2</sub>O<sub>5</sub>. Last season's 247.000 tonnes are at the lower side of the annual supplies from 2000.

**Table 37: Supply of nitrogen, phosphate, potash and lime fertilisers to agriculture (Statistisches Bundesamt, 2012).**

| Year    | Nitrogen         | Phosphate                     | Potash           | Lime  |
|---------|------------------|-------------------------------|------------------|-------|
|         | 1000 t nutrients |                               |                  |       |
|         | N                | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O | CaO   |
| 2011/12 | 1'640            | 247                           | 386              | 2'398 |

2008/2009 phosphate fertiliser supplies translate into 14.8 kg P<sub>2</sub>O<sub>5</sub> per hectare, a value much below the crop uptake being estimated at some 30-50 kg P<sub>2</sub>O<sub>5</sub> per hectare. The negative balance is partly and regionally compensated by secondary resources such as manure and sewage sludge with an estimated 585'000 additional tonnes P<sub>2</sub>O<sub>5</sub> or some 35 kg P<sub>2</sub>O<sub>5</sub> per hectare cropland.

The total phosphate supply to German cropland results in a slightly positive nutrient balance a surplus of a few kg P<sub>2</sub>O<sub>5</sub> per hectare. The problem is that manure is not equally distributed across the country. Most of manure is being spread in those regions with high livestock density, particularly in Lower Saxony and Schleswig Holstein. This translates into a high P surplus in the livestock intensive regions and a significant P-deficit in regions with low livestock density, in particular the eastern Federal States Saxony, Saxony-Anhalt, Thuringia, Brandenburg and Mecklenburg-Vorpommern (Table 37, Table 38).

**Table 38: Mineral fertiliser application in kg nutrient per ha agriculturally used land (including fallow land) (Statistisches Bundesamt, 2012).**

| Year    | Nitrogen       | Phosphate                     | Potash           | Lime  |
|---------|----------------|-------------------------------|------------------|-------|
|         | kg nutrient/ha |                               |                  |       |
|         | N              | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O | CaO   |
| 2011/12 | 98.1           | 14.8                          | 23.1             | 138.1 |

## 6.5 Regional market aspects

Another important factor for recycled phosphates and in particular those with relatively low nutrient concentrations is logistics. Fertilisers are a cheap commodity product that does not tolerate high transport costs – this holds true for primary and secondary phosphate fertilisers.

Hence, the location of a recycling facility is of high importance for the economic viability of a large recycling project. It should either be located in one of the Federal States with high levels of phosphate sales or at least at a transportation hub with railroad and port facilities.

Most phosphate fertilisers are sold in Lower Saxony and Schleswig Holstein, followed by Bavaria at the extreme ends of Germany. Important phosphate markets are in addition Northrhine Westfalia, Mecklenburg-Vorpommern and Baden Württemberg.

Road transport and handling costs can easily attain €30-50 per tonne of product – for a product containing 20% P<sub>2</sub>O<sub>5</sub> this would mean €150-250 per tonne P<sub>2</sub>O<sub>5</sub>. Railroad transport is not much cheaper than road transport – relevant advantages depend on the possibility to rent whole trains. Not many recyclers will, however, transport 800 tonnes in one shipment. The same holds true for transports on inland waterways. Barges start from 800 tonnes per shipment. If production capacities allow such freight volumes, corresponding warehouse facilities are needed.

If the facility should be located close to the market, one of the above mentioned Federal States should be selected. However, the location also depends on the availability of feedstock, the regional regulatory bodies, political decision makers and the public at large. Thus a selection must be based on a number of sometimes contradictory criteria (Table 39).

**Table 39: Domestic sales of phosphate fertilisers by Federal State and type, 2010/2011 in t P<sub>2</sub>O<sub>5</sub> (Statistisches Bundesamt, 2012)**

| Federal State                 | Total in t | Single nutrient fertilisers    |   | Complex fertilisers |                |                 |
|-------------------------------|------------|--------------------------------|---|---------------------|----------------|-----------------|
|                               |            | Single/Triple Super Phosphates | Other phosphate fertilisers <sup>1)</sup> | PK-fertilisers      | NP-fertilisers | NPK-fertilisers |
| <b>Baden-Württemberg</b>      | 23 352     | 227                            | 1 154                                     | 3 992               | 9 906          | 8 073           |
| <b>Bayern</b>                 | 37 737     | 546                            | 1 568                                     | 4 192               | 20 842         | 10 589          |
| <b>Berlin</b>                 | 176        | 150                            | -   | 26                  | -              | -               |
| <b>Brandenburg</b>            | 8 613      | 703                            | 623                                       | 572                 | 4 929          | 1 786           |
| <b>Bremen</b>                 | 15         | -                              | -   | -                   | 1              | 14              |
| <b>Hamburg</b>                | 232        | 124                            | 6   | 94                  | 5              | 3               |
| <b>Hessen</b>                 | 9 029      | 339                            | 168                                       | 981                 | 2 487          | 5 054           |
| <b>Mecklenburg-Vorpommern</b> | 26 455     | 896                            | 784                                       | 1 455               | 20 400         | 2 920           |
| <b>Niedersachsen</b>          | 51 615     | 2 420                          | 1 216                                     | 2 454               | 40 958         | 4 567           |
| <b>Nordrhein-Westfalen</b>    | 18 309     | 824                            | 619                                       | 1 358               | 13 188         | 2 320           |
| <b>Rheinland-Pfalz</b>        | 7 649      | 146                            | 115                                       | 1 177               | 1 498          | 4 713           |
| <b>Saarland</b>               | 101        | 12                             | 7   | 81                  | 1              | -               |
| <b>Sachsen</b>                | 8 383      | 1 165                          | 446                                       | 117                 | 5 719          | 936             |
| <b>Sachsen-Anhalt</b>         | 10 038     | 2 835                          | 302                                       | 1 287               | 2 992          | 2 622           |
| <b>Schleswig-Holstein</b>     | 42 097     | 336                            | 71  | 1 345               | 37 143         | 3 202           |
| <b>Thüringen</b>              | 3 279      | 1 147                          | 251                                       | 227                 | 1 323          | 331             |
| <b>Germany</b>                | 247 080    | 11 870                         | 7 330                                     | 19 358              | 161 392        | 47 130          |

<sup>1)</sup> Soft ground rock phosphate, partially solubilised rock phosphate, dicalcium phosphate, Thomas phosphate, rock phosphate with carbonate of lime

More than 53% of phosphate fertilisers are sold in three Federal States: Lower Saxony, Schleswig-Holstein, Bavaria. If trying to determine a regional focus, the northern regions represent 56% of the total phosphate sales and the southern regions 44% (Table 40).

**Table 40: Share of Federal States in total sales by type of phosphate fertiliser in P<sub>2</sub>O<sub>5</sub>, 2011/2012 in percent (Statistisches Bundesamt, 2012)**

| Federal State                 | Total | Single nutrient fertiliser     |   | Complex fertilisers |                |                |
|-------------------------------|-------|--------------------------------|---|---------------------|----------------|----------------|
|                               |       | Single/Triple Super Phosphates | Other phosphate fertilisers <sup>1)</sup> | PK-fertilisers      | NP-fertilisers | NPK-fertiliser |
| <b>Baden-Württemberg</b>      | 9,5   | 1,9                            | 15,7                                      | 20,6                | 6,1            | 17,1           |
| <b>Bayern</b>                 | 15,3  | 4,6                            | 21,4                                      | 21,7                | 12,9           | 22,5           |
| <b>Berlin</b>                 | 0,1   | 1,3                            | 0,0                                       | 0,1                 | 0,0            | 0,0            |
| <b>Brandenburg</b>            | 3,5   | 5,9                            | 8,5                                       | 3,0                 | 3,1            | 3,8            |
| <b>Bremen</b>                 | 0,0   | 0,0                            | 0,0                                       | 0,0                 | 0,0            | 0,0            |
| <b>Hamburg</b>                | 0,1   | 1,0                            | 0,1                                       | 0,5                 | 0,0            | 0,0            |
| <b>Hessen</b>                 | 3,7   | 2,9                            | 2,3                                       | 5,1                 | 1,5            | 10,7           |
| <b>Mecklenburg-Vorpommern</b> | 10,7  | 7,5                            | 10,7                                      | 7,5                 | 12,6           | 6,2            |
| <b>Niedersachsen.</b>         | 20,9  | 20,4                           | 16,6                                      | 12,7                | 25,4           | 9,7            |
| <b>Nordrhein-Westfalen</b>    | 7,4   | 6,9                            | 8,4                                       | 7,0                 | 8,2            | 4,9            |
| <b>Rheinland-Pfalz</b>        | 3,1   | 1,2                            | 1,6                                       | 6,1                 | 0,9            | 10,0           |
| <b>Saarland</b>               | 0,0   | 0,1                            | 0,1                                       | 0,4                 | 0,0            | 0,0            |
| <b>Sachsen</b>                | 3,4   | 9,8                            | 6,1                                       | 0,6                 | 3,5            | 2,0            |
| <b>Sachsen-Anhalt</b>         | 4,1   | 23,9                           | 4,1                                       | 6,6                 | 1,9            | 5,6            |
| <b>Schleswig-Holstein</b>     | 17,0  | 2,8                            | 1,0                                       | 6,9                 | 23,0           | 6,8            |
| <b>Thüringen</b>              | 1,3   | 9,7                            | 3,4                                       | 1,2                 | 0,8            | 0,7            |
| <b>Germany</b>                | 100,0 | 100,0                          | 100,0                                     | 100,0               | 100,0          | 100,0          |

<sup>1)</sup> Soft ground rock phosphate, partially solubilised rock phosphate, dicalcium phosphate, Thomas phosphate, rock phosphate with carbonate of lime

In terms of leading phosphate fertiliser types, NPs and among them DAP and MAP represent 65% of P-fertilisers in use in total Germany and almost 80% in the grain producing Federal States (Table 41).

**Table 41: Share of phosphate fertiliser types in P-fertiliser sales by Federal State, 2011/2012 in percent**

| Country                       | Total | Single nutrient fertiliser |               |   | Complex fertilisers |                |                 |
|-------------------------------|-------|----------------------------|---------------|---|---------------------|----------------|-----------------|
|                               |       | Single/Triple Phosphates   | Su-phosphates | Other phosphate fertilisers <sup>1)</sup> | PK-fertilisers      | NP-fertilisers | NPK-fertilisers |
| <b>Baden-Württemberg</b>      | 100,0 | 1,0                        |               | 4,9                                       | 17,1                | 42,4           | 34,6            |
| <b>Bayern</b>                 | 100,0 | 1,4                        |               | 4,2                                       | 11,1                | 55,2           | 28,1            |
| <b>Berlin</b>                 | 100,0 | 85,2                       |               | 0,0                                       | 14,8                | 0,0            | 0,0             |
| <b>Brandenburg</b>            | 100,0 | 8,2                        |               | 7,2                                       | 6,6                 | 57,2           | 20,7            |
| <b>Bremen</b>                 | 100,0 | 0,0                        |               | 0,0                                       | 0,0                 | 6,7            | 93,3            |
| <b>Hamburg</b>                | 100,0 | 53,4                       |               | 2,6                                       | 40,5                | 2,2            | 1,3             |
| <b>Hessen</b>                 | 100,0 | 3,8                        |               | 1,9                                       | 10,9                | 27,5           | 56,0            |
| <b>Mecklenburg-Vorpommern</b> | 100,0 | 3,4                        |               | 3,0                                       | 5,5                 | 77,1           | 11,0            |
| <b>Niedersachsen.</b>         | 100,0 | 4,7                        |               | 2,4                                       | 4,8                 | 79,4           | 8,8             |
| <b>Nordrhein-Westfalen</b>    | 100,0 | 4,5                        |               | 3,4                                       | 7,4                 | 72,0           | 12,7            |
| <b>Rheinland-Pfalz</b>        | 100,0 | 1,9                        |               | 1,5                                       | 15,4                | 19,6           | 61,6            |
| <b>Saarland</b>               | 100,0 | 11,9                       |               | 6,9                                       | 80,2                | 1,0            | 0,0             |
| <b>Sachsen</b>                | 100,0 | 13,9                       |               | 5,3                                       | 1,4                 | 68,2           | 11,2            |
| <b>Sachsen-Anhalt</b>         | 100,0 | 28,2                       |               | 3,0                                       | 12,8                | 29,8           | 26,1            |
| <b>Schleswig-Holstein</b>     | 100,0 | 0,8                        |               | 0,2                                       | 3,2                 | 88,2           | 7,6             |
| <b>Thüringen</b>              | 100,0 | 35,0                       |               | 7,7                                       | 6,9                 | 40,3           | 10,1            |
| <b>Deutschland</b>            | 100,0 | 4,8                        |               | 3,0                                       | 7,8                 | 65,3           | 19,1            |

<sup>1)</sup> Soft ground rock phosphate, partially solubilised rock phosphate, dicalcium phosphate, Thomas phosphate, rock phosphate with carbonate of lime

## 6.6 Fertiliser market value and prices

The fertiliser market in Germany has a total value of about €2.5 billion. Phosphate fertilisers represent about 10% of this market with total sales of €252 million (Table 42).

**Table 42: Farmers' expenditures for commercial fertilisers <sup>1)</sup> (Bundesministerium für Ernährung und Landwirtschaft, 2009)**

|  |                |
|--|----------------|
| <b>Product in 1000 t nutrient</b>                          | <b>2011/12</b> |
| <b>Nitrogen</b>  | 1 640          |
| <b>Phosphate</b>   | 247            |
| <b>Potash</b>  | 386            |
| <b>Lime</b>  | 2398           |
| <b>Total</b>   | 4671           |
| <b>Average prices per t nutrient in €<sup>2)3)4)</sup></b> |                |
| <b>Nitrogen</b>  | 1060           |
| <b>Phosphate</b>   | 1020           |
| <b>Potash</b>  | 710            |
| <b>Lime</b>  | 96             |
| <b>Expenses in Million €<sup>2)</sup></b>                  |                |
| <b>Nitrogen</b>  | 1739           |
| <b>Phosphate</b>   | 252            |
| <b>Potash</b>  | 274            |
| <b>Lime</b>  | 230            |
| <b>Total</b>   | 2495           |

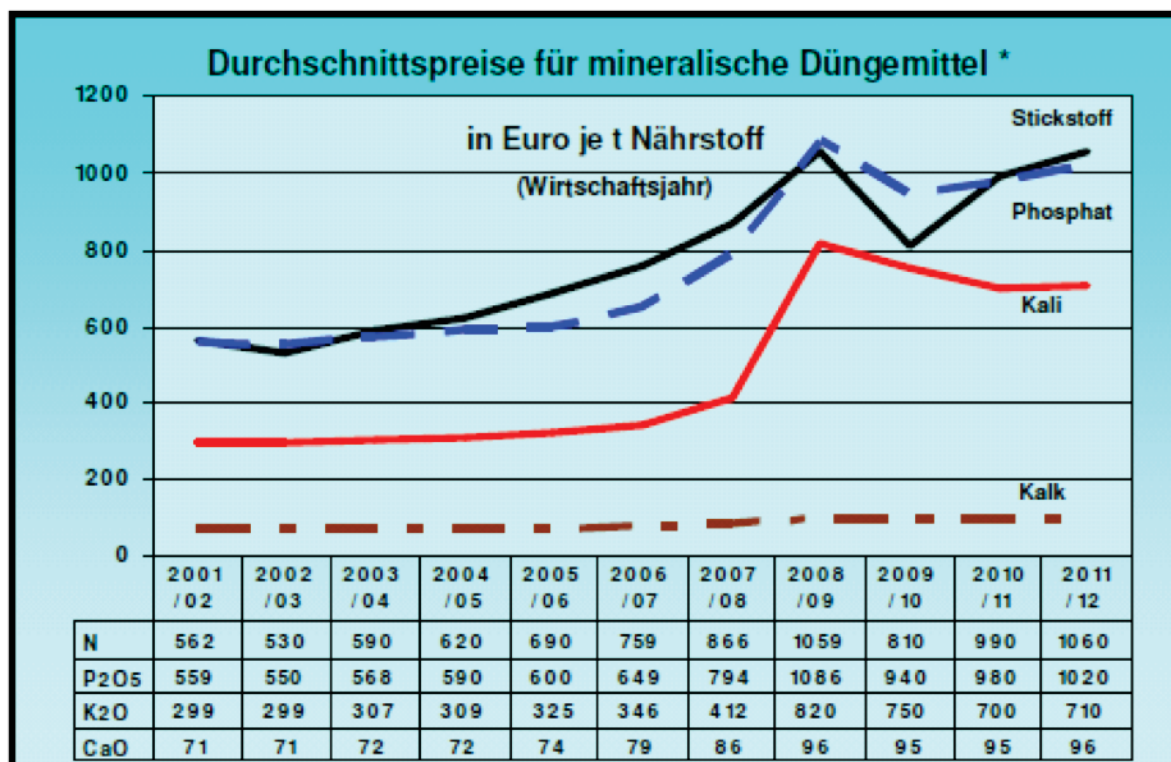
1) Incl. Horticulture; 2) Excluding VAT; 3) Weighted average price

While phosphate prices have started at €550 per tonne of P<sub>2</sub>O<sub>5</sub> in 2001 they have hit an average high of some €1050 in 2008 and 2011. In 2013 prices have returned to €800-850 per tonne of P<sub>2</sub>O<sub>5</sub>. Nitrogen and potassium have exhibited similar price fluctuations.

Prices shown are an orientation for recycled products, at least as long as standard products should be sold to average agricultural end-users. To do this, recycled fertilisers must be sold as granular fertilisers with similar characteristics as conventional fertilisers in terms of plant availability, performance, physical properties (dust free, round granules of 3-5 mm average diameter).

Wholesalers and retailers charge some 5-15 Euros per tonne of product – usually their margins are quite acceptable. If the P-recycler do not serve niche markets and do not build up their own marketing networks, they can only serve the agricultural market through the existing distribution networks (Figure 26).





\* Including horticulture, excluding taxes, including packaging cost and supplement for small quantities of 5% - measured average price.

**Figure 26: Average prices of mineral fertilisers in €per ton of nutrient (Statistisches Bundesamt, 2012)**

## 6.7 Conclusion

The present study demonstrates that producing and selling recycled phosphates is a rather challenging task. An additional complication is the fact that most recyclers do not understand agriculture and fertilisers from the beginning they are usually coming from different business sectors.

There are several traps a start-up may walk into. To begin with, even large fertiliser markets such as the German are not large if the recycling process is limited to one single product, for instance a straight P-fertiliser with 15-20% P<sub>2</sub>O<sub>5</sub>. In this case, the recycler can only address 8% of the total phosphate fertiliser market and a plant with, for instance, 30'000 tonnes capacity cannot sell its production in Germany any more, even with 100% market share.

Even if the product can be finished to be sold as P, NP or PK fertiliser, the rollout will be a challenge because the (rather conservative) stakeholders will see more risks than benefits and they may be right because none of the products being evaluated in P-REX can offer real benefits to the end user at best recycled products will be as effective as conventional fertilisers.

To conclude, the market is served with a variety of highly soluble and reasonably effective phosphate fertilisers at accessible prices. Nobody is waiting for recycled fertilisers to come. In addition, recycled phosphates are not expected to increase the crop yields. Hence, farmers and distributors cannot expect relevant benefits and their interest is consequently limited.

The rationale behind phosphate recycling is a societal, future oriented concern. As long as no real life benefits are offered to stakeholders, the roll out of products will remain difficult.

## 7 Spain

The aim of the present document is to introduce the most relevant aspects that have been considered during the development of the Spanish Fertilizer Market Analysis, in order to create a big picture of the country's behavior in this matter and to help the target audience in their market's venture and the previous measures that should be taken before entering the market.

The methodology implemented to perform such analysis was divided into four steps, each one of them oriented to obtain different kind of information from the fertilizer market. The first three steps of the methodology were focused on extracting all the technical information needed, while the last one was oriented to analyze the existent legislation in the country.

The first step was mainly looking for identifying the main objectives of the uses of the fertilizers based on phosphorus nutrients within this market. For this purpose, a random interview process was conducted between the main fertilizers producers.

Once, the main objective of this kind of market was identified. The second step consisted in the performance of a deep analysis about Spanish fertilizer market, focusing the research on phosphorus fertilizers. Among all the collected information, some points were identified as key parameters in order to present a proper understanding about the Spanish market: situation, consumption, prices evolution, structure of the market, etc.

The third step of the methodology conducted for the present market analysis was aimed to analyze the main actors that are involved in the value chain of the Spanish fertilizer market. Due to the peculiarities of this kind of market, seven groups were identified and studied as main actors of the market value chain. Apart from the typical actors present (producers, importers, exporters, wholesalers and retailers) in other kind of markets, two more actors were identified during this research process. These special actors were classified as associations and cooperatives, both of them composed by a high numbers of participants or associates. For analyzing these mentioned actors, 20 companies of a total of 35 (Table 44) were interviewed through email and conference calls in order to identify the role of each company into the market value chain. It has to be mentioned that the information related to the rest of the companies located in table one was obtained through publications of the sector (newsletters, reports, websites, etc.).

The final step of the present methodology was oriented to study and analyze all the issues related to the Spanish fertilizer legislation, emphasizing the research in all the issues related to the existent barriers of the legislation and the possibilities to solve them in order to provide the guidelines for restructuring the legislation of the country.

### 7.1 Agriculture in Spain

Agriculture is a very important activity for the national economy. Viewed in terms of land mass, Spain is one of the largest countries of Western Europe, and it ranks second in terms of its elevation, after Switzerland. A large part of the country is semiarid, with temperatures that range from extremely cold in the winter to scorching in the summer. Rainfall, which is often inadequate, tends to be concentrated in two generally brief periods during the year. Summer droughts occur frequently.

Spain has 50.5 million hectares of land, 25.1 million (CIA, 2011) or about 50 %, are used for cultivation. In addition, the roughness of the terrain has been an obstacle to agricultural mechanization and to other technological improvements. For this reason, the total agricultural surface in Spain is about 17.4 million

ha (35% of total surface), of which 3.4 million ha are under irrigation (19% of the total agricultural surface of the country). This difference between the suitable land for cultivation and the total agricultural surface harbors vineyards, fruit trees (citrus, other fruit trees and olive trees) and other permanent crops (Table 43).

Three irrigation systems are used: traditional 31% spray irrigation 21% and fertigation 48%. The rate of this last irrigation system increases every year due to the fact that Spain is a leading country in fertigation technologies and in the development of special liquid soluble fertilizers. (liquid NPK's, soluble fertilizers and acids).

**Table 43: Spanish Fertilizer Market - Domestic Consumption (million t) (ACEFER, 2011)**

| Products                   | Agricultural Sales |       |
|----------------------------|--------------------|-------|
|                            | 2009               | 2010  |
| Straight Nitrogen Products | 2'081              | 2'383 |
| Phosphates                 | 81                 | 152   |
| Potash                     | 77                 | 202   |
| NPK, NP, PK & NK           | 1'088              | 1'733 |
| Total Market               | 3'327              | 4'510 |

## 7.2 General Description of the fertilizers market in Spain

The main ideas about the Spanish fertilizers market that will be developed further in the document are that.

- In general terms Spanish fertilizer industry provides the full range of products demanded by Spanish agriculture.
- Spain maintains an external dependence on natural gas and phosphate rock.
- The Spanish fertilizers market is highly concentrated.
- There is a high rivalry on the market due to strong barriers of entry (important economies of scale, high fixed costs and difficulty of gaining access to providers) and of exit.
- There is a vast regulation on fertilizers especially with environmental laws and environmental regulations.
- There is a strong product differentiation, according to type of soil, development of the fruit on the sheets, specific feeding of plants, or improvement in the quality of the soil.
- The main substitute products for mineral fertilizers are organic fertilizers (highly available and with lower cost).

## 7.3 Fertilizers consumption

A brief overview about the fertilizer market in Spain and its distribution network to provide a better understanding of this kind of market in this country.

The raw materials consumption of the Spanish fertilizer industry can be seen in Figure 27. Around half of the phosphorus and other raw materials are imported

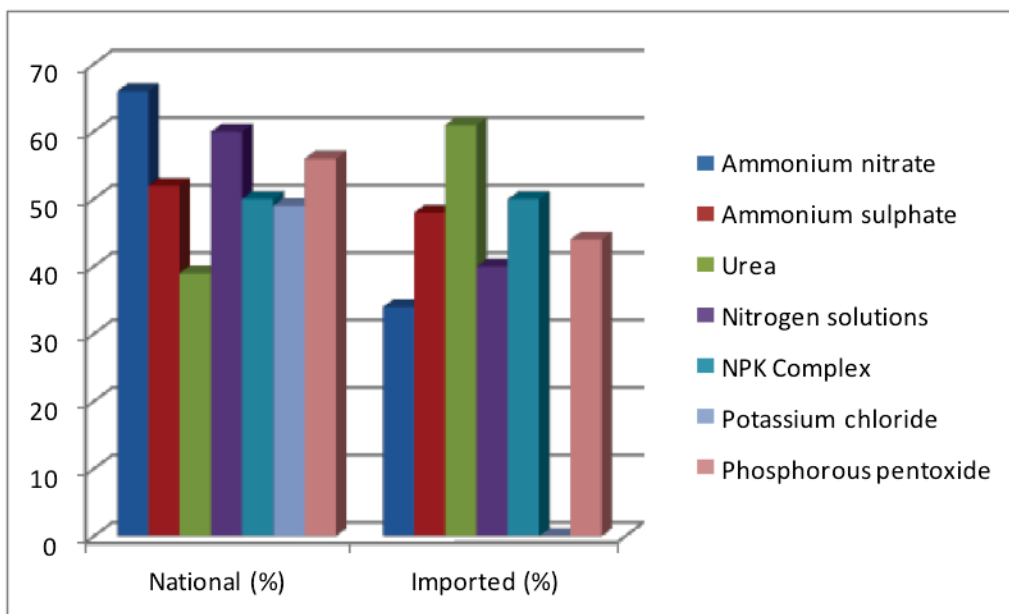


Figure 27: Spanish Fertilizer Overview (ANFE, 2009)

Four major fertilizer types represent almost the totality of the market Nitrogen Fertilizers, Phosphate fertilizers, Potassium fertilizers and complex fertilizers. Within these four groups, there are two main groups that reach over 90% of the market: Nitrogen fertilizers and Complex fertilizers; while the other two groups represent only 9% of the market (Figure 28).

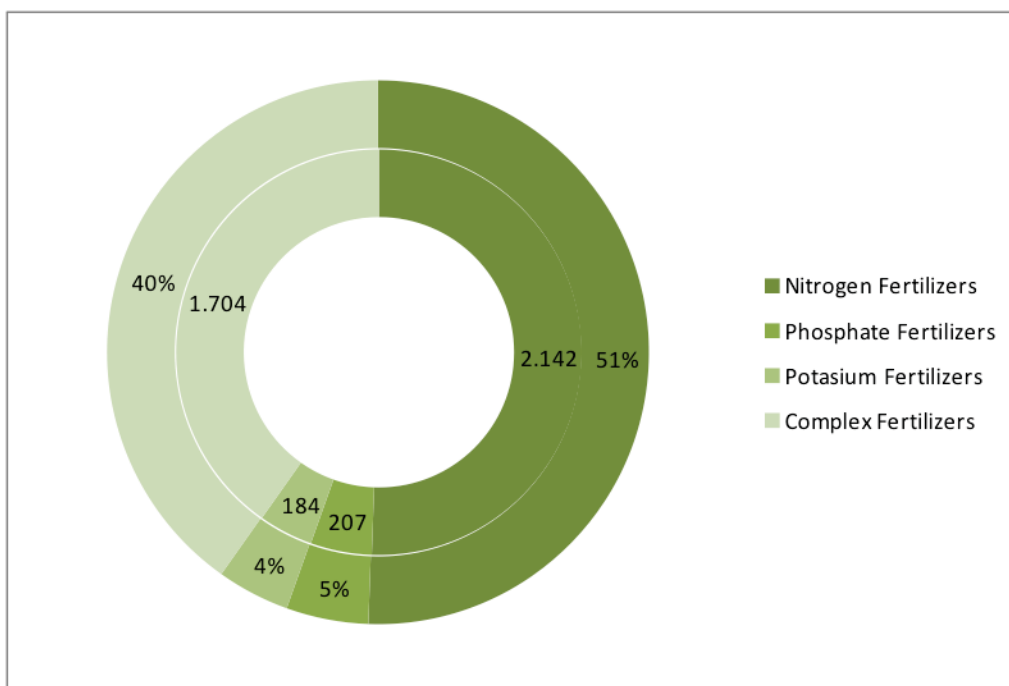
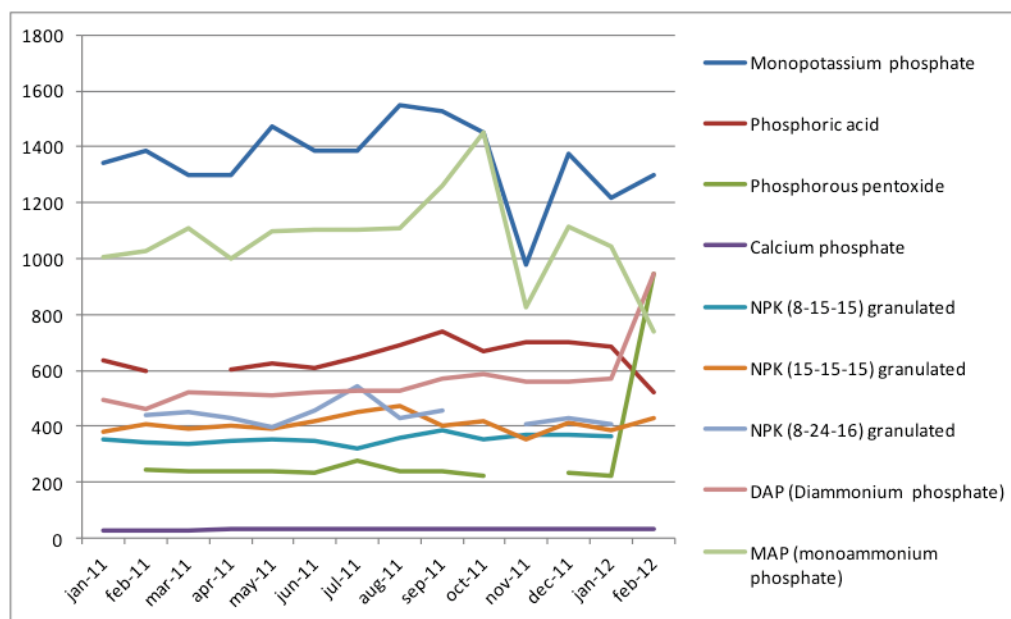


Figure 28. Fertilizer Sales in Spain (million t) (ACEFER, 2012)

The prices of Spanish fertilizers vary during the year, as shown in Figure 29. This seasonal behaviour is mainly related to the combination of five kinds of variables: type of crop, composition of the soil, normal meteorological conditions of the area, type of activity to be performed during the season and climatological season of the year (Figure 29).



**Figure 29: Seasonal Evolution of the Phosphorus Fertilizer Prices in Spain (COAG; IFA, 2012)**

From 2000 to 2008, the demand and the prices of the Spanish fertilizer market, varied mainly due to the rain falls and never over  $\pm 5\%$ . In 2008, market demand fell to a low level due to a decrease on the agricultural product prices and the increase of the raw materials. Today the market demand has almost reached the 2000-2007 average again.

The forecast of future demand is uncertain and is mainly dependant on the depth of the crisis of the country and the euro area. When reducing costs, farmers tend to cut P and K applications before reducing N rates (UAGA, 2013).

## 7.4 Actors in the value chain

A first step to chain development is to identify its main actors in order to analyze and well define their skills. This helps to a better understanding of the products characteristics and consumption trends. In Table 44 all actors in the value chain which were interviewed except the farmers cooperatives are listed. Their part of the value chain is indicated, except for the blending of fertilizers. This activity has not been recorded.

**Table 44: Companies covering different parts of the value chain**

| Company                 | Importer | Exporter | Phosphorus<br>Producer | Compound | Fertilizer<br>Compounder | Wholesaler | Retailer |
|-------------------------|----------|----------|------------------------|----------|--------------------------|------------|----------|
| ADIEGO HERMANOS         |          |          |                        |          |                          |            |          |
| AGRI TECHNOLOGY         |          |          |                        |          |                          |            |          |
| AGRICOLA DE ASPE        |          |          |                        |          |                          |            |          |
| AGRIMARTIN              |          |          |                        |          |                          |            |          |
| AGRITECNO FERTILIZANTES |          |          |                        |          |                          |            |          |
| AGROFLUIDE, S.L.        |          |          |                        |          |                          |            |          |
| AGROMEDITERRÁNEA BG     |          |          |                        |          |                          |            |          |
| AGROSERNA, S.L.         |          |          |                        |          |                          |            |          |
| AL'N                    |          |          |                        |          |                          |            |          |
| ALTINCOAGRO             |          |          |                        |          |                          |            |          |
| ARTAL                   |          |          |                        |          |                          |            |          |
| ARVENSIS AGRO, S.A.     |          |          |                        |          |                          |            |          |
| ASTURIANA FERTILIZANTES |          |          |                        |          |                          |            |          |
| ATLANTICA AGRICOLA,     |          |          |                        |          |                          |            |          |
| CODIAGRO                |          |          |                        |          |                          |            |          |
| DAYMSA                  |          |          |                        |          |                          |            |          |
| ECONATUR                |          |          |                        |          |                          |            |          |
| FERTIBERIA              |          |          |                        |          |                          |            |          |
| FERTINAGRO              |          |          |                        |          |                          |            |          |
| FERTISAC                |          |          |                        |          |                          |            |          |
| HEROGRA                 |          |          |                        |          |                          |            |          |
| IBERPOTASH              |          |          |                        |          |                          |            |          |
| INDALVA, S.L.           |          |          |                        |          |                          |            |          |
| INFERTOSA               |          |          |                        |          |                          |            |          |
| JILOCA INDUSTRIAL       |          |          |                        |          |                          |            |          |
| MIRAT                   |          |          |                        |          |                          |            |          |
| REPSOL                  |          |          |                        |          |                          |            |          |
| SADER - FERTIEUROPA     |          |          |                        |          |                          |            |          |
| STOLLER                 |          |          |                        |          |                          |            |          |
| TARAZONA                |          |          |                        |          |                          |            |          |
| TESSENDERLO CHEMIE      |          |          |                        |          |                          |            |          |
| TIMAC AGRO              |          |          |                        |          |                          |            |          |
| TRADECORP               |          |          |                        |          |                          |            |          |
| UBE CHEMICAL EUROPE     |          |          |                        |          |                          |            |          |
| YARA IBERIAN            |          |          |                        |          |                          |            |          |

The actors on the Spanish fertilizer market are 5 major importers (all of them non SMEs), 17 exporters (three of them SMEs), 42 non SME producers<sup>2</sup>, 48 wholesalers, a large number of retailers and over a million farmers Figure 30.



**Figure 30: Number of actors in the fertilizers value chain**

In order to obtain a better understanding of the figure above, the following consideration should be taken into account:

- Importers and producers supply the quantity of fertilizers demanded by exporters and wholesalers. The business activities of the wholesalers are aimed to supply the demand of the smaller actors of the value chain: retailers and farmers. The exporters supply part of the demand of the foreign countries, increasing in this way the competitiveness of the Spanish products against the rest of the markets.
- The terms mayor and/or main were added to some actors of the Spanish market value chain in order to reflect the importance of these particular actors over the market share. This mentioned discrimination was considered taking into account the volume of products of these companies against the volume of products involved in the rest of the companies that performs the same type of activities into the market.

<sup>2</sup> Big and Medium Producers: Agri Technology Investigations, SL; Agrícola de Aspe; Agrimartin fertilizantes, SL; Agritecno fertilizantes; Agrofluide, SL; Agromediterránea Business Group; Agroquímicos y Nutrientes; Al'n ; Altincoagro ; Artal ; Arvensis Agro, SA; Asturiana de fertilizantes, SA; Atlántica Agrícola, SA; Basf; Biológicos Canarias; Biovert ;Carbotecnia; Desarrollo agrícola y minero, SA; Estimulantes vegetales agrícolas; Fertiberia; Fertinagro; Fertisac; Greencare by SAS; Herogra ; Iberpotash; Indalva, SL; Infertosa; Jiloca Industrial; Labin ; Lida plant research ; Mirat; Morera; Playmag , Repsol; Sader-Fertieuropa Group; Seipasa ; Servalesa , Tarazona; Tessenderlo Chemie España; Timac Agro, Ube Chemical Europe , Valagra , Yara Iberia

- Although, there are over 200 producers companies in Spain, only 42 of them can be considered as big or medium producers. Within these 42 companies are located 15 factories which are considered as the largest fertilizer factories of the country. The outputs of these factories overcome the 5% of the total country production.

The data in Table 45 shows **Fehler! Verweisquelle konnte nicht gefunden werden.**again that imports make up about half the Spanish fertilizer consumption. The data contain some uncertainties: the sum of imports and production exceeds that of export and consumption by a million tonnes (15%).

**Table 45: Production, Consumption, Imports and Exports of fertilizers into the Spanish Market (ANFFE, 2013)**

|                   | Mass (Million t) |             | Mass (Million t) |
|-------------------|------------------|-------------|------------------|
| <b>Production</b> | 5.7              | Consumption | 4.2              |
| <b>Export</b>     | 2.1              | Import      | 2.6              |
| <b>Total</b>      | 7.8              | Total       | 6.8              |

## 7.5 Importers

The Spanish market is supplied 55% by local produced fertilizers and 45% by imported ones. This also applies to phosphorus. Yara, Fertiva/K+S, ADP (Portugal) and CAN are the biggest importers. The reduction of the market in the last five years affected more the imports than the local productions, with the exception of NPK where local productions was been also reduced (Table 46).

**Table 46. Spanish Fertilizer Market - Imports (Million t) (ACEFER, 2012)**

| Products                          | Imports |       |       |
|-----------------------------------|---------|-------|-------|
|                                   | 2009    | 2010  | 2011  |
| <b>Straight Nitrogen Products</b> | 1,105   | 1,360 | 1,400 |
| <b>Phosphates</b>                 | 48      | 56    | 57    |
| <b>Potash</b>                     | 96      | 294   | 302   |
| <b>NPK, NP, PK &amp; NK</b>       | 610     | 863   | 888   |
| <b>Total Market</b>               | 1,859   | 2,533 | 2,608 |





**Figure 31: Fertilizer import ports (ACEFER, 2011)**

The Spanish import ports are the gateway for the foreign fertilizers to the Spanish market (Figure 31). From there they are delivered to the rest of the country.

## 7.6 Producers

Although Spain counts 15 largest fertilizer factories, Fertiberia is clearly the leader in the Spanish market and decides local prices, always following international/European ones. Fertiberia and other producers are also importers of fertilizers and raw materials.

Fertiberia is one of the five biggest fertilizer manufacturers within the European Union and consequently, the biggest manufacturer company in Spain. In 2012, 35% of the phosphorus in the Spanish fertilisers was produced by Fertiberia.

The other fertilizer producers on the Spanish market mainly produce NPK for regional use (Table 48)

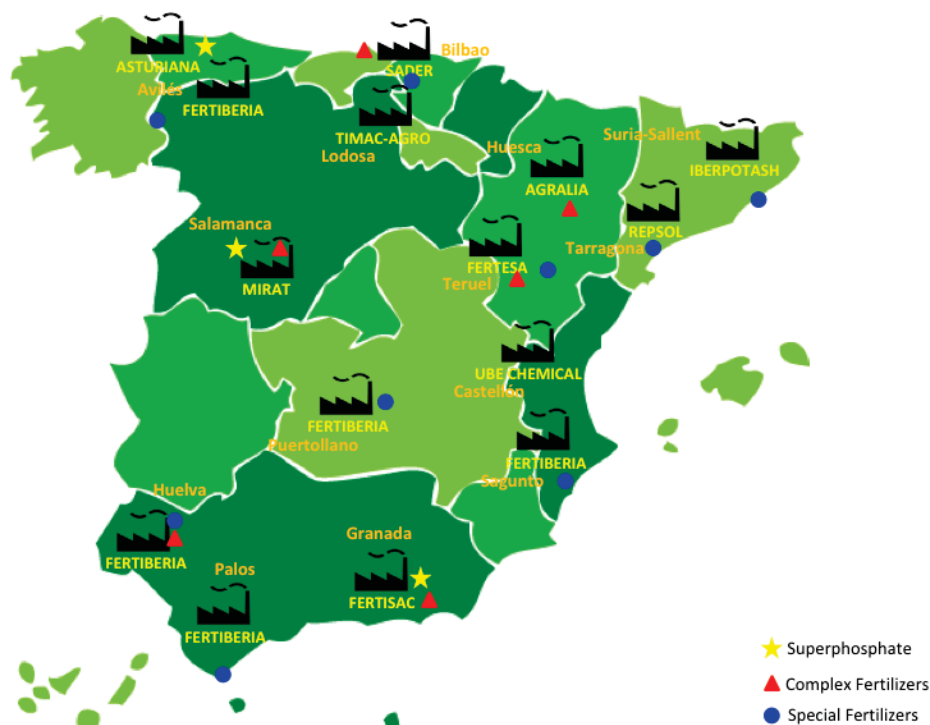
**Table 47: Spanish fertilizer producers**

|                     | Fertilizer Production (Million t) |
|---------------------|-----------------------------------|
| Fertiberia          | 650                               |
| Roullier (Inabonos) | 250                               |
| Agrimartin          | 250                               |
| SA Mirat            | 120                               |
| Sader               | 70                                |
| Fertisac            | 70                                |

**Table 48: Spanish Fertilizer Market, Production (Million t)**

| Products                   | Production   |              |              |
|----------------------------|--------------|--------------|--------------|
|                            | 2009         | 2010         | 2011         |
| Straight Nitrogen Products | 1'997        | 1'969        | 2'093        |
| Phosphates                 | 51           | 172          | 182          |
| Potash                     | 579          | 522          | 554          |
| NPK, NP, PK & NK           | 612          | 1'321        | 1'404        |
| <b>Total Market</b>        | <b>3'239</b> | <b>3'984</b> | <b>4'234</b> |

There are a total of 15 largest factories in Spain with chemical processing or granulation of raw materials. It is worth mentioning that only three of these mentioned factories process mineral phosphorus raw materials (e.g. rock) Figure 32 and none of the fifteen factories perform blending activities.

**Figure 32. Main Fertilizer Production Plants in Spain**

## 7.7 Wholesalers and retailers

The Spanish fertilizer distribution network consists of:

- Private wholesalers: 15-18 companies with yearly volumes going from 70'000- million t /a to 600'000 million t/a.
- Big Cooperatives: 5-6 big coops.
- Three subsidiaries of Fertiberia acting as both wholesalers and retailers.

Traditionally, fertilizer retailing in Spain has been characterized by a high proportion of independent outlets and independent retailers continue to account for the bulk of retail outlets. They are family-owned and generally passed down from father to son. These independent outlets have been perceived as less

professional than outlet chains. In the severe economic crisis and the latest liberalization measures many of them could not compete with the outlet chains which benefit from economies of scale.

**Table 49: Wholesalers and retailers distribution into the Spanish market.**

|             |  |                          |
|-------------|--|--------------------------|
| Wholesalers | Fertiberia 75%                               | Rest of companies<br>25% |
|             | End-users<br>Agricultural and Gardening 100% |                          |

As it can be worked out from the information located in Table 49 above, Fertiveria controls the business of fertilizer's wholesalers into the Spanish market with almost three quarters of the market share, Through this quantity, the influence that Fertiveria possesses over the prices of the market can be estimated.

In addition, the table above shows that the Spanish fertilizers market revolves around two main activities: agricultural and gardening. This means that the fluctuations of the market impact directly over the performance of both activities.

## 7.8 Farms and Farmers cooperatives

The turnover of Spanish farm cooperatives has grown as a consequence of the latest changes in the regulations governing Spanish cooperatives. Major cooperative groups with high turnovers have developed in this positive environment.

The total number of farms in Spain is above 1 million of which 79% are smaller than 20 ha (of which 52 % smaller than 5 ha). Detailed information on all companies involved in the Spanish fertilizer market can be found in Annex G.

## 7.9 Conclusions

This document contains a Spanish fertilizers market research and aims to be used as a guideline. An analysis of technical aspects and Spanish legislation have been performed as well as a compilation of information about the current fertilizers related company in Spain in order to give an overview of the possible cooperation partners in the field. The market research conducted showed the following main ideas:

- Agriculture in Spain was one of the most important activities for the national economy during the 60s and 70s. The agricultural sector contributed around 23% of annual GDP. The democratization of the country and the access to the European Union has diminished the importance of the agriculture in favour of the services. In 2012 agriculture accounted for about 3% of GDP.
- Of Spain's 50.5 million hectares of land, 25 million, or about 50 %, are suitable for cultivation.
- The Spanish fertilizer industry can produce the full range of products demanded by Spanish agriculture. Import causes are mainly economic.
- The main substitute products for mineral fertilizers are organic fertilizers (farm yard manure, soil conditioner). They are highly available due to the existence of numerous producers and with a cheaper cost of production.

- Nitrogen fertilizers are the dominant ones in the Spanish market; those account for a 45% of the total amount of fertilizers consumed in the country, followed by complex fertilizers with a contribution of 40%, phosphate and potassium ones up to a 4% respectively and others, 5%.
- 55% of the Spanish fertilizers are domestically produced and 45% are imported. This ratio is also valid for the phosphorus fraction.
- In Spain the only visible efforts in phosphorus recycling are R&D projects conducted by universities, R&D enterprises and big chemical companies.
- It can be said that in Spain there is room for phosphate recycling, due to the increase of raw materials prices for fertilizer production and the lack of recycling plants.

Considering the abovementioned factors recycling of phosphorus for the fertilizers market in Spain seems viable. Recyclers could use the present guideline as a source of information for technical matters and fertilizers legislation as well as for finding possible business partners in Spain.

Conversely Spanish companies are not exactly "early adopters" for any kind of innovative technology. This conservative mindset is something to be taken seriously, moreover when the success of the recycling business depend on potential adopters belonging to the agricultural sector

## 8 Switzerland

### 8.1 Overview

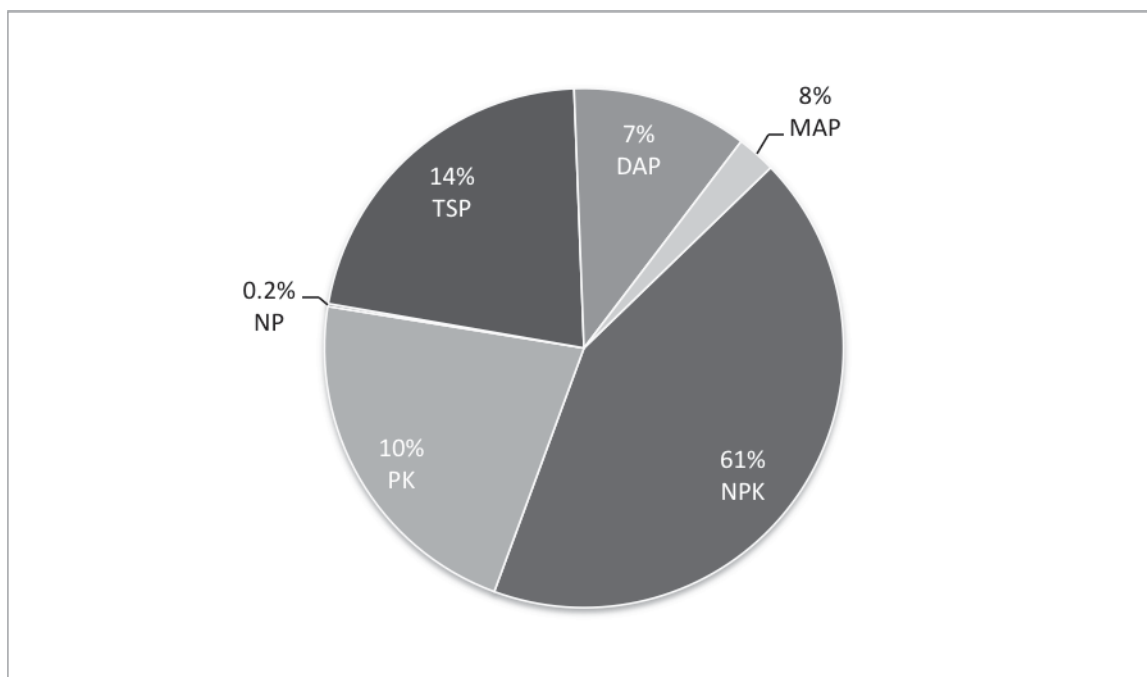
The Swiss market structure survey was based on literature data and a survey of 10 major actors in the value chain (Table 50). The interviewed actors represent all of the above mentioned groups except phosphorus compound producers which are not present in Switzerland. The survey data were collected through questionnaire-based interviews conducted by phone conversation or a meeting.

The majority of the farmers (80 %) in Switzerland are members of the farmer cooperation (Landi). The farmers' coops common supply organisation is called Fenaco. Fenaco is the biggest player in the Swiss fertilizer market with the daughter companies Landor, Agroline and UFA Samen. The farmers coop imports (Fertag), distributes (Landor, Agroline, UFA Samen) and retails (Landi) different kinds of fertilizer.

Most of Swiss fertilizers are produced abroad and shipped on the Rhine river. Swiss fertilizers are similar to those of other European countries, the most notable difference being the legal limit on cadmium content to 50 g/t phosphorus (22 g /t P<sub>2</sub>O<sub>5</sub>as compared to typical limits of 50 g /t P<sub>2</sub>O<sub>5</sub> in other European countries) which makes special product lines for Switzerland necessary. Since 1990 the total Swiss phosphorus fertilizer use decreased from some 20'000 t/a to some 5'000 t/a today (Swiss Farmers associations, 2013) due to better knowledge of plant needs coupled with more stringent regulation. Swiss farmers get subsidies on condition that their input and output of nutrients is balanced. The other phosphorus source in Swiss agriculture is manure (29'000 t/a P; (Binder, de Baan, & Dominic, 2009)), whereas no sewage sludge is used since this practice was forbidden in 2006.

Besides Fenaco there are smaller companies which make up 25 % of the Swiss fertilizer market. In some cases they also sell via the Landi farmers coops. There are also private resellers which buy fertilizer over the border and sell it in Switzerland. These resellers make up a small part of the market since they deal with amounts of a single truck.

Most of the imported phosphorus for fertilizer enters the Swiss market as complex fertilizer (NP, PK, NPK; 71%) (Figure 33). Phosphorus compounds for further processing (TSP, DAP and MAP; 29%) are usually mixed with other ingredients to produce complex fertilizer.



**Figure 33: Mass fraction of phosphorus present in different forms in the Swiss fertilizer imports (Eidgenössische Zollverwaltung, 2012)**

The agricultural market is by far the biggest fertilizer market in Switzerland. The horticultural market is smaller and hard to differentiate from the agricultural market since it has the same distribution channels and similar products (Raaflaub & Genoni, 2005). Together they make up about 95% in terms of phosphorus (85% global fertilizer volume). The gardening and landscaping market has other kinds of fertilizer. The data on market structure was collected for the entire fertilizer market, rather than separately for the three sectors. It will be presented under the main market, agriculture, and some particularities of the other markets will be described in separate chapters.

## 8.2 Agriculture

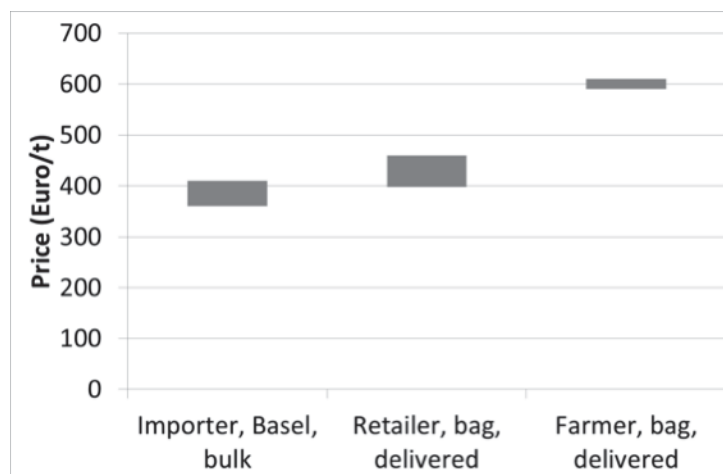
An overview of the different parts in the fertilizer value chain and the companies which cover them is given in Table 50. Most imports are products for the end-user. There are two fertilizer compounders in Switzerland (CU Agro AG for Agriculture and Hauert for gardening and landscaping markets). Opdebeeck SA blend imported granules. Landor distributes imported complex fertilizers and also blends to some extent.

**Table 50: Companies covering different parts of the value chain (Data from company interviews)**

| Company                               | Importer | Phosphorus compound producer | Fertilizer compounder | Fertilizer blender | Wholesaler | Retailer | Farmers coop | Farmer |
|---------------------------------------|----------|------------------------------|-----------------------|--------------------|------------|----------|--------------|--------|
| Agroline                              |          |                              |                       |                    |            |          |              |        |
| Calcium Agro                          |          |                              |                       |                    |            |          |              |        |
| CU Agro AG                            |          |                              |                       |                    |            |          |              |        |
| Hauert                                |          |                              |                       |                    |            |          |              |        |
| Landor                                |          |                              |                       |                    |            |          |              |        |
| Landi                                 |          |                              |                       |                    |            |          |              |        |
| Omya                                  |          |                              |                       |                    |            |          |              |        |
| Opdebeeck SA                          |          |                              |                       |                    |            |          |              |        |
| UFA-Samen                             |          |                              |                       |                    |            |          |              |        |
| Societe cooperative agricole d'Apples |          |                              |                       |                    |            |          |              |        |

Not shown in the Table 50 is the storage capacity. Wholesalers make special offers to distribute sales evenly over the year and not just before growing season. Thus the farmers provide storage capacity to cover the consumption peak in spring. The farmers usually buy their fertilizer from persons they know well and trust and the products mostly remain the same. The level of innovation is low.

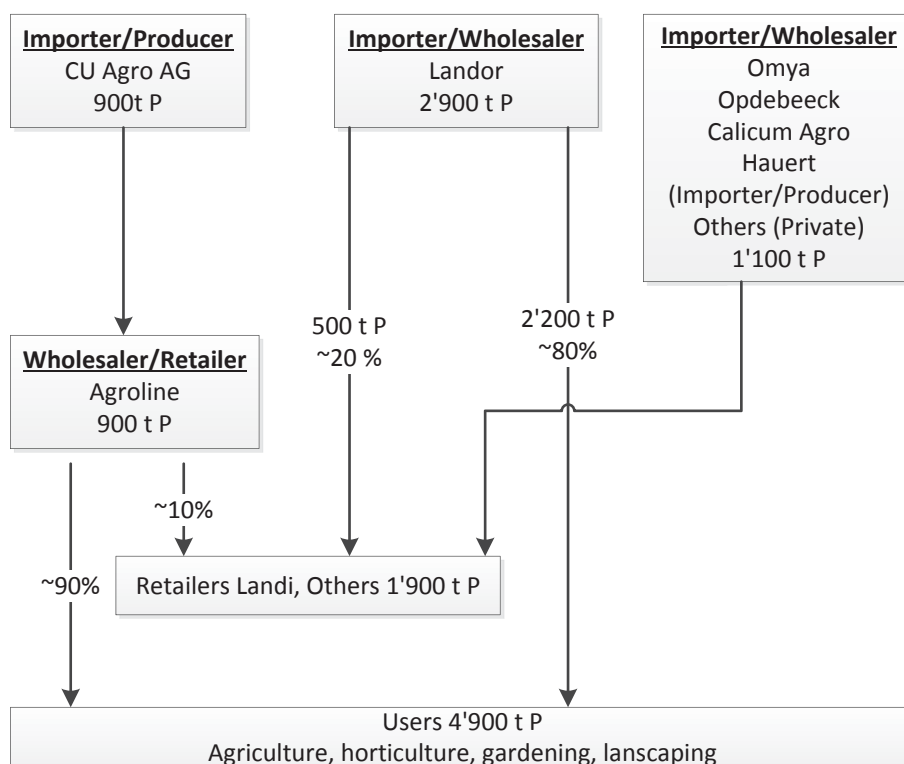
The Triplesuperphosphate (TSP) price paid by actors along the fertilizer value chain in Switzerland (Figure 34) was calculated with data from company interviews. The prices shown represent the agricultural and horticultural markets. Prices and margins in the specialized gardening and landscaping markets are considerably higher.



**Figure 34: TSP price paid by actors along the value chain in the Swiss fertilizer market (from company interviews; values from 2 actors)**

The data from Raaflaub and Genoni, (2005) and the Swiss import statistic were used to get an overview of the phosphorus flow in Switzerland (Figure 35). 6 companies import, and two of them (CU Agro, Hauert) also compound. Some of the importers are also retailers (total of 5 retailers), whereas some concentrate on wholesale. A total of 4'900 t phosphorus is imported and sold every year.

The listed amounts of phosphorus are calculated starting with the import and then split into the different importers according to their information. Landor only distributes to the customer, the sale is made via Landi as can see in the retail part of the sector map (Figure 36).



**Figure 35: P-flow based in the Swiss fertilizer market (Eidgenössische Zollverwaltung, 2012) (Raaflaub & Genoni, 2005) (company interviews)**

The sector map from Figure 36 shows the share phosphorus sales of each company for the different steps in the Swiss fertilizer value chain. Landor has a major market share (55%) of imports and wholesale, CU Agroas exclusive importer/producer for Agroline coming second (20%). The market share of CU Agro is decreasing and they will reportedly plan to close production. In the retail step Landi dominates (70%) since they sell the fertilizers from Landor, part of those of Agroline and most of the small players (Opdebeeck, Calcium Agro, Omya) products. Agroline in contrast to Landor sell mostly direct to customers and is thus also a major retailer. Omya is also a retailer, directly addressing large farmers, and there is a small fraction of other retailers. In the end-user step the agricultural and horticultural sector absorbs most of the phosphorus; the gardening and landscaping sector make up some 5%.



|                         |                                   |                   |   |
|-------------------------|-----------------------------------|-------------------|---|
| Importers/<br>producers | Landor 55%                        | CU Agro AG<br>20% | Opdebeeck 5-10%,<br>Calcium Agro 5-10%,<br>Omya 5-10%, Hauert<br>plus Others 0-5% |
| Wholesalers             | Landor 55%                        | Agroline 20 %     | Opdebeeck 5-10%,<br>Calcium Agro 5-10%,<br>Omya 5-10%, Others 0-<br>5%            |
| Retailers               | Landi 70%                         | Agroline<br>15%   | Omya 0-5%<br>Others 5-15%   |
| End-users               | Agriculture and horticulture 95 % |                   | Garden<br>ing,<br>landscap<br>ing<br>5 %  |

**Figure 36: Sector map of the phosphorus sales in the Swiss fertilizer market (Eidgenössische Zollverwaltung, 2012) (Raaflaub & Genoni, 2005) (company interviews)**

The actors in the chain were asked what they need to know from the preceding and the following step. In Table 51 the information flow between the steps in the value chain is summarized. More detailed information on Swiss fertilizer companies can be found in Annex H.

**Table 51: Information flow in value chain (data from company interviews)**

| Importer<br>Producer   | Wholesaler<br>Retailer  | Farmer<br>Coop   |
|--|---|--|
| Price<br>P-content in % (e.g. TSP 42-46 %)<br>Cd-content (50 g Cd/t P)<br>Physical characteristics (dust content,<br>granulation)<br>quality | Price<br>Availability<br>Packaging (bigbags, bags)<br>Quality | Local access to the farm (possible<br>with truck?)<br>How the will get their delivery<br>(home delivery, pick up, store)<br>Physical characteristics<br>What kind of fertilizer distributor<br>they use<br>Packaging (bigbags, bags)<br>Creditworthiness<br>Feedback |

## 8.3 Other Markets

### 8.3.1 Horticultural, gardening and landscaping

The horticultural market is much smaller than the agricultural market. It is difficult to distinguish between them because they usually have the same distribution channel and similar products.

The niche market for gardening and landscaping, including also sports facilities and production of ornamentals (potted plants, plant nurseries) constitutes 5% of the Swiss fertilizer market. This market is dominated by Hauer HBG and UFA-Samen who are specialised in it.

The phosphorus content of the niche market fertilizers is 1 % rather than the 3 % common in agricultural products. This is due to the fact that the soil usually gets enough phosphorus from soil conditioner. The added phosphorus can be useful in initial growing phase of the plant.

### **8.3.2 Ecological Farming**

The ecological farming market represents 12% of the agricultural area. Three mineral phosphorus containing materials are allowed as defined in SR 910.181 Annex 2 which implements EC No 889/2009 in Switzerland. Of those only soft rock phosphate is used. A fertilizer for ecological farming should not be chemically processed and preferentially not water soluble. The recycling of nutrients is regarded positively since ecological farming strives for closed material flows. However, it would be a challenge to convince this sector that there is no relevant risk of contamination of soils and products with pollutants present in the wastewater. Currently no activities for homologation of new mineral phosphorus fertilizers for ecological farming is on-going.

### **8.3.3 Other**

According to an interview partner phosphorus compounds can be used for plant protection if they are highly concentrated and liquid.

## **8.4 Fertilizer Stakeholders in Switzerland**

The fertilizer companies listed below give an overview of the players in the Swiss fertilizer market. The data are collected from company interviews. These profiles show the collected data from the companies and what they do. The phosphorus turnovers are set in ranges from 100-300, 300-1000 and 1000-3000 t P/a according to the collected data from the company interviews.

## **8.5 Discussion of Swiss Market Structure and Conclusions**

The contacted companies were really positive and interested in a recycling product. All of them would be able to use recycled phosphorus as a new phosphorus-source. They would pay a price which is the same as the standard phosphorus or lower. Furthermore, most of the companies recycling product has to be already granulated for further use as a fertilizer. The recycled amount has to be fitted to the need for certain product lines or for the portfolio of one or several companies. Opdebeeck SA and Landor AG are able to use granulated recycling phosphorus together with the other ingredients for a bulk blend. CU Agro AG and Hauer HBG AG have compounding plants, so they can produce granules from phosphorus compounds in various forms.

To be accepted, the recycled phosphorus should offer the same quality as the normal phosphorus, in particular fulfilling the required Cd-content. It also has to have good bio availability. No company mentioned any potential marketing advantages of recycled phosphorus.

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