

MAGDALENA ŚMIGLAK-KRAJEWSKA

Poznań University of Life Sciences, Poland

DETERMINANTS OF THE SELECTION OF RAW MATERIALS USED IN ANIMAL FEED PRODUCTION

Key words: protein feed, legumes, soya bean meal, feed operators

ABSTRACT. The main purpose of this paper was to identify the factors affecting the selection of raw materials used by feed operators in feed production. An attempt was also made to indicate the barriers to increasing the use of native protein plants by feed operators in feed production. Today, many EU countries (including Poland) primarily rely on vegetable protein derived from genetically modified soya bean meal (mainly imported from South America and the U.S.) in addressing their needs for protein raw material used in animal feed. For many years now, Poland has taken steps to increase the production and use of native protein raw material to partially replace soya bean meal imports. The use of mixes of diverse domestic protein sources derived from grain legumes (peas, field beans, lupine) can provide an advantageous alternative to compound feeding stuff based on imported post-extraction soya bean meal. To meet the objective defined above, this paper relied on the results of a 2018 survey conducted with a sample of 29 feed operators located across the country. More than half (55%) of the enterprises surveyed did not use legumes in feed production; the use of legumes was above 10% in only 3% of respondents. When asked about the key factors affecting the selection of raw materials used in production processes, the respondents declared to be interested in buying large batches of homogeneous raw materials that meet specific quality parameters (33% replied “rather yes” and 67% replied “definitely yes”). The protein content of plant seeds used in feed production was identified as another aspect of extreme importance (55% replied “rather yes” and 24% replied “definitely yes”).

INTRODUCTION

The feed industry, a sub-sector of the food industry, exhibits certain particularities. This is because it manufactures products which, instead of being consumed directly by humans, are intended for animal feed use and this is how they address human nutritional needs. Industrial feed is bought by the agricultural sector; the demand for finished feed is primarily driven by the type, scale and intensity of animal production [Drożdż et al. 2014]. High-quality industrial feed is the basis for the development of intensive poultry or pig production, which is a necessary condition for the dynamic growth of animal product exports and increased meat consumption [Nowakowska-Hapel 2016].

Poland has an index of self-sufficiency in vegetable proteins at a level of only 30% of total demand. The remaining part is supplemented with soya bean meal imported from

the Americas. Consequently, the Polish and many other European Union (EU) markets have become dependent upon foreign sources of vegetable protein.

According to estimates by the Institute of Agricultural and Food Economics, soya bean meal contributes ca. 62% to meeting the demand for feed protein in Poland. The corresponding shares of rapeseed components and sunflower seed meal are 23% and ca. 7.5%. In turn, the contribution of protein derived from legumes is only 6.5%¹ [Grela, Czech 2019].

In the 2017/2018 season, Poland imported over 2.4 million tonnes of soya bean meal (27% more than in the 2011/2012 season) and 106.2 thousand tonnes of soya beans (950% more than in the 2011/2012 season). The above findings come to support the opinion that animal feed production strongly depends upon imports of soya bean meal, mainly originating from the Americas [Jerzak, Śmigłak-Krajewska 2020, Soroka, Wojciechowska-Solis 2019].

Today, native protein crop species (used in the production of feed, mostly for poultry and pigs, in the 1980s) have been marginalized. In the late 1980s / early 1990s, Poland had nearly 400 thousand ha of land under legumes [Jerzak et al. 2020]. The interest in these crops was driven by the country's commitment to become self-sufficient in the production of protein feed intended for use in compound animal feed. Also, this period was marked by difficulties in accessing imported post-extraction soya bean meal. Imports could be considerably restricted by using domestic protein sources, including grain legume (peas, field beans, sweet lupines) seeds, which exhibit adequate protein content.

The purpose of this paper was to identify the factors affecting the selection of raw materials used by feed operators in feed production. An attempt was also made to indicate the barriers to increasing the use of native legumes by feed operators in feed production.

MATERIAL AND METHODS OF STUDIES

To meet the objective defined above, this paper relied on the results of a 2018 survey conducted with a sample of 29 feed operators located across the country. Also, this paper referred to research carried out under the multi-annual programme of the Ministry of Agriculture and Rural Development for 2016–2020² (“Enhancing the use of domestic feed protein in the production of high-quality animal products in a sustainable development perspective”). A purposeful sampling technique was used in selecting the respondents. The following was used as the basic criteria for respondent selection: animal feed production as the main line of business (group 10.9 in the Polish Classification of Economic Activity); and company size, measured as the number of employees (based on data provided by the Central Statistical Office). According to the Central Statistical Office, there were 85 animal feed producers with no less than 10 employees in 2018. This survey covered 29 feed producers (34% of all operators with more than 10 employees), including: 52% of small enterprises with up to 49 employees; 41% of feed mills with 50 to 250 employees; and 7% of large establishments with over 250 employees. The measurement method employed

¹ There are two sub-groups of legumes: grain legumes and bloom (perennial) legumes [Kapusta 2012].

² A survey was conducted by Bogdan Sojkin, Dobrosława Mruk-Tomczak, Szymon Michalak, The Poznań University of Economics and Business, as a part of the multi-annual programme.

was a direct interview based on a standardized survey questionnaire. The questions were asked with the use of the rank scale and the Likert scale. Once collected, the information was analyzed and described with the use of descriptive statistics methods.

SURVEY RESULTS AND DISCUSSION

The key condition for the market to operate efficiently is interest from feed operators in using the seeds of native protein plants in animal feed production. More than half (55%) of the enterprises surveyed did not use legumes in feed production; the use of legumes was above 10% among only 3% of respondents (Figure 1). This is fully understandable in a context where feed operators can access large, readily available quantities of imported soya bean meal.

The producers were asked about the key factors that make them choose specific raw materials used in feed production (Figure 2).

Figure 1. Use of legumes in animal feed production.
Source: own study based on survey data

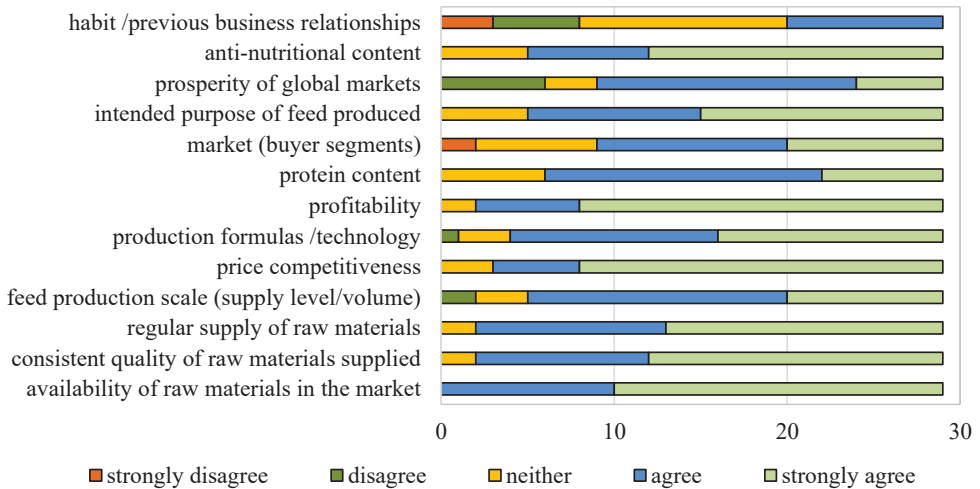
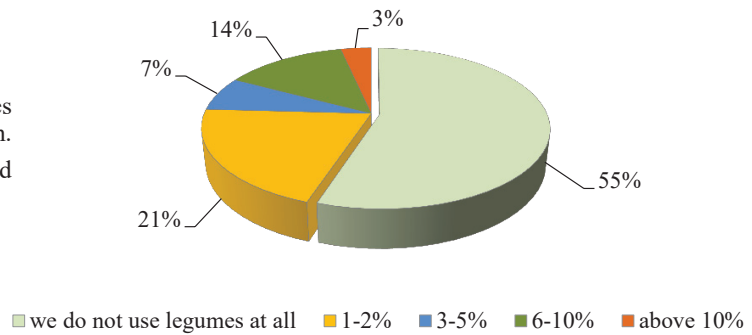


Figure 2. Factors decisive for the selection of raw materials used in animal feed production (n = 29)
Source: own study based on survey data

All respondents declared to be interested in large batches of homogeneous raw materials (33% replied “rather yes”; 67% replied “definitely yes”). Over 60% of respondents believe that the volume of a contract entered into with a single supplier should be over 100 tonnes. The area under legumes should be increased in order to ensure sufficiently large batches of legume seeds. Hence, post-extraction soya bean meal could be partially replaced with domestic protein provided that large batches of domestic protein raw materials are regularly supplied in an organized manner to feed producers.

The key drivers of animal production profitability also include the adequate quality of raw materials [Prus 2010], which has a direct impact on feed quality. Indeed, low-quality raw materials involve many threats and can contribute to the spread of diseases and an increased number of farm animal deaths. The above is also corroborated by survey results: the respondents believe adequate and consistent quality to be the second most important determinant of their choice of raw materials (Figure 2). With fair-quality feed ingredients, it is possible to produce high-quality feeding stuff. Conversely, inadequate feed quality can result in diverse digestive and metabolic disorders, translating into a deterioration of animal health and a reduction in the quality of animal products.

Proteins (and amino acids they contain) are nutrients of particular importance, and have a decisive impact on production performance. Therefore, compound feeding stuff must be balanced with large quantities of protein materials [Dzwonkowski 2016]. The respondents also found the protein content of seeds to be an important factor considered when selecting feed raw materials (cf. Figure 2). Also, such proteins should exhibit good digestibility. Soya seeds contain ca. 40% of protein with a perfect profile and up to 20% of fat with a high content of essential unsaturated fatty acids [Kapusta 2012]. The average total protein content of legumes varies in the range of 21% (pea) to as much as 43% (yellow lupine). While legume protein has a low content of sulfuric amino acids (methionine and cystine), it contains relatively large quantities of lysine, making it a good additive in cereal feeding stuff [Hanczakowska, Książak 2012]. According to a vast majority of enterprises surveyed, protein derived from legumes demonstrates medium or good quality (Figure 3).

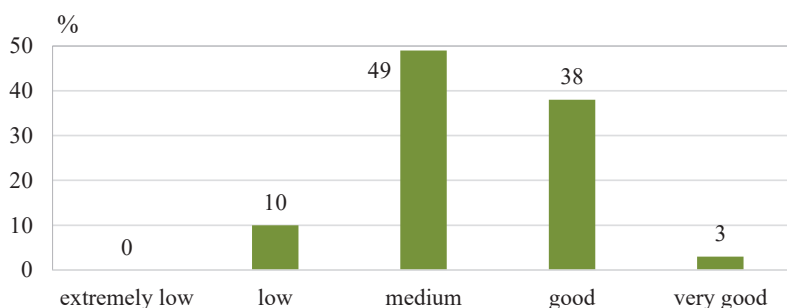


Figure 3. Assessing the quality of legume protein as a feed component

Source: own study based on survey data

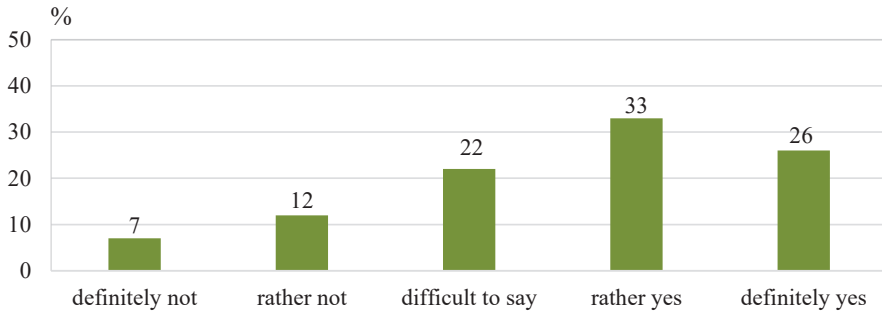


Figure 4. Increased use of legumes in feed production upon reducing the content of anti-nutritional substances

Source: own study based on survey data

However, replacing soya bean meals with legumes (peas, lupines, field beans) will require specific measures to be taken to “enhance” protein derived from the latter. One of the arguments in favor of using soya bean meal is a proven, stable level of protein. Replacing soya bean meal with legumes will require making the quality of protein at least equal to that of protein derived from soya bean meal (which receives excellent feedback).

Major factors affecting the selection of raw materials for feed production, as mentioned earlier, include anti-nutritional substances present in plant seeds (Figure 2). According to Wiesław Dzwonkowski [2016], legumes are used to a small extent due to their nutritional restrictions and excessive content of fiber and anti-nutritional substances (alkaloids and tannins). The importance of these aspects is also reflected in the distribution of replies to one of the questions included in the questionnaire. It suggests that only 19% of respondents would not increase their use of legumes in feed production if the presence of anti-nutritional substances was reduced. Slightly over 22% have no opinion on this issue. In the situation envisaged above, representatives of other enterprises would be interested in starting to use, or increasing the share of, legumes in the mix of feed raw material.

In addition to price factors (profitability) and the availability, homogeneity and consistency of supplies, it will be of utmost importance to ensure raw materials of adequate quality.

Furthermore, in addition to being provided with raw materials that meet defined quality parameters, feed producers find it key to rely on homogeneous, repeatable and consistent supplies (which is currently a major problem) (Figure 5). Meeting that condition (combined with price and quality factors) could also provide an incentive to start using, or increase the use of, legumes by feed operators in their production processes.

Most (66%) enterprises surveyed declare that the use of legumes in feed production will require them to incur additional costs involved in the need to adjust their infrastructure; 41% of that group expect these costs to be high and extremely high (Figure 6). Costs that must be borne (relating both to infrastructural adjustments and other aspects) primarily include: additional storage space (the construction of silos); an upgrade of the technological line (e.g. grinding lines, conveyers, storage tanks, dosing tanks, pre-processing equipment); the need to “work” with seeds (additional drying, decortication, thermal process-

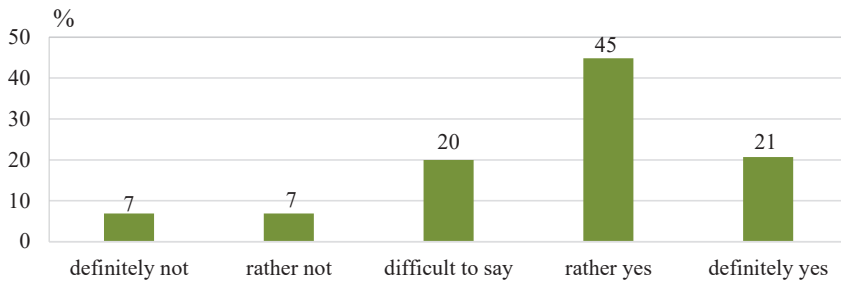


Figure 5. Increased use of legumes in feed production upon ensuring homogeneous, repeatable and consistent supplies

Source: own study based on survey data

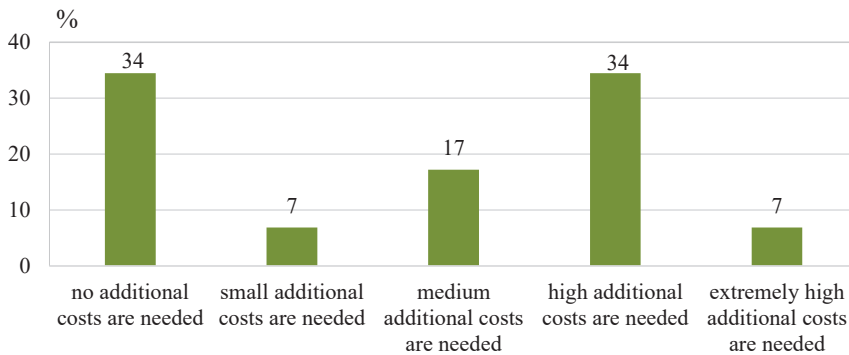


Figure 6. Adjustments to the existing infrastructure: additional costs involved in using legumes in feed production

Source: own study based on survey data

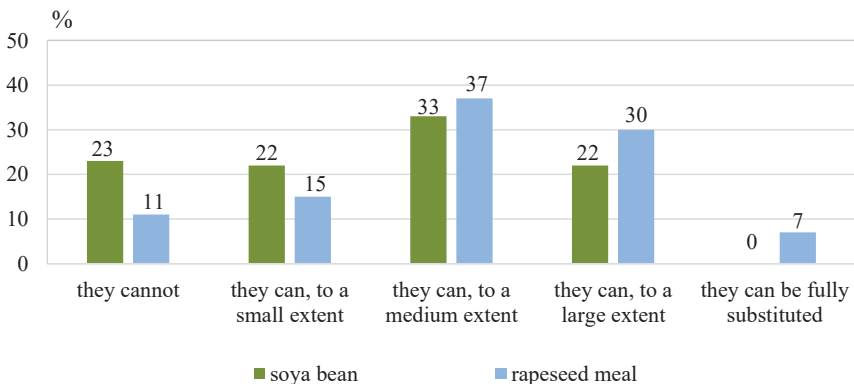


Figure 7. Opinion on whether soya bean and rapeseed meal can be substituted with legumes

Source: own study based on survey data

ing, cleaning, grinding); employee and customer training sessions; and costs involved in protecting the alimentary tract of animals.

Feed operators differ in their opinion on whether soya bean and/or rapeseed meal can be substituted with legumes (Figure 7). The reason behind such large discrepancies in how they view it needs to be examined. This may be caused by insufficient knowledge of legume properties as a potential raw material used in feed production, or by currently available legume varieties not being good enough to replace

other ingredients, especially soya bean meal (which has been used for many years and is highly appreciated). Again, the key requirement is to develop a production raw material with adequate parameters. Also, intense communication efforts need to be made to raise the awareness of properties and possible uses of legumes in the feed market (attaining the satisfactory acceptance of legumes as a substitute raw material for feed).

Research suggests that legumes have a relatively high potential to replace soya bean meal (these findings were confirmed in personal interviews with production and product managers of large feed companies).

Entrepreneurs were also asked to indicate three factors they believe could pose a barrier to acceptance by buyers (e.g. pig or poultry producers) of feed containing legumes (peas, field beans, lupines).

The main limitations to the acceptance of feed containing legumes by buyers include barriers related to qualitative parameters, e.g. protein content and quality, the technological processing of components (where needed) or the need to use enzymes (32%). Next, are barriers related to the content of anti-nutritional substances and nutrition itself, including animals being unwilling to consume feed, poor digestibility, tolerability issues, problems related to alimentary tract dysfunctions in animals, as well as barriers related to low awareness and not having enough information (28%). Other barriers to acceptance indicated in this survey are use efficiency (weight gains), price, availability and the homogeneity of raw materials.

Table 1. Barriers/limitations to the acceptance of feed containing legumes by buyers

Barriers and limitations	%
Quality /parameters /protein	32
Concerns /reluctance /awareness	28
Nutritional /anti-nutritional substances	28
Use efficiency	16
Price	12
Homogeneity of raw materials	8
Availability of legumes	8
No barriers	8

Source: own study based on survey data

SUMMARY

The main weakness of the Polish protein plants sector is the highly fragmented structure of producers and low, variable yield, which make it impossible to deliver larger, homogeneous batches of raw materials. As a consequence, feed companies show little interest in domestic protein crops. Due to the high purchasing costs of small quantities of native raw materials, feed producers are not interested in them, and use readily available, imported soya bean meal instead.

Taking all the factors listed above into account is necessary in order for feed operators to consider an increased use of legumes (peas, field beans, lupines) in their production processes. According to feed enterprises covered by this survey, the main reasons for not using native legumes include the inability to buy large batches of materials, as necessary to maintain all-year-round production. Without sufficient availability, consistent quality and regular supplies of raw materials, all plans regarding the increased use of legumes in the feed market will remain unrealistic. Enterprises will not be willing to take risks and no longer rely on proven, readily available soya beans, if they are not provided with reliable and guaranteed supplies of an alternative component. Habits and previous business relationships should not be a major barrier in replacing soya bean meal with legumes. However, adequate prices of raw materials (and, as a consequence, profitability) must be ensured.

Other potential problems which need to be solved by R&D establishments or plant cultivation institutes include: providing farmers with adequate seed, i.e. varieties with appropriate protein content, delivered in homogeneous batches; and reducing the amount of anti-nutritional substances in legume seeds. Farmers could produce seeds that meet the expectations (demand) of feed operators, in accordance with a unified technology required by the buyer. Also, they could select varieties with smaller amounts of undesired substances to make legume seeds better suited for animal nutrition purposes.

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DETERMINANTY WYBORU SUROWCÓW WYKORZYSTYWANYCH DO PRODUKCJI PASZ

Słowa kluczowe: pasze wysokobiałkowe, rośliny strączkowe, śruta sojowa, przedsiębiorstwa paszowe

ABSTRAKT

Celem artykułu jest wskazanie czynników wpływających na wybór surowców wykorzystywanych do produkcji pasz przez zakłady paszowe. Podjęto także próbę wskazania barier ograniczających możliwości zwiększenia wykorzystania rodzimych roślin białkowych przez przedsiębiorstwa paszowe do produkcji pasz. Obecnie w wielu krajach UE, jak i w Polsce, potrzeby w zakresie paszowego surowca białkowego zaspokajane są głównie białkiem roślinnym, pochodzącym z genetycznie modyfikowanej śruty sojowej, importowanej głównie z Ameryki Południowej oraz USA. Od wielu lat w Polsce podejmowane są działania w kierunku zwiększenia produkcji oraz wykorzystania rodzimych surowców białkowych, w celu częściowego zastąpienia importowanej śruty sojowej. W realizacji postawionego celu posłużono się wynikami badań przeprowadzonych w 2018 roku na próbie 29 przedsiębiorstw paszowych z terenu całej Polski. Ponad połowa (55%) spośród przebadanych przedsiębiorstw nie wykorzystywała roślin strączkowych do produkcji pasz, a jedynie w 3% podmiotów ich wykorzystanie przekraczało 10%. Wśród najważniejszych czynników wpływających na wybór surowców do produkcji, respondenci wskazali możliwość zakupu dużych partii jednolitego surowca, o określonych parametrach jakościowych (33% wskazań „raczej tak”; 67% „zdecydowanie tak”). Również bardzo ważnym czynnikiem była zawartość białka w nasionach roślin wykorzystywanych do produkcji pasz (55% wskazań „raczej tak”; 24% „zdecydowanie tak”).

AUTHOR

MAGDALENA ŚMIGŁAK-KRAJEWSKA, PHD
ORCID: 0000-0001-9984-6599
Poznań University of Life Sciences
Faculty of Economics and Social Sciences
Department of Finance and Accounting
28 Wojska Polskiego St., 60-637 Poznań, Poland