Novafert

Novafert

D4.1 – Industry analysis of the fertiliser market

Author(s):	*Ana-Marija Špicnagel, Morana Jednačak, Mirna Avdić, Natalija Vugrin, Sara Ekić, Viktorija Grubišić (IPS Konzalting)*
Version:	*Final version*
Quality review:	*Jorge Senan (UVIC)* *Patrick Forestal, Donal Kinsella, (TEAGASC)*
Date:	*06/03/2024*
Dissemination level:	*Public (PU)*
Grant Agreement N°:	*101060835*
Starting Date:	*01-09-2022*
Duration:	*36 months*
Coordinator:	*Prof. Erik Meers, Ghent University*
Contact details:	*erik.meers@ugent.be*

Table of Contents

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Abbreviations

BBFs	Biobased Fertilisers
BMC	Business Model Canvas
CAGR	Compound annual growth rate
CH	Channels
CR	Customer relationships
CRM	Costumer relationship model
CS	Customer Segments
DAP	Diammonium phosphate
DIY	Do it yourself stores
EC	European commission
EU	European Union
EUR	Euro
F&B	Food and beverage processing
FAO	Food and Agriculture Organization of the United Nations
FPR	Fertilising products regulations
GHGs	Green House Gasses
GPS	Global Positioning System
ha	Hectare
IFA	International Fertilizer Association
LF	Liquid form
K2O	Potassium oxide
K2S2O3	Potassium thiosulfate
K	Potassium
KTS	Potassium thiosulfate
MAP	Monoammonium phosphate
MgNH4PO4 · 6H2O	Magnesium ammonium phosphate/ Potensiometric of Struvite
MOP	Potassium chloride
MSc	Master of Science
N	Nitrogen
NGO	Non-governmental organization
NH3	Ammonia
NH_4NO_3	Ammonium nitrate
NH4H2PO4	Monoammonium phosphate
(NH4)2SO4	Ammonium sulphate
P2O5	Phosphorus pentoxide
P	Phosphorus
pH	Potential of hydrogen
PhD	Professional Doctorate Degree
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation
RO	Reverse osmosis
S	Sulphur
SEO	Search engine optimization
SF	Solid form

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

SMEs	Small and medium enterprises
TRL	Technology readiness level
UN	United Nations
USD	American dollar
VP	Value proposition
WP	Work package

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Executive Summary

This deliverable provides a comprehensive analysis of the fertilisers market, with a particular focus on Bio-Based Fertilizers (BBFs) and examines the dynamics of the European Union's fertilisers sector. It explores the importance of BBFs within the context of current environmental and agricultural challenges and offers insights into the evolving landscape of the fertilizers industry.

The document starts by presenting a brief overview of the global fertilizers market, highlighting the critical role of BBFs in sustainable agriculture. It then narrows down to provide an in-depth look at the EU fertilizers market, detailing current trends, challenges, and the regulatory framework that shapes the industry. This analysis is crucial for understanding the market's direction and the impact of legislation on business operations.

A significant portion of the report is dedicated to analysing currently existing alternative fertilisers, assessing market needs, and understanding the demands for these alternatives. The pros and cons of incorporating alternative fertilizers into agricultural practices are discussed, providing a balanced view of their benefits and potential drawbacks.

Key players within the fertilizer industry are identified, along with an analysis of the competitive landscape and market concentration. This section offers insights into the major players in the mineral fertilizer market, highlighting their strategies, market positions, and contributions to the industry's development.

Customer segmentation and approach strategies are explored through behavioural analysis based on conducted surveys. This analysis helps in understanding the motivations, preferences, and concerns of different customer segments, facilitating more effective marketing and product development strategies.

The deliverable also introduces a business model canvas focusing on specific customer relationships and strategies for building long-term relationships with customers. This framework serves as a guide for companies in the fertilizer industry to structure their business models around customer needs and establish enduring partnerships.

To sum up, the deliverable emphasizes the growing importance of alternative fertilisers, particularly BBFs, in the context of environmental sustainability and agricultural productivity. It provides valuable insights for industry stakeholders, policymakers, and businesses, offering a roadmap for navigating the complex fertilizers market and capitalizing on emerging opportunities.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

1 Introduction

The push for sustainable agriculture and resource independence from fossil fuels, coupled with the high demand for nutrients and the current strain on natural resources, has brought BBFs to the forefront of the European Union (EU)'s political agenda.

The European Union aims to boost the production of fertilisers from various waste streams, such as bio-waste, bio-products, digestate, sludge, wastewater, treated manure, and more, also known as a bio-based fertilisers (BBFs).

The primary aim of NOVAFERT is to showcase the technical, economic, and environmental viability and safe usage of a diverse range of BBFs fertilising products. These products contain recovered nutrients from various waste streams, such as wastewater, sewage sludge, bio-waste, biological by-products, digestate, and treated manure. The ultimate objective is to facilitate the replacement of synthetic and mineral fertilisers, thereby reducing environmental impacts and external nutrient dependence in agriculture across representative countries from Eastern, Western, Northern, Southern, and Central Europe.

This will help to improve sustainability and economic viability by recycling bio-based by-products and waste streams.

NOVAFERT aims to encourage farmers to adopt improved practices, leading to regenerative soil and nutrient management. This can result in enhanced ecosystem quality, reduced greenhouse gas emissions, cleaner air and water, and improved soil health. For example, crop nitrogen use efficiency in the EU could increase to 70 % and nitrogen and phosphorus surpluses in hotspots may be minimized, reducing environmental harm. Our approach anticipates that the identification of effective roadmaps will guide the establishment of site-specific targets and policies, fostering collective actions for sustainable and tailored solutions by governments, businesses, farmers, and other stakeholders.

1.1 Brief overview of the fertilisers market

In the 2023, fertiliser market was estimated 202 billion USD and it is anticipated to register a compound annual growth rate (CAGR) of over 2.7 % between 2024 and 2023 (link). Nitrogen-containing fertilisers, phosphates, and potash stand out as essential products influencing this market, serving diverse crops and soil varieties. The growth of the market is notably propelled by developing economies with expanding agricultural sectors. Nevertheless, apprehensions about nutrient runoff and greenhouse gas emissions stemming from fertiliser application have prompted a heightened emphasis on adopting sustainable and precision agricultural practices (K. Pulidindi, A. Prakash).The expansion of the fertiliser market will be fueled by a growing population and escalating food demand. Fertilisers offer benefits such as enhanced crop production in confined spaces and improved accessibility of soil nutrients.

The evolution of advanced fertilisers, including water-soluble variants, has enabled farmers to

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

use them more effectively, reducing the potential for excessive fertiliser application. Numerous players in the industry are concentrating on broadening their geographic presence by establishing new sales and marketing facilities worldwide. Additionally, industry participants

are embracing strategic initiatives like mergers and acquisitions, as well as introducing new products, to boost profitability and facilitate progress in the sector. The market is experiencing significant shifts influenced by changing agricultural methods and environmental concerns. Notably, sustainable agriculture is a prominent trend, resulting in a heightened desire for organic and BBF fertilisers. These BBFs contribute to soil health, diminish environmental effects, and align with the increasing preference for environmentally friendly farming practices. Categorized by form, the market is divided into solid and liquid segments. As of 2023 solid commanded the leading market share, amounting to USD 169 billion. The implementation of precision agriculture, utilizing digital tools for precise application, is enhancing the efficiency of dry fertiliser utilization. Growing emphasis on nutrient efficiency and environmental conservation is driving innovations in fertiliser formulations. In response to the demand for environmentally conscious agriculture, the dry fertiliser sector is evolving to meet the requirements of modern farming while addressing sustainability concerns. Categorized by application, the fertiliser market is segmented into agriculture, horticulture, gardening, and other sectors. In 2023, agriculture constituted over 42 % of the market share and is anticipated to continue growing until 2032. The increasing adoption of precision agriculture technologies, including GPS-guided equipment and sensors, is influencing fertiliser practices, leading to the optimization of nutrient use efficiency. Rising awareness of environmental consequences has prompted a shift toward sustainable practices, highlighting the utilization of organic and bio-based fertilisers, cover cropping, and reduced reliance on chemical inputs (K.Pulidindi, A.Prakash).

1.2 Importance of BBFs

Different types of fertilisers, when compared to conventional mineral fertilisers, work to counteract specific conditions or environments, thereby enhancing the efficiency of nutrient utilization. Various fertiliser technologies with increased nutrient use efficiency exist, aiming to minimize nutrient losses, such as:

1. Formula-modified fertilisers
2. Crop residues/compost/biochar
3. Bio-based fertilisers (BBFs)
4. Liquid fertilisers

The use of BBFs not only decreases their own losses but also facilitates the mobilization of nutrients fixed in the soil through modifications to reactions and soil conditions. Benefits of the BBFs include:

1. Controlled release of nutrients
2. Reduced nutrients fixation and losses by denitrification and volatilization

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

3. Increased nutrients availability
4. Remobilized the fixed micro and macro-nutrients
5. Improved soil health
6. Increased water holding capacity of soil (Innovations in Sustainable Agriculture).

One advantage of BBFs fertilisers is that its nutrients are released at a slower rate compared to mineral fertilisers. This gradual process enables the plant to assimilate the fertiliser in a more natural manner, preventing over-fertilization and potential harm to the plant.

Typically, mineral fertilisers include non-biodegradable chemicals that can leach into the soil and, eventually, enter the water system, being consumed by birds and other wildlife. On the contrary, BBFs fertilisers lack such harmful compounds, eliminating this risk even with increased usage. They preserve beneficial microorganisms in the soil and contribute to enhancing soil structure, including air circulation. This supports the activity of beneficial microorganisms that aid in nutrient release into the soil (S. Assefa, S. Tadesse).

1.3 Objectives of the analysis

The primary objectives of the presented market analysis for the European fertilisers market, within the scope of the NOVAFERT project, are to assess the current landscape of BBFs comprehensively, identify key players and market dynamics, analyse customer needs and preferences through a targeted survey, and develop a robust business model and customer relationship framework. Through a focused examination of these elements, the conducted analysis aims to provide valuable insights into the market, supports informed decision-making, and contributes to developing and promoting sustainable fertiliser solutions in the European context.

This deliverable reports the findings on current market needs and specificities identified in T4.1 "Industry analysis of the fertiliser market".

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

2 Market landscape

2.1 Overview of the EU fertilisers market

The European mineral fertilising products market seems to be fragmented, as numerous global entities, including Yara International ASA, Eurochem, Achema, OCI N.V, Petrokemija DD Fertilizer Factory, Nitroenmuvek Zrt., ICl Specialty Fertilisers, Grupa Azoty, Fertberia, BASF SE, and The Mosaic Company dominate its landscape (Europe Fertilizer Market).

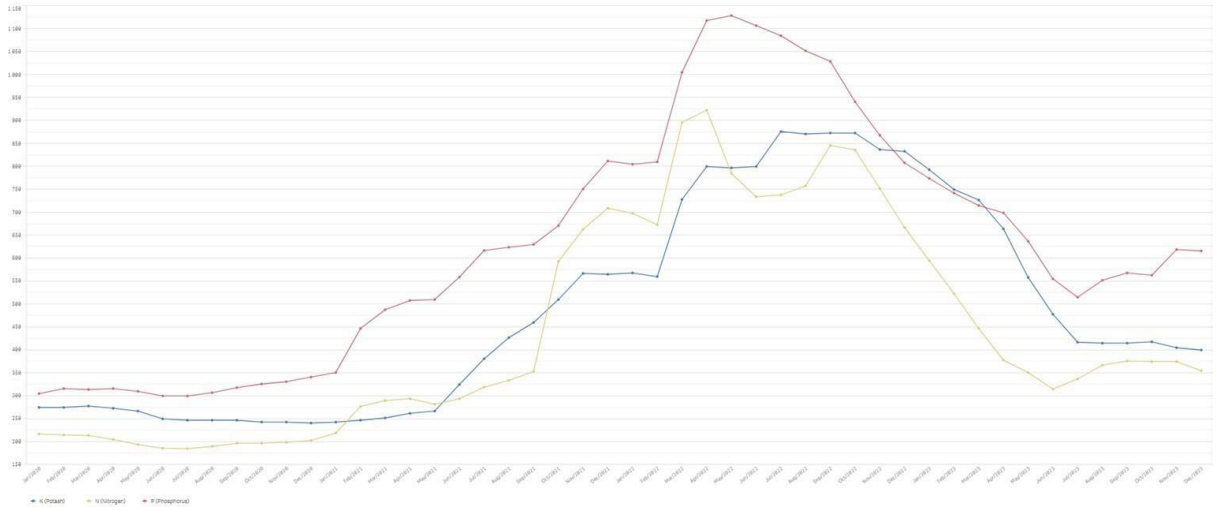


Figure 1. Price evolution per nutrient from Jan 1st 2020 to Dec 1st 2023 in the EU

Source: https://agridata.ec.europa.eu/extensions/DashboardFertiliser/FertiliserPrices.html

As reported by the EC (link) in 2021, agricultural mineral fertiliser consumption (nitrogen and phosphorus) in the EU was 10.9 million tonnes, marking a 2.2 % decrease from 2020 and a 6.4 % decline from the 2017 peak. N-based fertiliser usage was estimated at 9.8 million tonnes, showing a 2 % year-on-year decrease, consistent with trends since 2017. Despite this, the overall N-based fertiliser consumption returned to a level like the previous decade. The highest consumption of N-based fertilisers in 2021 occurred in key EU agricultural producers: France, Germany, Poland, and Spain, collectively accounting for 50 % of the EU's total usage.

Additionally, phosphorus fertiliser consumption in EU agriculture was 1.1 million tonnes in 2021, indicating a 3.8 % decrease from 2020 but aligning with the average over the previous decade. The major consumers of phosphorus-based fertilisers in 2021 were France, Spain, Poland, Romania, Italy, and Germany, contributing to nearly three-quarters of the EU's total usage.

Share under organic

In 2021, the EU's organic agricultural production covered approximately 16 million hectares,

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

marking a substantial 70 % increase from 2012 to 2021.

The proportion of the EU's utilized agricultural area dedicated to organic farming rose from 5.9 % in 2012 to an estimated 9.9 % in 2021. Notably, four EU Member States France (17.3 %), Spain (16.5 %), Italy (13.7 %), and Germany (10 %) accounted for nearly three-fifths (57.5 %) of the total organic area in the EU in 2021 (link). Despite experiencing notable growth in the last decade, additional efforts are required to fulfil the EU's commitment of allocating 25 % of its total arable area for organic cultivation by 2030 (link). A considerable gap remains in reaching the target, highlighting the substantial areas yet to be converted to organic farming practices. Between 2010 and 2020, the use of inorganic fertilisers per utilised agricultural area in the EU increased by 10.1 %. Most EU Member States observed a rise, with Bulgaria, Greece, Romania, and Hungary experiencing growth of over 50 %, while Germany recorded the largest decrease at 10.8 %.

In 2022, the value of imported fertilisers (organic and inorganic) into the EU amounted to 12 billion EUR, constituting 0.4 % of all imported goods. N-based fertilisers comprised 61.9 % of imports, mixed-element fertilisers accounted for 24.7 %, potassium-based fertilisersconstituted 11 %, and there were smaller shares of phosphorous-based fertilisers and organic(animal and vegetable) fertilisers.

Key figures on the European food chain 2023 edition

In 2020, the EU's utilized agricultural area comprised 157.4 million hectares, representing 38.4 % of its total land area. Of this, 62.3 % was dedicated to arable land for crop cultivation, primarily for human and animal consumption. Permanent grassland constituted 30.5 % of the utilized agricultural area, serving mainly as fodder and forage for animals. The remaining portion, approximately 7.1 % of the total agricultural area, was predominantly allocated to permanent crops, including fruit such as grapes) and olives (link). Regarding farm categories, there was a significant change in the EU between 2010 and 2020, characterized by a noticeable shift away from farms specializing in livestock and mixed farming towards those specializing in crops (link).

Green House Gases (GHGs)

In 2021, agricultural processes in the EU produced 378 million tonnes of CO_2 equivalents of greenhouse gases. Although emissions from agriculture fell by more than one-fifth (down 21.9 % between 1990 and 2021), agriculture's share of all greenhouse gas emissions increased from 9.8 % in 1990 to 10.7 % by 2021.

Almost half of the overall decrease in the quantity of agricultural GHGs took place between 1990 and 1992 and the rest between 1992 and 2010. After this date, agricultural emission levels increased at a modest rate, up 0.6 % between 2010 and 2021.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

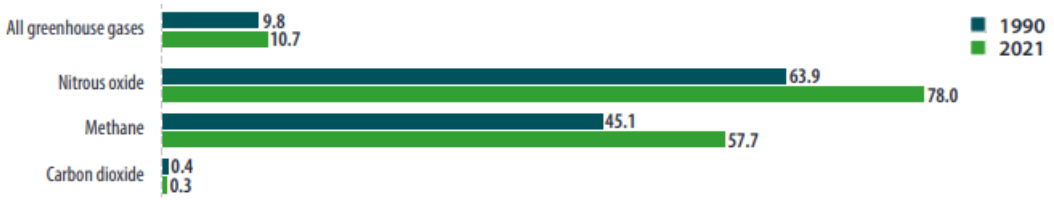


Figure 2 Source of emission in million tonnes. Source: https://ec.europa.eu/eurostat/documents/15216629/18054337/KS-FK-23-001-EN-N.pdf/048e130f-79fa-e870-6c46-d80c9408620b?version=7.0&t=1707290893751

Agricultural soils are a main source of emissions of carbon dioxide, methane, and nitrous oxide; they can also be a sink, storing GHGs. Emissions from manure management are around two-thirds methane and one-third nitrous oxide. Emissions from enteric fermentation made up almost half (48.2 %) of all GHGs emissions from agriculture within the EU in 2021, while the share for managed agricultural soils was close to one-third (31.2 %); the third largest contributor to agricultural GHGs emissions was manure management (16.6 %).

Agriculture, forestry, and fishing as well as the processing of food and beverage and (hereafter referred to as F&B processing) generated 55.3 million tonnes of waste across the EU in 2020. Together these activities accounted for 2.8 % of all waste from productive activities. EU waste generated by F&B processing fell by almost one quarter (down 22.9 % overall) between 2010 and 2020. The level of waste from agriculture, forestry and fishing was relatively stable, other than a short-lived contraction in 2014; it increased overall by 3.9 % between 2010 and 2020.

Focusing specifically on food waste, an indicative average of 131 kilograms of fresh mass was collected per person within the EU in 2021; just over half of this quantity was from households. The main productive activity from which food waste was collected was the processing and manufacturing of food and beverages, with a share of just over one-fifth of the total.

2.2 Trends and challenges in the market

One of the main objectives of the NOVAFERT project is to reduce environmental impacts and external nutrient dependence in European agriculture. Fertilisers play a crucial role in ensuring food security. Half of the European agricultural production is enabled because of the utilisation of fertilisers (link). Europe heavily relies on substantial synthetic fertiliser and raw material imports (5.1 million tonnes N, 1 million P_2O_5, and 1.4 million K_2O), with Russia being a key partner in this trade, amounting to an import value of 2564 million EUR in 2022 (link). The European Union relies on external sources for 30 %, 68 %, and 85 % of its inorganic nitrogen, phosphates, and potash nutrient consumption, respectively (link).

The initiation of Russia's aggression against Ukraine has triggered a global crisis in mineral fertilisers and energy, affecting both food security and prices worldwide (link). Current fertiliser production, heavily dependent on natural gas prices is unsustainable in the long term. This is evident as natural gas prices are escalating in the European market due to reduced supply from Russia, rendering it more susceptible to global market price fluctuations (link). Approximately 40 % of the European hydrogen total is generated by the fertiliser industryfor

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

ammonia production (link). Hydrogen production and its high costs significantly contributeto GHGs emissions, causing adverse environmental effects. Considering alternatives is crucial to align with the Zero Pollution action plan objectives.

The European fertiliser industry is, therefore, facing significant repercussions from record-breaking gas prices, as they constitute up to 90 % of the variable costs in fertiliser production, which has already led to the curtailment of approximately 70 % of European production capacity in 2022 (link). As reported by the EC in 2022, the surges in gas prices during the summer resulted in a 149 % increase in the cost of nitrogen fertilisers for EU farmers in September 2022, compared to the same month in 2021 (link). During the same period, extracted fertiliser costs (P, K) rose by 63 % and 90 %, respectively.

These cost hikes pose potential threats to European food safety, sustainability, and strategic self-reliance by compelling farmers to increase end-product prices to offset higher input costs, as reported by the EC (link). In 2021 and 2022, there was a swift rise in output prices for most crops in the EU. This escalation can be attributed to several factors, including adverse growing conditions, escalating costs of fertilizers, energy, and other inputs, as well as disruptions in global trade associated with the impact of Russian military aggression against Ukraine. Cereals and oilseeds and oleaginous fruits in the EU experienced the highest output price increases at 86.8 % and 80.2 %, respectively, from 2020 to 2022. Sugar beet and olive oil also saw substantial increases of 53.6 % each. Importantly, none of the crops displayed lower output prices in 2022 compared to 2020. (link)

2.3 Regulatory framework affecting the fertilisers market

The key legislative components for addressing the European market's secondary nutrients and promoting the circular economy are the Fertilising Products Regulation (2019/1009), the Waste Framework Directive, the REACH Regulation, and the Nitrate Directive (91/676/EEC), according to (link).

The Farm to Fork Strategy seeks to expedite the shift toward a sustainable food system characterised by a neutral or positive environmental impact, climate change mitigation and adaptation, biodiversity conservation, and the assurance of food security, nutrition, and public health. Additionally, it aims to uphold food affordability, generate fair economic returns, enhance the competitiveness of the EU supply sector, and promote fair trade (link). Its main objectives include a minimum 50 % reduction in nutrient losses (without compromising soil fertility), a 20 % decrease in fertiliser and pesticide usage, and an expansion of organic farming to encompass up to 25 % of total European farmland by 2030 (link).

Additional EU legislative landscape concerning the fertiliser application, safe use, trade, etc. (taken from Oger, 2022. link):

- Water Framework Directive (2000/60/EC): This regulation, along with the Nitrate directive, aim to control nutrient losses through proper agricultural land management, including reducing pesticide and fertilizer use to conserve natural habitats and promote

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

biodiversity within the EU.

- Urban Waste Water Treatment Directive (91/271/EEC): This directive focuses on protecting the environment from the negative impacts of urban and industrial wastewater discharges, particularly from food industries, including the revised version from 2014 (link)
- Ambient Air Quality Directive (2008/50/EC) and National Emissions Ceiling Directive ((EU) 2016/2284): These directives set limits for air pollution and require EU member states to reduce emissions of pollutants like nitrogen oxides and ammonia, which contribute to acidification, eutrophication, and ground-level ozone pollution.
- Effort Sharing Regulation ((EU) 2023/857): This regulation addresses emissions from agricultural activities, particularly nitrous oxide emissions from fertilizer use, by setting annual emissions targets for EU member states.
- EU Circular Economy Action Plan (March 2020): This plan aims to make food and water production, consumption, and waste more circular. It includes measures like encouraging water reuse in agriculture and developing an Integrated Nutrient Management Plan to promote sustainable nutrient application.
- Carbon Border Adjustment Mechanism ((EU) 2023/956): This mechanism covers fertilisers and aims to address emissions associated with their production and use.
- Animal by-products Regulation (1069/2009):

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

3 Analysis of Currently Existing Alternative Fertilisers

3.1 Analysis of already established alternative fertilisers

In Europe **"mineral concentrate"**, primarily composed of ammonium-nitrogen and soluble potassium, is a concentrated solution of mineral nutrients derived from the separation of waste streams via techniques like membrane filtration or evaporation. This method intensifies the mineral nutrient content in the final product compared to the initial input (link). The main aim of mineral concentrate production is to avoid transporting liquid streams with inadequate nutrient content and to tailor the nutrient ratios, including nitrogen, potassium, and sulphur, in fertilizers to match specific crop needs. This concentrated mineral solution is suitable for various conventional agricultural applications, including the cultivation of fresh vegetables, root vegetables, grains like maize and corn, permanent grasslands, as well as dry pulses and protein crops.

Application can be conducted using conventional liquid fertiliser injection systems, a preferred method due to its ability to mitigate ammonia evaporation. This practice is mandated by national regulations in the Netherlands and Flanders (Belgium) (link). Mineral concentrates typically have nitrogen content of less than 1%, which is lower than that of mineral fertilisers. This might necessitate adjustments to equipment used for applying synthetic fertilisers to ensure accurate application rates. Moreover, there is no evidence suggesting that mineral concentrates elevate nitrate levels in groundwater (link).

The primary phosphates in demand are the ammoniated phosphates known as **monoammonium phosphate (MAP)** and **diammonium phosphate (DAP)**. These varieties represent 38 % of all sold finished products and contribute to 60 % of the total phosphate molecules utilized by farmers (link). MAP stands out as a crucial phosphate fertilizer due to its significance as a primary supplier of nitrogen and phosphorus. Widely utilized in agriculture, this essential granular fertiliser enhances crop growth and overall yields. It finds applicability across a diverse array of crops including cereals, fruits, vegetables, and oilseeds (Figure 3). In 2022, the worldwide market for phosphate fertilisers reached a value of 63.81 billion USD. Projections indicate a steady growth trajectory, with an anticipated compound annual growth rate (CAGR) of 5.7 % from 2021 to 2040, culminating in an estimated value of 176.06 billion USD by 2040 (link). The MAP fertiliser market is highly competitive, with several key players vying for dominance. Among the prominent companies in this sector are Haifa Group, Luxi Chemical, Koch Fertilizer, CF Industries, SABIC, Yara, Nutrien, EuroChem, Bunge Limited, and Uralchem. Haifa Group, in particular, holds a significant position as a major global supplier of MAP fertiliser (link).

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

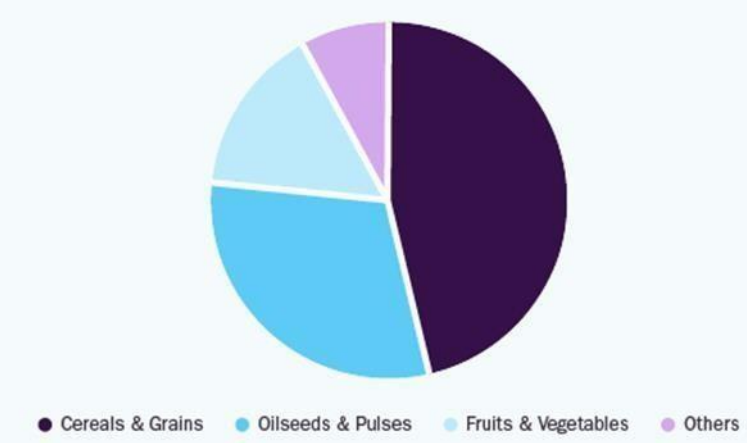


Figure 3. Global phosphate fertiliser market

Source: Phosphate fertiliser market, GVR, 2021

Potassium thiosulfate, known as KTS, is a fertiliser that incorporates potassium and sulphur. It finds application across various agricultural crops since the demand for potassium typically rises during phases of rapid growth and fruit development in most crops (link). In 2023, the global potash market was valued at approximately 59.95 billion USD. It is projected to experience a compound annual growth rate (CAGR) of 4.9 % from 2023 to 2032. Several key players dominate the potash market, including: JSC Belaruskali, Compass Minerals Intl. Ltd., Mosaic Company, Uralkali, Rio Tinto Ltd., BHP Billiton Ltd., Eurochem, Red Metal Ltd., Encanto Potash Corp. (EPC), Intrepid Potash Inc, K+S Aktiengesellschaft and Nutrien (link).

Ammonium nitrate serves as a widely utilized high-nitrogen fertiliser in agriculture due to its rich nitrogen content, providing vital nutrients essential for plant growth. However, several nations, such as Australia, mainland China, Germany, Ireland, the Netherlands, and Turkey, have prohibited the sale of ammonium nitrate as a fertiliser due to concerns regarding its potential misuse in terrorist activities or accidental detonations. This restriction has adversely affected global consumption growth. Projections suggest that between 2022 and 2027, the market share of ammonium nitrate will continue to diminish as more consumers opt for urea or preferurea-ammonium nitrate solutions due to their easier handling and enhanced safety features. The main consumers of ammonium nitrate are the Commonwealth of Independent States andBaltic States, Western Europe, and the United States. In 2022, these three regions accounted for approximately 53% of the global consumption of ammonium nitrate. The global market size for ammonium nitrate was valued at 4.67 billion USD in 2016. It is projected that demandfor this fertiliser will grow at a compound annual growth rate (CAGR) of 3.5% from 2016 to 2025.

Ammonium sulphate serves as a commonly utilized mineral fertiliser providing vital nutrients to plants. The importance of sulphur as a necessary nutrient for plant development has grown, as it aids in the synthesis of amino acids, proteins, enzymes, vitamins, and chlorophyll. It proves advantageous for a wide range of crops, including perennial ryegrass, clover, canola, alfalfa, corn, potatoes, rice, vegetables, and wheat (link). Its main application lies in reducing the acidity

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

of alkaline soils characterized by high pH levels. Major uses of ammonium sulphate encompass fertilisers, additives in food and feed, pharmaceuticals, and water treatment. Predominantly, it is employed in fertiliser manufacturing and is favored by major global producers of nitrogenous fertilisers. Leading companies in the global ammonium sulfate industry include BASF SE, Evonik Industries, Lanxess Corporation, Novus International, Sumitomo Chemical, Honeywell International, and Royal DSM. In 2021, the global market size for ammonium sulphate reached 2.81 billion USD and is projected to demonstrate a compound annual growthrate of 6.7% from 2022 to 2030 (link). The market growth may be ascribed to the heightened demand for ammonium sulphate in formulating nitrogenous fertilisers, widely used in the agricultural sector. World consumption of ammonium sulphate is concentrated in Southeast Asia and Oceania, Central and South America, mainland China, Western Europe, and the UnitedStates (Figure 4).

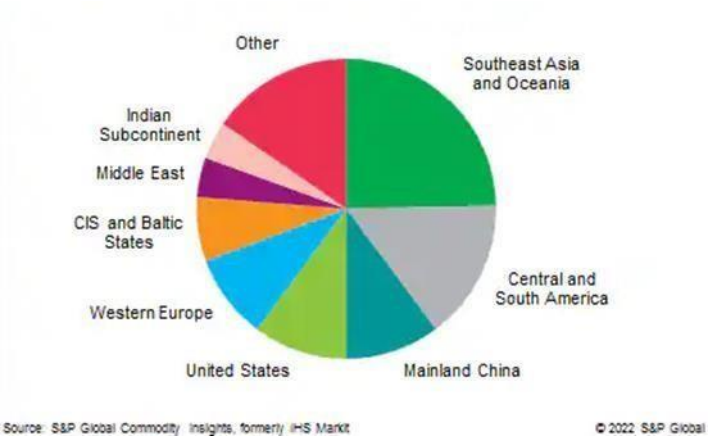


Figure 4. World consumption of ammonium sulphate in 2022.

Source: https://www.spglobal.com/commodityinsights/en/ci/products/ammonium-sulfate-chemical-economics-handbook.html

Struvite (magnesium ammonium phosphate) is used to satisfy plants' phosphorus needs and can be used in all crops (arable, horticultural, forage). It's a naturally occurring mineral found in some human and animal waste, as well as in certain wastewater treatment systems. Depending on the process, normally 12-22 % of P present in wastewater is recovered in struvite(link). One of struvite's primary benefits is its potential as a slow-release fertiliser. This means that nutrients are gradually released over time to plants, reducing the probability of nutrient leaching and runoff that can pose a threat to the environment.

In recent years, technological progress and a growing interest in preserving resources and the environment have resulted in the establishment of extensive commercial struvite production in various countries, including Germany, The Netherlands, Japan, Canada, and the United States (link).

In Europe, the struvite market is currently dominated by the technologies of Airprex, NuReSys and Anphos. Most of the struvite is produced in the Netherlands (35–43 %), Belgium (16–20 %)

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

and Germany (15 %).

Up to 1250 ton of the 1350 ton struvite produced annually in the EU can be considered suitable for direct use as fertiliser or as secondary raw material for fertiliser production.

The recovered amounts are very low compared to the total P fluxes and agricultural demand. Furthermore, the recovery of struvite from municipal wastewater has an efficiency (Pstruvite/Ptotal-plant influent) of between 20 and 43 %. Assuming a maximum struvite recovery efficiency of 43 %, this would provide about 13 % of the P fertiliser demand in the EU (link).

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Table 1. Overview of most common alternative fertilisers and types of alternative fertilsers

Category	Alternative fertilising product	Description of an alternative fertilising product	Country
MINERAL	NH_4NO_3 Ammonium nitrate	Technology: stripping and scrubbing Sources: liquid fraction of pig slurry	Belgium, Netherlands
	Ammonium nitrate/sulphate	Technology: stripping and scrubbing Sources: digestate, liquid fraction, pre-treated manure	Netherlands
	Ammonium nitrate/sulphate	Technology: detricon stripping and scrubbing process Sources: liquid fraction of manure	Belgium
	Ammonium nitrate/sulphate from raw digestate	Technology: AMFER stripping process Source: digestate or liquid fraction	Netherlands
	Liquid ammonium sulphate or ammonium nitrate	Technology: stripping and scrubbing with H_2SO_4 or HNO_3 Source: separated liquid slurry	Netherlands
	$(NH_4)_2SO_4$ Ammonium sulphate	Technology: on-farm scrubbing (ammonium sulphate recovered from NH_3 emissions), stripping and scrubbing Sources: pig manure	Belgium
	$(NH_4)_2SO_4$ Ammonium sulphate	Technology: digestate by "Biogas Bree" process Source: mix of manure, organic wastes (cfr Vlarema (Flanders)) and positive list FOD (B)) and/or energy maize	Belgium
	Ammonium sulphate (N-fertiliser 21 % N, 24 % S added with lime)	Technology: "TerraSaline S (ASL)" water extraction Source: treated manure	Germany
	Ammonium sulphate (solid organic phase, P-concentrate, N-concentrate)	Technology: TerraOrganic FFT&HEF system Source: manure	Germany

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

	Ammonium sulphate pellets	Technology: anaerobic digestion Sources: organic material and agricultural by-products from all sectors	Ireland
	AS solution	Technology: anaerobic digestion, N stripper and scrubber Source: sewage sludge, biowaste	Italy
	AS solution, calcium carbonate sludge, LF of digestate, SF of digestate	Technology: N stripper, fibre production Source: corn silage, poultry litter	Germany
	$NH_4H_2PO_4$ Monoammonium phosphate (MAP)	Technology: PolFerAsh - Polish Fertilisers form Ash Sources: industrial sewage sludge	Poland
	$K_2S_2O_3$ Potassium thiosulfate	Technology: Claus process Sources: sulphur dioxide from the installation to produce sulphuric acid	Poland
	Struvite	Technology: Ostara's Pearl phosphorus recovery Source: wastewater (urban wastewater)	Ireland
	Struvite	Technology: the crystallization Source: biological byproduct	EU
	$MgNH_4PO_4 \cdot 6H_2O$ Struvite pellets	Technology: NuReSys process Source: digestate	Belgium
	Biolan Ravinneneste	Technology: gas scrubber	Finland

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

		Source: ammonia from chicken manure composting, lactic acid, water, potassium sulphate, potassium sorbate, seaweed	
	Novarbo Aino 3-0-3, Novarbo Aino 1-0-3, Novarbo Aino 5-0-0	Technology: gas scrubber Source: ammonia from chicken manure composting, lactic acid, potassium sulphate, water potassium sorbate	Finland
	N recovery as ammonium	Technology: chemical addition Source: pig slurry	Denmark
	Enriched reclaimed water (rich in N (especially organic nitrogen), P and K	Technology: sequencing batch reactor (SBR) + nutrients recovery module Source: wastewater from the slaughtering industry	Spain (Andalusia region, Salteras municipality)
	NH_3 water, scrubber water	Technology: solid liquid separation, reverse osmosis, stripping Source: pig manure, digestate	Denmark
	Condensed ammonia water, evaporator concentrate, dried SF of digestate	Technology: evaporation, reverse osmosis Source: pig slurry, biowaste, sewage sludge	Belgium
	Evaporator concentrate	Technology: evaporation and reverse osmosis Source: biowaste from the agro-food industry	Belgium
	RO concentrate	Technology: microfiltration and reverse osmosis, ion exchange, RePeat system Source: biowaste from agroindustry and pig slurry	Netherlands
	Mineral concentrate	Technology: membrane filtration Source: pig manure, coproduct	Belgium
	Mineral- and Potassium-concentrate, NH_3-water, ammonium sulphate, clean dischargeable water	Technology: VP-Hobe manure and digestate valorisation system Source: digestate	Netherlands

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

	Mineral nitrogen concentrates	Technology: reverse osmosis, evaporation Source: raw pig manure	Netherland
	Inorganic soil conditioner	Technology: Source: it contains special supplements Mescal and Physio + complex	Croatia
ORGANO – MINERAL	Biolan Havu- ja rodolannoite	Technology: drying, mixing, pelletizing and granulation Source: feather meal, meat and bone meal, potassium sulphate, vinasse powder	Finland
	Biolan Parvekekasvilannoite Biolan Tomaatti- ja vihanneslannoite	Technology: drying, mixing, pelletizing and granulation Source: meat and bone meal, potassium sulphate, kieserite, blood meal, seaweed	Finland
	Biolan Kasvimaalannoite Biolan Peruna- ja juureslannoite	Technology: drying, mixing, pelletizing and granulation Source: chicken manure, potassium sulphate	Finland
	Organo-mineral fertiliser OrCal®CM12	Technology: FuelCAl® Source: sewage sludge, biodegradable waste, selected animal by-products	Poland
	Organic-mineral	Technology: anaerobic digestion Source: digestate	Croatia
ORGANIC AMENDMENTS	AGROLINIJA-S	Technology: manure heating-dispersing technology Source: cattle manure	Poland
	Arvo 11-1-2-1, Arvo 8-1-5-2	Technology: drying, mixing, pelletizing and granulation Source: chicken manure, blood meal, potassium sulphatee	Finland
	Arvo 3-1-7-3,	Technology: drying, mixing, pelletizing and granulation	Finland

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

	Arvo 3-1-15-5, Arvo 4-1-6-2	Source: chicken manure, potassium sulphate	
	Arvo 4-1-3-1	Technology: drying, mixing, pelletizing and granulation Source: chicken manure	Finland
	Arvo 8-1-2-1	Technology: drying, mixing, pelletizing and granulation Source: chicken manure, blood meal	Finland
	ASH	Technology: combustion Source: pig slurry, biodried solid fraction	Spain, Finland
	ASH	Technology: BMC Moerdijk thermochemical process Source: poultry manure	Netherlands
	ASH	Technology: the biowaste may need to be sieved, sorted, and dried depending on its moisture content Source: garden and park waste, food and kitchen waste	EU
	Biolan Ravinnepuikko	Technology: drying, mixing, pelletizing and granulation Source: chicken manure, seaweed, potato starch	Finland
	Biolan Hevonkakkalannoite	Technology: drying, mixing, pelletizing and granulation Source: horse manure, feather meal, potassium sulphate	Finland
	Biolan Kanankakka Biolan Luonnonlannoite	Technology: drying, mixing, pelletizing and granulation Source: chicken manure, seaweed	Finland
	Biolan Yrtti- ja taimilannoite	Technology: drying, mixing, pelletizing and granulation Source: meat and bone meal, blood meal, potassium sulphate	Finland
	Biolan Marja- ja hedelmälannoite	Technology: drying, mixing, pelletizing and granulation	Finland

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

		Source: chicken manure, apatite, feather meal, potassium sulphate	
	Biopower, Rolpower	Technology: composting and air drying Source: chicken manure	Poland
	BIOROL Natural Fertiliser	Technology: Biorol technology Source: sewage sludge, ashes from biomass combustion	Poland
	Compost	Technology: composting Source: household bio-waste, household waste, biowaste	Finland, Ireland, EU
	Compost	Technology: Biociclo Source: green waste and food waste	Italy
	Compost	Technology: ACEA pinerolese Source: municipal organic waste	Italy
	Compost	Technology: IOK Afvalbeheer Source: biowaste	Belgium
	Composted biological by-products	Technology: composting Source: biological by-product	Germany
	Composted sewage sludge	Technology: composting Source:	Italy
	Digestate	Technology: farm scale anaerobic digestion Source: digestate pig slurry	Belgium
	Untreated (raw) digestate without animal manure	Technology: anaerobic digestion	EU

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

		Source:	
	Dynamo, PK Plus, pelletised broiler manure	Technology: drying, heating, cooling, pelletising, sieving and bagging Source: broiler manure, seaweed, bone meal and blood meal	Ireland
	Granbial	Technology: activated sludge wastewater treatment Source: sewage sludge	Poland
	Liquid manure	Technology: decanter centrifuge Source: solid fraction and clarified liquid	Germany
	Liquid manure	Technology: Geamix housing system Source: raw manure from calves	Netherlands
	Organic fertiliser	Technology: composting Source: mix of composted poultry manure and composted pig manure, chicken manure, cattle manure	Netherlands, Poland, France
	Organic fertiliser +2:2	Technology: composting Source: mix of composted poultry manure and composted pig manure	Netherlands
	PK fertiliser from ash of poultry manure	Technology: thermochemical nutrient recovery Source: ash from poultry manure	Netherlands
	Solid fraction from livestock manure	Technology: belt press sieve Source: slurry, manure from pigs and cattle	Netherlands
	Urine from pig manure	Technology: physical chemical nitrogen recovery (VeDoWS adapted stable construction system) Source: raw pig manure	Belgium

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

3.2 Market needs and demands for alternative fertilisers

Considering the market needs of individual farms for alternative fertilisers, several factors come into play, reflecting the diversity in farm types, sizes, locations, and crop or livestock systems. BBFs, often pursued for their environmental benefits and to reduce reliance on synthetic inputs, can include a wide range of products such as compost, manure, biochar, and other organic amendments.

Many farms are seeking ways to reduce their carbon footprint and improve soil health. ¸BBFs derived from organic sources can help sequester carbon in the soil and reduce GHGs emissions associated with synthetic fertiliser production and application. The economic viability of switching to alternative fertilizers is a significant consideration for farmers. They need affordable options that do not compromise crop yields. The long-term cost savings through improved soil health and reduced chemical use can also be appealing. BBFs can offer better soil structure, increase organic matter content, and enhance the biodiversity of soil microbes, contributing to overall soil health. Farms are looking for products that can help them achieve these outcomes. Different crops have unique nutritional requirements. Farms need alternative fertilisers that can be tailored or selected based on the specific needs of their crops, including the right balance of nutrients to optimize growth and yield. With increasing regulation around synthetic fertilizer use and environmental protection, farms need alternative fertilisers that help them comply with these regulations without compromising their productivity. The physical characteristics of alternative fertilisers, such as particle size, moisture content, and ease of spreading, are important for their practical use on the farm. Products that are easy to apply with existing equipment and labor practices are more likely to be adopted. Reliable access to alternative fertiliser products is crucial, especially for large-scale or commercial farms. This includes consistent quality, availability, and delivery of products. Transitioning to alternative fertilisers often requires new knowledge and strategies. Farms benefit from suppliers who can provide educational resources, soil testing, and personalized recommendations to optimize the use of these products. For organic farms or those selling to niche markets that value sustainable practices, using certified organic fertilisers can be essential for market access and premium pricing.

Meeting these needs requires innovation and collaboration among researchers, product developers, and distributors to ensure that alternative fertilisers are effective, economically viable, and accessible for farms of all sizes and types. Additionally, policy support and incentives can play a critical role in facilitating the wider adoption of sustainable fertiliser practices.

3.3 Pros and cons of incorporating alternative fertilisers

Incorporating alternative fertilizers into agricultural practices has become increasingly popular as a mean to address some of the environmental and economic challenges posed by conventional synthetic fertilisers. These alternatives include organic fertilisers, biofertilisers, and other sustainable materials that can improve soil health and fertility.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

4 Key Players in the Fertiliser industry

The chapter will offer a summary of the various types of fertilisers currently available in Europe. Statistical data concerning the production of the primary fertiliser types will also be illustrated. Additionally, the chapter will furnish details regarding the scope of the global fertiliser market and its specific size within the European Union.

It will also explore the utilization of fertilisers and agricultural sectors in the EU. This section holds significant importance as it offers a comprehensive understanding of the fertiliser market's size, the distribution of various fertilisers within the market, and the relationship between fertiliser types and agricultural sectors. This is crucial because one of the primary objectives of the NOVAFERT project is to develop, integrate, test, and validate nutrient management strategies aimed at efficiently recovering mineral nutrients and other valuable products with agronomic benefits (such as organic amendments and) from animal manure. The ultimate goal is to produce reliable and safe fertilisers that can effectively compete in the European fertiliser market.

4.1 Competitive landscape and market concentration

The European fertiliser industry is typically characterized by a few key players dominating the market. These players often operate on a global scale and are involved in the production and distribution of various types of fertilisers, including nitrogen, phosphorus, and potassium-based fertilisers. Some of the key factors influencing the competitive landscape include market share, geographical presence, technological advancements, and diversification of product portfolios.

The competitive landscape in the alternative fertilisers market is characterized by a growing number of players offering innovative and sustainable fertilization solutions. Alternative fertilisers have gained traction due to increasing environmental concerns, regulatory pressure, and consumer demand for sustainable agriculture practices.

The market includes a mix of established agricultural companies, start-ups, and research institutions developing and commercializing alternative fertilisers. Major players may offer a wide range of products, while smaller companies might focus on niche segments or specialized formulations. Additionally, here is very important product innovation and differentiation. Companies invest in research and development to create novel formulations that enhance plant growth, improve soil health, and provide environmental benefits. This includes fertilisers derived from microbial sources, organic matter, or natural minerals. Furthermore, sustainability is a key driver in the alternative fertilisers market. Companies differentiate themselves by highlighting the environmental benefits of their products, such as reduced greenhouse gas emissions, minimal chemical runoff, and promotion of soil biodiversity. Sustainability certifications and endorsements from environmental organizations can further strengthen a

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

company's position. Also, market concentration can vary significantly by region. In some regions, such as Europe and North America, there may be a higher concentration of established companies offering a wide range of alternative fertilisers. In contrast, emerging markets in Asia, Latin America, and Africa may have a more fragmented landscape with a mix of local producers and multinational corporations.

Overall, the alternative fertilisers market is dynamic and competitive, driven by evolving consumer preferences, technological advancements, and regulatory changes. Companies that can innovate sustainably, establish strong partnerships, and effectively communicate their value proposition are poised for success in this rapidly expanding market.

4.2 Analysis of major players in the mineral fertiliser market

In 2016, the global production of fertilisers, quantified by nutrient weight, reached 181 million tons. Among this total, nitrogen accounted for 108 million tons (approximately 60%), with urea contributing 60 million tons. Phosphorus constituted 41 million tons (around 23%), and potassium amounted to 32 million tons (about 17%). Fertilisers Europe reports that the European Union's fertiliser production is comparatively modest in relation to the global output: within the EU, 9% of nitrogen, 3% of phosphate, and 8% of potash are produced (link).

The global production of mineral nitrogen fertilisers is primarily centered in Russia (20%), the United States (19%), and Canada (6%). Although phosphate rock resources are plentiful, their distribution worldwide is uneven, with Morocco, China, and the US holding two-thirds of the world's capacities. Meanwhile, Canada, Russia, Belarus, and Israel collectively account for more than two-thirds of global potassium production. Notably, approximately 80% of potassium production is controlled by eight companies. Germany, Spain, and the UK are among the most significant potassium-producing member states (link).

The global usage of fertilisers is experiencing an annual growth of approximately 2% for phosphorus and potassium. However, the growth rate for nitrogen-based fertilisers is even higher (link).

The FAO fertilisers report provides significant data from recent years and outlines trends expected up to 2022 (Table 2; World fertiliser trends and outlook to 2022, FAO, 2019). In these data, it's essential to grasp the methodology completely: (i) capacity - the theoretical maximum capacity known as the nameplate capacity; (ii) supply - the effective capacity, which signifies the maximum achievable production; and (iii) demand - which can be categorized into fertiliser use and other uses. "Demand for fertiliser use" denotes the application of fertilisers at a specific moment, whereas "demand for other uses" encompasses consumption for non-fertiliser purposes, losses, and demand that cannot be attributed elsewhere.

The global capacity for the most essential nutrients is projected to reach a total of 318,652 thousand tons by 2022, with nearly 60% of this amount attributed to ammonia. However, the actual supply (effective capacity) is significantly lower than the total capacity. For instance, the

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

supply of ammonia stands at only 163,219 thousand tons, which is approximately 27 thousand tons less. Similarly, the disparity for phosphoric acid and potash is smaller, at around 11 thousand tons each.

Regarding the global demand for nutrients in terms of fertiliser production, the estimated total demand for 2022 is approximately 200,000 thousand tons, while the total demand for other uses amounts to around 54,000 thousand tons.

Table 2. World capacity for producing ammonia, phosphoric acid and potash, 2016 - 2022 (thousands tonnes) Source: https://www.fao.org/publications/card/en/c/CA6746EN/

Year	2016	2017	2018	2019	2020	2021	2022
Ammonia, as N	180 496	184 558	186 974	189 523	187 354	188 908	190 397
Phosphoric acid, as P_2O_5	57 295	60 224	61 464	62 357	62 612	63 552	63 702
Potash, as K_2O	54 638	58 455	61 951	62 055	63 467	63 513	64 553
Total (N+ P_2O_5+ K2O	**292 429**	**303 237**	**310 386**	**313 935**	**313 433**	**315 973**	**318 652**

Table 3. World supply of ammonia, phospohoric acid and potash, 2016 - 2022 (thousands tonnes) Source: https://www.fao.org/publications/card/en/c/CA6746EN/

Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Ammonia, as N	153 646	155 253	157 819	161 504	160 492	161 572	163 219
Phosphoric acid, as P_2O_5	46 308	47 564	48 620	49 510	50 520	51 520	52 066
Potash, as K_2O	44 177	46 284	49 422	51 373	52 752	53 664	54 197
Total (N+ P_2O_5+ K2O	**244 131**	**249 101**	**255 861**	**262 387**	**263 764**	**266 756**	**269 482**

Table 4. World demand for nitrogen, phosphorus (phosphoric acid based) and potassium for fertiliser uses, 2016 - 2022 (thousand tonnes) Source: https://www.fao.org/publications/card/en/c/CA6746EN/

Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Nitrogen, N	105 148	105 050	105 893	107 424	108 744	110 193	111 591
Phosphoric, as P_2O_5	44 481	45 152	45 902	46 587	47 402	48 264	49 096
Potassium, as K_2O	35 434	36 349	37 171	37 971	38 711	39 473	40 232
Total (N+ P_2O_5+ K2O	**185 063**	**186 551**	**188 966**	**191 981**	**194 857**	**197 930**	**200 919**

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Table 5. World demand for nitrogen, phosphorous (phosphoric acid based) and potassium for the other uses, 2016 - 2022 (thousand tonnes) Source: https://www.fao.org/publications/card/en/c/CA6746EN/

Year	2015	2016	2016	2017	2018	2019	2020
Nitrogen,N	36 930	37 663	38 320	38 965	39 569	40 127	40 660
Phosphorus (phos. acid based), as P_2O_5	6 444	6 677	7 036	7 170	7 291	7 482	7 734
Potassium, as K_2O	5 572	5 752	5 876	5 993	6 112	6 237	6 363
Total (N+ P_2O_5+ K2O	**48 946**	**50 092**	**51 232**	**52 128**	**52 972**	**53 846**	**54 757**

According to the IFA report, the collective employment in the nutrient industry totals 964 thousand individuals (Figure 5), with an additional estimated 2.2 million people employed indirectly through supply chain activities such as transportation and retail. However, this calculation does not encompass the indirect employment generated at the farm level.

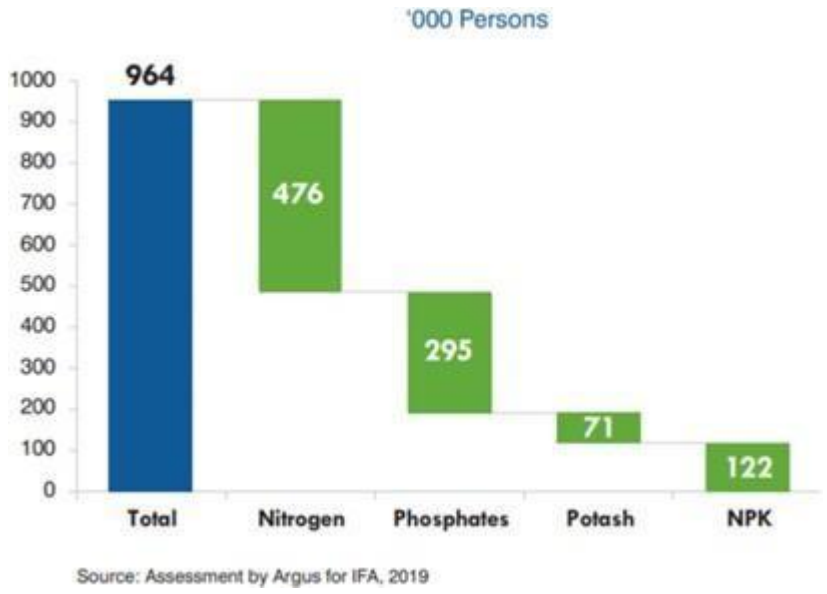


Figure 5. Employment by nutrients.

Source: https://www.scribd.com/document/460442439/2020-IFA-Sustainability-Report-pdf-pdf

As per the estimates from the European Commission (EC), the fertilising products industry generates an annual turnover of approximately 20 to 25 billion EUR and supports around 100,000 jobs (measured in Full Time Equivalent). In the market for inorganic fertilisers, major corporations account for 75% of the total market value, whereas small and medium-sized enterprises (SMEs) represent approximately 98% of other product categories. Ultimately, SMEs make up 90% of companies engaged in fertiliser production (link).

As depicted in Figure 6, nitrogen stands out as the most consumed nutrient, with a projected annual growth rate of 1.1%. The International Fertilizer Association (IFA) anticipates a 1.1% annual growth in nitrogen fertiliser demand up to 2021. Phosphate is estimated to have a growth rate of 1.6% per year, while potassium is expected to grow at a rate of 2.2% annually. Urea is forecasted to experience a higher growth rate.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

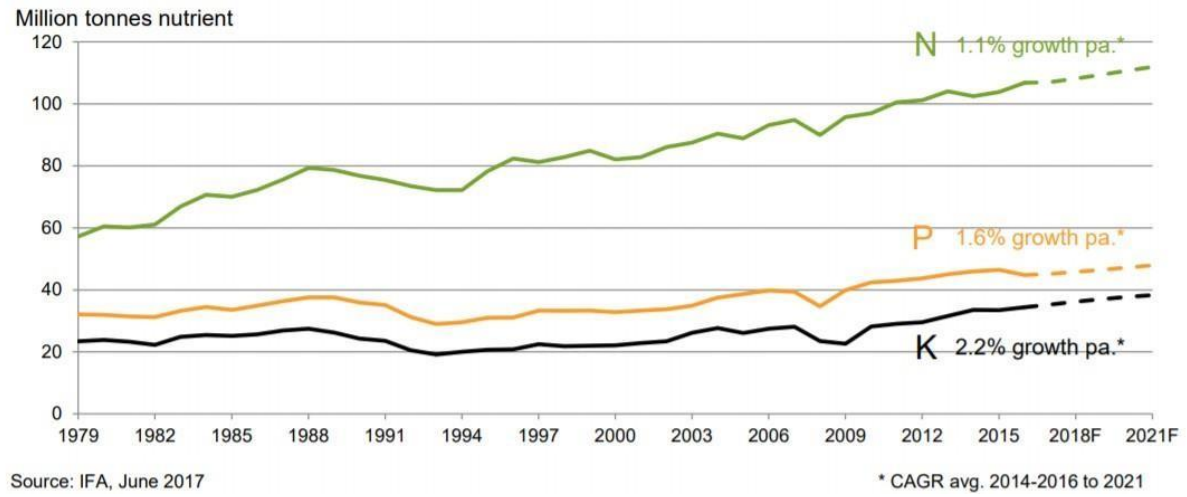


Figure 6. Fertiliser consumption in the EU (1979 – 2017, forecast to 2021)

Source: https://www.yara.com/siteassets/investors/057-reports-and-presentations/other/2018/fertilizer-industry-handbook-2018.pdf/

When examining fertiliser products globally, four key products hold significant market share and are notably traded worldwide (Figure 8):

- **urea** (46 % N)
- **diammonium phosphate** (DAP – 46 % P_2O_5 + 18 % N) and **monoammonium phosphate** (MAP – 46 % phosphate + 11 % N)
- **potassium chloride** (MOP – 60 % K_2O)

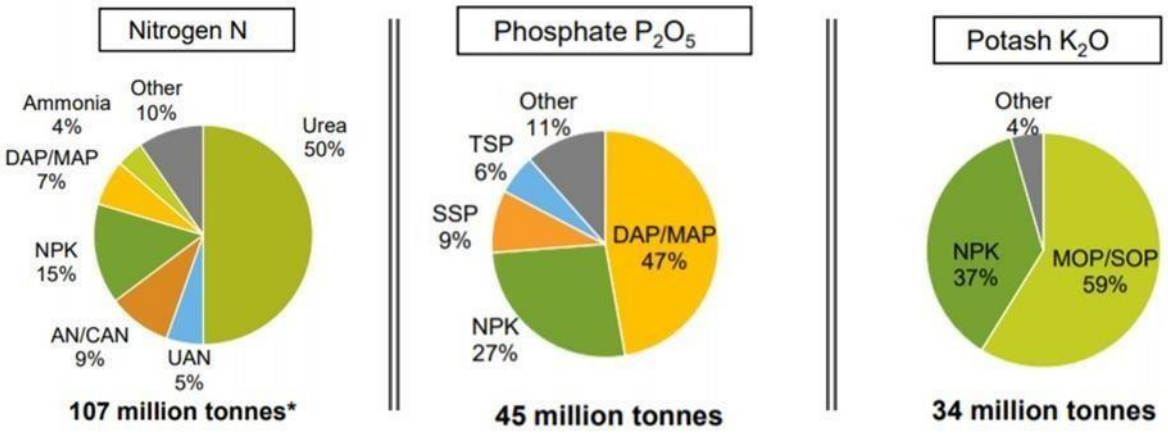


Figure 7. Key global fertiliser products – source IFA 2016 and 2015

Source: https://www.yara.com/siteassets/investors/057-reports-and-presentations/other/2018/fertilizer-industry-handbook-2018.pdf/

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

When examining regions globally, it becomes evident that fertiliser demand is significantly influenced by various factors such as changes in planted areas, crop yields, types of crops, rotation practices, crop prices, fertiliser subsidy policies, and nutrient recycling methods. Approximately 60% of total fertiliser consumption is attributed to nitrogen (N), particularly urea. This correlation is directly linked to common fertiliser practices, as nitrogen typically needs to be applied annually, unlike phosphorus and potassium, which may not require such frequent application. However, the map highlights that Brazil exhibits a different ratio of nitrogen to phosphorus and potassium application (Figure 9). This is due to Brazil's substantialsoybean production, accounting for 30% of global production in 2016, which necessitates higher quantities of phosphorus and potassium (Fertiliser industry handbook 2018, Yara, 2018).

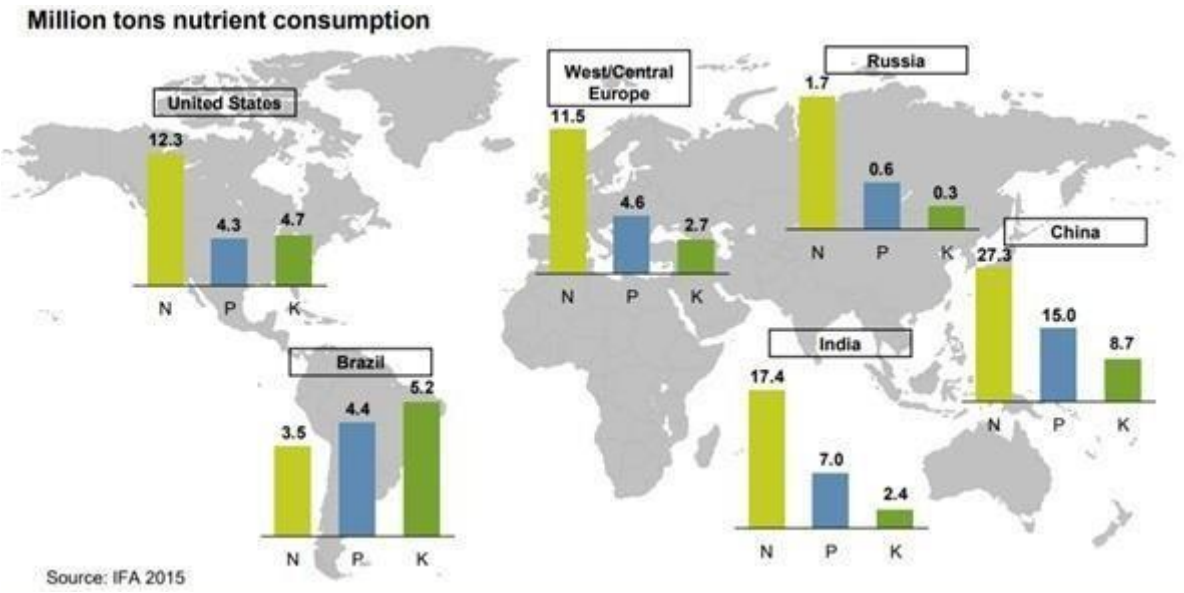


Figure 8. Key markets for fertiliser consumption worldwide–source IFA 2015

Source: https://www.yara.com/siteassets/investors/057-reports-and-presentations/other/2018/fertilizer-industry-handbook-2018.pdf/

Examination of the fertiliser industry reveals variations among different nutrients. Specifically, the nitrogen sector appears fragmented, whereas the phosphorus and potassium sectors demonstrate greater concentration. According to statistics from the International Fertiliser Association (IFA), the top three nitrogen producers collectively account for only approximately 15% of the total global capacity. In contrast, the top three phosphate producers hold about 24% of the capacity, while the potassium industry is even more consolidated, with the top three producers representing 49% of the capacity (Fertiliser industry handbook 2018, Yara, 2018).

Additionally, reports from the International Fertilizer Association (IFA) in 2015 reaffirm that urea remains among the most commonly utilized fertilisers (Figure 10). In the EU-28, Russia, and India, nitrogen fertilisers are predominantly employed in wheat production, whereas in the USA and Brazil, maize is the dominant sector. Notably, nitrogen application in China is primarily

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

associated with the fruits and vegetables sector, as well as maize (Figure 11, Fertiliser industry handbook 2018, Yara, 2018).

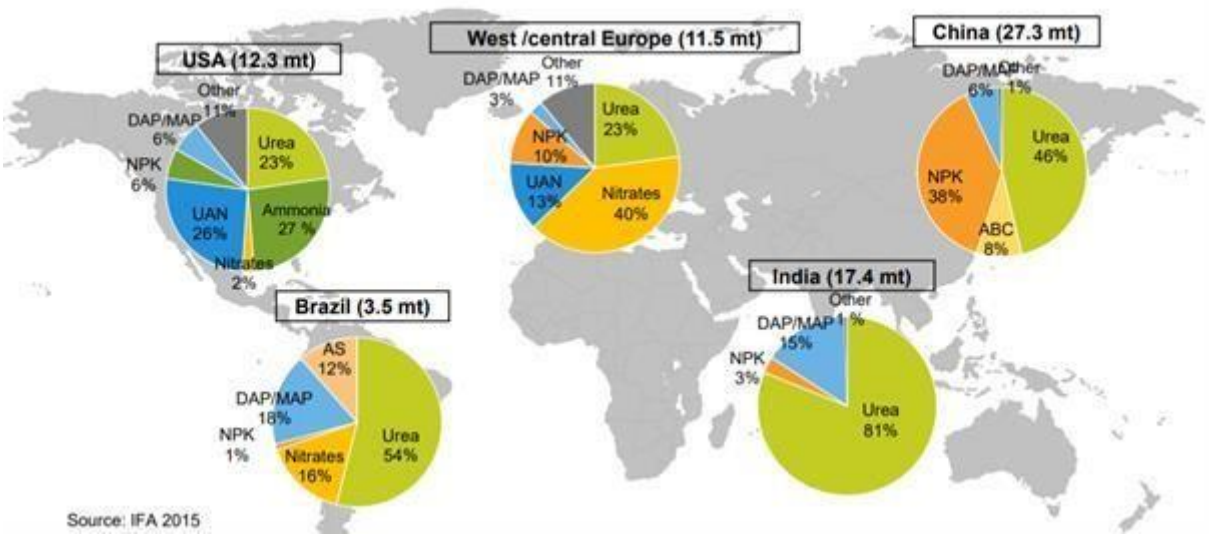


Figure 9. Nitrogen fertiliser application by region and product

Source: https://www.yara.com/siteassets/investors/057-reports-and-presentations/other/2018/fertilizer-industry-handbook-2018.pdf/

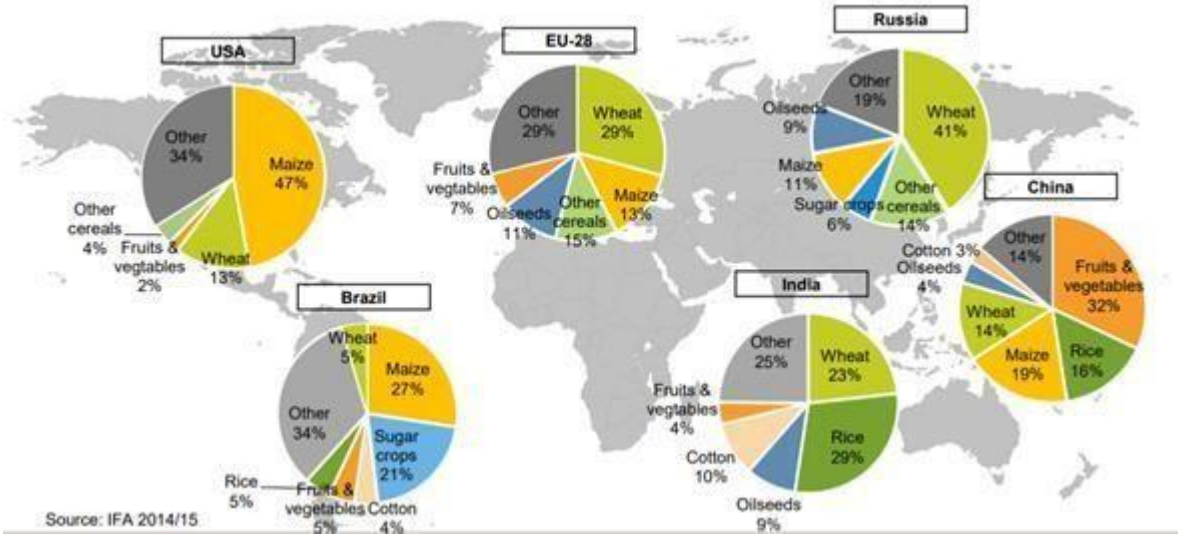


Figure 10. Nitrogen fertiliser application by region and crop

Source: https://www.yara.com/siteassets/investors/057-reports-and-presentations/other/2018/fertilizer-industry-handbook-2018.pdf/

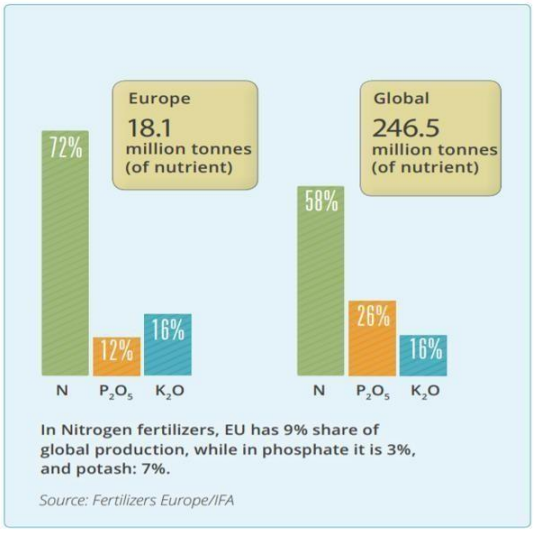
The European Union heavily relies on imports for the majority of its mineral fertilisers. In 2017, the value of the fertiliser market amounted to 17 billion EUR. France, Germany, and the UK collectively account for 40% of this market. The quantity of fertilisers utilized within the EU constitutes 10% of the global total (Fertilisers in the EU, EC, 2019).

The EU's primary trade partners in the fertiliser sector include both importing and exporting countries. As per data from Eurostat and the annual report by Fertilizers Europe, the largest

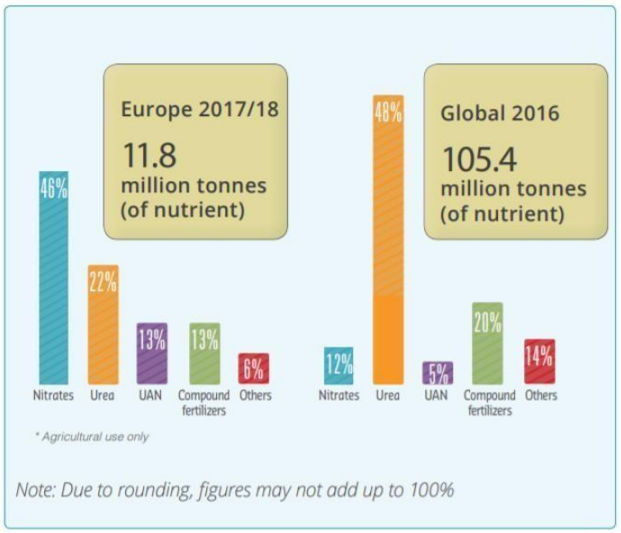
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

imports to the EU originate from Brazil (375 million EUR), Ukraine (202 million EUR), China (195 million EUR), and the United States (136 million EUR). Conversely, the most significant exports to the EU come from Russia (1.367 million EUR), Morocco (410 million EUR), Egypt (476 million EUR), and Belarus (429 million EUR) (Industry facts and figures – 2019, Fertilisers Europe, 2019).

Figure 12. illustrates fertiliser production categorized by nutrient, with the EU accounting for 9% of global production. On the right side of the figure, nitrogen fertiliser consumption by product is depicted, revealing that within the EU agricultural sector, nitrates are predominantly used (46%), followed by urea (22%). In contrast, on a global scale, urea is the most utilized nitrogen form (48%) (Industry facts and figures – 2019, Fertilisers Europe, 2019).



fertiliser production by nutrient (2017)



nitrogen fertiliser consumption by nutrient

Figure 11. Fertiliser production by nutrient and N fertiliser consumption by product in the EU and global

Source: https://www.fertilizerseurope.com/wp-content/uploads/2019/07/Industry-Facts-and-Figures-2019-Digital-version.pdf

4.3 Analysis of major players in the organic fertiliser market

The mineral fertiliser sector within the EU accounts for over 80% of the estimated total value of the fertilising materials market (Figure 13). The organic fertiliser sector is approximately 5%, excluding applications directly carried out by farmers, such as the use of manure. Notably, the overview of the market excludes raw manure due to its predominant utilization by farmers directly on their own or nearby fields, typically without involving commercial transactions. Additionally, the combined sectors of soil improvers (5%), growing media (5%), and bio-stimulant materials (2%) constitute approximately 12%. Based on these figures, it is estimated that the new Fertilizing Product Regulation will impact roughly 20% of the total market value of all fertilising products.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

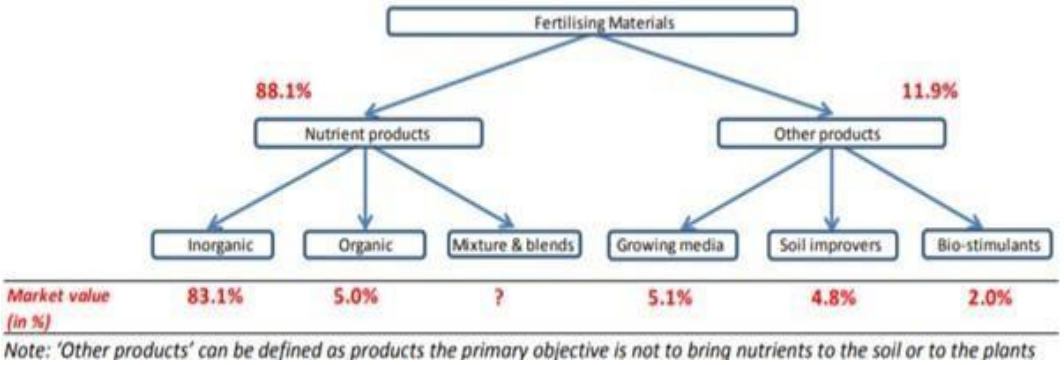


Figure 12. Market value distribution per category of fertilising products

Source: Fertilisers Study, 2012

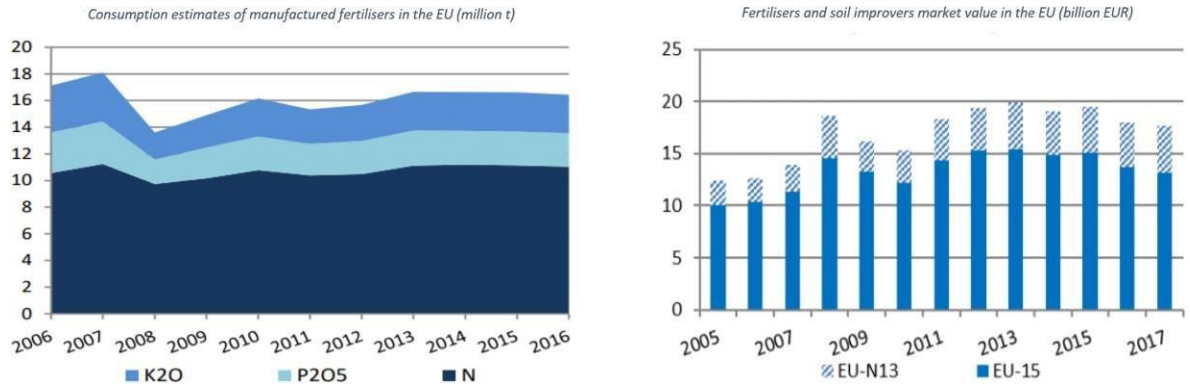


Figure 13. Consumption estimates (million t) and market value of fertilisers in the EU (billion EUR)

Source: https://commission.europa.eu/sites/default/files/food-farming-fisheries/farming/documents/market-brief-fertilisers_june2019_en.pdf

Throughout the season, fertilisers containing an average of 11.5 million tons of nitrogen, 2.7 million tons of phosphate, and 3.1 million tons of potash were administered across 133.8 million hectares of farmland (Forecast of food, farming and fertiliser use in the European Union, Fertilisers Europe, 2019). Figure 15 offers insights into the nitrogen sources utilized in EU agriculture. The primary sources of nitrogen predominantly include mineral fertilisers and manure.

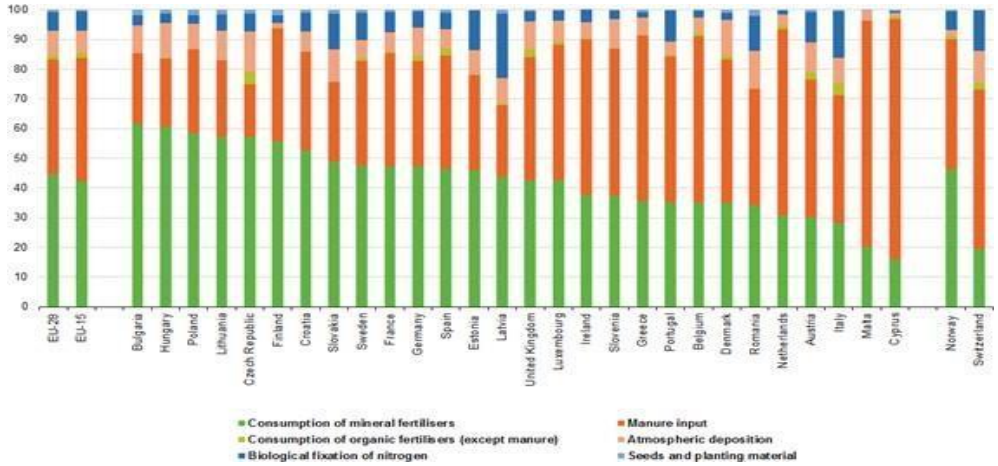


Figure 14. Sources of nitrogen inputs in the EU agriculture (Source: Fertilisers Study, 2012)

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Table 6. Summary figures per fertilising materials market segment ; Source: Fertilisers Study, 2012

Sub-sector	Market value	Market volume	Employment	Companies	SME ratio	Level of innovation	Other/Additional information
Mineral (Inorganic) fertilisers	17 billion € turnover (2010) mature market	GLOBAL - 170 Mio metric tonnes (2008/2009) (60 % N) EU MARKET - 16 Mio tons nutrients (consumption/yr) - 10.3 million tons N - 2.5 million tons P_2O_5 - 2.7 million tons K_2O	56 000 56 400	N: few huge gas industries P_2O_5 and K_2O: few companies in the mining industry +/- 100 producers and about 30 importers (large market players have +/- 90 % market share) more than 1000 SME's trading and blending inorganic fertilisers 1056 companies (source: ESTAT)	N: low K: low P: low blenders: high	low to moderate	market with different actors for each nutrient developed distribution networks low risk of substitution through organic fertilisers
Organic fertilisers (excluding manure, compost and digestate, industrial by-products only)	6 % of 17 billion € (1.02 billion € - estimated by the study team) moderate market value increase	EU MARKET - 332,800 tonnes N (2.9%) - 540 000 tonnes P (15.2%) - On average 6 % of the total inorganic fertiliser market	2 600	mostly SMEs, well organised 95 companies	very high (98 %)	high for all sectors including industrial by-products and manure	some also active in bio-stimulant and soil improver sectors market developed mainly in the Mediterranean countries
Organo-mineral fertilisers	475 million € high market value increase potential	Producing Member States: IT, FR, ES, DE, BE, NL	1 650	75 companies	very high		main markets in IT, ES, FR, DE, NL, BE, HR + RS high exports to non-EU MS market potential in other MS
Soil improvers Liming materials industry	2.5 billion € (added value, not turnover) maximum 20% concern use in	EU MARKET - 5.6 million tonnes - 28.4 million tonnes	2 200 11 000 people in 23 countries	30 companies active in the agro sector blending by distributors	very low for producers very high for distributors	low to average	part of a larger business sector in which agriculture market segment is low (about 20 %)

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

	agricultural sector *mature market*			*100 companies (200 production plants) – 4 or 5 at EU level*			
Organic soil improvers sector (mainly products from waste, recycling activities, compost and digestate)	*1.045 billion € (estimated turnover)* *(hobby representing 20% of total)* *high market value increase potential*	*EU MARKET* *- 23.6 million tonnes of biowaste (collected separately out of 80.1 million tonnes collectable, i.e., 29%)* *- growth potential - 124 million tonnes in EU-27* *- 13.3 million tonnes of compost (2008) from the 23,6 million tonnes collected* *- green waste compost: 5.7 million tonnes* *- bio-waste compost: 4.8 million tonnes* *- sewage compost: 1.5 million tonnes* *- mixed waste compost: 1.4 million tonnes* *- agricultural use + growing media products = 70 % of the consumption*	*20 000 for the whole sector*	*at least 3 000 companies, including very large waste processors and many SMEs, some of which are rather old (>100-year-old) and were involved with fertilisers before mineral fertilisers were marketed* *around 8 000 companies, including very large waste processors and a majority of SMEs active in the production of compost and digestate from source segregated waste*	*high*	*high*	*the turnover of 1.045 billion € comes from 2 sources:* *- the price paid by waste producers to deliver waste to the compost producing plants (largest part)* *- the price paid by the users of compost (minor part)* *the second part might be considered as being part of the fertilising materials/products market* *- estimation of the second part - 500 million € maximum*
Growing media sector (mainly peat)	*1.262 million €* *1.038 million € (estimated total turnover for the fertiliser market)* *mature market*	*EU MARKET* *- 74 % of the EU production by FI, IE and DE* *- FI and IE use most peat for energy purposes* *- intense intra-EU trade flows (25% of global EU market) compared to other organic product markets*	*13 000*	*500 companies (EE, FI, DE, IE, LV, LT, NL, PL, SE,UK)* *mostly SMEs* *only 14 large companies*	*high/very high*	*average*	

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

		- 37 million m^3 equivalent to circa 11 million tonnes according to EPAGMA					
Bio-stimulants	*low market value* *400 million € (estimated turnover)* *high market value increase potential*	*mainly intra-EU trade*	*no statistics available*	*high level of fragmentation* *mainly SMEs in ES, IT, FR and DE with national or regional scope* *no statistics on number of companies*	*high*	*highly innovative* *large number of innovative products*	*limited product flows across MS* *speciality crops and high price* *high margins for producers* *often associated to liquid fertilisers*
Fertilising additives	*640 million €* *high market value increase potential*	*EU MARKET* *- markets in ES, FR, IT, DE, BE, DK, HU, PL, UK, NL, PT, CZ*	*3 300*	*200 companies*	*very high*		

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

5 Customer Segmentation and Approach

In today's world of marketing from technology/product orientation to customer orientation, the management of customer treatment can be seen as a main key to revenue growth and profitability. Understanding customer behaviour empowers marketing strategies to engage with them strategically, fostering plans for enhancement and the broader implementation of the most impactful strategies (link). Customer segmentation has virtually unlimited potential as a tool that can guide toward more effective ways to market products and develop new ones.

In general, customer segmentation focuses on dividing customers into smaller groups that reflect similarities among customers in each of the groups (link). By dividing them into smaller, more manageable groups based on factors such as age, location, purchasing behaviour and other indicators, a prepared marketing strategy can better suit the needs and desires of each group (link). It is important to know how to relate to customers in each segment to maximize the value of each customer to the business.

Determining the ideal customer for alternative fertilisers requires a thoughtful and intentional approach. It involves a methodical process to identify specific groups of consumers who are more inclined to accept and gain advantages from using these sustainable agricultural products. The goal is to target an audience that is most likely to adopt and benefit from the unique features and benefits offered by alternative fertilisers.

A segmentation variable can include (link):

- Who they are?
- What they do?
- What they want?

In the realm of alternative fertilisers, recognizing segmentation variables is crucial for customization, allowing tailored approaches and products to meet the unique needs of diverse customer segments. This insight, coupled with effective experience data collection that can take various forms, ranging from direct customer surveys to indirect insights derived from datanot obtained directly, enhances the effectiveness of marketing strategies. This ensures that alternative fertilisers closely align with the preferences and requirements of their target audience by understanding and adapting to valuable trends in customer behavior.

In this context, collaboration with stakeholders/customers along the different value chains addressed by the NOVAFERT project is essential to identify and pinpoint the complex causes related to the acceptance of alternative fertilisers as well as to define and implement strategies to accelerate the transition to bio-based fertilisers (BBFs).

Followed by all the above, the opinions of stakeholders/customers will be provided through organized workshops and through a questionnaire called "What stakeholders seek to find in novel fertilisers". The questionnaire aimed to assess end users' preferences and willingness to purchase fertilisers from diverse waste streams (e.g., biowaste, bioproducts, digestate. It also gauged industry willingness, including producers and the private sector, to overcome obstacles hindering the production and distribution of BBFs. Moreover, it sought insights from other

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

quadruple helix participants (scientific and governmental experts) to contribute to the NOVAFERT project's objectives, while identifying crucial issues for the future development of this emerging market. All the collected information will help in future defining customer segmentation and approach.

A more detailed description of the questionnaire and its results will be described in the following chapters.

5.1 Identification of the ideal customer for alternative fertilisers

The "Identification of ideal customer for alternative fertilisers" refers to the process of determining the target audience or specific group of individuals and entities who are most likely to adopt and benefit from BBFs. In the context of sustainable agriculture, BBFs may include organic or environmentally friendly options that aim to reduce the ecological impact of traditional fertilisation methods. Identifying the ideal customer involves considering factors such as the type of farming practices, environmental awareness, economic considerations and other relevant criteria to tailor marketing and outreach efforts effectively. This process helps ensure that BBFs are promoted to those who are more inclined to adopt and integrate them into their agricultural practices.

Identifying the ideal customer for BBFs demands a strategic process aimed at pinpointing consumer segments poised to embrace and benefit from sustainable agricultural inputs. This process gains added depth when considered in the context of the NOVAFERT project, given its diverse set of stakeholders, each with distinct roles and interests.

Within the NOVAFERT project, stakeholders encompass organizations wielding influence, interest, skills, and knowledge in the realm of fertilisers derived from bio-based resources. Their involvement extends to evaluating and testing solutions proposed by NOVAFERT, intending to accelerate the adoption of BBFs.

The project's overarching goal involves engaging various stakeholders to foster interactions along the value chain, facilitating the transfer of knowledge for the efficient and safe use of fertilising products.

Stakeholders are within the project divided into 2 primary categories: the "aware" community, comprising individuals well-versed in BBFs and actively engaged in sustainable practices, and the "unaware" community, consisting of individuals lacking awareness, including the public. By aligning the identification of ideal customers with the roles and interests of NOVAFERT stakeholders, the project ensures a targeted approach.

This approach resonates with those positioned to champion and adopt alternative fertilisers while concurrently addressing knowledge gaps within the broader community (*information on stakeholders is provided from WP5*).

To ensure the effectiveness of the stakeholder engagement plan at the global and local levels,

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

a monitoring process of stakeholder engagement will be implemented and will include regularly checking in (every 9 months) on the achieved actions to make adjustments when needed. This is an ongoing process that will be performed throughout the project to ensure that needs and expectations are being met (*information on stakeholders is provided from WP5*).

NOVAFERT aims to accelerate the shift to a circular economy in agriculture by promoting awareness and understanding of BBFs among end-users and the value chain. In the application phase, the consortium identified key strategic partners at European, national, and regional levels to facilitate an effective exchange of information and practical knowledge on BBFs.

The different types of ecosystem members are segmented as follows (*information on stakeholders is provided from WP5*):
farmers, farm associations, fertilisers producers, farmer advisors and trainers. These groups will be strongly involved in the project through participatory workshops (WP5) to discuss effective strategies to overcome the barriers in the use of alternative fertilising products and the possibilities of actively collaborating with the NOVAFERT consortium. They will also play a relevant role through the network of Lighthouse demos (WP1 and WP4), described in paragraph 8.

- **academia and researchers** will also provide a valuable input for research on nutrient recycling and the related technologies and products. Their engagement through dedicated events and initiatives will help to raise awareness on the benefits of BBFs and identify the existing gaps between research and practice.
- **policy makers** whose engagement at local, regional, national and European level might contribute to the effective implementation of the Fertilising Products Regulation (FPR) based on science-based guidance.
- **public** which will be informed about the benefits of alternative fertilisers through a social awareness campaign showcasing the efficiency and environmental safety of alternative fertilising products.

To support the transition to wider use of alternative fertilisers, multi-stakeholder engagement and collaboration is essential. Therefore, bearing in mind the sectors identified before, the NOVAFERT stakeholder engagement strategy is based on the Quadruple helix approach which is a collaborative model of innovation recognizing four major actors in the innovation systems: **science (academia), policy (government), industry (producers, private sector) and society (civil society organizations)**.

Consumers and end-users are usually perceived as passive actors, who consume the products, or the services made available by businesses. In the quadruple helix model, consumers and end-users play a central role in being directly involved in the conception and development of innovative solutions. This approach is likely to enhance the overall societal benefit at a reduced cost and increase the involvement of end-users, who will become an active part of the innovation system.
The sum up of stakeholders within the NOVAFERT project is foreseen in table 8.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Table 7. Type of stakeholders within the NOVAFERT project

Type of stakeholder	Sector
Business - Large company	Private sector
Business - SME	Academic sector
Business - Start-ups/entrepreneurs	Public sector
Farmers	Civil society
Association	
Foundation	
University	
Technology centre	
Research centre	
Local public administration	
Regional public administration	
National public administration	
NGO	
Other	

By aligning the identification of ideal customers for BBFs with existing stakeholder groups, a collaborative ecosystem that promotes the adoption of sustainable practices can be created. This approach leverages shared resources, expertise and networks to facilitate a smoother transition toward alternative fertilization methods within the agricultural community. Incorporating farmers into the identification process of ideal customers for alternative fertilisers is crucial for successful adoption.

Some of the recommendations are:

- Collaboration with **university stakeholders** to leverage academic expertise. Seek insights from agricultural departments to understand the scientific aspects of alternative fertilisers.
- Incorporating **farmers** as their active involvement fosters community support, addresses economic considerations, and provides valuable feedback for continuous improvement, making the transition to alternative fertilisers more farmer-centric and sustainable.
- Working closely with **SMEs and start-ups** in the agriculture sector. Understand their challenges and aspirations related to sustainable farming practices. Tailor alternative fertilisers to address the needs of these businesses.
- Collaboration with NGOs.
- Engagement with **regional public administration stakeholders** to understand local agricultural policies and regulations. Align strategies with regional sustainability goals, ensuring that alternative fertilisers comply with local standards.
- Collaboration with research centres to validate the effectiveness and environmental impact of alternative fertilisers.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

By integrating stakeholders into the identification process, the relevance of the ideal customer profile is heightened, fostering a collaborative environment that aligns with the uniqueinterests and expertise of each stakeholder group. Consistent communication and active participation in the project further contribute to a comprehensive and successful identificationprocess in the third phase.

5.2 Tailoring marketing and sales strategies for different customer segments

Understanding the unique needs and preferences of various customer segments is key to developing effective marketing strategies. By dividing the customer base into distinct segments based on demographics, behaviours or characteristics, targeted campaigns that resonate with each group can be created. Tailoring marketing strategies for different customer segments allows for to maximization of resources and increases the efficiency of overall marketing efforts (link).

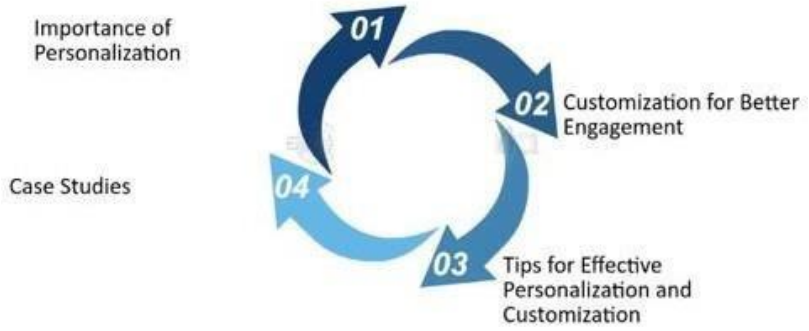


Figure 15. Tailoring marketing strategies to customer preferences

Source: https://fastercapital.com/startup-topic/Tailoring-Marketing-Strategies-with-Customer.html

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

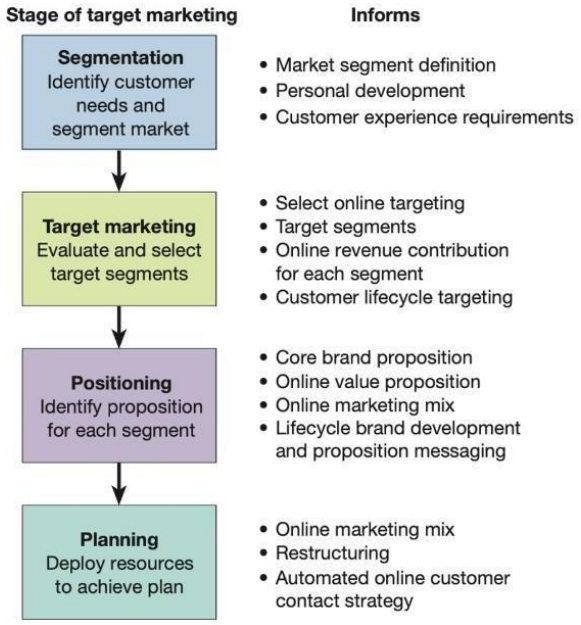


Figure 16. Stage of target marketing

Source: https://www.zabanga.us/internet-marketing-2/decision-3-target-marketing-strategy.html

Figure 17. Tailoring marketing strategies for different customer segments

Source: https://fastercapital.com/keyword/another-method.html

Distribution Channels and Partnerships

When it comes to developing a successful go-to-market strategy, your distribution channels and partnerships are two critical factors that can significantly impact your business's success. While there are many different distribution channels to choose from, two primary options are direct and indirect distribution.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Direct vs. Indirect Distribution

Direct distribution involves selling your products directly to your customers through your sales team or e-commerce platform. This approach can be highly effective, as it allows you to maintain complete control over your sales process and customer experience. Additionally, direct distribution can help you build stronger relationships with your customers, as you have more direct contact with them.

On the other hand, indirect distribution involves partnering with distributors or retailers to sell your products. This approach can be advantageous if you're looking to expand your reach quickly or if you don't have the resources to manage a direct sales team. By partnering with established distributors or retailers, you can tap into their existing customer base and leverage their expertise to drive sales.

Ultimately, the distribution channel that's best suited for your business will depend on various factors, including customer preferences, reach, and cost. It's essential to carefully evaluate your options to determine which approach will be most effective for your business. (link)

5.3 Understanding customer preferences and needs

A growing global awareness of the environmental impact of chemical fertilisers, driving increased demand for sustainable alternatives, is concurrently shaping the BBFs market's significant growth in the upcoming years. This shift in consumer preferences, coupled with strict regulatory frameworks impacting the fertiliser and chemicals industry, necessitatescompliance for the safety and quality of produced products. Moreover, as environmental concerns continue to influence the industry's trajectory, companies are investing in research and development to create eco-friendly alternatives (link).

Understanding customer needs and pain points is foundational to a successful go-to-market strategy, requiring comprehensive research on challenges, purchase decision processes and influencing factors (link).

By understanding customers' needs and pain points, products could be tailored and the service offerings could be addressed more effectively, which can help with business stand out from the competition.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

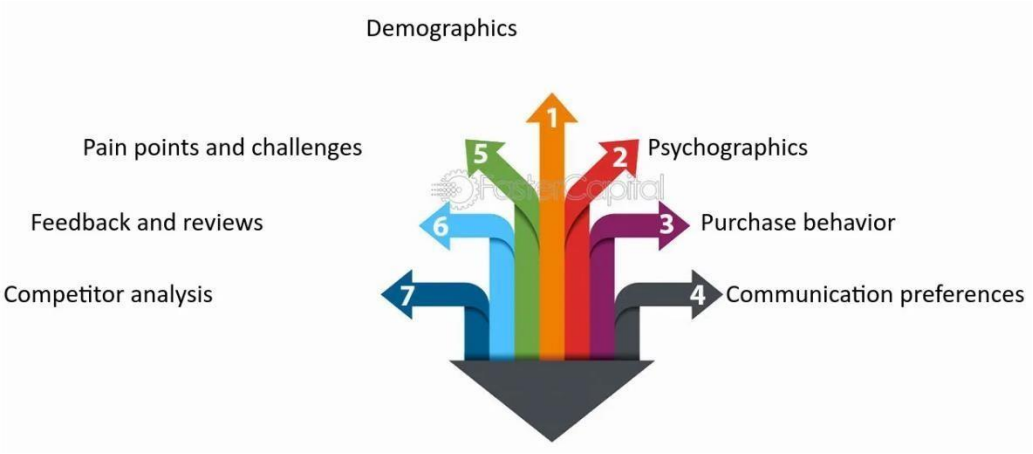


Figure 18. Understanding customer preferences and needs

Source: https://fastercapital.com/startup-topic/Understanding-Customer-Needs-and-Preferences.html

Effectively segmenting customer base requires a deep understanding of their preferences and needs. By gaining insights into what drives their purchasing decisions and how they interact with products or services, marketing strategies could be tailored to better meet their expectations.

To understand customer preferences and needs, it is important to:

- examine demographic information. Understanding these demographics allows for tailored messaging and product offerings.
- delve deeper into customers' psychographics to understand their interests, values and lifestyle choices.
- analyze customers' past purchase behaviour to reveal valuable insights, including frequency, average order value and preferred channels.
- understand how customers prefer to engage with the brand. Some may prefer email newsletters, while others favour social media updates. Respecting these preferences allows for delivering targeted messages through the right channels and increasing engagement.
- identify the pain points and challenges customers face. Surveys, interviews and customer support interactions can gather this information.
- know customer feedback and reviews, positive and negative. Positive feedback highlights aspects resonating well with customers, while negative feedback reveals areas for improvement. Actively engaging with customers through feedback channels shows commitment to enhancing their experience.
- analyze competitors and their customer base for insights into what attracts customers to their offerings. It is important to look for gaps or unmet needs that competitors may have overlooked, providing opportunities for differentiation and innovation.

As part of the project, a questionnaire will be conducted that will greatly help in understanding the preferences of end users. The plan is also to have workshops through which the main problems and preferences of users when it comes to alternative fertilizers will be found.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

6 Behavioural Analysis based on conducted survey

The questionnaire was used to gather information from stakeholders and was therefore divided into multiple sections. It encompassed general profile inquiries as well as questions on the acceptance of BBFs and the regulatory aspects of using BBFs.

The general inquiries were made to determine the respondents' profile, current on-farm fertiliser consumption and production, market prices and fertiliser practices. Generally, the initial section of the questionnaire was designed to gather information on the current fertiliser practices used by end users as well as the production practices of the industry. In the part of the questionnaire dealing with the acceptance of BBFs, an attempt is made to find out what are the main factors that would encourage stakeholders to use BBFs, but also what are the main obstacles preventing them from doing so. The regulatory segment of the questionnaire evaluated knowledge of legislative frameworks and regulations governing the use and production of BBFs, as well as support and promotion at the national and European Union levels.

Based on the literature review, a questionnaire "What stakeholders seek to find in novel fertilisers" was prepared to assess the preferences and willingness of end users to purchase fertilisers from different waste streams such as biowaste, biological by products, digestate, sludge, wastewater, treated manure, etc. Additionally, the survey evaluated the willingness of the industry (producers, private sector) to overcome various obstacles that prevent them from producing and distributing BBFs. The questionnaire also was designed to investigate the preferences and willingness of other quadruple helix participants (scientific and governmental experts) who could contribute their knowledge and skills to help achieve the main objective of the NOVAFERT project. Additionally, it aimed to identify issues that could be of importance for the future development of this still emerging and fragile market.

The purpose of the questionnaire was to identify the key parameters for stakeholders and gain an understanding of market preferences before developing business plans and generating policy proposals.

To specifically address the part related to end-users' preferences, a questionnaire was designed and after adjustments translated into the languages of the consortium: English, Croatian, Spanish, Finnish, Polish, and Dutch. The translations were cross-checked by native speakers familiar with related terminology in each country. The full translated survey ran from January 2024 until February 2024. All language versions were programmed in the online survey software SurveySparrow. The survey was disseminated online through contact databases in the agricultural field and distributed via various communication channels.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

6.1 Survey to collect customer/market needs

Methodology

The questionnaire has been prepared in the Survey Sparrow app and a total of 6 language versions (English, Croatian, Polish, Spanish, Finnish, Dutch) of the questionnaire for EU stakeholders were created.

The questionnaire was distributed to all partners in January 2024. Partners from TEAGAS, LUKE, UVIC, MEERI, BIOAZUL, EITFOOD, and UGENT distributed the questionnaire further to their stakeholders.

After the first round of the distribution, insufficient number of responses was collected. Therefore, a new round of reminders was sent to our dedicated partners in the consortium.

After the second round of the distribution, a larger number of responses were collected, however, still not enough for a concrete and detailed behaviour analysis which is one of the segments of market analysis.

For a better understanding of the situation on the ground, and not just from a literature review, it is desirable to include responses from various stakeholders. For this reason, the consortium is making a great effort to cooperate with different stakeholders from different countries in order to cover various regions at the level of the European Union.

Therefore, we will continue to distribute the questionnaire along with our dedicated partners during communication activities (workshops, seminars) in order to collect as many responses as possible.

Overview of respondents

Currently, 54 responses have been collected, of which 5 are from Croatia, 14 from Ireland, 18 from Spain, 5 from Finland, 2 from Belgium and 10 from Poland.

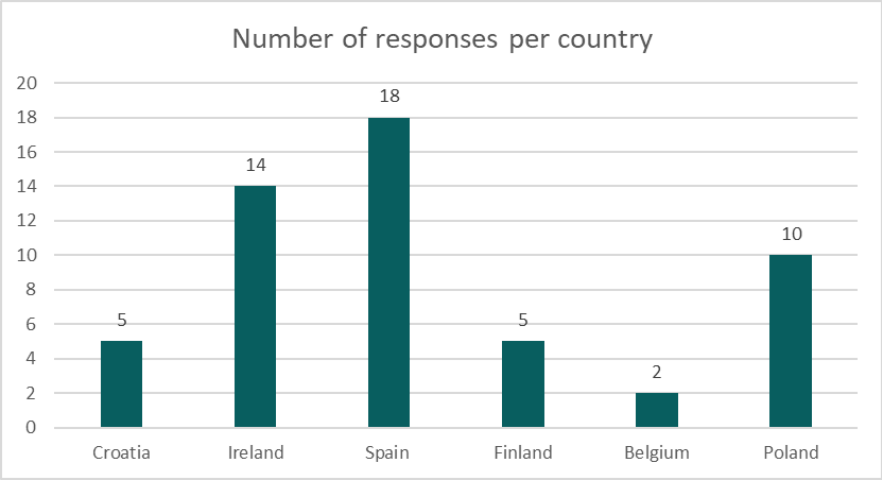


Figure 19. Number of respondents per country

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Age group

In **Croatia**, most respondents are between 41 and 50 years old (40,00 %), followed by respondents between 51 and 60 years old (60,00 %).

In **Ireland**, most respondents are 20 – 30 years old (50,00 %), followed by those that are 41 – 50 years old (33,33 %). Slightly smaller percentage refers to participants aged 31 - 40 years (16,67%).

In **Spain**, most respondents are between 41 and 50 years old (33,33 %), followed by those that are 51 – 60 years old (27,78 %).

In **Finland** and **Belgium**, most respondents are between 51 and 60 years old (60 %).

In **Poland**, most respondents are between 20 – 30 years old (60 %).

In conclusion, younger respondents have a greater interest in issues that can contributeto a better future for agriculture.

Overview

From the responses received farmers are currently using several fertiliser products on their farms. Croatian farms mainly use mineral and organo-mineral fertilisers, which is in line with the principles they apply to their farms. In Ireland, due to a higher level of awareness, a large percentage of them also use organic fertilisers. In Poland, mainly used are organic and organo-mineral fertilisers. Regarding Spain, a large percentage of them use organic fertilisers. In Belgium and Finland, the use of organo-mineral fertilisers is increasing.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

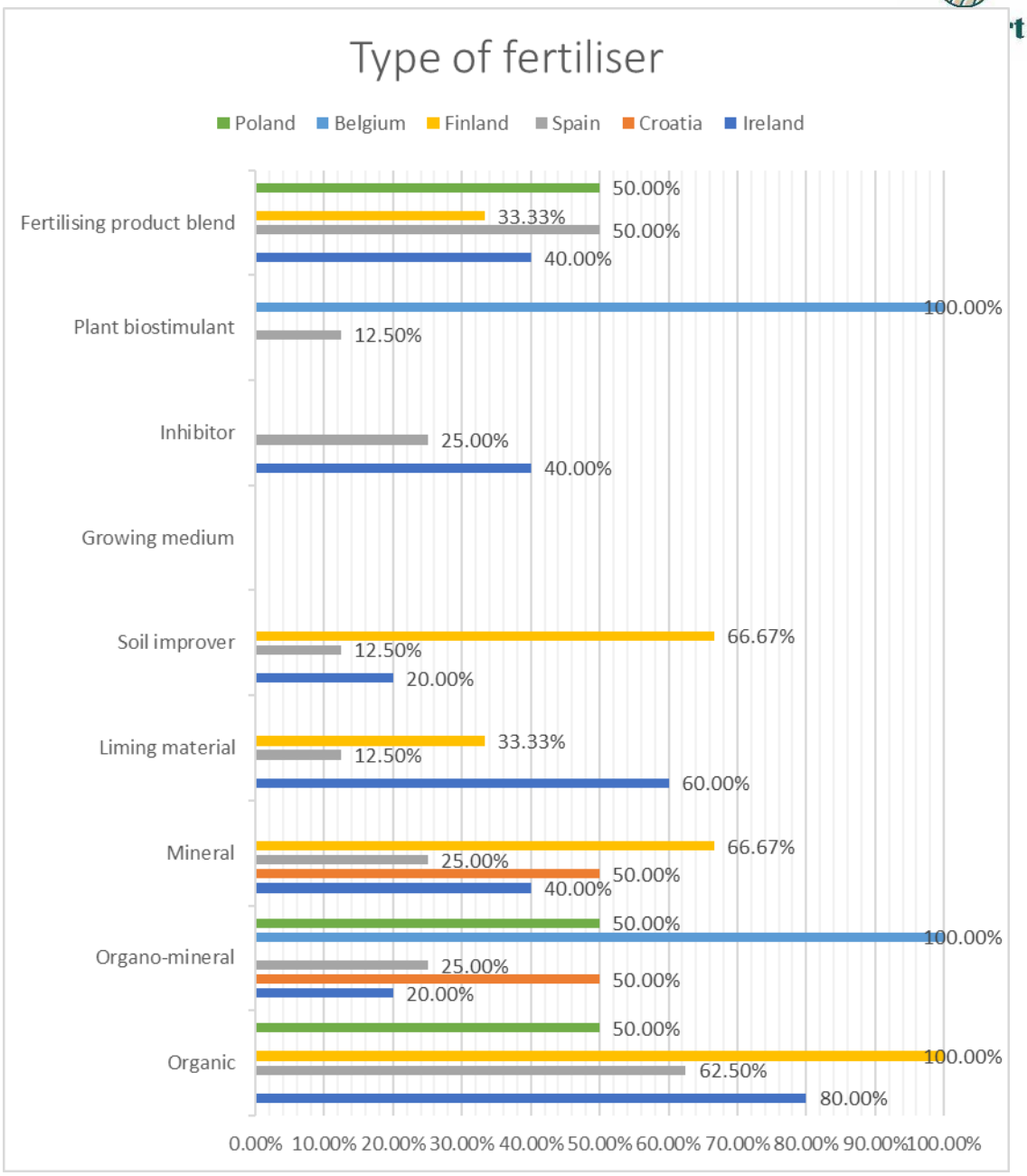


Figure 20. Currently used fertiliser

For example, the most used type of fertilizer is liquid (Poland, Belgium, and Finland 100%, Spain 87.50%, Croatia 50%, while Ireland is at 40%).

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

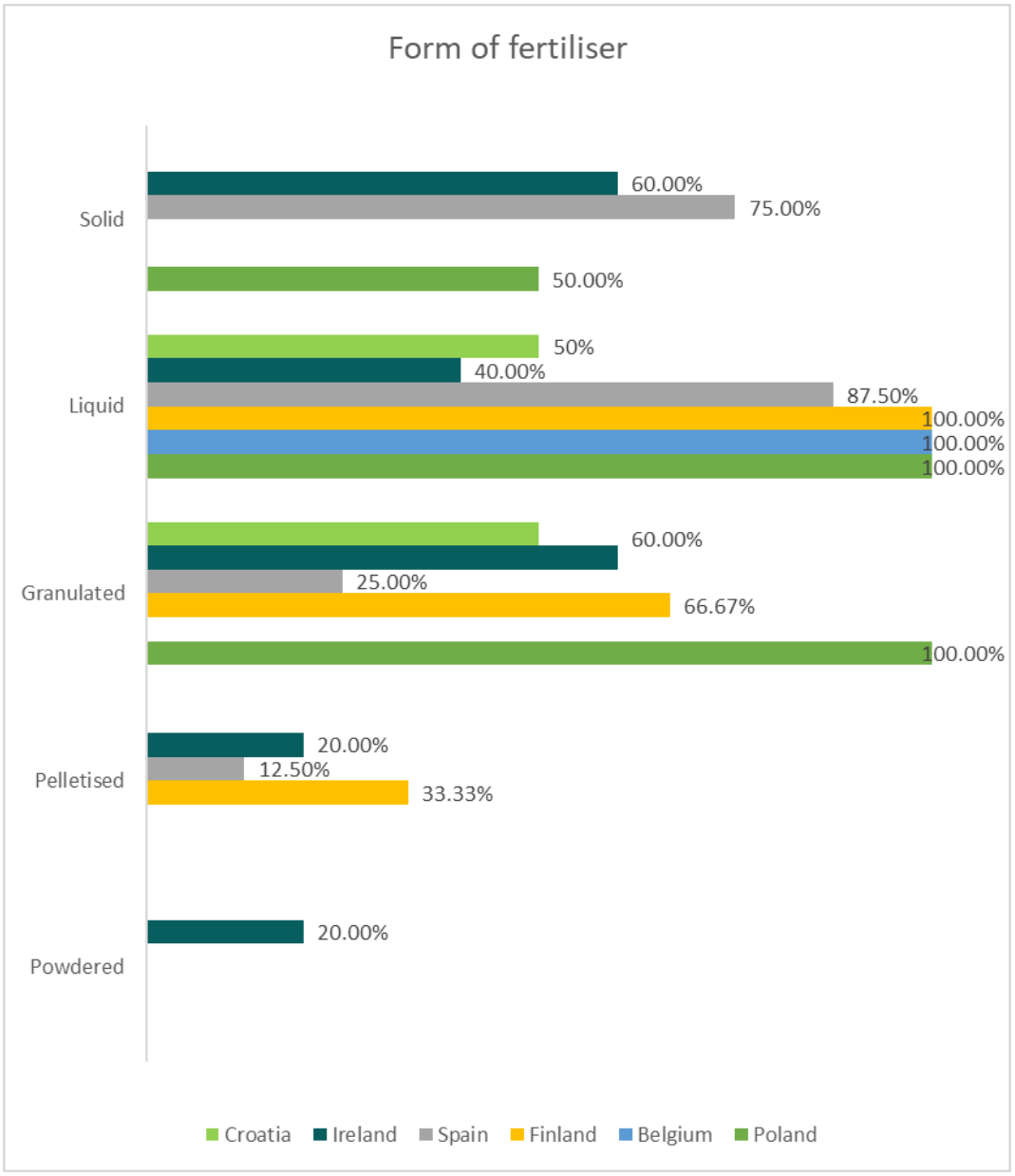


Figure 21. Form of fertilisers currently used on Irish farms

The difference between farmers can be seen in the amount they spend on fertiliser products, while Croatian farmers spend 1001-5000 €/ha/year (50,00%) or ≥ 5001 €/ha/year (50,00%), Irish farmers spend 200-500 €/ha/year (40,00 %) or 501-1000 €/ha/year (40,00 %).

Regarding the annual cost of fertilization per hectare in Poland, Belgium, and Finland, it amounts to 200-500 €/ha/year (100,00%). In Spain, the situation is significantly different. Thus, their costs are divided almost equally across all categories.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

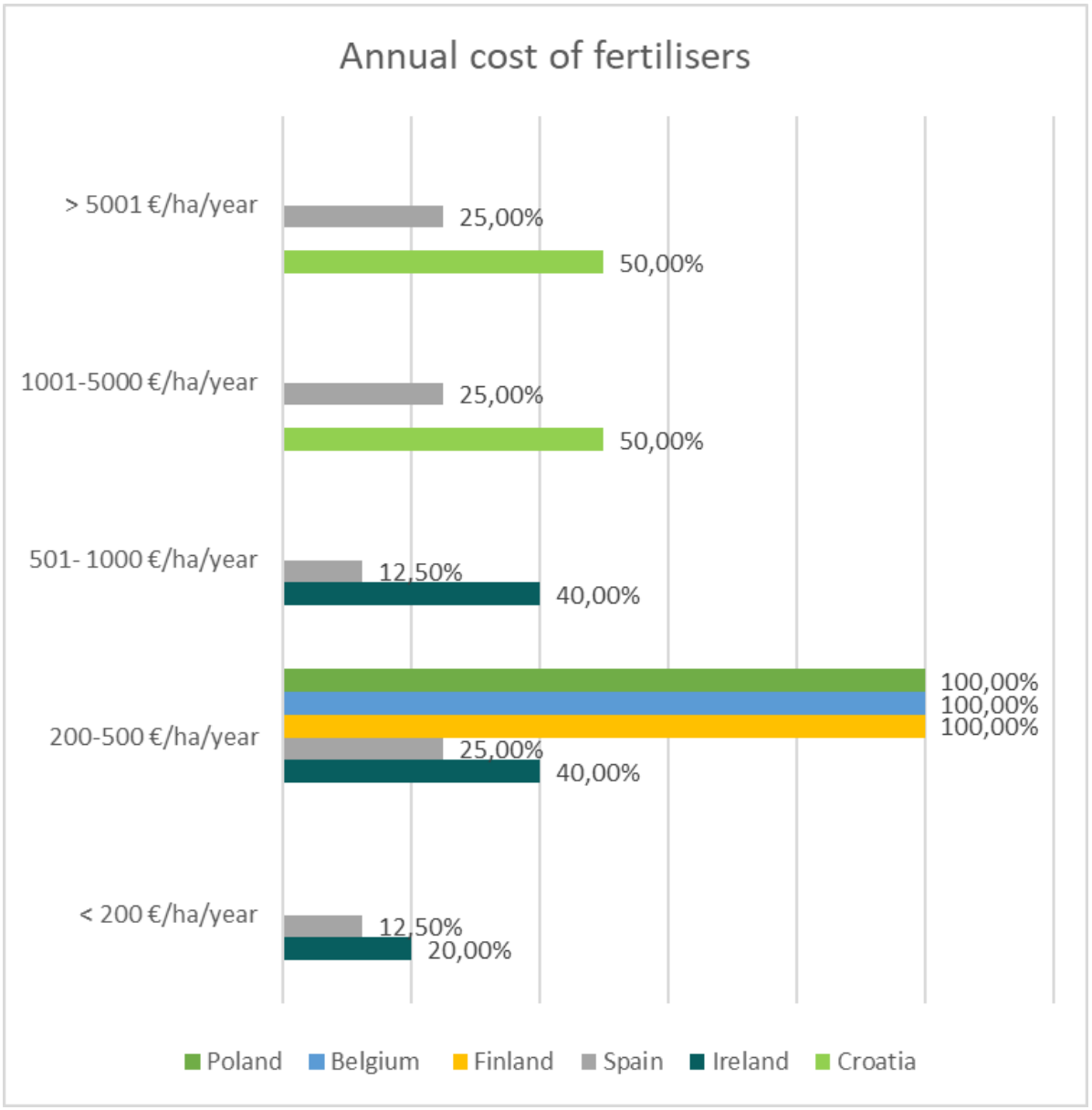


Figure 22. Annual cost of fertilisation per hectare

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

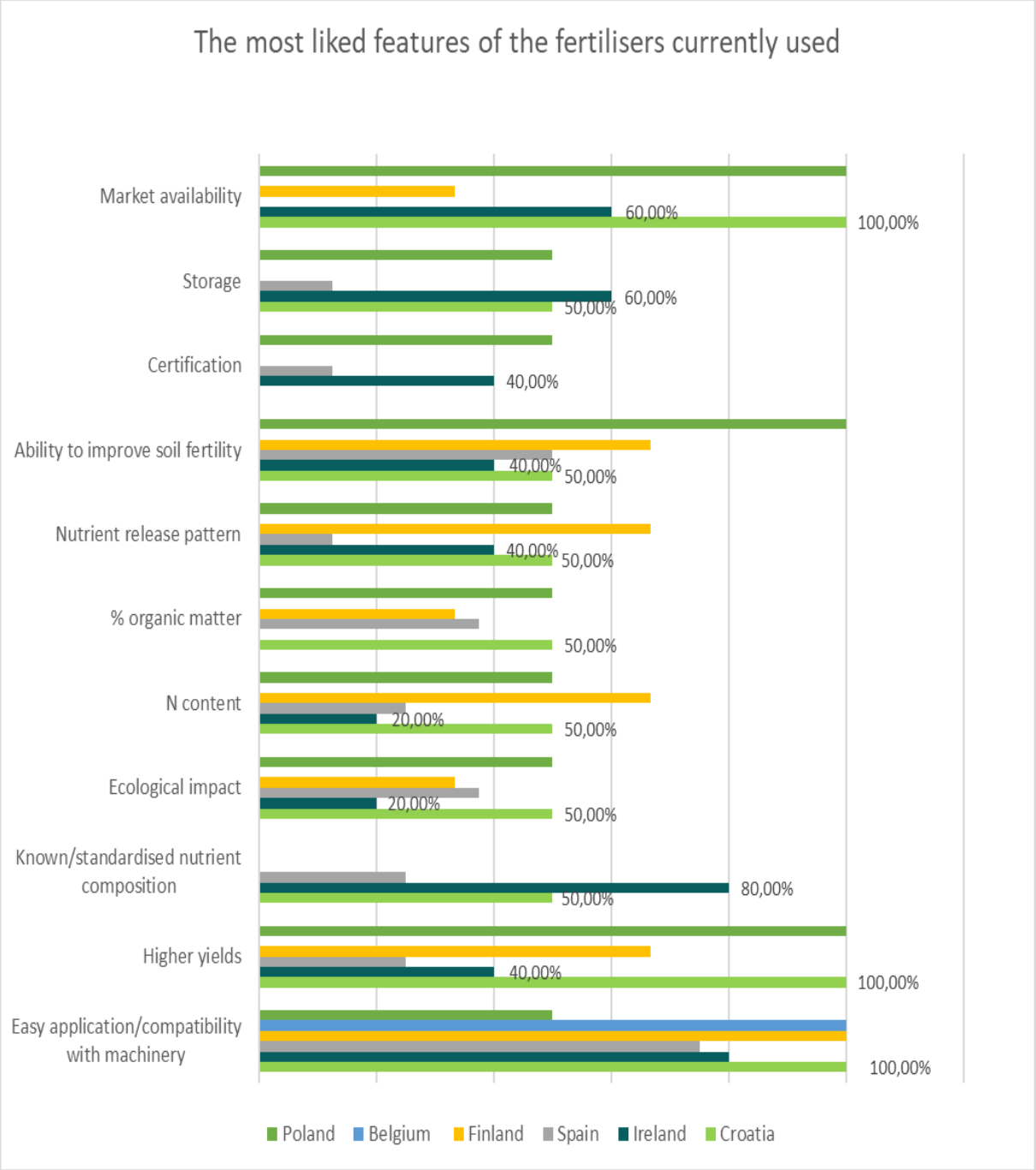


Figure 23. The most liked features of the currently used fertilisers

To understand farmers' preferences, the best characteristics of the fertilisers currently used were also investigated. Most of the respondents indicated that the most important feature is ease of use and compatibility with existing machinery. Also, one important feature that respondents have indicated is market availability.

The provided results are based on the current analysis. A more detailed analysis with a larger number of respondents will be conducted after the communication and dissemination activities that follow in each of the NOVAFERT regions. This will give us a clearer picture of the market and allow us to make concrete recommendations for improving the placement of alternative fertilizers.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

6.2 Insights from the survey results and comparison with similarsurveys conducted within EU

European Union has developed Horizon 2020 programme, which addresses climate change, contributes to achieve the UN's Sustainable Development Goals, and enhances the competitiveness and growth of the EU. The initiative promotes cooperation, reinforcing the influence of research and innovation in formulating, endorsing, and executing EU policies aimed at addressing worldwide challenges. It assists in generating and more widely disseminating outstanding knowledge and technologies.

One of the projects is FERTIMANURE, which is dedicated to the innovative nutrient recovery from secondary sources for the production of high-added value fertilisers from animal manure.

Age group and educational level:

To conclude, it is an ongoing trend that younger farmers across the EU and CELAC regions have a higher educational background before starting the farm business. This consequently may affect their understanding of market trends resulting in a different process of decision making.

Type and size of legal form:

Based on the above-mentioned data, one can conclude that the trending legal form among farmers in these countries is family-owned farm (either inherited or founded). The work on the farm is mostly done either by the owner or the owner and family members.

Farming principles:

The most prevalent type of agricultural production in the participating countries is conventional farming, while sustainable farming showed less interest in participating. Despite that, the objectives of the new Common Agricultural Policy could encourage greater development and transition from conventional to sustainable and organic agricultural production and farming practices, and therefore increased interest in the use of bio-based fertilisers. Concerning the soil analysis, data are not uniform as some countries carry out soil analysis regularly (Argentina, Italy, France, Belgium, Germany, the Netherlands), while others don't have this practice (Croatia, Spain).

Production on the farm:

Crop residues, manure and slurry are the most prominent by-products on the farms of these respondents. The prevalent trend is the use of such by-products for direct fertilisation of the agricultural fields of the farmers. This shows a positive view on using agricultural by-products for on-farm fertiliser production.

Fertilisers on farms:

Since solid and granular types of fertilisers have the highest rate of use, producers should keep

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

in mind that farmers would not have to adjust mechanization if the produced BBFs are in solid or granular form, because most respondents do not have difficulties applying the fertilisers they currently use.

Application of a new type of fertilisers:

- The highest percentage of respondents from Croatia are willing to try a new type of fertiliser if they are cheaper than the present mineral fertilisers (Croatia 37,93 %).
- In Croatia, 20,20 % would buy, if the benefits of fertiliser are well clarified.
- In Spain, an equal number of respondents (32,65 %) would try new types of fertilisers if they would be cheaper than the present used mineral fertilisers, and if fertiliser benefits are clearly explained regarding the effect of fertilisers on soil structure, nutrients form, etc.
- Respondents from Belgium are more likely to accept bio-based fertilisers that use waste from the food industry for production, than other participating countries. Respondents from The Netherlands had the most positive response of all participants to accepting sewage sludge as a source for the production of bio-based fertilisers. The acceptance of green waste as a source to produce bio-based fertilisers is highest in all participants except Croatia.
- Respondents from all countries are mostly willing to accept BBFs from manure, which isn't surprising given that a solid fraction of manure and compost are mostly used on their farms. Using these types of agricultural by-products for fertilisation purposes means that participants are already well informed and have experience using them. When it comes to sewage sludge, the use of wastewater as fertilisers, municipal waste, and biochar, the application is very small in all countries.
- As these countries are ecologically orientated for the protection and preservation of the environment, 58,62 % of the respondents from Croatia are prepared to convert to organic farming and/or the use of fertilisers on a biological basis.
- A certain percentage of respondents from all countries would agree, only if there is the right legislative framework (Croatia 35,47 %, Spain 40,82 %).
- If bio-based fertilisers had a positive impact on soil quality, 87,19 % of respondents in Croatia would have passed on their application. In Spain, 38,78 % of the respondents are willing to switch to organic agriculture and the use of bio-based fertilisers to preserve the environment, while 20,41 % of them are not willing to do so.
- Concerning the legislation for the application of fertilisers, 31,03 % of the respondents from Croatia are familiar with it, 43,35 % is only partially familiar, while 25,62 % of the respondents is not at all familiar with the legislation.
- In Croatia, 53,69 % of the respondents are keeping in track of news regarding legislation and regulations.
- Respondents from Spain showed that they are most informed about bio-based

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

fertilisers of all participating countries.

- Respondents from Croatia responded that they are not informed about bio-based fertilisers. Least informed about bio-fertilisers in Croatia are respondents between 40 and 50 years of age, while well informed are between 20 and 30 years of age. In the Netherlands and Spain respondents from 50 – 60 are well informed about bio-based fertilisers.
- The results of the question about the legislation showed that the respondents are somewhat familiar with the legislation for the application of fertilisers but are not informed about BBFs. Farmers that are more informed about BBFs are younger.

Cost of annual fertilisation application per hectare (ha):

- The largest percentage in Croatia is willing to pay more for organic and environmentally friendly fertilisers if the quality is better than the one respondent currently use (47,78 %), while 36,45 % are not ready to pay more. Most of the respondents from Spain are not willing to pay more for organic and environmentally friendly fertiliser (46,94 %), while 36,73 % of them are willing to pay more if the quality of fertiliser is better than the one, they currently use. Respondents from the Netherlands (66,00%) would pay the same price as for mineral fertilisers.
- If the price is the same as for mineral fertilisers, 32,51 % of respondents from Croatia are willing to pay for bio-based fertilisers concerning mineral fertilisers, while 20,69 % is willing to pay the price 10 % of the majority. In Spain, 28,75 % would pay the same price as mineral fertilisers, followed by 26,53 % of the respondents who aren't willing to pay more for bio-based fertilisers compared to mineral fertilisers, and 20,41 % who would pay 10 % higher price.
- Most of respondents in this survey are not willing to pay more for BBFs compared to mineral fertilisers. This indicates that for a successful user acceptance of end-products, newly made BBFs will have to have competitive market prices.
- In Croatia, a percentage of 50,58 % of respondents believe that the obstacle to their application is their price, while 27,24 % is concerned by technical equipment for their use in the field.
- Respondents from Spain (29,63 %) consider the legislative framework and financial/economic effects to be an obstacle to using BBFs.
- The biggest concern for Belgium (36,36 %) and The Netherlands (40 %) is legislative framework.
- In Croatia, users consider the composition of bio-based fertilisers adapted to crop nutrient demand to be the most important in application of bio-fertilisers, as well as high organic matter content (31 %), the ease of use (36 %), and the possibility of using the same mechanisation (42 %).
- In Spain, respondents rate most important nutrient ratio that fits with crop nutrient demand (26,53 %), followed by high organic matter content (22,45 %), ease of use

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

(22,45 %), and price per unit of nitrogen (N) or other nutrients (22,45 %).

- For the Netherlands (57 %) and Belgium (62 %) most important is nutrient ratio that fits with crop nutrient demand.

General conclusion:

The questionnaire concluded that although BBFs have a bright future, they need to offer affordability to be competitive in the market. It is also important to secure quality regarding the contact of organic matter and reduce the risk of infection, followed by nutrient action rate (link).

Based on the identified attributes, a discrete choice experiment was designed to reveal farmers' preferences and willingness to pay for these attributes. Identical experiments were conducted in seven different European countries. The results indicate that farmers from different countries have common preferences for concentrated products that have certainty in the nitrogen content and at a lower price than chemical fertiliser. Other attributes such as the presence of organic carbon, hygienization of the product and fast release of nutrients were only statistically significant in some countries. The results imply that bio-based fertilisers like chemical fertilisers could be sold at around 65 % of the price of mineral fertiliser. Additionally, we show which attributes the industry should consider when estimating the demand for new bio-based fertiliser products (link).

Among the potential users of such products are farmers, but also nurserymen, who are usually overlooked in research on behaviour, awareness, and trends in the use of waste-based fertilisers. The current study showed that nurserymen are potentially interested in actively participating in the transformation toward the CE in the fertiliser sector by using waste-based fertiliser. However, they indicated some concerns, such as a lack of knowledge and experience in the use of such products. Therefore, further efforts to raise awareness of the importance of the sustainable and circular use of waste fertilisers and increase competencies among end-users of waste-based products are necessary (link).

- To achieve the fastest adoption of a BBFs, a 30–46% discount compared to a mineral fertiliser is needed.
- To maximise the uptake of BBFs by the market, producers have to miss out on 25–32% of the potential revenue.
- To maximise the revenue, producers can charge prices for BBFs equivalent to mineral fertilisers

The use of organic fertilisers was strongly influenced by farm activity. More than half of arable/horticulture farmers used at least one type of organic waste product, and larger farms were also more likely to use organic fertilisers.

At a macro level, there is a clear lack of aggregate data on the quantities of different waste materials used in agriculture at the European level, as the example of France illustrates.

European data lacks cruelly and does not allow economists to understand how demand evolves in a long-term perspective, and what factors determine this demand (the price of fertilisers, oil,

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

weather conditions…) through statistical and econometric tools.

This void could be filled if the EU imposed statistics on all industries producing waste and waste-based fertilisers used in agriculture (green waste, agro-food waste, ash from combustion, biochar…). This would also enable governments to better inform farmers and regulate potential negative externalities. This information could trigger multidisciplinary research on the sustainability of recycling waste in agriculture. If we do not know what is used in agriculture, how can we properly evaluate environmental and health-related impacts?

Except for FARTIMANURE, SEA2LAND is another project that aims to provide solutions to help overcome challenges related to food production, climate change, and waste reuse. This project promotes the production of large-scale fertilisers in the EU from own raw materials, such as waste from fish and aquaculture industry.

Age group:

The highest number of respondents who participated in the questionnaire belonged to the age group of 41 – 50 years old, although both younger and older respondents also participated.

Type and size of legal form:

Most of the respondents work in a commercial company, followed by respondents who have family farms.

Farming principles:

The most represented type of production in participating countries is conventional farming, while sustainable agriculture is less represented among the participants. Regarding new EU policies, it is expacted that the number of organic farmers will rise in the upcoming period.

Production on the farm:

The most prominent by-products on farms are animal manure and slurry, followed by crop residue. Most of the participants stated that they use their by-products in a raw form as a fertiliser or they transform or process by-products into organic fertilisers and used on farm.

Fertilisers on farm:

In all participating countries, respondents use both, solid and liquid fertilisers. For farmers is very important that they could use the same machinery for new fertilisers.

Application of a new type of fertilisers:

Most of the participants are willing to try BBFs produced from fish waste if those fertilisers meet the requirements such as price, the content of organic matter and nitrogen, etc.Additionally, participants have stated that the biggest obstacles in purchasing and using BBFsare legislative framework and machinery.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

6.3 Implications for Product Development and marketing strategies

Once the questionnaire results have been processed, the implications for product development and marketing strategies will be described in more detail.

The main threat is the risk of delays in progress caused by a legal framework that fails to keep up with the market.

The market for producers and agricultural end-users is still emerging and fragile, despite the interest generated by relevant circular economy actions and sustainability targets. The European Commission and Member States must continue consistently on the path they have initiated by setting policy targets, encouraging end-user adoption, and addressing any remaining policy constraints at the EU level. They should also pay sufficient attention to the national implementation of nutrient management plans.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

7 Business Model Canvas

The Business Model Canvas (BMC) represents the visual modeling technique designed to capture a company's business model. Comprising nine distinct building blocks, this method entails the placement of sticky notes on each block to symbolize the various components of the business model (link).

Those nine blocks encompass four main areas of the business: customers, offer, infrastructure, and financial viability (link). Once the process is complete, the finalized BMC provides a snapshot of the essential elements within the business model at a specific moment, as determined by its creator (link).. As stated above, BMC contains 9 building blocks:

a) Customer segments
b) Value proposition
c) Channels
d) Customer relationship
e) Revenue streams
f) Key resources
g) Key activities
h) Key partnerships
i) Cost structure

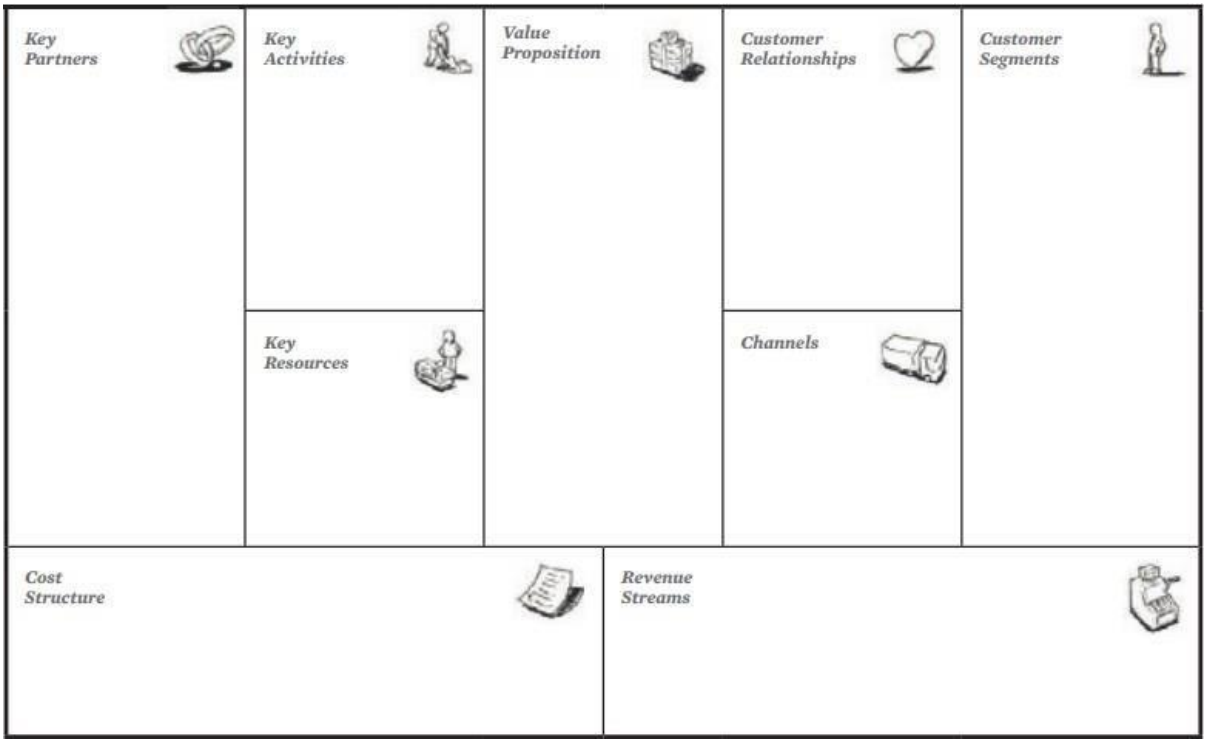


Figure 25. Business Model Canvas

Source: https://vace.uky.edu/sites/vace/files/downloads/9_business_model_generation.pdf

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

7.1 Business model canvas – focus points

Within NOVAFERT project 4 segments of BMC are covered:

5. customer segments,
6. value proposition,
7. channels and
8. customer relationship.

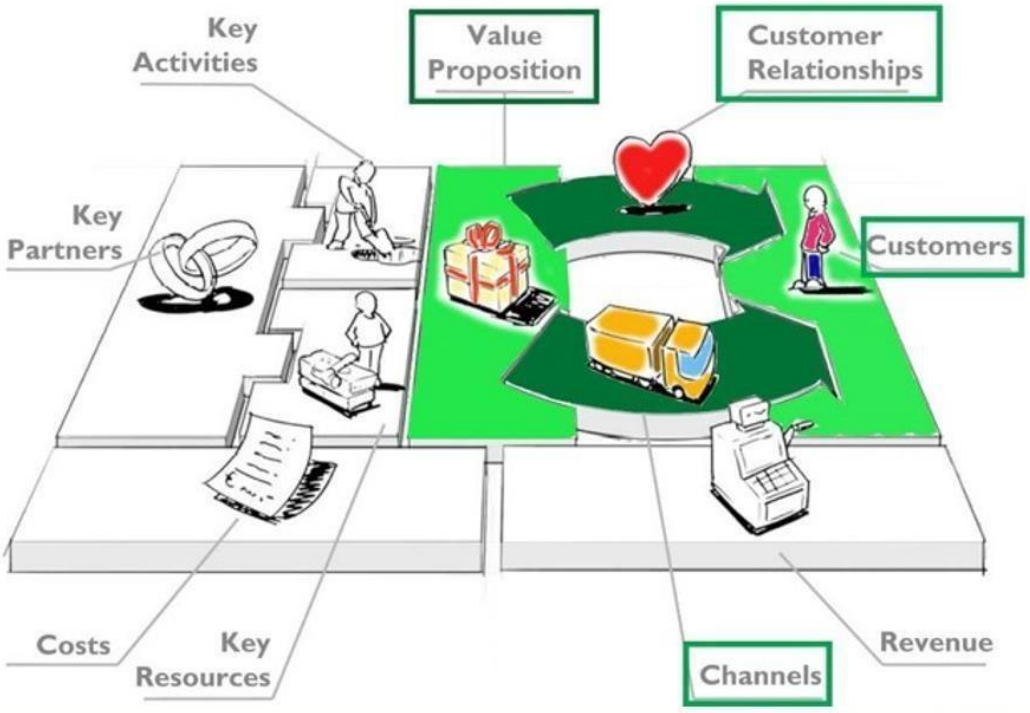


Figure 26. Four segments of the BMC covered in the NOVAFERT project

The **Customer Segments** (CS) outlines the various categories of individuals or entities that a business aims to reach and serve. To enhance customer satisfaction, a company might categorize its customers into specific segments based on shared needs, behaviors, or other characteristics. A business model could identify either a singular or multiple Customer Segment. An organization needs to deliberately choose the segments it wants to serve and which segments to ignore. After making this decision, a business model can be carefully designed around a strong understanding of specific customer needs (link). For example, fertilizer producers need to identify the specific groups within the agricultural sector or other industries that they aim to serve. This may include farmers, agricultural enterprises, or specific crop producers.

The **Value Propositions** (VP) describe the combination of products and services that generate value for a particular Customer Segment. VP is an important segment of the business because it solves customer doubts or satisfies their needs. Each Value Proposition comprises a carefully

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

chosen package of products and/or services designed to meet the needs of a specific group of customers. In this context, the Value Proposition is a compilation of advantages that a company provides to its customers, for example, enhanced crop yield, improved soil fertility, or specialized formulations for different types of crops. Certain Value Propositions may be groundbreaking, introducing a new or disruptive offering, while others might resemble existing market offers but come with additional features and attributes. A Value Proposition generates value for a specific Customer Segment by offering a unique combination of elements that address the needs of that particular segment. Values may be quantitative (e.g. price, speed of service) or qualitative (e.g. design, customer experience) (link).

The **Channels** (CH) outline the methods through which a company engages and connects with its Customer Segments to deliver a Value Proposition. Communication, distribution, and sales Channels constitute the interface through which a company interacts with its customers. These Channels serve as touchpoints in the customer experience, playing a crucial role in the overall interaction. Channels go through five specific stages (Table 7), and each channel may encompass either some or all of these phases. A distinction can be made between direct and indirect channels, as well as between owned channels and partner channels (link).

Table 9.Five phases of channels

<table>
<tr><td colspan="3">Channel Types</td><td colspan="5">Channel Phases</td></tr>
<tr><td rowspan="2">Own</td><td rowspan="3">Direct</td><td>Sales force</td><td rowspan="4">Awareness
How company raises awareness about our company's products and services?</td><td rowspan="4">Evaluation
How to help customers evaluate a company's Value Proposition?</td><td rowspan="4">Purchase
How company deliver a Value Proposition to customers?</td><td rowspan="4">Delivery
How company deliver a Value Proposition to customers?</td><td rowspan="4">After-sales
How company provide post-purchase customer support?</td></tr>
<tr><td>Web sales</td></tr>
<tr><td rowspan="2">Indirect</td><td>Own stores</td></tr>
<tr><td>Partner</td><td>Partner stores</td></tr>
<tr><td></td><td></td><td>Wholesaler</td></tr>
</table>

The **Customer Relationships** (CR) outlines the various types of connections and interactions a company forms with customers. Different categories of Customer Relationships can be identified, and these may simultaneously exist in a company's interactions with a specific Customer Segment, such as: Personal assistance, Dedicated personal assistance, Self-service, Automated services, etc (link).

Considering these components within the business model canvas framework enables businesses operating in the BBFs market to effectively identify and address the needs of their target customers, develop compelling value propositions, establish efficient distribution channels, and build lasting relationships with their customer base. This, in turn, can lead to sustainable growth and success in a rapidly evolving and competitive market landscape.

Based on extensive research on BBFs, current literature review, and our experience in working on this topic, we have drawn the most important conclusions for the creation of the BMC (Table 10).

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Table 10. Business model canvas conclusions

<table>
<tr>
<td rowspan="2">KEY PARTNERS</td>
<td>KEY ACTIVITIES</td>
<td rowspan="2">VALUE PROPOSITION

Integral Fertilization Programs (PFI) based on target soil and crop using tailor-made biostimulant
New generation of tailor-made high-quality, sustainable and safe biobased, biostimulant fertilisers
New generation of commercial, sustainable and safe fertilisers based on organic by-products
Lack of variability in the quality of BBFs
Could assure the adequacy of each BBFs for a specific geographical area
Provides farmers with sustainable and efficient nutrition solutions working together with end-users
Production of standardize and reliable TMF
Selling chemicals and other supplements to farmers for producing TMS on-farm
Solving inter and intra regional nutrient imbalaces
Constribution to food security, decrease in environmental imoacts
Revaluation of products and possible income
Sustainability of agricultural production and diversification of production
New source of income for the company/farm that produces and transform manure into BBFs</td>
<td>CUSTOMER RELATIONSHIP

Close collaboration with final customers: proximity to farmers is the key
Long-term and stable relationship with customers
Designing the best nutrition plan for each case, enhancing soil and crops depending on the geo-climatic zone where crops are located
Close collaboration with big distributors and many smaller final customers
Free initial application for client capture
Demonstrative tests in fields
Provided support during the optimization of the plant/application
The importance of having all the numbers and ‘answers’ in a simplified format</td>
<td rowspan="2">CUSTOMER SEGMENTS

Farmers

Horticulture

Gardening

Hobbyist gardeners</td>
</tr>
<tr>
<td>KEY RESOURCES</td>
<td>CHANNELS

National and international commercial network
Distributors and cooperatives
Website
End-users’ engagement plan
Farmers in the Consortium and direct targeting to current customers of the partners and new prospects
Development of business network with different stakeholder groups
Agricultural fairs
Fertiliser producer</td>
</tr>
<tr>
<td colspan="2">COST STRUCTURE</td>
<td colspan="3">REVENUE STREAMS</td>
</tr>
</table>

7.2 Communication strategies

The Costumer relationship model (CRM) can be described as a business strategy aimed at comprehending and influencing customer behaviour through relevant communications. The goal is to improve customer purchases, retention, loyalty, and overall profitability (link). The CRM involves marketing, customer service, and sales activities. These activities work together to manage and enhance customer relationships throughout their lifecycle.

CRM enables agricultural businesses to collect and assess customer information, including buying patterns, preferences, and feedback. This data empowers agribusinesses to develop a more profound insight into their customers' requirements and choices, facilitating the customization of products and services to meet those specific needs. Additionally, CRM systems offer agribusinesses diverse communication channels, incorporating email, phone, andintegration with social media. Through these channels, agribusinesses can interact with their customers promptly and in a personalized manner, promoting improved communication and the establishment of stronger relationships. Furthermore, this model promotes collaboration among various departments within an agribusiness, including sales, marketing, and customer service. Through the sharing of customer information and insights, teams can collaborate to deliver smooth and personalized customer service, addressing issues promptly and efficiently (link).

Communication strategies are part of the CRM model, and they can be divided for every segment of the Business Model Canvas. For example, one of the communication strategies in the customer segment is identifying target customers, such as environmentally conscious farmers, organic farms, or those looking for sustainable agriculture practices. Fertiliser companies are developing advertising campaigns, creating content that addresses the uniqueneeds of their fertilisers, and using personalized communication channels. One of the ways ofcommunication in Value Proposition is developing educational content on the benefits (improved soil health, reduced environmental impact, and enhanced crop yields) of alternativefertilisers through online platforms, seminars, and partnerships with agricultural influencers. Regarding the Channels, it is important to have online and offline channels for distribution. Inthis segment, it would be good to collaborate with agriculture magazines, trade shows, and social media platforms for a bigger reach. The business needs to have long-term relationshipsby providing a customer support system, regular newsletters, and webinars to keep customersinformed and engaged.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

7.3 Sales/distribution channels and logistics planning

To effectively manage sales and distribution for BBFs, a strategic approach is essential. First step would be comprehensive market research to gauge demand in specific regions, identifyingtarget customer segments such as organic farmers or environmentally conscious consumers. It is important to emphasize the benefits of alternative fertilisers, such as improved soil health and reduced environmental impact. Distribution channels needs to include direct sales, partnerships with agricultural supply stores, and online platforms.

The consideration should be collaborations with existing agricultural input suppliers or cooperatives to maximize reach. Product seminars should be provided to sales teams to effectively convey the advantages of alternative fertilisers, providing them with educational materials to address customer inquiries. The second step should be developing a targeted marketing strategy, highlighting the environmental benefits, improved crop yields, and overalleffectiveness of alternative fertilisers. Leverage a mix of online and offline channels, such as social media, agricultural trade shows, and educational workshops. One of the solutions for a better sale of fertiliser is informative packaging, compliant with regulations, and effectively communicates the value proposition. Display any certifications, such as organic or eco-friendly certifications. Furthermore, a reliable supply chain to meet the growing demand for BBFs, andmaintaining consistent product quality through collaboration with manufacturers is needed. Provide excellent customer support to address inquiries, offer product information, and assist with any issues. Create a feedback loop to gather insights from customers, enabling continuousimprovement of products and services. Ensure compliance with local and international regulations related to the production and distribution of BBFs, staying informed about changesin organic farming and sustainable agriculture regulations. Implement monitoring systems to assess sales performance, customer satisfaction, and market trends. Regularly evaluate the effectiveness of sales and distribution strategies, making adjustments as needed to stay alignedwith the evolving landscape of sustainable agriculture.

By reviewing the literature, we found the results of the survey regarding consumer fertiliser purchasing preferences. The highest number of respondents stated that they buy fertilisers from brick-and-mortar businesses (92.7 %), followed by respondents who buy fertilizers online(13.9 %), and a small number of respondents have fertilisers delivered to their homes (1.6 %). It is important to mention that respondents could select more than one answer. Among the brick-and-mortar transactions, 80.8% occurred at do-it-yourself (DIY) stores, 18.5% at plant nurseries, and 17.3% at supermarkets. Regarding the decision-making process, 71% of the survey participants stated that they made their decisions independently, while 28% received support from their partner, children, sales consultants, or other individuals (link).

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

8 Specific Customer Relationship

Successful companies understand that building and maintaining strong customer relationshipsis the key to long-term success. Customer Relationship Management (CRM) has emerged as apowerful tool for modern marketing strategies, helping businesses to effectively engage, understand and nurture customer base (link). The rapid pace of technological advancements provides companies with an increasing range of tools to better understand their clients' behavioural patterns and needs. It is the company's responsibility to use this information to tailor marketing offers to suit each customer segment (link).

The CRM is a tool which involves understanding customers, maintaining healthy relationships with them and managing the entire process to create loyal customers, ultimately increasing performance and profitability (link). It represents a practical guideline for introducing new bio- based products to the agricultural market. It is a strategic approach that helps agribusinesses effectively manage customer interactions and relationships (link).

By using CRM tools and techniques, agribusinesses can improve customer communication andcollaboration, leading to enhanced customer satisfaction and increased business success (link).

To meet the expectations of modern consumers, it is essential to provide a personalised customer experience that is able to meet individual needs. This requires a deep understanding of customers and the ability to deliver on their needs more effectively than competitors (link). In other words, by collecting data on what drives customers to consider BBFs, their motivation, or barriers, we can develop effective marketing strategies.

Raising farmers' awareness of the advantages of using BBFs will result in greater market acceptance of these products. However, to market such products effectively, it is necessary tochoose the most appropriate method. The CRM model can be used because it combines the specific needs, preferences and challenges of customers in the agricultural industry (link).

The customer relationship model encompasses marketing, customer service and sales activitiesthat work together to manage and enhance customer relationships throughout their lifecycle.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

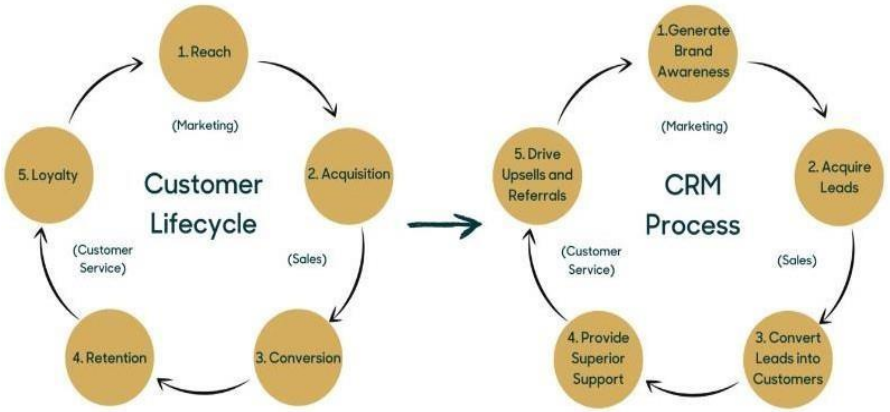


Figure 29. Customer lifecycle to CRM process

Source: https://www.zendesk.com/blog/crm-process/

Generating brand awareness involves - learning about the target audience's interests, preferredcommunication channels and what messages they respond the most, segmenting the target audience into groups with similar interests or demographics to determine which types of people are most likely to become customers and who the campaigns should target, creating marketing campaigns that effectively target specific demographics through social media and email, developing lead acquisition strategies to increase customer engagement. Acquiring leads means introducing the brand to a potential customer (encouraging them to find out more about the business, e.g. encouraging website visitors to share their email address to receive a newsletter or live chat on the website) (link).

Turning leads into customers means finding out how interested leads are and more importantly, whether they're interested enough to make a purchase. Support teams need to be able to provide superior support whenever, wherever, and however, their customers expect it. With CRM tools, support agents can easily access the historical customer information they need to resolve a ticket quickly. The right CRM can create a targeted, personalised experiencethat naturally drives leads through the pipeline (link).

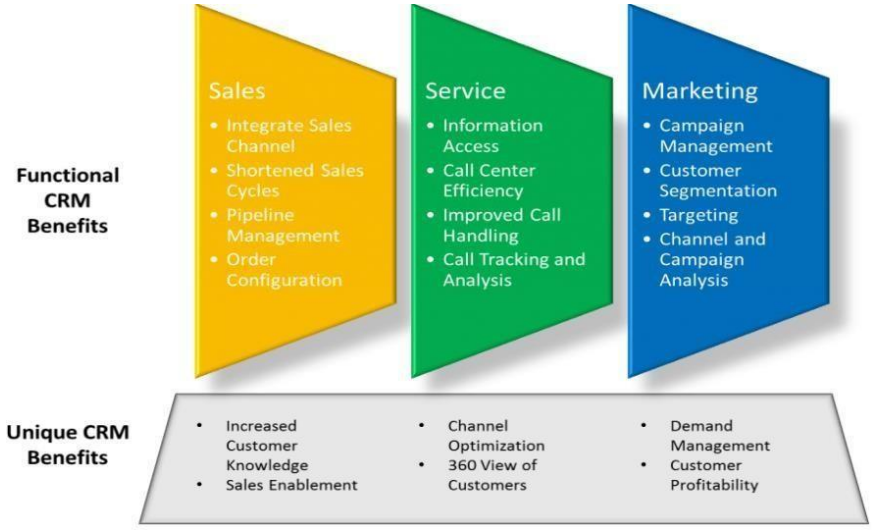


Figure 30. Benefits of Customer Relationship Model
Source: https://www.slideshare.net/gagan_k/customer-relationship-management-in-healthcare-industry-project

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

To introduce new alternative fertilisers to the market, it is helpful to utilise elements from the CRM model such as personalised service, education, support, responsive communication, feedback gathering, demonstration organisation, cooperation and environmental friendliness.

Firstly, it is important to understand who we are trying to reach and segment our customers based on different stakeholder groups and demographics. This should be followed by conducting surveys, focus groups or social media listenings to understand their motivations for using BBFs, challenges and preferred information sources.

Based on the research conducted, we can create personalised messages using terminology andkey points that resonate with each customer segment. In other words, we should highlight thespecific benefits of alternative fertilisers that are relevant to their needs. For example, sustainability for environmentally conscious farmers.

As shown above, it is important to consider personalised service when launching a new fertiliser and to take into account the diverse needs of all stakeholders in the agronomic industry, such as farmers, crop growers and fertiliser producers. This can be achieved through educational materials and workshops that disseminate knowledge and demonstrate good practices. Besides that, key messages should be delivered through various targeted channels such as social media platforms, newsletters and content marketing (informative articles, guides, and case studies).

Additionally, responsive communication with customers is crucial in providing accurate answers to inquiries and valuable information. A variety of contact channels, such as phone, email, chat support and social media, can be used to achieve this. Obtaining feedback from customers about their experience with new BBFs and fertilisers, in general, can be accomplished through surveys and feedback forms which is performed within the project. Organising demonstrations on farms to showcase the benefits of using new fertilisers could instil confidence in potential customers about the products.

In brief, providing customer support is important. Train your team on BBFs to ensure they canoffer knowledgeable support. Offer multiple channels and make it easy for customers to reachyou. This will ultimately contribute to building trust with customers.

Furthermore, collaborating with agricultural experts and research institutions could enhance the reputation of the new brand and establish it as a reliable source of information. This would provide potential customers with access to valuable knowledge and research results.

As BBFs are environmentally friendly, it is important to educate customers on sustainable agricultural practices and how these products contribute to those efforts. Provide ongoing post-purchase assistance, including problem-solving and periodic check-ins to ensure customer satisfaction and resolve any issues.

CRM can bring numerous benefits to agribusiness, including (link):

- **enhanced customer understanding**: it enables agribusinesses to collect and analyse customer data, including purchase history, preferences and feedback. This informationenhances understanding of customers' needs and preferences, enabling

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

them to customise their products and services accordingly.

- **improved communication channels**: CRM systems provide agribusinesses with various communication channels, such as email, phone, and social media integration. This allows them to interact with their customers in a personalised and timely manner.
- **efficient sales and marketing processes**: CRM tools simplify sales and marketing processes by automating tasks such as lead generation, customer interaction tracking,and sales channel management. This efficiency enables agribusinesses to deploy their resources effectively and focus on nurturing customer relationships.
- **collaborative customer service**: CRM enables collaboration among various departments in an agribusiness, including sales, marketing, and customer service. This way, teams can work together to provide seamless and personalised customer service, resolving issues promptly and effectively.
- **data-driven decision-making**: by examining customer data, agribusinesses can make informed decisions about product development, marketing strategies, and customer retention initiatives.

In conclusion, CRM is essential for enhancing communication and collaboration between agribusinesses and their customers. Agribusinesses can improve their understanding of customers, streamline sales and marketing processes, and provide collaborative customer service by using CRM tools and techniques (link).

CRM should be considered as a business technique or mission rather than just a concept or tool (link).

In today's competitive environment, it is crucial to understand both the customers and the market to sustain success. CRM can help identify the current needs and future expectations of customers. A reliable system assists in identifying and comprehending customers, ultimately promoting loyalty by providing appropriate products and services at the right time, through the right channel, and at the right cost. Achieving successful CRM in the bio-based fertiliser industry necessitates education, communication, responsiveness and a sincere commitment toenvironmental sustainability (link).

8.1 Customer relationship model for alternative fertiliser market

Designing a customer relationship model tailored for the fertiliser market includes:

1. Customer segmentation (identify and segment your customers based on their specificneeds, such as crop type, farming practices, and geographical location)
2. Customer Data Management (collect and manage customer data, like customer contactdetails, purchase history, preferred communication channels, and feedback)
3. Personalized Communication (personalize communication and marketing efforts, provide information on the benefits of BBFs for different crops and farming practices)
4. Educational Content (about the advantages of BBFs, including case studies, research findings, application guidelines, industry trends, sustainable farming practices, and

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

theenvironmental benefits of using BBFs)

5. Feedback Mechanism (through surveys, customer interviews, and social media to gather insights on customer satisfaction, product performance, and areas for improvement)
6. Customer Support and Training (offer training sessions, webinars, or resources to helpcustomers optimize the use of BBFs and achieve the best results)
7. Supply Chain Transparency (highlight certifications, quality standards, and sustainabilitypractices to reinforce the reliability of BBFs)
8. Collaboration and Partnerships (collaborate with agricultural experts, universities, and research institutions to stay at the forefront of industry advancements, foster partnerships with distributors, retailers, and influencers to extend the reach of bio-based fertilisers)
9. Continuous Improvement (regularly evaluate and update your CRM strategy based on markettrends, customer feedback, and the evolving needs of the agricultural industry, embrace innovation and new technologies to enhance the customer experience).

8.2 Building long-term relationship with customer

In the ever-evolving landscape of agriculture, the cultivation of long-term relationships with customers becomes paramount, particularly when dealing with users of BBFs and the technologies that drive their production. Unlike traditional customer relationships, the nature of these connections extends beyond - it encompasses a shared commitment to sustainable farming practices, environmental stewardship and the ongoing success of agricultural endeavours.

In the pursuit of building enduring ties with customers, the focus extends beyond the immediate sale of BBFs. Instead, the emphasis lies in understanding the unique needs, challenges and aspirations of the users within the agricultural community. By aligning product offerings with these specific requirements, businesses can foster trust and demonstrate a genuine commitment to the prosperity of their customers.

Building long - term relationships with customers in the BBFs and technologies sector requires a thoughtful and strategic approach. Most important is to understand customer needs. Regularly engagement with customers is important to gather feedback on product performance and to be responsive to their evolving requirements.
From previously gathered inputs and information, one of the beneficial ways to build long-term relationships refers to comprehensive training programs or workshops to educate users on the proper application and benefits of BBFs. It is important to establish a responsive customer support system to address queries, troubleshoot issues and provide ongoing assistance.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

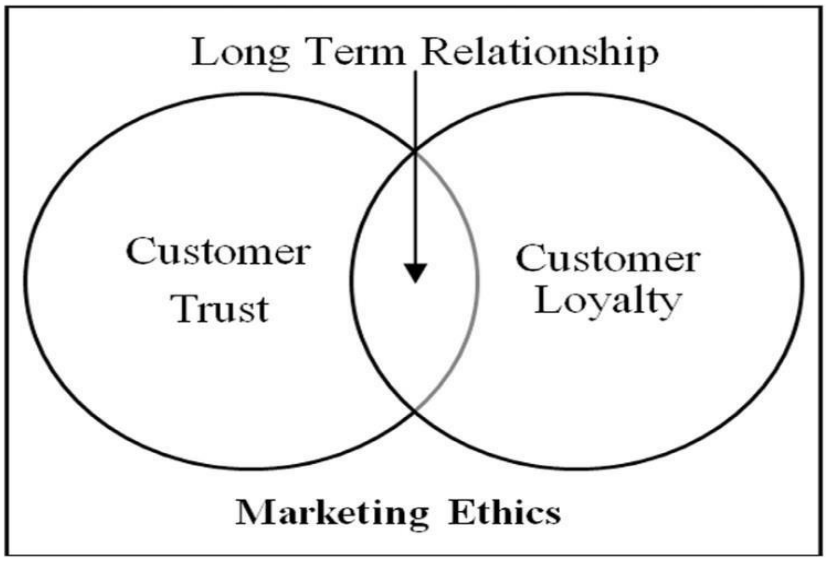


Figure 31. Marketing Ethics: Enhancing Customer Trust and Loyalty and Building Long-Term Relationship
Source: https://www.researchgate.net/figure/Marketing-Ethics-Enhancing-Customer-Trust-and-Loyalty-and-Building-Long-Term-Relationship_fig1_347936526

Furthermore, it is crucial to tailor offerings to meet the specific needs of different customers orsegments within the agricultural community. Provide flexible solutions that can adapt to various farming practices and scales. To build long-term relationship it is important to keep customers informed about product updates, new technologies, and industry trends through newsletters, webinars, or other communication channels. Actively seek feedback and demonstrate a commitment to continuous improvement based on customer input. Engagement in community initiatives, support local farming organizations, and showcasing commitment to social responsibility should be also included.

Building long-term relationships in the BBFs and technologies sector requires a combination of product excellence, customer-centricity, and a commitment to shared values. By consistentlydelivering value and fostering a sense of partnership, businesses can create enduring connections that go beyond mere transactions.

8.3 Customer retention strategies

Customer retention strategies are a set of practices and techniques that businesses employ toretain their existing customers and foster long-term relationships. Keeping customers satisfiedand engaged is often more cost-effective than acquiring new customers, making retention strategies crucial for sustainable business growth.

Here are some tips and tricks for customer managing relationships in the BBFs sector:

Educational content	Educational materials, blog posts, webinars, and infographics that explain the science behind using BBFs and their environmental benefits.
Partnerships and collaborations	Collaborate with agricultural experts, universities, or research institutions. These partnerships can enhance the credibility of BBFs and provide access to new markets.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Networking and events	Attending industry events, trade shows, or agricultural conferences offers networking opportunities and a chance to showcase BBFs.
Customer education and training	Workshops or training sessions on the use of BBFs.
Demonstrate results	Share success stories or case studies that demonstrate how the use of BBFs has positively impacted other farmers' yields or sustainability goals.
Adapt to market trends	Stay up-to-date with market trends and regulations related to sustainable agriculture.
Personalized approach	Adjusting of communication and offers accordingly.
Feedback loops	Establish a feedback system (surveys, follow-up calls, or online forms).
Customer support	A responsive support team that can respond quickly to questions, concerns or issues.
Long-term relationships	Consider offering incentives for repeat purchases to foster ongoing partnerships.
Regular communication	Share updates on new product developments, industry news or tips on how to maximise the benefits of BBFs.
Transparency	Ensure transparency regarding the ingredients, production process, and environmental impact of BBFs.

High-quality content and storytelling are two crucial aspects of modern marketing strategies.They serve to engage consumers, forge a deeper emotional connection, and build trademarkloyalty. Some key points about embracing high-quality content:

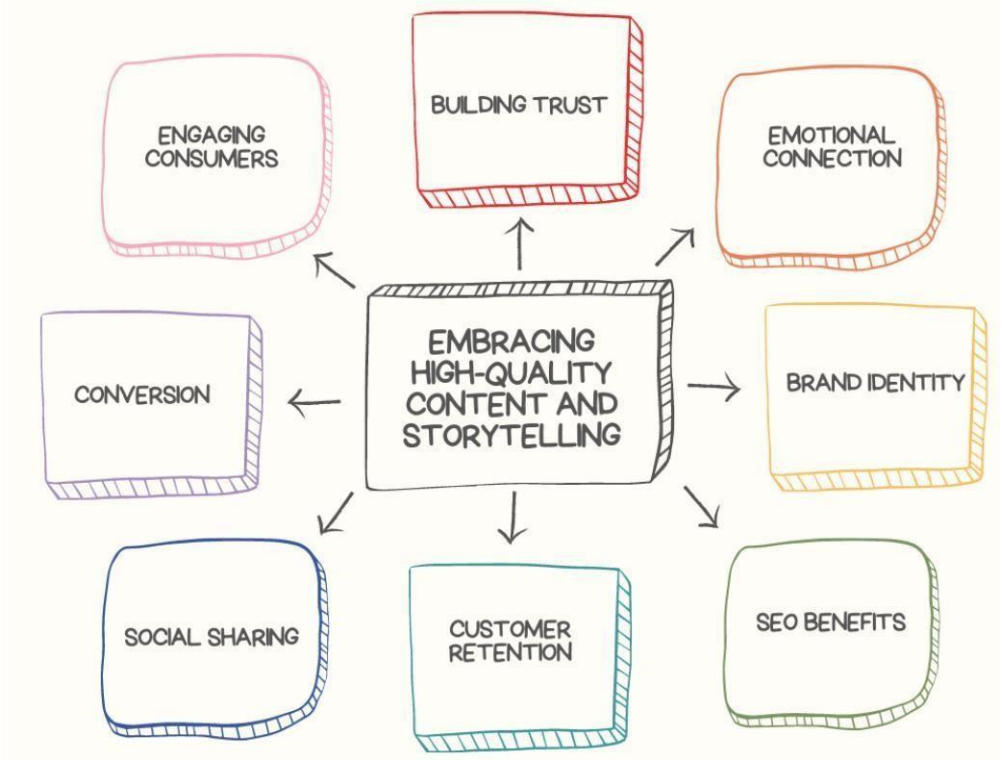


Figure 32. Key points about embracing high-quality content

Source: https://www.simplimba.com/which-strategy-best-helps-a-famous-brand/

The principles of engaging consumers, building trust, forging emotional bonds, shaping brandidentity, and utilizing SEO benefits can be applicable to farmers and users of BBFs.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

However, it's essential to tailor these strategies to the specific needs, preferences, and challenges faced by the agricultural community.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

It is important to focus on:

Engaging farmers	Provide informative and educational content about the benefits of using BBFs. This could include blog posts, videos and social media content showcasing successful experiences and results from other farmers.
Building trust in BBFs	Create content that highlights the science and research behind BBFs, demonstrating their effectiveness and reliability.
Emotional connection in agriculture	Share stories of farmers who have transitioned to BBFs, emphasizing the positive impact on their crops, soil health and sustainability efforts.
Brand identity in agriculture	Establish a brand identity for BBFs by communicating values such as environmental sustainability, organic farming and the long-term benefits for both farmers and the land. Consistently reinforce this identity through various content channels.
SEO benefits for agricultural practices	Develop content that addresses common questions and challenges faced by farmers regarding BBFs. This content, when optimized for search engines, can enhance visibility among farmers seeking sustainable and effective agricultural solutions.
Customer retention in agriculture	Provide ongoing support and information to farmers who choose alternative fertilisers, ensuring they understand best practices and stay informed about innovations in sustainable agriculture.
Social sharing in agriculture	Encourage farmers to share their success stories with alternative fertilisers on social media platforms. This not only amplifies brand exposure but also creates a community where farmers can learn from each other's experiences.
Conversion in agriculture	While the primary goal is not always immediate sales, content should emphasize the long-term benefits and ROI of using this type of fertilisers. Educational materials can help farmers make informed decisions that lead to successful conversions.

Adapting these strategies to the agricultural context can help promote the adoption of BBFs, foster a community of environmentally conscious farmers, and contribute to sustainable agricultural practices.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

9 Conclusion

In conclusion, this deliverable offers a thorough and insightful analysis of the fertilizers market within the European Union, with a special emphasis on Bio-Based Fertilizers (BBFs). Byexploring the global context and then delving into the specifics of the EU market, the report sheds light on the critical role of BBFs in promoting sustainable agriculture and meeting the environmental and agricultural challenges of our time. The detailed examination of current trends, challenges, and the regulatory environment provides a clear understanding of the market dynamics and the implications of policy on the industry.

The analysis of alternative fertilisers, market demands, and the pros and cons associated with their use offers a balanced perspective on the opportunities and obstacles in incorporating these products into agricultural practices. The identification of key industry players and the competitive landscape analysis reveal the strategies and market positions that are shaping the industry's future. Moreover, the customer segmentation and approach strategies highlight the diverse needs and preferences of the market, guiding more effective marketing and product development.

Business model canvas tailored to the fertilisers industry underscores the importance of customer-centric strategies and long-term relationships in achieving business success. Ultimately, the report underscores the vital role of alternative fertilisers, especially BBFs, in achieving environmental sustainability and enhancing agricultural productivity. It provides a comprehensive roadmap for stakeholders, policymakers, and businesses to navigate the complexities of the fertilisers market and seize the emerging opportunities for growth and innovation.

This deliverable not only enriches our understanding of the current market landscape but also offers strategic insights for future developments, positioning industry players for successin a rapidly evolving sector.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

References

K. Pulidindi, A. Prakash. Fertilizer Market - By Form (Dry, Liquid) By Product (Organic, Inorganic), By Application (Agriculture, Horticulture, Gardening), Forecast 2024 – 2032: Fertilizer Market Size & Share | Growth Forecast Report – 2032 (gminsights.com)

M. Zahir Aziz, M. Naveed, T. Abbas, S. Siddique, M. Yaseen.(2019). Alternative Fertilizers and Sustainable Agriculture: Alternative Fertilizers and Sustainable Agriculture | SpringerLink
S. Assefa, S. Tadesse. (2019). The Principal Role of Organic Fertilizer on Soil Properties and Agricultural Productivity -A Review: The Principal Role of Organic Fertilizer on Soil Properties and Agricultural Productivity -A Review (juniperpublishers.com)

Europe Fertilizer Market, Size, Forecast 2024-2030, Industry Trends, Share, Growth, Insight, Impact of Inflation, Volume, Type, Application, Countries, Companies Analysis: Europe Fertilizer Market, Size, Forecast 2024-2030, Industry Trends, Share, Growth, Insight, Impact of Inflation, Volume, Type, Application, Countries, Companies Analysis (researchandmarkets.com)

Fertiliser prices. Directorate-General for Agriculture and Rural Development: https://agridata.ec.europa.eu/extensions/DashboardFertiliser/FertiliserPrices.html
Article. 2023. Consumption of fertilisers in the EU down 2% in 2021.:https://ec.europa.eu/eurostat/en/web/products-eurostat-news/w/ddn-20230630-1
Article. European Council. Council of the European Union: From farm to fork - Consilium(europa.eu)
Eurostat. 2023. Key figures on the European food chain: Key figures on the European foodchain– 2023 edition (europa.eu)

Fertilizers Europe. 2023. Fertilizers Industry. Fact & Figures 2023: Industry-Facts-and-figures-2023.pdf (fertilizerseurope.com)

Ensuring availability and affordability of fertilisers. Addressing the need for available and affordable fertilisers: https://agriculture.ec.europa.eu/common-agricultural-policy/agri-food-supply-chain/ensuring-availability-and-affordability-fertilisers_en

Agriculture and rural development. Commission calls for applications to join the upcoming EU Fertilisers Market Observatory. 2023: Commission calls for applications to join the upcoming EU Fertilisers Market Observatory - European Commission (europa.eu)

Fertilisers Europe. Roadmap for the European Fertilizer Industry. 2023: Ammonia-Roadmap-Fertilizer-Europe-FINAL-Sept-22-2023.pdf (fertilizerseurope.com)
Fertilisers Europe. Why do we need a strong European fertilizer industry? 2021.: EU industryunder threat of shutting down - Act now - Fertilizers Europe
European Commission. Agriculture and rural development. Price dashboard. 2023.: https://agriculture.ec.europa.eu/data-and-analysis/markets/price-data/price-dashboard_en

Consolidated text: Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC): EUR-

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Lex- 01991L0676-20081211 - EN - EUR-Lex (europa.eu)

Marieke Verbeke. Cover Delivery Report. 2021: https://systemicproject.eu/wp-content/uploads/D3.4-Market-research-in-Europe_update2021-1.pdf
Antoine Oger. The fertiliser transition Addressing social and environmental spillovers in the fertiliser sector. 2022: https://ieep.eu/wp-content/uploads/2022/11/The-fertiliser-transition_IEEP-2022.pdf

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. 2014: https://eur- lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060

Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31991L0271

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe: https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32008L0050

Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC (Text with EEA relevance): Directive- 2016/2284 - EN - EUR-Lex (europa.eu)

Regulation (EU) 2023/857 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductionsby Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement, and Regulation (EU) 2018/1999 (Text with EEA relevance): Regulation - 2023/857 - EN - EUR-Lex (europa.eu)

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF

THE REGIONS A new Circular Economy Action Plan For a cleaner and more competitive Europe: EUR-Lex - 52020DC0098 - EN - EUR-Lex (europa.eu)

Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 establishing a carbon border adjustment mechanism (Text with EEA relevance): Regulation - 2023/956 - EN - cbam regulation - EUR-Lex (europa.eu)

Consolidated text: Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation): EUR-Lex - 02009R1069-20140101 - EN - EUR-Lex (europa.eu)

Nutriman. Thematic training material for the use of mineral concentrate as fertilizer has been published. 2021: https://nutriman.net/news/thematic-training-material-use-mineral-concentrate-fertilizer-has-been-published

RENURE material. Mineral Concentrate from processed manure or digestate: Systemic-Mineral- Concentrate-V04.pdf (systemicproject.eu)
Phosphates Fertilizer Market and Price Analysis:

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

https://www.spglobal.com/commodityinsights/en/ci/products/fertilizers-phosphates.html
Phosphate Fertilizer Market Size, Share & Trends Analysis Report By Product(Monoammonium Phosphate, Diammonium Phosphate), By Application, By Region, AndSegment Forecasts, 2022– 2040: https://www.grandviewresearch.com/industry-analysis/phosphate-fertilizers-market

Monoammonium Phosphate(MAP) Fertilizer Market Research Report Unlocks Analysis onthe Market Financial Status, Market Size, and Market Revenue upto 20:https://www.linkedin.com/pulse/monoammonium-phosphatemap-fertilizer-market- research- gqzbe/

Potassium Thiosulfate Fertilizer Market Size and Forecasts (2021 - 2031), Global and Regional Share, Trends,and GrowthOpportunity Analysis: https://www.theinsightpartners.com/reports/potassium-thiosulfate-fertilizer-market

Potash Market Size, Share & Trends Analysis Report By Product (Potassium Chloride, Potassium Sulphate, Potassium Nitrate), By End-use (Agricultural, Non-Agricultural), By Region, And Segment Forecasts, 2023 – 2032: https://www.grandviewresearch.com/industry-analysis/potash-market-report

Ammonium Sulfate. 2022: Ammonium Sulfate - Chemical Economics Handbook (CEH) | S&P Global (spglobal.com)
Ammonium Sulfate Market Size, Share & Trends Analysis Report By Product (Solid, Liquid), By Application (Fertilizer, Pharmaceutical, Food & Feed Additive), By Region, And Segment Forecasts, 2024 – 2030: https://www.grandviewresearch.com/industry-analysis/ammonium-sulfate-market

Struvite's potential as an alternative phos phorus source for organic agriculture: https://relacs-project.eu/wp-content/uploads/2021/05/RELACS_PA_07_struvite_FiBL_final.pdf

Assessment of Struvite as an Alternative Sources of Fertilizer-Phosphorus for Flood-Irrigated Rice. Kristofor R. Brye. 2022: Sustainability | Free Full-Text | Assessment of Struvite as an Alternative Sources of Fertilizer-Phosphorus for Flood-Irrigated Rice (mdpi.com)

A systematic comparison of commercially produced struvite: Quantities, qualities and soil-maize phosphorus availability. Maarten Muys, Rishav Phukan, Günter Brader, Abdul Samad, Michele Moretti, Barbara Haiden, Sylvain Pluchon, Kees Roest, Siegfried E. Vlaeminck, Marc Spiller.2021: A systematic comparison of commercially produced struvite: Quantities, qualities and soil-maize phosphorus availability - ScienceDirect

Fertilisers in the EU. Prices, trade and use. EU Agricultural Markets Briefs. 2019: market-brief- fertilisers_june2019_en_0.pdf (europa.eu)
Yara Fertilizer Industry Handbook. 2018: Fertilizer Industry Handbook 2018 (yara.com)

Industry facts and figures – 2019. Fertilisers Europe. 2019: Industry-Facts-and-Figures-2019-Digital-version.pdf (fertilizerseurope.com)
Forecast of food, farming and fertiliser use in the European Union. Fertilisers Europe. 2019:Forecast-of-food-farming-and-fertilizer-use-in-the-European-Union.pdf (fertilizerseurope.com)

New approach to customer segmentation based on changes in customer value.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

M.Hosseini, M. Shabani. 2015: https://link.springer.com/article/10.1057/jma.2015.10
Article. Customer Segmentation: https://www.optimove.com/resources/learning-center/customer-segmentation

Using customer segmentation to optimize your marketing strategy. J.Mehta. 2023: Usingcustomer segmentation to optimize your marketing strategy (abmatic.ai)
Article. Tailoring Marketing Strategies with Customer: https://fastercapital.com/startup-topic/Tailoring-Marketing-Strategies-with-Customer.html
Article. Go-to-Market Strategy for Fertilizers and Chemicals: https://www.haveignition.com/industry-guides/go-to-market-strategy-for-fertilizers-and- chemicals

Farmers' reasons to accept bio-based fertilizers: A choice experiment in seven different European countries: Juan Tur-Cardona, Ole Bonnichsen, Stijn Speelman, Ann Verspecht, Louise Carpentier, Lies Debruyne, Fleur Marchand, Brian H. Jacobsen, Jeroen Buy. 2018: https://www.sciencedirect.com/science/article/abs/pii/S0959652618318225

Transition to Circular Economy in the Fertilizer Sector—Analysis of Recommended Directionsand End-Users' Perception of Waste-Based Products in Poland. M. Smol. 2021: https://www.mdpi.com/1996-1073/14/14/4312

Assessment of willingness-to-pay for bio-based fertilisers among farmers and agricultural advisors in the EU. Egor Moshkin, Sergio Garmendia Lemus, Lies Bamelis, Jeroen Buysse. 2023: https://www.sciencedirect.com/science/article/pii/S0959652623017067

Visualizing Business Model Evolution with the Business Model Canvas: Concept and Tool. Boris Fritscher, Yves Pigneur. 2014: Visualizing Business Model Evolution with the Business Model Canvas: Concept and Tool | IEEE Conference Publication | IEEE Xplore

Business model generation. Alexander Osterwalder & Yves Pigneur: https://vace.uky.edu/sites/vace/files/downloads/9_business_model_generation.pdf
Customer relationship management in the agricultural machinery market. Amanda Letícia PitNunes, Otavio Jorge Grigoli Abi-Saab, Ricardo Ralisch.2017: scielo.br/j/cr/a/wh563hhXNpC9cqLKtL9ZZNf/?lang=en&format=pdf

Article. How can CRM help agribusinesses improve their communication and collaboration with customers?. 2023: How can CRM help agribusinesses improve their communication and collaboration with customers? – Agriculture.Gov.Capital

Marketing Green Fertilizers: Insights into Consumer Preferences. Johannes Dahlin. 2016: Sustainability | Free Full-Text | Marketing Green Fertilizers: Insights into Consumer Preferences (mdpi.com)
The Importance of Customer Relationship Management (CRM) in Marketing. S. Liberatore. 2023: The Importance of Customer Relationship Management (CRM) in Marketing | by Susie Liberatore | Medium

Importance of CRM in Agriculture Loan by Regional Rural Banks: A Study Based on Rural Banks in Indi. Masud Ahmed. 2018: IJCRT1892234.pdf

Article. What is the CRM process? 5 key steps. 2023: https://www.zendesk.com/blog/crm-process/

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.