The Role of GCC Fertilizers in Addressing Food Security
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Section 1:
Food Security
1.1 Global Food Security

1.1.1 Definition

Food security can be described as the sufficient availability, access and use of food or nutrients which ensures survival and growth of the human population. The World Health Organisation defines food security to exist “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”. With a fast growing global population, food production has to also intensify substantially\(^{(1)}\) from less available land due to urban expansion and land degradation, in order to meet future food needs. This makes food security arguably one of the greatest challenges the world is facing and directs to the importance of optimising available land productivity through the efficient utilisation of fertilizers.

The nutrients extracted from the soil through crop growth, which ultimately ensure the survival of the human population, need to be replenished in order to provide sustainable crop production. The application of fertilizers used to stimulate plant growth has been the preoccupation of farmers for many years. In the 19th century the modern science of soil fertility began with European scientists experimenting on the effects of various manures on plant growth. In early 1800’s, the first mineral fertilizers were used in Europe in the form of bones rich in phosphate, which further lead to the development of the phosphate fertilizer industry. The main technological breakthrough with regards to the fertilizer industry came however in the early 20th century when the Haber process was invented which to date still forms the basis for the production of ammonia from nitrogen and hydrogen (usually derived from methane). The size of the industry has since come a long way. According to Fertilizers Europe, presently 48 percent of the global population is fed thanks to the use of mineral fertilizers, which makes the fertilizer industry paramount in the sustainable development of human population.

The mineral fertilizer industry is therefore one of the most important contributors to the survival of the human population through facilitating production of more and better food, economic wealth, human health and socio-political stability.

1.1.2 Fertilizer Value Chain

In general, macronutrients provide the bulk energy for an organism’s metabolic system to function, whereas micronutrients provide the necessary cofactors. The growth of plants and crops which are ultimately consumed by humans and animals depend primarily on three main macronutrients, namely nitrogen (N), phosphate (P2O5) and potassium (K). Micronutrients required for healthy crops include calcium (Ca), Magnesium (Mg) and sulphur (S) as well as other minor, albeit important to a healthy nutrition, compounds. The nutrients consumed by plants can be replenished through the application of fertilizers to the soil.

Nitrogen forms around 80 percent of the atmosphere and this is used to make ammonia (NH3), the starting point for virtually all nitrogenous fertilizer production. The hydrogen (H) component of ammonia is sourced from hydrocarbon natural resources, most commonly methane (CH4) which is the main component of natural gas. Phosphate and potassium are sourced by extraction from mineral ores.

Although individual crops require different nutrient ratios, nitrogen is generally applied in larger quantities compared to phosphate and potassium.

\[^{(1)}\] According to FAO, global food production must rise by 70 percent over the next decades and must double in developing countries to meet demand.

Figure 1  Relative Nutrient Application of Different Crops, 2012

Source: Nexant’s Strategic Business Analysis Program (SBA)
The feedstocks and production routes for the various fertilizers are shown below where N-P-K refers to compound fertilizers with macronutrient fertilizers mixed intentionally. Such fertilizers are named according to the content of each of the three main macronutrients. For example, if nitrogen is the main element, the fertilizer is often described as a nitrogen or nitrogenous fertilizer.
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1.1.3 Food Security Drivers and Challenges

As the global population grows, so does the requirement for fertilizers in order to provide sustainable sources of food. A growing population not only requires larger quantities of food but also more urbanized areas which result in a trade-off between the availability of agricultural and urban land, which ultimately leads to the necessity of increasing crop yields from existing arable fields. It is well understood that the availability and correct application of fertilizers and other modern agricultural technologies and practices such as high yield crops, proper irrigation and machinery can increase crop yields per unit of land substantially and can contribute towards increased food security.

The global population has increased from 5.2 billion in 1990 to an estimated 7.1 billion in 2014 (ca. 1.2 percent per year on average). Most of this growth has come from Asia and the regional growth distribution of the global population is not expected to change in the long term. The global population is projected to reach a total of 9 billion by 2050 (around 0.7 percent per year on average), which is over six times the global population recorded in the early 20th century.

Naturally, this strong increase in population has brought along some challenges with regards to food production and security. Since most of the population growth stems from lower income countries where the consumption of food exhausts (and often exceeds) the majority of a household’s budget, malnutrition has also become a critical issue in some parts of the world where there is currently inefficient food production to sustain a healthy diet (e.g. in parts of Africa).

Although population growth is the main driver for an increased requirement for food and hence fertilizer production, economic growth is also a contributing factor. Increasing global wealth leads to a growing desire for a more varied diet. For example, the production of one kilogram of meat requires a multiple of the volume of fertilizers compared to the production of one kilogram of vegetables. Hence it is not surprising that often lower income countries consume less meat on a per capita basis compared to wealthier nations. In addition, there is an on-going debate in the agricultural industry which argues that certain countries, especially in South East Asia, should diversify their crop production away from a predominantly rice based industry. This would lower the requirements of local governments to import expensive food as they could be produced locally and at the same time lower the risk of one main dominating crop depending on sufficient precipitation. In economically developed nations, dietary trends change as a result of varying health, fitness and lifestyle trends.

A key issue regarding the agricultural industry is sufficient irrigation of crops. Water is essential for crop growth and the fertilizer industry as it transports the nutrients provided inter alia through the application of fertilizers to the plants. There are a number of reasons for increasing shortages of fresh water available for the agricultural industry, which include a growing
population and increasing wealth, pollution of fresh water sources, desertification etc. According to a 2012 UN Water Development Report, agriculture accounts for at least 70 percent of the global freshwater use. Hence a sustainable and efficient use of freshwater is mandatory to ensure a long lasting solution to the global freshwater supply. Without proper water management in the agricultural sector large quantities of freshwater could be wasted. This is likely to have a negative impact on food security in the long run. Although many countries are affected by desertification, poorer countries are often exposed to greater risks resulting from droughts. Naturally, poorer countries have limited financial means to source food and water from other sources in times of droughts and those countries usually also lack the appropriate water infrastructure such as large reservoirs and irrigation systems to prevent and reduce the risk of decreased crop production. Hence during times of low precipitation such as that occurred in the Horn of Africa in 2011 and in the Sahel Belt in 2012, poorer countries have suffered from humanitarian crisis leaving millions (particularly children) malnourished.

In many parts of the world farmers cultivate their land not for commercial purposes but purely for providing food to their families. These types of farms are usually small and provide poor economics of scale. In these cases large and efficient farming equipment is often not a sensible solution to improve crop yields. In addition, for farms located in very mountainous terrain, farming equipment is often impractical only allowing for fertilizer application by hand. Improving crop yields and food security from these farms is generally more difficult than for large, accessible farms. Furthermore, the size of farms in many countries gets progressively smaller due to the division of land through inheritance. Hence, the chances for these farmers to benefit from economics of scale decreases with time.

Another obstacle for small farmers to increase their productivity through investments in more acreage, fertilizers and farming equipment is a lack of access to the required capital. Especially farmers which cultivate their land with the sole purpose of feeding their families with their farming products have hardly any access to the modern financial systems. Smaller commercial farms often don’t generate enough capital to acquire, maintain and operate large modern farming equipment which would provide a more efficient way of applying fertilizers and general farming practices; especially in lower income countries where agricultural labour is cheap.

Food security concerns not only the physical availability of food but also food prices. Food prices are linked to the cost of production, including fertilizer cost, and the balance between supply and demand. A hunger crisis in developing nations, as a result of high food prices, is a breeding ground for crime and social-political instability. Lower food prices would help households to diversify their nutrition which can ultimately also lead to an enhanced food security and contribute towards increased physical and intellectual capacity of the population and a more efficient workforce. A larger portion of a household’s budget available to spend on other (non-food related) products would also help to stimulate the economic development of countries. Lower food prices would hence not only provide a contribution to preventing starvation but possibly also to lower crime and stimulate economic development.
Some of the food security related issues that the global population will continue facing in the future are extremely challenging. Climate change which could lead to droughts in various regions of the globe is such an issue which has a direct effect on food production and security. Although it is impossible for humans to directly influence precipitation some measures could be put in place in order to help irrigation of crops during longer dry periods such as fresh water reservoirs and sea water desalination units as well as the relevant piping and irrigation systems. However, this infrastructure is costly and the required financial resources are often not accessible to lower income nations.

There are various other possible remedies which could contribute towards an improving global food security in the future. Arguably the most important measure is the provision of the right nutrient combination to the soil in sufficient quantity to ensure continued increases in crop production. There are two aspects to this point. First and foremost is the physical provision of sufficient quantities of fertilizers to the global agricultural industry followed by the optimal application of N, P and K to the each particular soil and crop. In many lower income nations farmers tend to apply fertilizers to their fields not based on in-depth soil and crop analysis but rather use a particular fertilizer due to tradition. Different plants require different ratios of N, P and K and hence the soil in question will need replenishing of these specific nutrients. In most developed nations soil analysis is already common practice. Applying these methods could provide an easy and cost effective solution for many countries to increase crop yields. The key issue here is the lack of the farmer education in the agricultural industries of many countries. Hence providing training to local farmers, especially in lower income nations is an important aspect of increasing global agricultural productivity.

Other measures that could be put in place through education of local farmers include improved fertilizer application methods such as IFDC’s Fertilizer Deep Placement (FDP). When applying fertilizers normally (especially urea) a lot of it is lost to the atmosphere. With FDP, fertilizer granules are converted into larger briquettes and placed below the surface in order to reduce fertilizer usage which results in lower costs to the farmers, increased crop yields and a lower possibility of ground water contamination and water ways due to runoff/floodwater escaping a field’s containment barriers. Genetically modified crops (GM crops) are another potential help in contributing towards global food
security. GM crops are plants of which the DNA has been modified to enhance certain attributes of the plants such as resistance to certain pests and diseases, environmental conditions and improved nutrition. Although GM crops arguably could help to improve global food security, they are not socially accepted in some parts of the world. While the Americas as well as parts of Asia make use of GM crops there is currently a large debate within the European Union weather or not to accept the use of them with most of the countries backing a ban of the use of GM crops. However, the negotiations between the US and the EU for a free trade agreement could have an impact on the use of GM crops in Europe as such an agreement could lead to mutual recognition of standards which for the use of GM crops are less stringent in the US compared to the EU. Key areas of controversy related to genetically modified food are whether GM food should be labelled, the role of government regulators, the effect of GM crops on health and the environment, the effect on pesticide resistance, the impact of GM crops for farmers, and the role of GM crops in feeding the world population. Although the largest resistance to GM crops comes from the EU, some rural farmers in developing nations also need to be convinced of the non-toxicity of new seeds and fertilizers. However, resistance in the key geographic growth areas for food production is less than in the economically developed European Union. Despite GM food currently facing resistance for various social, political and environmental reasons it can be expected that GM crops will play an increasing role in helping towards improving food security on a global scale in the future.

Another measure to improve food security and indeed help develop larger scale crop production in lower income and more remote areas of the world is the development of improved cold food storage infrastructure to allow for long-distance transportation of food and improve the shelf life of the products. This is particularly important for regions with an increased risk of droughts and large populations compared to crop production. Cold storage infrastructure will allow farmers to increase production and sales during harvest season and could help towards preventing food shortages.

Providing modern financing schemes and subsidies to help fund the use of fertilizers and modern farming equipment is an additional important step to help increasing crop yields, economies of scale and self-sustainability for small farms in low income countries. For instance, the Indian government has traditionally provided fertilizers to Indian farmers at subsidised prices in order to ensure local food production, jobs and to avoid unpopular decisions regarding a large group of voters. Fertilizer subsidies are beneficial to a large part of the population in India (ca. two thirds) which directly or indirectly depend on the domestic agricultural sector. The Indian government has only recently ruled out cutting any fertilizer subsidies by increasing urea prices in order to provide some release to a strained government budget.

All of the above mentioned aspects could contribute to a long term sustainable solution to ensure food/nutritional security. However, arguably the most important aspect of the solution to the food security challenge to feed the projected future population is the fertilizer industry’s ability to provide fertilizers in sufficient quantities to replenish the nutrients consumed through plant growth. The provision of fertilizers does not only ensure sufficient quantities of food for the global population but it can also help in reducing the price of food. The application of fertilizers on the soil ensures higher yields per hectare of farm land. In other words, even though the physical properties of the farms don’t change, the production of food increases with the use of fertilizers. However, the production costs of the farmers do change as the fertilizers have to be purchased, applied to the soil and sufficient irrigation needs to be ensured in order for the fertilizers to be effective. The cost of production and consequently the price of food is hence directly linked to the development of fertilizer prices. During times of high fertilizer prices, the general cost of food increases globally as well and vice versa. As discussed in the previous section, high food prices, which can be a direct result of high fertilizer prices, can lead to starvation, crime, social/political unrest and economic stagnation. Understanding, evaluating and forecasting the development of fertilizer prices, which are inherently linked to the development of fertilizer supply and demand, is therefore an intrinsically important part of understanding the underlying price developments for food. Where, why and how fertilizer capacity develops influences the supply and ultimately price of fertilizers and food for the global population.
1.3 Fertilizer Production And The Middle East’s Role In Global Food Security

1.3.1 Feedstock Situation

Industrial scale fertilizer production is paramount in maintaining and further increasing food production to the levels required to ensure global population growth is not compromised. Providing sufficient fertilizers does not only ensure the survival of humankind but also helps in sustaining socioeconomic stability. The distribution of global reserves required for the production of fertilizers is rather uneven.

Figure 4   Global Proven Natural Gas, P2O5 and K Reserves (2013)
Source: USGS / BP / Nexant
Since the Middle East holds a significant portion of global proven natural gas reserves (ca. 43 percent of the global total) it is likely to continue playing a major role in the provision of nitrogen fertilizers; the Middle East has the required resources to derive hydrogen in ample quantities through steam reforming and hence one of the essential ingredients for the production of ammonia, the main building block for basically all nitrogenous fertilizer, and in particular urea.

Although the Middle East region has one of the largest gas reserves in the world its distribution in individual countries are by no means even.

![Gas Reserves Distribution of the Middle East, 2013](source: BP/Nexant)

Iran and Qatar jointly hold ca. 73 percent of the Middle Eastern reserves, followed by Saudi Arabia with 10 percent and the UAE with 8 percent. Due to the rapid economic development of many Middle Eastern countries domestic gas requirements have increased sharply in recent years. Natural gas upstream capacity development has not always kept pace with domestic gas demand increases. Gas allocation to new nitrogenous fertilizer plants (ammonia/urea) has therefore commenced to compete with gas consumption in other industries and sectors respectively such as in the petrochemical industry and power and water desalination sector. While gas allocation is an increasing issue in Saudi Arabia, Qatar and Iran have more spare gas production capacity available in the medium term. It is hence no surprise that future ammonia capacity additions are mainly expected to take place in these two countries.

The Middle East also holds significant phosphate reserves albeit the total reserves of P2O5 are modest compared to African phosphate reserves and the Middle East’s own natural gas reserves. Hence it can be expected that the Middle East’s long term role in contributing to global food security will be through the provision of nitrogen to the agricultural industries around the world.

### 1.3.2 Global Ammonia Capacity

In 2012, the global installed ammonia capacity was 217.9 million tons up from 208.7 million tons per year in 2011. Over the past years, global ammonia capacity has been seen to migrate to regions with cost competitive “stranded gas” feedstock. During the recent economic crisis, a significant amount of capacity in Western and Central Europe was idled - some on a short term basis, but some production is likely to be closed permanently in the longer term due to the sustained high gas prices. Facilities in China mostly use coal as a feedstock and the cost advantages are far lower than regions with low cost natural gas resources. These coal based capacities will experience temporary shutdown during a low market, when demand is low, e.g. 25-35 percent of Chinese capacity chose to cease production during the recent economic crisis. Furthermore, there have been a large number of plant closures in China over the last couple of years which is expected to continue in the short term. These plants were all of small capacity (typically around 20,000 to 60,000 tons per year). However, net capacity has grown in China as the smaller plants have been replaced with fewer large scale plants which promise better economics of scale and hence more financial protection in an economic downturn.

![Global Ammonia Capacity, 2014](source: Nexant’s Strategic Business Analysis Program (SBA))
Global ammonia capacity is projected to grow at levels slightly below global GDP growth through to 2030. Recent major capacity expansions have occurred in South America, Africa, Middle East and Asia Pacific. The largest expanding region has been, and is predicted to remain, Asia Pacific with just over five million tons of ammonia capacity added in 2012 and an estimated four million tons in 2013. Also parts of the Middle East, in particular Iran, have announced numerous new ammonia-urea facilities. However, the political uncertainty in the country may lead to the delay or, even the possible cancellation of some of these developments, albeit a recent easing of tensions and possible international sanctions against Iran could also increase the incentive to commission these new facilities quicker. Future capacity developments are expected to be concentrated in these regions as well as new capacity in North America due to shale gas developments. All these areas have access to low cost gas or ample coal feedstock.

The issue of how much ammonia capacity will be added in North America is an important topic that concerns the whole industry, especially net-exporting regions which deliver nitrogenous fertilizers to the US market. During 2012 and continuing into 2013, a whole host of companies announced new capacity in the region as ammonia prices strengthened and U.S. natural gas prices fell substantially. Although not all of the announced capacity will materialize, firm additions in excess of 5 million tons per annum can be expected in the US over the next decade.

China is also expected to continue increasing its ammonia and urea capacity over the next few years. Hence, how ammonia / urea capacity is going to develop in the medium term is not necessarily a question of where the largest gas reserves are located. Ammonia capacity is predominately added where gas prices are low (and expected to remain low) and where sufficient upstream gas capacity is available to support the downstream investments. Furthermore, an increasing share of the global ammonia capacity is based on coal gasification technology. This is primarily the case in China, which already accounts for 28 percent of the global capacity.

The Middle East has a rather special role within the global supply of nitrogenous fertilizers and its contribution to food security. Although the Middle East currently still only represents a relatively small part of the global ammonia capacity (approximately 5 percent), it is a major export hub for ammonia and urea. The main reason of course is the vast gas reserves that the region holds coupled with relatively low local demand. Furthermore, as the region consists predominantly of arid land and deserts, regional consumption requirements for fertilizers are very low. Hence despite its moderate capacity in the global context the region is an important contributor to global nitrogenous fertilizer trade.
1.3.3 Global Nitrogenous Fertilizer Trade

As a liquefied gas, ammonia is expensive and difficult to transport because it requires specialized refrigerated and pressurised rail and ocean vessels. This means ammonia is mainly consumed where it is produced. The predominant form of transporting nitrogenous fertilizers is in the form of urea. Freight costs per ton of urea are comparatively low as it is typically shipped as a dry bulk product.

The two main hubs in the urea trade market are the Black Sea and the Middle East. The Middle East supplies urea to countries all around the world; shipping urea over long distances, both east and west, is economically viable because of the low cost of production and relative ease of transporting solid urea. In 2012, the Middle East exported to a large number of countries including the United States (3 million tons), India (3.9 million tons), Australia (1.7 million tons) and Thailand (1.7 million tons).

The Americas, Western Europe, India and other Asia Pacific (excluding China/India) are historically urea net importers and are expected to retain this status in the future. Eastern Europe, the Middle East and China are currently the major net exporters. Capacity in the Middle East is expected to expand over the next two decades.

Basicall new capacity additions in the Middle East are purely dedicated for exports. In 2012, China exported 6.9 million tons up from four million tons in 2011, mainly to nearby Asian countries and India. China delivered 3.3 million tons of urea to India and another 0.7 million tons to other parts of the sub-continent as well as 0.8 million tons to South East Asia in 2012. In the forecast period China is expected to remain a net-exporter and exports are projected to grow albeit at a slower pace than in the last few years. Interestingly, South America is a major ammonia net exporter but a urea net importer. This is because most of Trinidad’s ammonia output is exported to the United States, leaving a shortage in regional urea supply.

The Black Sea ships the majority of its urea exports to South America, Europe and Turkey. There are additional trade flows of importance however. For example, Egypt shipped over 1.3 million tons to Western Europe and Canada exported 1.4 million tons to the United States in 2012.
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As described in previous sections, the price of fertilizers is an important factor influencing food security. Especially in less economically developed countries farmers often don’t have the financial means to purchase the relevant fertilizers to improve crop yields per land unit resulting in poor land use and ultimately relatively expensive food. In some countries, such as in India, fertilizer subsidies are political and social imperatives ensuring the survival of a large part of the population living in poverty. Understanding the underlying fertilizer price mechanisms and projecting price developments is hence not only important to direct industry participants but also to governments and households planning their financial budgets, respectively.

Ammonia and urea, as with other commodity chemicals, have prices which respond to complex and widespread market forces but can be considered as driven in the price influencing regions by two key factors:

\[
\text{Price} = \text{Cost (driven by feedstock)} + \text{Margin (driven by supply/demand)}
\]

Historically the U.S. and Western Europe have exerted a strong influence on global pricing due to their “global laggard” (high cost) status, market size and high level of ammonia and urea imports. The traditionally high cost of production in these regions is a result of relatively high domestic gas prices (the main raw material in the production of ammonia, with the exception of coal particularly in China). The region with the highest costs of ammonia production has varied over the past decade, switching between the United States and Western Europe. This is because natural gas prices in the regions have fluctuated substantially. Western Europe is currently the highest cost producer of ammonia and thus the main price influencing region for setting the floor for ammonia and urea prices for the foreseeable future. US natural gas prices are currently low compared to prices in Europe due to the on-going shale gas boom.

As can be seen in the figure below West European cash cost margins are currently much lower than US margins which for a brief period even exceeded cash cost margins in the Middle East. Producers in the US clearly benefit from lower gas prices due to the developments in the shale gas industry while the Middle East as a pure exporter typically receives lower netbacks due to higher transportation costs bringing the products to the markets. However, in general margins of Middle Eastern fertilizer producers are very healthy compared to their international piers due to lower average gas prices in the region.

1.3.4 Nitrogenous Fertilizers Production Costs and Prices

The large amount of capacity expected to come onstream globally over the next few year, as described in the previous sections, is expected to have a lowering effect on international fertilizer prices which are projected to remain close to European cash costs of production.
The likely low price environment in the near term is expected to remain until global fertilizer demand has caught up with the increased global production capacity and average industry operating rates increase. Understanding and forecasting the cyclical nature of the industry is not only key for industry participants when planning their investments but also for government bodies providing subsidies to the agricultural industries when planning their annual budgets. While lower fertilizers prices are beneficial for the agricultural industry and contribute to lower food prices, they naturally have a negative impact on producers’ margins and the ability to reinvest in new capacity. High prices in a tight market with high operating rates on the other hand increase the ability for producers to reinvest in new capacity and ensure a sustained provision of sufficient fertilizers and in essence contribute towards increased food security.

The Middle East’s role in contributing to global food security lies predominantly in producing fertilizers for export to farming regions around the world. Its vast natural gas reserves and increasing industrial infrastructure provide an important basis for future investments in capacity for the production of ammonia, the building block of virtually all nitrogenous fertilizers. The installation of export orientated fertilizer production capacity in the Middle East is especially important for the populous nations of South and South East Asia which often lack sufficient domestic natural gas reserves to provide adequate amounts of fertilizers to their agricultural industries. Fertilizer prices on the other hand are typically more influenced by production cost development in high cost regions, such as Europe and China. Although the global capacity development relative to global demand development has an influence on the cyclicality of fertilizer prices, the effect of each individual plant addition to the global capacity has rather little effect on global prices due to the large size of the market.

Figure 9  Historic Ammonia Cash Cost Margins
Source: Nexant’s Strategic Business Analysis Program (SBA)
1.4 Conclusions

Food security can be described as the sufficient availability, access and use of food or nutrients which ensures survival and growth of human population. It is naturally a fundamentally important topic that refers to the very survival and quality of life of all organisms including the human population. With a fast growing global population, food production has to also intensify substantially from less available land which makes food security arguably one of the greatest challenges the world is facing.

Food security is a complex combination of different factors that need to work together in order to ensure sufficient food production for the global population. The risk of malnutrition is currently concentrated in lower income countries which do not have the financial means or the right education to effectively cultivate arable fields in order to ensure sufficient domestic crop production at low costs. Some suggested measures to address these challenges include but are by no means limited to:

- **Education of farmers on:**
  - **Soil analysis** – every soil is different and nutrients should be applied to the soil depending on the specific nutrient requirements of the crops and the respective deficiencies in the soil; nutrient and contaminated content, composition, and other characteristics such as the acidity or pH level. A soil test can determine fertility, or the expected growth potential of the soil which indicates nutrient deficiencies, potential toxicities from excessive fertility and inhibitions from the presence of non-essential trace minerals. Although extensive lab test are not an easy solution for rural areas in low income countries, there are more cost effective solutions such as do-it-yourself kits which have lower analytical abilities but can relatively accurately determine the deficiencies of the macronutrients N, P and K.
  - **The use of fertilizers and its effect on crop growth** – this requires a combination of educating the farmers about how fertilizers function, which fertilizers to apply to which crops and in combination of the results of soil tests and even convincing farmers of the safety of fertilizers as in some areas these chemicals are regarded as suspect.
  - **Improved fertilizer application methods such as IFDC’s Fertilizer Deep Placement (FDP)** – When applying fertilizers normally (especially urea) a lot of it is lost to the atmosphere. With FDP, fertilizer granules are converted into larger briquettes and placed below the surface in order to reduce fertilizer usage which results in lower costs to the farmers, increased crop yields and a lower possibility of ground water contamination and contamination of water ways due to runoff/floodwater escaping a field’s containment barriers.
- **Use of GM crops** – GM crops undoubtedly can have some advantages with regards to increasing crop yields per unit of land, lowering costs of using pesticides due to higher resistance to diseases etc. However, GM crops to date remain a highly debated topic and care should be taken when considering the use of GM crops.

- **Providing access to modern financing options** – Providing modern financing schemes and subsidies to help fund the use of fertilizers and modern farming equipment is an important step to help increasing crop yields, economies of scale and self-sustainability for small farms in low income countries.

- **Funding and implementation of modern water reservoirs and irrigation systems** – although climate change as such cannot be avoided by the agricultural sector there are some preventative measures that can be put in place to maintain crop production during extended drought periods.

- **Improved cold storage infrastructure** – The right cold storage infrastructure could allow farmers to increase production and sales during harvest season and could help towards preventing food shortages.

- **Physical distribution of fertilizers** – Not only the production of sufficient fertilizers is important but also the physical distribution of it to the end consumer. Extensions of fertilizer distribution systems are required.

Naturally all the above mentioned solutions need to be communicated and provided to the farmers, respectively. These kind of close relationships with the end-consumers might primarily be a concern of the fertilizer distribution companies but nevertheless it would be beneficial for the entire industry if modern, best farming practices are applied. The involvement of fertilizer producers with the fertilizer end-consumer would not only help the farmers to increase their agricultural output but it could also improve brand visibility and sales for the producers. A practical implementation could be through the cooperation between producing companies and local cooperatives which typically have a wide-reaching and strong influence on the local farming community.

Although all of the above mentioned aspects could contribute to a long term sustainable solution to ensure food / nutritional security, arguably the most important aspect of the solution is the agricultural industry’s ability to provide fertilizers in sufficient quantities to replenish the nutrients consumed through plant growth.

The Middle East’s primary role in the provision of food security is the export of nitrogenous fertilizers to agricultural regions. The Middle East’s vast natural gas reserves provide the feedstock for hydrogen production.
via steam reforming which in turn is an essential building block for the production of ammonia, the starting point for effectively all nitrogenous fertilizers. The Middle East has already become a major export hub for ammonia and particularly urea; a downstream product of ammonia which is easier to handle and less expensive to transport. Although capacity expansions in the Middle East are likely to be concentrated in Iran and Qatar in the medium term, the region at large will remain an important contributor to the global supply of ammonia and urea in the long run.

A vast amount of new ammonia and urea capacity is expected to come onstream in the next few years, particularly in China and the US but to some extent also in the Middle East and Africa. Nexant expects this capacity to have a lowering effect on average industry operating rates as supply is expected to outstrip demand. This will likely cause fertilizer prices and producers’ margins to decrease. The duration of this trough will be subject to how fast global demand will develop.

Since the recent developments in the US shale gas industry, gas prices in the US have drastically declined, lowering producers’ cost of production and increasing margins. West Europe is expected to remain the global ammonia and urea price influencing region in the future. West European producers’ cash cost margins are not expected to fall below breakeven parity for a sustained period of time. Hence West European cash cost of production essentially represent a floor for ammonia and urea prices. The main factor influencing cash costs of production in Europe is the relevant gas price. This in turn can be influenced through a great variety of factors including political issues such as in the recent situation in the Ukraine.

How European cash cost of production and industry margins are going to develop is an important topic that concerns not only direct industry participants but also governments providing subsidies to the agricultural industry in order to contribute to the food security in their countries. The price of fertilizers will ultimately also influence the price of crops and as such affects food security of the entire global population.
About Nexant

Nexant Energy & Chemical Advisory Services offers clients a suite of products and advisory services with an exclusive focus on the energy, chemicals, and related industries. Using a combination of business and technical expertise, with deep and broad understanding of markets, technologies and economics, we provide solutions that these industries have relied upon for over 45 years. Services include Strategic Investment Studies, Market and Technical Due Diligence, Strategic Growth Plans, Independent Engineering, Project Feasibility Studies, Industry Analytics, Forecasting and Market Research, Litigation Support and Expert Testimony. NexantThinking report subscription programs and online product portal, formerly known as ChemSystems®, provides customers with insightful analytics, forecasts, and planning tools for the fertilizers, chemicals, polymers, oil & gas, energy and clean tech sectors. Global in scope, Nexant serves its clients from over 30 offices located throughout the Americas, Europe, the Middle East, Africa and Asia.

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The Gulf Petrochemicals and Chemicals Association (GPCA) represents the downstream hydrocarbon industry in the Arabian Gulf. Established in 2006, the association voices the common interests of more than 230 member companies from the chemical and allied industries, accounting for over 95% of chemical output in the Gulf region. The industry makes up the second largest manufacturing sector in the region, producing up to $US 97.3 billion worth of products a year.

The association supports the region’s petrochemical and chemical industry through advocacy, networking and thought leadership initiatives that help member companies to connect, to share and advance knowledge, to contribute to international dialogue, and to become prime influencers in shaping the future of the global petrochemicals industry.

Committed to providing a regional platform for stakeholders from across the industry, the GPCA manages six working committees – Plastics, Supply Chain, Fertilizers, International Trade, Research and Innovation, and Responsible Care – and organizes six world-class events each year. The association also publishes an annual report, regular newsletters and reports.

For more information, please visit www.gpca.org.ae