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PRESENT SITUATION, FUTURE TRENDS AND OUTLOOKS ON INCREASING THE EFFICIENCY OF NITROGEN FERTILISER IN ASIA

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With the total agricultural area of 9 million ha, in which the primary crops occupying largest areas are rice, rubber, coffee, fruits and vegetables. According to the Department of Crops Planting, in 2010, Vietnam consumes over 11 million tonnes of fertilisers of all types, of which, nitrogen fertilisers account for 2.5 million tonnes in the forms of Urea, Ammonium Sulphate... and the quantity used by each unit of agricultural area increases year by year.

Currently, on average each ha uses approximately 202kg of fertilisers of all types. This is quite a large number compared with the world average of 163kg. In some countries, the average fertilisation rate is much higher as depicted in Table 2 below. Increased fertilisation brings the positive effect of increased crop yield, but at the cost of some unwanted outcomes and one of those is wastage as a result of inefficient fertiliser utilisation.

Table 1. Increased fertilisation results in increased crop yield.

Year	Fertilisation quantity per ha	Yield per ha (Ton)	Total national rice production (million tons)
1976	5 – 6 kgs	2.20	12.60
2002	155 – 175kgs	4.80	35.00
2007	175 – 202kgs	5.40	39.00

Source: Bui huy Hien, Fertilizer Market News.

Table 2. The average application rate of mineral fertilisers in some countries.

Country	World's average	Vietnam	China	Sth Korea	US	Japan
Fertilisation rate (Kgs/ha)	163	202	245	260	270	441

Source: Bui huy Hien, Fertilizer Market News.

Table 3. Agricultural area for the major crops production in Vietnam.

Crop	Cultivated area (ha)	Notes
Rice and maize	8,254,000	
Fruits	774,000	
Industrial crops	1,936,200	
Others	≈ 1,000,000	Vegetables, annual industrial crops...

Source: General Statistic Office.

The Dobermann & Fairhurst study revealed that in order to achieve the yield of 6 tonnes/ha, rice crops need 162 kgN/ha, of which 115 kgN comes from fertilisers, 2 kgN from rain water, 5 kgN from irrigated water and 40 kgN fixed from N₂ gas. However, inevitably only 63 kgN ends up in the grains, 40 kgN in the rest of the plant, the remaining 60 kgN is lost. The lost due to erosion and deep absorption into the soil is 10 kg, but the lost due to evaporation is 50 kg. It's clear that utilisation of Nitrogen fertilisers only reached the 40-45% level while this is a fertiliser in high demand and we must meet more than half of this demand by imports. Every year, Vietnam apply approximately 2.2 million tonnes of urea to soil, but crops are only able to utilise 0.9 – 1 million tonnes, the remainder 1.2 – 1.3 million tonnes are lost to erosion, evaporation and deep absorption, resulting in significant wastage. The substantial loss of urea fertiliser is due to its rapidly dissolving nature in a liquid environment. At 10°C, 100% of urea is totally dissolved after 7 days, at 26°C, completely dissolved after 4 days. Vietnam is a tropical country with a warm and moist climate, leading to urea rapidly dissolving after application to soil, crops don't have time to fully benefit from fertilisation resulting in an even larger loss.

Applications of wasteful, unbalanced, large quantities of fertiliser leads to environmental harm affecting the underground water source, resulting in acid rain, contributing to the global greenhouse effect, loss in soil fertility, soil becoming more barren, soil inundated with nitrate and other heavy metals. The over-application of Nitrogen may indirectly result in the over-use of pesticides because as the crops become greener and more attractive to pests, farmers have to counter this by using more potent dosages of pesticides...

As a result, Vietnam's mineral fertiliser application strategy recently, which will continue into the future, is to reduce the quantity, especially for Nitrogen fertilisers. Fertiliser application according to the techniques of "3 less, 3 more", "1 must, 5 less" , application using leaf colour comparison charts, deep soil application, application in conjunction with organic fertilisers, application in smaller quantities more frequently... are all solutions to meet the Nitrogen needs of crops, minimising wastage.

Fertilisers consumed in Vietnam that are produced in part domestically are Urea, Phosphorus, DAP and various organic fertilisers. The remaining demand is met by importation such as Potassium, DAP, SA... These figures are presented in the table below:

Table 4. The fertiliser needs and production capacity of Vietnam in 2010.

Fertiliser	Demand	Production	Imports	Notes
Urea	2,400,000	950,000	1,450,000	
SA	1,105,000	0	1,105,000	
DAP	998,000	65,000	933,000	
Phosphorus	3,200,000	1,970,000	1,230,000	
KCl & K ₂ SO ₄	750,000		750,000	
Others	?	?	?	There is no fixed figures
Total	8,453,000	2,985,000	5,468,000	
Various organic fertilisers		800,000		Based only on the quantity commercially produced in factories.

Source: General Statistic Office.

In recent years, scientists have carried out many study projects in Vietnam, at the same time applying global technological advancements in the methods of increasing nitrogen efficiency such as:

- Performing split application with smaller quantities more frequently;
- Applying the principles of 4-Rights including: Right time, right quantity, right type, right method;
- Applying the deep placement method by directly digging large size granulated fertilisers into the root system;
- Coating urea using various chemical compounds such as rubber, sulphur, neem oil, NEB26, Agrotain;
- Recommending the use of NPK fertilisers in the drive to introduce the balanced method of application;
- Blending urea into composted organic material in order to produce a type of blended organic fertiliser called organic mineral fertiliser, which is a way of both helping to lend a hand to recondition agricultural land while at the same time minimising the erosion of fertiliser due to the soil becoming barren... These solutions have been recommended by the national system of agricultural promotion centres, research institutes or manufacturers and have been communicated to farmers through various means.

In the many above-mentioned experiments, the method of fertilisation by burying around the root area in trials gave positive results, however it cannot be applied to large scale production due to the prohibitive labour costs. The principles of 4-Rights are theoretically accepted by many, however upon application into real production environment, the difficulty is in establishing the right quantity. The method habitually applied well by farmers is the division and application of fertilisers more frequently in smaller quantities. Using combination fertilisers NPK in lieu of individual fertilisers in the balanced fertilisation program and applying organic mineral fertilisers.

Recently, producers have introduced a solution, although not new, has become more suitable due to the ever increasing price of urea, which is to coat urea with compounds that have the ability to limit the loss of nitrogen in various ways. Some of those compounds are Agrotain and NEB26. According to scientific reports on trials done in Vietnam, when applying urea coated with Agrotain, we can reduce up to 30% the amount applied compared with ordinary urea. In 2010, the quantity of Agrotain imported into Vietnam is over 500,000 litres and is used to coat 250,000 tonnes of urea. Currently, the trend of using this type of nitrogen fertiliser is rapidly increasing.

With the current yearly production capacity of urea from the two plants: Phu My and Ha Bac, estimated around one million tons, VN plans to be self-sufficient with urea by the year 2015 with new plants opening up in Ca Mau and Ninh Binh. This vision in conjunction with the use of compounds that help to increase the effectiveness of urea application such as Agrotain will help Vietnam become a net exporter of urea. Another fertilisation trend is to use organic fertilisers, some of which are produced by blending mineral fertilisers with composted organic material.

Scientists are working hand-in-hand with manufacturers aiming to introduce a new generation of fertilisers with the target of halving the average rate of fertilisation while maintaining maximum yields.