IFA International Workshop on Enhanced-Efficiency Fertilizers
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BENEFITS OF ENHANCED-EFFICIENCY FERTILIZERS FOR THE ENVIRONMENT

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Introduction

As we survey the many aspects and benefits of what will be called "Enhanced Efficiency Fertilizers (EEFs)" we must also look at some background issues to truly understand the issue. The background issues we will review include: current markets, uses & volumes of EEFs; the business drivers behind the use of EEFs; the personal motivations for decisions to use EEFs; the obvious (or perceived) environmental benefits of EEFs; and the true (sometimes hidden) benefits of EEFs. Once we have reviewed these issues we can then begin to make determinations regarding what can be done to expand use/acceptance of EEFs; how we can influence buying decisions; what we, as an industry, can do to be more environmentally responsible; and finally where does this really leave the environment in the grand scheme of our efforts to do business.

Current markets

The traditional (1960-1990) markets for EEF products included the following uses: Lawn & Garden (homeowner applications); Golf Course Greens & Tees (professionally maintained turf); Nurseries (wholesale plants for resale); High Value Specialty Crops (primarily seasonal vegetables and fruits under plastic); and Rice in Japan (intensive agriculture in a specific environment). In addition to these markets in recent years newer and emerging markets now include: Professional Turf (golf course fairways & roughs, institutional and sports turf); New Rice Areas (rice markets beyond Japan, e.g. China and the US); Citrus In Florida (high value highly maintained trees on light, low CEC, soils); Many More Vegetable Crops (expanded use on seasonal vegetables); and Conventional Agriculture On Light Soils (application based on yield guarantees).

Traditional and emerging uses/benefits for EEF products

The markets noted above have been built due to specific benefits related to the intended use of the material. A listing of the traditional benefits include: Convenience/fewer applications, greener/thicker grass, lower labor/less equipment cost, better/more uniform quality, safety/non-burning, and in some cases, increased yields. New and emerging uses include: the need to comply with local use/ application requirements, expanded use of EEFs in emerging/third world countries, the need to comply with (or take advantage of) regulatory rules or BMP incentives, new research shows wider varieties of crop yield enhancements, recommendations for use in environmentally sensitive areas is an aid obtaining permits in some development situations. In addition, demonstrating the use of these materials is a public relations benefit noted by development companies.

Volume of slow release fertilizers (a major segment of the EEF market)

Analysis of tonnage data from 2003 can be used to put the relative volume of slow release and EEF products in perspective to the entire market in general. This data can be presented in the simple table below. As noted to date EEF or SR products are not a large segment of the total nutrient tons of nitrogen in the world or the US. However, a closer examination of the motives for use and future drivers may indicate cause for at least some optimism.

Volumes of fertilizer products in 2003 (Estimated nutrient N in metric tons)

World	USA
Total N ~ 85 million tons	Total N ~ 12 million tons
SR N (@ 25% N) ~ 184 thousand tons	SR N (@ 25% N) ~ 129 thousand tons
~ 0.25% of total nutrient tons	~ 1.1% of total nutrient tons

Why are EEF products used today?

There are a number of drivers that influence use of EEFs today; these are noted in the table below.

Driver type	Motive
Technology	improved delivery of nutrients, efficiency, safety
User needs	Non burning, reduce labor, improve color/growth, yields, quality
Economic incentives	Subsidies, BMPs, public relations, reduce liability
Regulatory/political	Local, regional & state mandates, public opinion

As noted above not many people use EEFs because it is "better" for the environment; they have other motives. Although there might be folks that believe using more efficient fertilizers is better for the environment, most of those folks use natural/organic products, not what we would think of as EEFs.

A closer look at the motives

Excluding the above, what would cause someone to choose & use EEFs over traditional nutrients? There is one answer but two motives; the answer is obviously money. The two ways to manage money involves making and keeping it by buying or selling profitably and the second management issue involves avoiding loss, in other words keeping your money by reducing liability.

The perceived (obvious) benefits of EEFs

There are several benefits that are normally associated with EEFs these include: more N utilized by the plant, less N released to ground and surface water, easy means to achieve mandated or desired nutrient reduction goals, saving time/effort by reducing applications, higher yields can mean fewer acres needed to farm or more production per acre and better quality products (greener turf, higher quality vegetables and plants). However while these are often cited as benefits, and they certainly legitimate ones, the real advantages lie in secondary or less obvious benefits.

What are the hidden benefits?

The less obvious benefits include: reduced N into the air thus reducing NH_3 & NOx emitted from agricultural sources, reduced stress & consistent growth are often correlated to reduced disease and higher overall quality plants and crops, products with higher and more efficient nutrient concentrations reduce fertilizer transportation/fuel costs compared to simple soluble products or manure, there will likely be reduced soil contamination versus manure and biosolids, use of EEFs make it possible to match nutrient release with plant needs and also make it possible to manage nutrient release based on changing environmental conditions (water, temp…). Perhaps most importantly proper use of EEFs will someday make it possible to precisely blend nutrient release & ratio to local crop, soil, & growing conditions.

Drivers affecting EEF use in the USA

Regulatory activity & enforcement of EEF claims in the US is minimal. Although the US, through AAPFCO, has 8 terms & 21 definitions to address the issue (I am sure there are many more internationally) only 1-2 states in the US test for SR claims. This leaves the door open for some unscrupulous dealer to give the industry and our products a bad name by intentionally under formulating without any regulatory action until someone complains. Then it is unfortunately often too late to change opinions and regain reputations.

In addition there are many local laws mandating or preventing sale of classes of products or nutrients. These are currently mostly targeting phosphate sale, use, and application, but there are also some local laws affecting the use and best practices promoting the amount of EEF in lawn and garden materials. This is typically stating that at least half of the nitrogen should be in the slow release form. Furthermore there is mandated, subsidized, or priority use (or exclusion) of biosolids & manures as part of certain BMPs.

Current technology issues

Not only are regulatory activities affecting EEF decisions, there are also new products, definitions & claims that are constantly being introduced. Some of the new claims involve claims of days of availability or release within a certain window of time. This along with the past history of many specialty products on the shelves is the cause of consumer confusion and understanding of what they can and should purchase. This confusion, along with the lack of protection against ineffective products is a recipe for consumer backlash at some point in time.

Appropriate agronomic & analytical testing

Hand in hand with regulation must also be appropriate testing for the needs based on more efficient use of nutrients and the analytical testing of EE products themselves. Along with agronomic and soil testing must come appropriate nutrient ratio recommendations when using more efficient products. This then leads back to the lack of university research data to determine crop applicability and uptake needs based on new EE products.

Current environmental issues

Nutrient management planning techniques use of both N & P criteria to make nutrient decisions TMDL implementation has progressed to the point where bright line points are being set in hundreds of local and regional watershed locations that limit N, P, and other fertilizer related contaminants. There is little time to react and prove management plans will achieve the desired nutrient reduction goals. EPA has mandated timetables for implementation; these are forcing state action, often without appropriate data and usually without fertilizer industry participation.

Hypoxia is another environmental issue not well understood, but nutrient overload is always listed as the primary cause of this high profile issue. It continues to be a PR and scientific problem for the industry because we can not offer viable solutions. The only comments we offer are economic impacts of proposed fertilizer application reductions, management and tillage practice modifications and diffusing the issue by raising other potential causes of the problem. EE products offer an opportunity to offer legitimate proactive answers to fertilizer's role in the hypoxia issue in addition to simply offering the above "defensive" arguments.

Another looming environmental issue revolves around air emissions. Historically this issue has only impacted fertilizers via CFO regulation and by forcing manure into the market. However it is clear that fertilizers, row crops, field emissions are next on EPA's list. This might be a double threat issue because there is also the PM 2.5 issue that could also impact fertilizers application as well as tillage and field crop management. If you are interested information on one such upcoming meeting on the subject can be found at http://www.esa.org/AirWorkshop

Future drivers

Through the work of TFI and its Advanced Products task group there will be new USDA NRCS technical notes and code 590 language that reference EEFs. These citations could impact US Farm Bill as well as local payments and incentives to use these products. This will need to be monitored by TFI as well as AAPFCO to make sure that there are not conflicting definitions or improper use of the terms that have been crafted to date by AAPFCO.

TMDL's, requiring BMP implementation, have and will continue to be implemented. These will be at the local and regional level so it will be difficult for industry to interact effectively with each group of decision makers. To this end TFI has formed another task group designed to address many of these issues; the Nutrient Use Taskforce has just been formed and will play an important role in providing input in this area. There will certainly be mandated nutrient reduction in watersheds as well as model plans for nutrient reductions, as these models are formed a unique opportunity exists for input from the EEF community.

CFOs will continue to expand in numbers and size, manure & biosolids use will continue to be on the rise. This is not just a US concern, as emerging nations raise their living standards, the demand for meet in diets will increase. Consequently developing solutions to the manure management issue will become a world wide issue all too soon.

A few words about "Organic Farming"

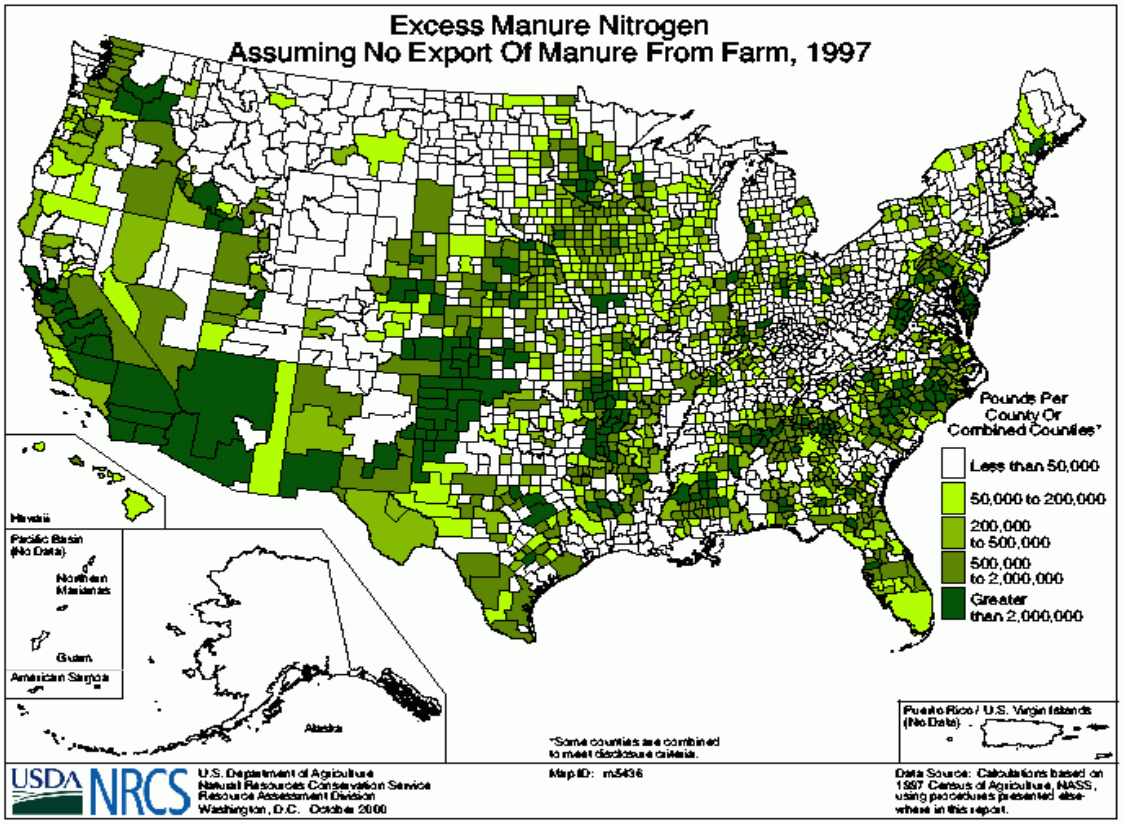
When it was one shelf in the health food store it wasn't a concern, when it was one shelf in the big grocery store it was not a big deal. But now there are "Organic" options all through the store and the USDA NOP program is getting attention. Organic is now big business; while this may seem like a strange marriage it is becoming fact. In fact some small organic farmers now find it hard to compete with the big organic farming operations. The fertilizer labeling using the word "organic" is now a major concern and a source of contention. AAPFCO has had to deal with this for issue in its terms and definitions committee for the last 2-3 years. It will again be a major part of their agenda this August. The problem is that the chemical definition of organic is not the definition the organic community wants to accept. As an example of the growth in this area a short history of organic sales in the US is listed below.

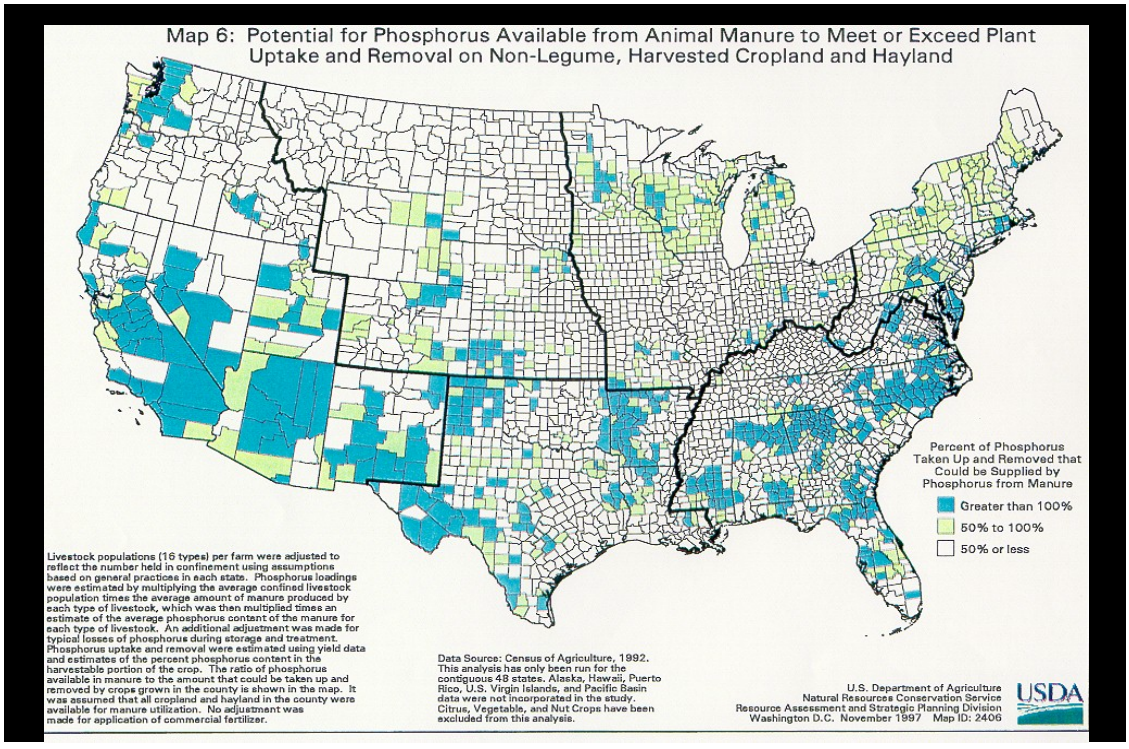
Consumer Sales and Growth Rates of Organic Foods

Year	Sales (in billions of $)	Growth Rate (%)
1997	3.6	
1998	4.3	19.7
1999	5.0	18.2
2000	6.1	21.0
2001	7.4	20.7
2002	8.6	17.3
2003	10.4	20.2
2005 Est.	15.0	@ 20.0

Manure – friend or foe?

I want to discuss manure briefly. Although this may sound like an unlikely topic for the subject it is really something that needs to be addressed. Why Focus on Manure? Animals produce a lot of manure, 130 times more manure than do humans. Over 1.4 billion solid tons are produced in the U.S. annually, that is 5 tons for every man, woman & child. This waste/resource is equal to about 30% of all US N requirements, 70% of all US P_2O_5 requirements, and 70% of all US K_2O requirements. Nutrient management plans (NMPs), best management practices (BMPs), and total maximum daily loads (TMDLs) have and will continue to be formed. They all will require more/better manure use. Although they may seem like just suggestions or guidance their implementation by reference in regulation is a common way for those in power to indirectly require their implementation. This could not only simply affect use but also possibly even transportation subsidies and mandated prohibition of manure use in certain areas. As you can see by this graphic even in 1997 the placement of manure I many locations is far in excess of its possible land application potential.


Excess Manure Nitrogen
Assuming No Export Of Manure From Farm, 1997
Pounds Per County Or Combined Counties*
Less than 50,000
50,000 to 200,000
200,000 to 500,000
500,000 to 2,000,000
Greater than 2,000,000
Hawaii
Pacific Basin (No Data)
Northern Marianas
Guam
American Samoa
Alaska
Puerto Rico / U.S. Virgin Islands (No Data)
*Some counties are combined to meet disclosure criteria.
USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service
Resource Assessment Division
Washington, D.C. October 2000
Map ID: m5436
Data Source: Calculations based on 1997 Census of Agriculture, NASS, using procedures presented elsewhere in this report.


Map 6: Potential for Phosphorus Available from Animal Manure to Meet or Exceed Plant Uptake and Removal on Non-Legume, Harvested Cropland and Hayland
Percent of Phosphorus Taken Up and Removed that Could be Supplied by Phosphorus from Manure
Greater than 100%
50% to 100%
50% or less
Livestock populations (16 types) per farm were adjusted to reflect the number held in confinement using assumptions based on general practices in each state. Phosphorus loadings were estimated by multiplying the average confined livestock population times the average amount of manure produced by each type of livestock, which was then multiplied times an estimate of the average phosphorus content of the manure for each type of livestock. An additional adjustment was made for typical losses of phosphorus during storage and treatment. Phosphorus uptake and removal were estimated using yield data and estimates of the percent phosphorus content in the harvestable portion of the crop. The ratio of phosphorus available in manure to the amount that could be taken up and removed by crops grown in the county is shown in the map. It was assumed that all cropland and hayland in the county were available for manure utilization. No adjustment was made for application of commercial fertilizer.
Data Source: Census of Agriculture, 1992. This analysis has only been run for the contiguous 48 states. Alaska, Hawaii, Puerto Rico, U.S. Virgin Islands, and Pacific Basin data were not incorporated in the study. Citrus, Vegetable, and Nut Crops have been excluded from this analysis.
U.S. Department of Agriculture
Natural Resources Conservation Service
Resource Assessment and Strategic Planning Division
Washington D.C. November 1997 Map ID: 2406
USDA

In addition because of the low analysis noted below the transportation or concentration of nutrients must be addressed in order to make land application of all manures efficient.

Values are in % concentration on a dry weight basis

Source	%TN	%NH3N	%TP	%WEP
Hog	1.00	0.27	2.9	0.9
Dairy	1.10	0.13	0.7	0.4
Beef	0.59	0.07	0.5	0.2
Poultry	2.00	0.54	2.1	0.7

N Data from OMA FRA, 1998; P data from "Survey of Water Extractable Phosphorus in Livestock Manures", Kleinman et al, SSSA Journal, April 2005

There are three take away messages from this data; the nutrients available form manure are in the wrong places; the nutrient concentrations are quite low; however there is, on a percentage basis, a fair amount of water insoluble nutrient remaining in these materials. There will be an element of urea N that exists in the manures, but there will also be protein nitrogen and other forms not immediately available. And keep in mind that because of the regulatory focus on this product it will be required to be used. This is not the case with traditional fertilizer products.

Issues specific to AAPFCO

Although you will hear from Dale Dubberly later, I want to address a few issues specific to the US and AAPFCO (Association of American Plant Food Control Officials) and their Slow Release Committee. This group has been busy since its formation as a taskforce; in fact they have been in existence since 1993. Because the issues were ongoing and growing in importance they were transitioned into a standing committee in 2004. This group is responsible for the following actions taken by AAPFCO: They developed a draft AAPFCO policy statement regarding slow release and stabilized fertilizers presenting new terminology for a broad class of products characterized as "Enhanced Efficiency Fertilizers" that include both slow release and stabilized materials, this became policy in 1999. "Enhanced Efficiency Fertilizer" was recently adopted by USDA NRCS for inclusion in revised 590 Code language and will be used in future NRCS Technical Notes. As a result it was important for AAPFCO to officially adopt the following terms that were proposed in February of 2005:

T-69 Enhanced Efficiency (EE) fertilizer Products with characteristics that minimize the potential of nutrient losses to the environment, as compared to "reference soluble" products.
T-70 "Slow Release" fertilizer Products that release (convert to a plant - available form) their plant nutrients at a slower rate relative to a "reference soluble" product. Examples of slow release products are coated or occluded, which control the release of soluble nutrients through coating or occlusion of the soluble nutrient compounds, water insoluble, or slowly available water soluble.
T-71 "Stabilized" fertilizer Products amended with an additive reducing the transformation rate of fertilizer compounds, resulting in extended time of availability in the soil. Examples of stabilizing amendments are nitrification inhibitors, nitrogen stabilizers or urease inhibitors.

While here we will discuss the harmonization of these terms with others used internationally. I think this effort is worthwhile and worth the effort because fertilizers (including EEFs) are worldwide commodities traded internationally.

What can we do to expand the use of EEFs?

So this is the background and current situation for our products. What can we do to expand use of EEFs? I have some ideas, I am sure that you can think of others. My list of benefits is below:

Begin to measure air emissions when research is planned – include comparisons of EEFs versus soluble/organic sources

Look at how our products fit into the carbon sequestration equation – little is known about this in terms of EEFs

Assess possible disease reduction benefits of EEFs – more work needs to be done in this area, pesticide reduction cold be a positive aspect we seldom even consider

We must collect environmental data - not just yield/quality data as we conduct research

Research transportation, production & nutrient cycles - we must look at the total picture

Research nutrient needs under controlled conditions - if we are to make recommendations we must know the nutrient needs for each crop over time

Build data bases and blending programs for EEFs - a simple percent of the N that is classified as slow release is not sophisticated enough to manage nutrient supplies over a growing season

Recognize our competition - wasted nutrients and animal waste

Influence those who influence our customers - education of traditional Ag managers is needed. What can we do to influence these decisions: engage others – get out of our own world get out of our own world; meet with regulators, activists, the public & academics. But, to do this we need two things – data & strategy data & strategy

Develop knowledge – study efficiency, not just yield; we need to develop a positive case based on science. This can be done by conducting more long term comparisons to biosolids & manures, include soil quality & contaminant buildup (there are many weaknesses of these products in terms of meeting long term crop and soil needs)

Communicate data as an industry & individuals - let others know that EEFs are viable alternatives if used in appropriate situations. No one product or company is likely to fit all applications. Then market our products appropriately by targeting when and where they will be of true benefit.

Demonstrate credibility - police ourselves, prevent unscrupulous dealers (more on this later); don't be ashamed to disclose our motives and beliefs. Our actions should be based on two perspectives – "ours" & "theirs", we need to be aware of how others perceive our industry and products.

Communicate - work together to sell the EE concept, work independently to sell our products

How can we be environmentally responsible?

We are in business to make money, but we also need to be responsible for our products and actions. How can we do this? I again have a few suggestions:
Believe that EEFs are better for the environment - be united in that belief and convince others

Understand that no single product is the answer – information on product performance must be applied appropriately

Focus research on solutions not causes of pollution – others simply want to convict fertilizers of the crime of pollution, we need to show them that alternatives exist and we have answers

Commit to "slowly available", "long lasting" growth – this is a long term research and education effort, we will not likely see the type of growth the "Organic" folks have enjoyed

Raise awareness of the $$ benefits of EE fertilizers – remember the motivations noted earlier there must be some long term payback to farmers, regulators or to the energy/nitrogen cycle

Raise user awareness of environmental liability – in the future there will be a price to pay. Who will be responsible is still unclear, but someone will ultimately be accountable

Demonstrate solutions to regulators and the public - show users that achieving both economic and environmental efficiency is a realistic goal environmental efficiency is a realistic goal

Where does this leave the environment?

How can we motivate customers to use EEFs, thus ensuring EE products benefit the environment? Look at motives from the ultimate ($$) perspective. Technology can be one motive; new and better products must compete & be effective, competition will lead to even more efficiency. Regulation, in the US it's simple, there is practically none. The door is open to unscrupulous dealers, we need to close it, or we (and our products) will loose credibility. Subsidies, BMPs & regulation will drive manure & biosolids into the market, we need them working for us too. Learning how to market and sell through new (Ag) channels will be a challenge, but the market is huge and worth pursuing. EE products (where applicable) must be the clear answer to user needs; in order to make this case we need much more data than is currently available.

Closing thought

Enhanced Efficiency Fertilizers should not be thought of simply as fertilizer products.
We're not just selling nutrients - we are selling a result, **efficiency**.

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