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COMBINING FARMERS' AND SCIENTISTS' VIEWS OF NUTRIENT MANAGEMENT IN INTENSIVE IRRIGATED RICE PRODUCTION SYSTEMS IN THE MEKONG DELTA OF VIETNAM

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ABSTRACT

Improvements in the efficiency of fertilizer use have benefit for farmers and society as a whole. Soil scientists at the International Rice Research Institute (IRRI) have developed a technique called site specific nutrient management (SSNM), which employs real time nitrogen (N) management with field-specific fertilizer rates for nitrogen, phosphorus, and potassium (NPK). SSNM is used for defining recommended rates of NPK for particular rice fields, in given seasons, with expected yield levels, considering the field-specific soil supply of N,P and K. Farmers in the Mekong Delta also have a method for determining NPK timing and rates, which incorporates concepts of field-level variability, season, weather, expected yield levels, and a host of other factors. Farmers' base their practices on experience and shared knowledge. We found that both scientists and farmers use many of the same factors to determine the proper rates and timing of nutrient applications, but they do so for different reasons and with different outcomes. These differences are barriers to the optimization of nutrient use by farmers, and the integration of farmers' knowledge in the creation of fertilizer recommendations. In this paper, we compare the two approaches to fertilizer use and outline common ground between them. This can be used to save farmers time and money and improve the natural environment.

INTRODUCTION

Vietnam is an agricultural country in which millions of farmers rely on the output of grains, particularly rice, to sustain their families. Fertilizers are an important part of Vietnam's agricultural economy because they not only increase the agricultural output of farmers but also generate income for producers and distributors.

The adoption of strategies that improve the efficiency of fertilizer use among farmers would have great benefit for farmers and society as a whole. Farmers would see the benefit in terms of lower fertilizer costs, and, if reductions in use are great enough, improved natural environment. Society would likewise see an improved natural environment and reduced reliance on imported fertilizers.

This research is an analysis of a particular system of fertilizer use referred to as site specific nutrient management (SSNM). SSNM is a method that allows farmers to analyze their own soil and crop conditions and match their fertilizer use to those conditions. Throughout this paper comparisons are made between the recommendations of the scientists who developed SSNM and farmers' existing fertilizer management practices in the Mekong Delta region of southern Vietnam.

This is a description of a belief, planning, and practice system surrounding fertilizer use in South Vietnam. We will describe what farmers believe about important aspects of the fertilizer system, show how they plan according to those beliefs, and then show the behavior (outcome) that result from this belief and planning system. The outcome also relates back to the belief system, reinforcing existing beliefs or forcing a change in beliefs. We are not judging the veracity of the statements made by the farmers. For the purposes of this report, we accept the farmers' beliefs as true, regardless of the opinion of experts at IRRI or the national system. Our goal is to construct an internally consistent

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belief system, showing the links between beliefs and behavior

The paper concludes with a set of recommendations to increase the validity of SSNM in relation to farmers' existing practice. This is done increase the livelihood of adoption by Vietnamese, and eventually other farmers, of the SSNM practices.

Background

In general there is a correspondence between the SSNM approach developed by IRRI scientists and farmers' practices. As you will see, farmers already do what can be considered site specific nutrient management, i.e. adjusting nutrient decisions according to an understanding of physical variability and yield limitations at the plot level. Furthermore, through understanding of crop needs and the role of fertilizers in crop growth, farmers also use real-time nutrient management, i.e. adjust their input levels according to variables that change within and between seasons and fields. Farmers can perform their own version SSNM.

Site specific behavior and real-time nutrient management are the hallmarks of IRRI's SSNM. It is worth asking why, given the evident similarity, at least in form, between farmers' practice and the IRRI system, would farmers be motivated to adopt or even try the IRRI system? The answer lies within two broad themes: in the potential for increased efficiency of resource use, and an assurance that the practices of the farmers have been validated by researchers and is optimum in some formal sense. (Note: farmers operate in a virtually enclosed information system, so outside validation is important.)

Farming system

The farming system in the study area (Phuoc Thoi and Dinh Mon villages) is characterized by 3 rice crops per year. Thoi Trinh hamlet (Phuoc Thoi) and Dinh Phuoc hamlet (Dinh Mon) were selected because they were mega project sites. These villages were chosen because they had similar social and environmental conditions. Because the farms are located in a delta region periodic flooding is a common problem. Irrigation is widely available.

Modeling farmers' beliefs, intentions and decision-making

Not surprisingly, farmers have a deep and complex understanding of the natural environment on their farms. This is translated into a decision-making process that it tightly linked to the social, economic, and natural system. In order for researchers to fully understand, and thereby utilize farmer knowledge, it is important to know what information and knowledge is there, and to effectively integrate existing recommendations with that knowledge base. We must understand what farmers do and why in order to know how our recommendations fit with the existing practice. We also need to know what farmers are doing so we can change or modify recommendations to make them easier to accomplish by farmers, thereby increasing the relevancy of the adoption.

We have developed a simple model to understand how farmers make decisions in their fertilizer use (Figure 1). Farmers perceive their environment, including natural, economic and socio-political factors. This leads to understanding of the environment which is mediated by education, history, enculturation etc. This understanding informs decision-making, or the intention to act in a certain, prescribed way. Intention refers to an ideal, or prototype, of behavior that conforms to some predetermined set of factors, namely perception and understanding in goal-oriented context. Intention is mediated by the existing constraints and opportunities (real and imagined) facing farmers, especially climatic, biotic and economic factors. This mediated intention gives rise to behavior, or in this case, the actual fertilizer applications.

- Modeling decision-making:
  - Farmers' perception leads to
  - Understanding, which informs
  - Decision-making, which determines
  - Behavior (implement decisions)

Figure 1

An application of this model is presented in Figure 2. The beliefs about crop "behavior", by nutrient interactions, field characteristics, the role of particular nutrients, soil types, etc represent a core of beliefs, also known generally as ethnopedological beliefs. These beliefs, taken as a mostly integrated and undifferentiated whole, give rise to intentions. These intentions, circumscribed by local factors such as the level of water in the field, crop growth stage etc., result in specific actions or behavior. The result of these behaviors is fed back into the belief system by way of observation and experience.

Figure 2

Beliefs about interactions of crop and nutrients, and effects, including (fixed) field characteristics
- season, field level, soil type, P x N, etc

Beliefs

Intention or plan for a given field in a season

Plans

Timing and amount of inputs varies according to changing factors
- variety, leaf color, input price, water level
- condition of crop at growth stages

Behavior

Farmers' beliefs

Accurately assessing what farmers believe about anything is a difficult task, if not impossible, without a clear definition of the limits of the assessment. Farmers, as all people, maintain a wealth of information about their daily lives, only a small portion of which is used to actually create intentions, make decisions, and induce behavior. For fertilizer management, four areas are of concern: crop behavior, fertilizer properties, soil properties, and ecosystem interactions. Their beliefs are based on the way that crops affect, and are affected by soil, nutrients, sunlight, insects and other factors. These are ideas generated by observation of the plant itself. Their beliefs on soil properties include the pedological classification, beliefs about the effects of soil on plants, water retention, siltation and so forth. Their beliefs on fertilizer properties include beliefs about how fertilizers affect the crop and why they are used. Beliefs about ecosystem interactions are the most complex of beliefs to be analyzed here.

Crop growth stages and crop behavior

The basis of an understanding of crop behavior is growth stages. Farmers in the

Mekong Delta recognize the growth stages of the plant, and this governs many nutrient decisions, as well as perceptions of plant health. Metaphorical, or anthropomorphic usage is common in the description of the various plant stages. For instance, at 7 DAS (days after sowing) the plant is described as *cây con*, or literally child plant. This emphasizes both the vulnerability of the plant at this stage, and the human connection with the crop. The tillering stage is represented in reference to both the size of the plant and the hill. For the hill, it is aggressive (*mạnh*) expansion (*nở bụi)* of the hill, while tiller production *nẩy chồi mạnh* reflects more directly on the tiller production (*nẩy chồi*). This implies that there are really two important things going on – the tillers are being produced but the overall size of the plant is increasing. Presumably, if the size of the hill does not appreciably increase, while tiller number increases then a problem exists. Panicle initiation can be literally translated from the Vietnamese to English. Although the main tiller, or center tiller, is said to resemble a lamp wick, at the center (*tim*) of the lamp (*đèn*).

At each growth stage the plants require different amounts of nutrients. A notion of how the levels of growth is generalizable across the farmers in the study. In early stages of growth, e.g. before 15 DAS, urea is applied to improve crop growth and enhance vigor of the plant.

Fertilizer properties

N, P, K

Vietnamese farmers have specific beliefs about the properties of various crop nutrients. There is agreement among farmers that nutrients have a role in crop development, and generally these roles do not overlap. Nitrogen (N) is used for overall crop growth, i.e. size increase Potassium (K) is used to avoid lodging, especially when excessive N is used or when field conditions are likely to induce lodging. Phosphorous (P) is used mainly for seed development and for good plant color. Other factors, including increased use of pesticides at higher N rates, or relationships between soil properties and fertilizers were also acknowledged.

P, in its various applied forms, is used to decrease the acidity of the field and to maintain a green leaf. In the second season they use a basal P. This causes a reddening of the field and a reduction in the pH of the water. This is related to the upsurge of subterranean acid sulfate soil, especially iron and aluminum (the upsurge of acidic materials is called "*xì phèn"*. The basal P, applied 2-3 days before seeding, is meant reduce the acidity of the soil. This is especially problematic when there is not much rain, as in the 2nd season. The dry season still has leftover rainfall from the wet season. When the plot is dry there is no water pressure holding the acid sulfate down under ground. The acidic materials follow cracks in the soil subsurface and emerge. Many farmers mentioned the importance of adding P to change the soil acidity, especially the acid sulfate soils. This is unusual because it is rare for a farmer to talk of nutrients in relation to soil or field conditions, except in a negative way, i.e. overuse of fertilizers is said to make the soil hard (*đất chay*). The hardening of the soil can be reduced by lowering chemical fertilizer input through the use of green manure or organic inputs.

P is the only fertilizer that is applied according to a soil-based system of application. That is, according to the needs of the soil. Both N and K are applied according to the needs of the plant. Therefore, P is linked directly to the soil type or classification, while N and K are not.

Phosphorous and beliefs.

P is the only soil-based application. The application of nutrients is only significant with soil type for P. N and K are not apparently linked to soil type. Farmers are more likely to apply P to clay soil type soils. Furthermore high fields get more P as well (it is significant). Farmers believe that P reduces soil acidity. This acidity is present when a field dries, the acid sulfate comes up from the subsoil on to the surface when the surface is dry and there is no water to hold the acidity down. Because high fields are more likely to be drier, less prone to submergence, then the high fields need more P. (This effectively link belief with behavior.)

K is used if the leaf is too green, indicating excessive application of N and the threat of lodging. K helps to avoid lodging. If the plant does not show excessive greenness then farmers are less likely to use K. It is more common for these farmers to apply small amounts of K than not, especially considering the high N use. K also helps to increase the number of filled grains. K is used most in the 3rd season (wet). This is because the season is windy and rainy, therefore more likely to lodge.

K is often applied to reduce the greenness of the plant. This means that farmers see the greenness is the attractive aspect of the crop, not the implicit character of the plant when it is very green. In short, the important rice eating insects apparently, according to the farmers, prefer dark green food. Alternatively, yellow leaves are an automatic deterrent to these same insects.

The fundamental role of N is as a growth agent, like a vitamin, for the plants. N has no curative properties, i.e. if a plant gets sick N will not do anything to cure the problem. Some believe there is no difference between brands in terms of effectiveness of N while others, who have changed brands, believe there is a difference and certain brands work better than others

N is used most in the 2nd season because it is sunny and it cannot keep water so they have to help the plant by adding extra N. This is related to the evaporation principle mentioned by farmers. If the don't use extra N the plant won't grow well. They can't keep water in the field because it evaporates. N helps the plant grow under all circumstances. They know the basic amounts they need to apply through years of experience. So when they change their brand of fertilizers it is not a problem so long as they know the mixture (or they learn from the manufacturer what the N rate should be). N acts like medicine, we are sick so we go to the doctor.

Compound vs. single element fertilizers:

Farmers in Vietnam generally prefer compound fertilizers over single ingredient ones. There is a belief that there is some synergistic effects in using all three at once. For instance, some farmers will say that the beneficial greening effects of N last long when P is applied at the same time. The exception to the compound preference is in urea, which is applied in large amounts. It was never to us that compound fertilizers are more expensive per unit of effective ingredient.

Farmers who apply compound fertilizers do not typically calculate the net amount of individual nutrients they apply. In fact, oftentimes they do not even calculate the kilogram equivalent of compound fertilizers, opting instead for "bags", rather than kilos. A bag is equivalent to 50 kilos. So farmers often know neither the total kilogram amount they applied of a compound fertilizer nor the unit amount. Farmers are able to do this because they rely heavily on their experience to guide their decision-making. Experience will dictate the number of bags needed for a given field in a given season. It would be interesting to see how farmers change between brands, because there is a wide range of amounts and types of compound fertilizers. Urea, which is treated in a slightly different way, may also be calculated by the bag. Obviously, if farmers do not know the difference between types of compound fertilizers and the actual rates of application, there could be huge variations in the actual application rates. Switching from 16-16-8 to 16-8-8 implies a significant change in actual amount applied, especially over time. And given that the roles of P and K may not be well identified, the effect of the two may be less noticeable.

Foliars

Vietnamese farmers frequently use foliar fertilizers. They are used almost exclusively near the end of the growing season. Farmers have vary specific ideas about the function of foliar. Many believe it works to repair damaged leaves (e.g. after a herbicide application), or to rejuvenate leaves that have been depleted of nutrients. There may even be a correlation between late season herbicide use and foliar sprays. In addition, foliar sprays give very little actual nutrient, but our data suggests that both rich and poor farmers use these sprays.

Foliars sprays are typically the later fertilizer application of the season (or last 2-3 applications). They also function to ensure panicle and seed growth. In this light, it is worth noting that farmers view foliar applications as a targeted "vitamin" for the plant. So most granular applications occur early in the crop season and foliars later in the crop season. This can be related to the crop growth stages mentioned earlier. The youngest plant is called a child plant (*cây con*) at 7 DAS. At pre-booting the plant is referred to as a young girl not yet married (*thời kỳ con gái*). The plant, like the child, is also not fully mature, and not able to reproduce, just like the child.

These crop stages clearly shows the maturation of the plant — and the metaphorical child —and it portends 'adulthood' after panicle initiation. This splits the life of the crop into two parts: 'childhood' and 'adulthood'. In childhood, the bulk of the nutrients (in granular form) are applied. In adulthood, only small amounts of nutrients (in foliar form) are applied. These foliar applications result from specific threats to the plants, such as after damage resulting from herbicide application.

This treatment of the plant can be considered analogous to the care given children and adult humans. In early life, nutrition is particularly important, so great care is given to making sure the child is well fed, even to the point of causing adults to go hungry. In the case of the rice plant, the decision is likewise made; the bulk of the nutrients are given to the plant early in the season, taken away, in effect, from late season applications. Early applications of N and K reflect beliefs about the way the crop is engineered. For instance, farmers believe that K is responsible for creating a stiff stem, which by most accounts is true. They apparently believe as well (this is conjecture) that once the stem has been created, by booting stage, no more applications of K are necessary. Therefore, most K applications occur before booting stage. N controls overall plant growth, so early season is most important. Late season N, or NPK applications reflect sustaining the system, while not necessarily encouraging increased growth, except in the case of panicles and grains. One farmer, for instance, uses Bioted at 40 DAS to keep the leaves green and with head emergence. He uses Bioted at 70 DAS to feed the grain. When he applies the BIOTED he uses 8 sprays per big *cong* (1300 m^2) which takes him one working day (7 hours). He mixes it at 60 cc with 16 liters of water. The last application of granular fertilizer is at 40 DAS, which is still many days short of harvest, so he supplements the granular fertilizers with a liquid application for proper panicle growth.

Effective uptake time of nutrients

Some farmers believe that N usage is complete within the field. This is evidenced by the fact that once N is applied, little spills over into other fields because water flow is constricted. Periodic greening and browning of the plant implies the N has been used up. N takes about 3 days to show an effect and 10 days to be depleted. The effects of K are seen in about 10 to 15 days.

Soil properties

We determined that there are 6 main soil classes. This is a matrix of types based on height of the field above the river level (low, medium, or high) and soil type (loamy silt and clay soil). Table 3 shows the important characteristics of each soil type, without the medium level. In addition to height and soil type, farmers also consider taste, color, and strata as part of the soil description. As Table 1 shows, both low and high loamy silt soils are considered more fertile and loamy and easier to work than either of the clay soil, which are heavier, clay soils. Higher fields, in both the clay soil and loamy silt types are considered higher yielding in the first season, although this does not hold true throughout the year.

Table 1: Soil classification among farmers in Dinh Phuoc hamlet, Dinh Mon village, Cantho

Factor	Loamy silt		Clay soil	
% in hamlet	50		50	
	Low	High	Low	High
Elevation %	30	70	40	60
color	Pink yellow	White yellow	Brown gray	Yellow gray
Fertility (*)	2	1	4	3
Texture (softness) (*)	2	1	4	3

(*) 1: is the best rank

There is roughly equivalent land area in *Clay soil* and loamy silt, and slightly more high fields than low. Color is an important distinguishing feature, where gray predominates in the clay soil class and yellow in the loamy silt, Fertility is closely linked to texture. The loamy silt soils are considered more fertile and softer.

Soil classification is determined by the second to top layer in the strata of soils. Farmers recognize 4 soil types layers: *đất phù sa* (silt layer), identifier layer [either clay soil or *loamy silt*], *đất sỏi* [gravel layer], *Clay soil*[heavy sediment layer, blue or black in color]. There is some problem with defining soil types in the delta region. In one way of thinking, all soils in the region are alluvial since none escape the seasonal flooding. This gives some overall uniformity to the landscape. Farmers recognize this, and consequently use the 2nd layer to make classifications.

Farmers use various features of the soil to determine its type.

Siltation

The amount of sediment that is deposited on farmers fields varies year to year. In low years it may be less than 1 cm, and average years it is around 2-4 cm. One farmer reported harvesting sediment by flooding his field, letting the sediment settle, draining and reflooding. Farmers gauge the level of deposition by the feel of the sediment while plowing or walking through the field. Deeper deposits, found in natural depressions in the local topography, can be both positive and negative for plant growth. It can be positive because the soil is more fertile and fewer nutrients are required for plant growth. It can be negative because the soil is very loose (little structure) and the plant roots have nothing to grab to, and are therefore more prone to lodging. The top 2-5 cm will be recycled annually, implying on average all the sediment is recycled every year.

Sediment is valuable because it increases the fertility of the soil. The deposition affects the winter-spring season (dry season) most because the main season of deposition is the preceding wet season. Crop effects are seen most early in the growing season. Plants are taller sooner when the silt level is high. The only fertilizer effect is a reduction in urea applications, with no change in P or K. Some farmers said they will reduce their initial urea application by half and the second by a third if the silt level is high. The year 2000 was a very high silt year because of the very severe flooding that occurred.

Field level

The difference between low, medium and high fields is very small. A high field is considered 10 cm above some middle point, while low fields are 10 cm below the midpoint. This is an important consideration when floods occurs, as higher fields are less often flooded, receive less silt, and are less likely to remain submerged for a long period of time. Higher fields may have a slight coloration, either yellow or red, while the lower fields tend be darker (resulting from greater deposition of silt). In a typical year, lower fields get about 15% less nutrients than high fields, probably due to lower levels of siltation.

Ecosystem interactions

Pest and nutrients

Farmers recognize a number of interactions between pests and nutrients. Principal among these is the belief that as N inputs increase, pesticide use should likewise increase. This is based on the assumption that as the plant gets more green it becomes more succulent to invading pests. One way around this problem is to broadcast pesticides with fertilizers. When the pests come to feed or lay eggs, the plant can ward it off. Also, farmers may apply K to excessively dark green plants to lighten the leaf color and reduce the likelihood of disease.

Water, field level and nutrients

Farmers recognize a number of important relationships between water, fields, and nutrients. For instance, evaporation of water implies there is a loss of nutrients, but only in cases where the water level is low. In other words, if a field dries completely due to evaporation then the nutrient loss is the greatest. If the field stays wet the loss of nutrients is reduced, even though evaporation has occurred. Of course, plant canopy is related to evaporation, and the earlier one can establish a tall canopy the more likely it will be to reduce nutrient loss (hence early season emphasis on high N rates).

Farmers' Intentions

Farmers make plans based on experience of past events and expectations about future conditions. These plans are realistically contingency plans. No farmer ever knows the exact conditions of the future, and therefore he must assume some level of uncertainty in his planning.

From table 1, the result of a focus group discussion, we see that farmers link high fertility with high input rates. High loamy silt soils, which are considered the most fertile, also receive the most inputs, in each of the 3 seasons. Although high Clay soil also receives the equal inputs, it's yield is slightly in the 1st and 2nd seasons, and equivalent in the third.

Intermediate

Farmers in the Mekong Delta recognize a host of factors that impinge on their planning process. The importance of each varies by season and field level but will also be a response to external factors such as rice and fertilizer prices. However, much of the planning rests on a few key assumptions of farmers, including

- N is key for plant growth
- K is vital for plant (stem) strength, and as an antidote to excessive N
- P does little for the plant, but is valuable in its capacity to reduce soil acidity
- Silt only brings N to the field
- Field level determines many things, including silt deposition, likelihood of submergence, soil fertility, relative N rates
- More N means more K
- Carryover between seasons is not an issue
- The plant is anthropomorphized, given some human characteristics
- A child plant requires more nutrition than an adult
- N applications are at their highest possible level (so late season foliars are only useful to keep the leaves green)
- Late season applications are good mainly for maintaining green color

Table 2: One farmer's use of foliar fertilizer in relation to crop growth

Stage	Literally	DAS	Fertilization
Bón lót		1 days before sowing (considered basal stage)	Granular
Đợt một		12-15	Granular
Đẻ nhánh	Produce tillers	30	Granular + Foliar
Đòng đòng	Panicle initiation	45	Granular + Foliar
Trước trổ	Before flowering	55	Foliar

A focus group discussion method was used to ascertain the form plans may take in the course of a year. As is evident, farmers expect to apply more fertilizers as the yields decrease from season 1 to season 3. This is true for all land types, although the drop varies somewhat between seasons. For example, for low fields the increase from season 1 to season 2 is expected to be only 5 kilograms, and from season 2 to season 3, a 10 kilogram increase is expected. Alternatively, for high fields, the increase from season 1 to season 2 is 10 kilograms, while season 2 to season 3 a 5 kilogram increase is expected. The total increase from season 1 to season 3, regardless of soil type is 15 kilograms per hectare (or 43% increase in low fields and 38% in high fields.) High fields start with 5 kg ha –1 more applied and end the same way relative to the low fields.

Table 3: Fertilizer plans among farmers in Dinh Phuoc hamlet, Dinh Mon village, Cantho

Factor	Loamy silt		Clay soil	
	Low	High	Low	High
Fertilizer (kg)				
1st season	35	40	35	40
2nd season	40	50	40	50
3rd season	50	55	50	55
Difficulty in rotovation (1= most difficult)	3	4	2	1
Yield (gia/big cong)				
1st season Dry (Winter-Spring)	40 (6.2 t/ha)	45 (6.9 t/ha)	38 (5.9 t/ha)	42 (6.5 t/ha) (more filled grains)
2nd season (Spring-Summer)	35 (5.4)	30 (4.6)	30 (4.6)	25 (3.9)
3rd season Wet (Summer-Autumn)	20 (3.1)	25 (3.9)	20 (3.1)	25 (3.9)
Total	14.7	15.4	13.6	14.3
Rank	2	1	4	3

1 gia=20kg; 1 big cong = .13 ha

Table 4: Factors planned for in assessing fertilizer options in the season

Factors	Rank (Dry season) Season 1	Rank (in between) Season 2	Rank (wet season) Season 3	Mean Rank
Fertilizer Price	1	1	1	1
Rice Price	1	1	1	1
Water Level	1	1	3	1.7
Variety	2	2	1	1.7
Plant Color	2	3	3	2.7
Field Level	3	3	2	2.7
Threat of Disease	2	4	4	3.3
Threat of Lodging	2	-	2	2 (S1 and S3)
Individual Field Fertility	3	4	-	3.5 (S1 and S2)
Silt Level	3	-	-	3 (S1 only)
Weather	-	2	2	2 (S2 and S3)
Presence of Straw	-	2	-	2 (S2 only)
Time in Season	-	2	3	1.7 (S2 and S3)
Stubble	-	-	3	3 (S3 only)
Credit	-	4	4	4 (S2 and S3)

Note: 1 is the most important; S: Season

Table 5: Factors affecting nutrient use and their expected impact

Factors	**N***	**P***	**K***	**Factors**	**N***	**P***	**K***
Fertilizer Price				*Low Clay soil*	–	+	+
Low	+	+	+	*High Clay soil*	+	0	–
High	–	–	–	Silt Level (if silt level is …)			
Rice Price				Low	+	0	0
Low	+	–	–	High	–	0	+
High	+	+	+	Weather			
Water Level				Rainy/windy	–	0	+
Low	0	0	0	Generally calm	+	0	–
High	–	0	0	Presence of Straw	+	0	0
Variety	?	?	?	Presence of Stubble	?	?	?
Plant Color				Time in Season	+/–	+/–	+/–
Yellow	+	0	0	Credit			
Green	–	0	+	Available	+	+	+
Field Level				Unavailable	?	?	?
Low	–	0	+	Fertilizer availability	+	+	+
Medium	+/–	0	0	Available	+	+	+
High	+	0	0	Unavailable	–	–	–
Threat of Disease	–	0	+	Season			
Threat of Lodging	–	0	+	Winter-Spring	?	?	?
Individual Field Fertility				Summer	?	?	?
Low loamy silt	–	+	+	Autumn	?	?	?
High Loamy silt	+	0	–	Acidic Soil	0	0	+

**+ = increases level, – = decreases level, +/– = depends on existing conditions*
0 = no expected change, ? = not known

Recommendations based on the above findings

Farmers in the Mekong Delta make plans based on their beliefs about the interaction of various biological and agronomic factors and actual field conditions. They start with an un-shake able belief is the role that N plays in plant nutrition and growth. Combined with low labor costs (effectively $0 in the 3rd season), and subsidized fertilizers.

Our suggestion is to assume that farmers know how to bring fertilizer rates up, but are not familiar with bringing them down. This must be true, given the extraordinarily high rates of N (especially) among the farmers. Therefore, our (researchers) energies must be focused on encouraging farmers to lower N rates then training farmers to top off the excessively low recommendations. For instance, suppose the final N rate is 80 kg per ha. The recommendation may be 50, too low even under optimal weather conditions, with a further recommendation for farmers to increase their rates according to their known indicators of plant health, leaf color, disease condition etc. So, the recommendation itself would carry with it a set of decision options that farmers could use to optimize their actual fertilizer rates.

SUMMARY IN VIETNAMESE

Kết hợp quan điểm của nhà khoa học và nhà nông về quản lý dinh dưỡng ở vùng lúa thâm canh Đồng Bằng Sông Cửu Long (ĐBSCL), Việt Nam

Cải thiện hiệu quả sử dụng phân bón đem lại lợi ích cho nông dân nói riêng và cho xã hội nói chung. Các nhà khoa học Viện Nghiên Cứu Lúa Quốc Tế (IRRI) phát triển một kỹ thuật gọi là quản lý dinh dưỡng tại đồng ruộng cụ thể (SSNM) để áp dụng thời điểm bón N theo nhu cầu thực tế với tỷ lệ đạm, lân, kali (NPK) đặc thù cho ruộng đó. SSNM được dùng để xác định tỷ lệ NPK khuyến cáo cho từng ruộng cụ thể vào mùa vụ nhất định với mong muốn đạt được mức độ năng suất nhất định dưới sự chú ý khả năng cung cấp NPK của đất tại ruộng đó. Nông dân ở ĐBSCL cũng có phương pháp xác định thời điểm bón và tỷ lệ NPK dưới nhiều lý do khác nhau và cũng đạt những kết quả khác nhau. Những khác biệt này là rào cản cho việc tối hảo hoá sử dụng dinh dưỡng của nông dân, và tổng hợp kiến thức nông dân vào sự khuyến cáo. Bài này, chúng tôi so sánh hai quan điểm sử dụng phân và những điểm chung giữa chúng để có thể giúp nông dân tiết kiệm thời gian, tiền bạc và cải thiện môi trường tự nhiên.