THE FINANCIAL AND ECONOMIC COMPETITIVENESS OF RICE AND SELECTED FEED CROPS IN NORTHERN AND SOUTHERN VIETNAM

Summary of Methodology and Main Results

John Keyser*, Steven Jaffee, and Tuan Do Anh Nguyen*****

*Consultant; **World Bank; ***Center for Agricultural Policy

January 2013

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Abbreviations and Acronyms

CAP	Center for Agriculture Policy (of IPSARD)
CTU	Can Tho University
DARD	Department of Agriculture and Rural Development
DRC	Domestic Resource Cost Ratio
EPC	Effective Protection Coefficient
GSO	General Statistics Office of Vietnam
IPSARD	Institute of Policy and Strategy for Agricultural and Rural Development
MKD	Mekong Delta
NPC	Nominal Protection Coefficient
PAM	Policy Analysis Matrix
RRD	Red River Delta
S-A	Summer-autumn season
W-S	Winter-spring season

Exchange Rate

Local currency	=	Vietnamese Dong (VND)
USD 1.00	=	VND 20,860
VND 100,000	=	USD 4.79

Unless noted, local currency values all expressed in thousands of dong (VND '000)

Weights and Measures

1 hectare (ha)	=	2.471 acres
1 kilogram (kg)	=	2.204 pounds (lbs)
1,000 kilograms (kgs)	=	1 metric ton (ton)
1 kilometer (km)	=	0.62 miles

Local Area Equivalents

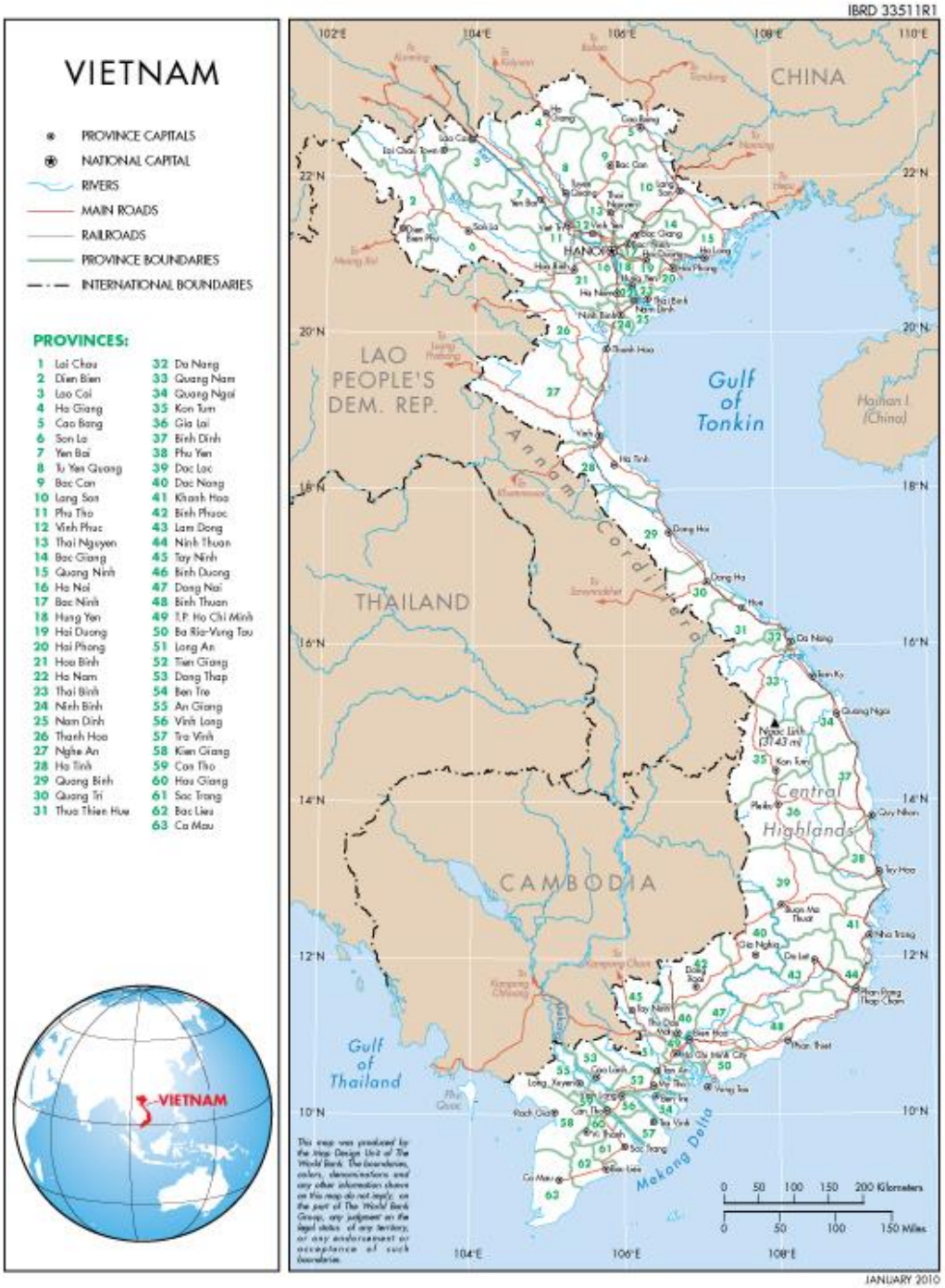
An Giang (southern Vietnam)

1 cong	=	1,000m^2 (0.1 ha)
1 ha	=	10 cong

Nam Dhin and Phu Tho (northern Vietnam)

1 sao	=	360m2 (0.036ha)
1 ha	=	27.8 sao

Map of Vietnam



I. INTRODUCTION

1. One area of weakness in current agricultural policy work in Vietnam is the lack of a clear understanding of both the private profitability of farmers for different crop activities and the social profitability of such activities. Agricultural performance is thus gauged in physical terms (i.e. yields and the volume of aggregate output) rather than in financial or economic terms. This has hampered efforts to compare and contrast the impacts and effectiveness of alternative policy and program measures. Comparative metrics for different crops and farm management systems have been lacking.

2. As a step towards improved sector planning, this paper utilizes the Policy Analysis Matrix (PAM) to analyze various farm management systems for rice, maize, and cassava in different parts of Vietnam. Tradeoffs are involved in all production decisions and the PAM provides a systematic way of comparing the private and underlying social costs and returns from different agriculture enterprises together with the effects of government policy. A spreadsheet template was custom-built for the PAM analysis that produces various financial and economic indicators relevant to government policymakers, farmers, private business people, development planners, and other agriculture sector stakeholders in Vietnam.

Main objectives

3. The main objectives of this working paper are to:

- **(i)** Describe the PAM methodology and how to interpret key financial and economic indicators;
- **(ii)** Document the underlying assumptions used for the analysis; and
- **(iii)** Provide a summary and brief interpretation of the main quantitative results and outcome of selected sensitivity tests.

4. Towards these ends, the working paper is presented in five sections. Following the current introduction, Section II describes the methodology and main assumptions used for the analysis. Section III then presents the main quantitative results for different kinds of rice grown for export in An Giang Province in the Mekong Delta of Southern Vietnam and for domestic rice and alternative stock feed crops grown in Northern Vietnam. Section IV then presents the results of various sensitivity tests that looked at the impact of changes in crop yields, commodity prices, fertilizer costs, and labor costs. The discussion concludes in Section V with a summary of key findings and policy recommendations.

II. METHODOLOGY AND ASSUMPTIONS

5. This section of the paper descries the methodology and underlying assumptions used for the analysis of Vietnam's agricultural comparative advantage. As shown in

6. Table 1, the analysis covers different kinds of domestic and export rice as well as cassava and maize grown for stock feed in selected parts of Vietnam during the Winter-Spring and Summer-Autumn seasons. These crops were the foci of this analysis due to (i) increased concerns about the (low) profitability of traditional rice cultivation and the policy options available

to address this situation, and (ii) the rising trend in Vietnamese animal feed and feed ingredient imports and questions regarding the scope for import substitutes.[1]

7. In Table 1 below, the terms *traditional* and *improved* refer to high and low-input management practices respectively. Presently, rice production in Vietnam is characterized by very high levels of input use including apparently excessive amounts of seed, fertilizer, pesticides, herbicides, and irrigation as part of a previous yield maximizing strategy. Government is now in the process of recommending farmers to improve their production by adopting the so-called "three reductions" (reduced seed, fertilizer, and chemicals) in order to save on costs and produce higher yield with better crop husbandry.[2]

Table 1: List of Enterprises Analyzed

	Location	Season			
		Winter-Spring		Summer-Autumn	
		Traditional	Improved	Traditional	Improved
Southern Vietnam					
1. Ordinary Rice (for export)					
Small farm	An Giang	X	X	X	X
Medium farm	An Giang	X	X	X	X
Large farm (outgrower)	An Giang	n/a	X	n/a	X
2. Jasmine Rice (for export)					
Small farm	An Giang	X	X	n/a	n/a
Medium farm	An Giang	X	X	n/a	n/a
Large farm (outgrower)	An Giang	n/a	X	n/a	n/a
Northern Vietnam (all micro farms)					
3. Domestic Rice					
Standard quality	Nam Dinh	X	X	X	X
Better quality	Nam Dinh	X	X	X	X
4. Maize (for animal feed) - manual and tractor cultivation					
Ordinary hybrid	Phu Tho	X	n/a	n/a	n/a
VN4 Hybrid (new hybrid)	Phu Tho	X	n/a	n/a	n/a
5. Cassava (for animal feed)					
Ordinary variety	Phu Tho	n/a	n/a	X	n/a
KM94 Hybrid (high starch)	Phu Tho	n/a	n/a	X	n/a

Note: For maize, analyzed ordinary and improved hybrid with manual land prep and hypothetical tractor prep. For rice, improved management refers to farmers participating in the "three reductions" program (i.e. reduced seed, fertilizer, and chemicals)

8. For maize and cassava grown in northern Vietnam, the analysis covers the traditional (high-input) management level only since improved (reduced) production systems are not yet being promoted for these commodities. Instead, the analysis of these alternatives crops for rice is based around different varieties of planting material including ordinary (traditional) hybrids and improved hybrids (specifically VN4 for maize and KM94 for cassava). For maize, which is generally grown on a very small scale with manual cultivation, the analysis further includes a hypothetical model based on (larger-scale) tractor cultivation to illustrate the potential costs and benefits of promoting this system as an alternative to rice. Once a basic set of spreadsheet

[1] In 2012, Vietnam's rice exports were valued at some $3.2 billion, while its imports of animal feed and feed ingredients exceeded $4 billion.

[2] With traditional practices, farmers plant "too much" seed to the point where individual plants crowd themselves out and/or apply "too much" fertilizer to the point where the plants grow to excessive heights and become top-heavy resulting in a large share of "fallen rice" and reduced harvest.

models covering different crops and farm systems has been prepared, it is relatively easy to make minor changes to the models and test the impact of different input and output assumptions.

A. Analysis of Farm Enterprises

9. The quantitative analysis began with a data collection exercise carried out in August 2012 together with CAP/IPSARD. The primary objective at this stage of the project was to prepare a set of indicative enterprise budgets that reflect the total costs of current farm practices and recommended technologies to the best extent possible. Many of the crop models used previously for policy analysis in Vietnam have excluded detailed estimates of family and hired labor costs, capital investment requirements, and state subsidies including the cost of maintaining primary and secondary irrigation canals, crop research and extension programs, and energy subsidies on fuel and electricity used during the production, processing, and marketing of agriculture commodities and crop inputs.

10. Data collection involved discussions with a wide range of agricultural sector stakeholders in An Giang, Nam Dinh, and Phu Tho Provinces including individual smallholder farmers, crop research and extension authorities, irrigation authorities, private traders, outgrower companies, plant protection companies, large and small scale milling companies, stock feed manufacturers, and others with a detailed knowledge of current agriculture conditions. Various research reports and official documents were also consulted including GSO agriculture statistics, reports by the Department for Agriculture and Rural Development (DARD) in each province comparing current and recommended farm practices, university research reports on input use, farm yields, crop prices, and farmer incomes, among others.

11. Based on these consultations, indicative enterprise budgets were prepared covering a range of current and recommended management practices with variations by farm size, level of input use, and season (see

12. Table 1). This approach is intended to allow the relative costs and profits from different management systems to be compared on as equal terms as possible from the financial and economic perspectives. At present, for example, rice farmers are being advised to scale back on their use of seed, fertilizer, and pesticides in order to save on costs and produce higher yields. According to agriculture administrators, previous farmer recommendations went too far in applying high input use to the point where yields and farmer profits have actually been compromised by using too many inputs. By preparing crop models based on traditional (high input) and improved (reduced input) management practices including the financial costs paid by individual farmers and economic costs paid by the wider society, it is possible to compare the advantages and disadvantages of the recommended system from a variety of perspectives. Similarly, by preparing crop models for ordinary and specialty export rice, domestic rice, and alternative stock feed crops by region and farm size, it is possible to compare the financial and economic tradeoffs of each competing enterprise and gain a better understanding of which systems policymakers may wish to support.

B. The Policy Analysis Matrix (PAM)

13. Based on the indicative production models for different crop and farm management systems, the next step of the analysis was to construct a set of policy analysis matrices (PAMs). As shown in Table 2, the PAM is a product of two accounting identities. The first defines *profitability* as the difference between revenues and costs; the second measures the effects of

government interventions or divergences (market failures) as the difference between observed parameters and parameters that would exist if the divergences were removed. By filling in the elements of the PAM for each activity, it is possible to measure the extent of policy effects as well as the inherent economic efficiency or comparative advantage of the production system. Other information regarding input costs, farmer profitability and financial rates of return can also be generated through this approach to agricultural analysis.[3]

Table 2: The Policy Analysis Matrix (PAM)

	Revenues	Tradable Input Costs	Domestic Factor Costs	Profits
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Policy Effects (transfers)	I	J	K	L

Where: D = A - B -C I = A – E
H = E - F - G J = B - F
L = I - J - K = D - H K = C - G

And: Domestic Resource Cost (DRC) = G / (E – F)
Nominal Protection Coefficient (NPC) = (A / E)
Effective Protection Coefficient (EPC) = (A - B) / (E - F)

14. The PAM is based on a familiar equation:

Profit = Revenue – Cost [1]

15. The PAM as presented in Table 2 has four columns. The first is for revenue, the second and third are for costs, and the fourth is for profitability. Each PAM contains two cost columns, one for tradable inputs and the other for domestic factors. It distinguishes between tradable inputs and domestic resources because exchange rate policies affect the former and because certain measures of efficiency require the distinction. Intermediate inputs – including fertilizer, pesticides, purchased seeds, electricity, transportation services, and fuel – are divided into their tradable-input and domestic factor components. Revenue is measured with reference to an import or export parity price, which is the amount of money a country either saves or earns from the production system being analyzed.

16. The PAM has three rows. The first two rows represent different versions of equation [1] with the first row evaluated using the actual (market) prices or “financial prices” encountered by the production system and the row below it evaluated at economic or social prices. The effects of government policy (or market failure) are measured in the third row, for which each entry is simply the difference between its value in the first row and second row.

[3] This section draws extensively from the PAM methodology described by Monke and Pearson, *The Policy Analysis Matrix for Agricultural Development*, Cornell University Press, Ithaca (1989).

Private Profitability (D)

17. The data entered in the first row of Table 2 measure a production system's private profitability. The term private refers to observed revenues and costs reflecting actual market prices received or paid by farmers, traders, and processors in the agricultural system. These private or actual market prices thus incorporate all underlying economic costs and valuations plus the effects of all policies and market failures. In Table 1, private profits (D) are the difference between revenues (A) and costs (B + C); and all four entries in the top row are measured in observed prices.

18. Because the PAM looks at an entire production system in which revenue is valued with reference to an international parity price, private profits (D) do not necessarily equal the income that accrues to individual farmers. Limited access to markets, lack of knowledge about world prices, and profit margins taken by traders and intermediary processor all mean that farmers are rarely paid import or export parity at the farm gate.

19. Since agricultural production revolves around farm-level decision making, several additional measures of financial profits and production costs are provided for each activity (see Box 1). These measures of farmer profitability are important because it is possible for an agricultural activity to be an efficient user of domestic resources, but unprofitable, or too expensive, from the farmer's private perspective.

Box 1: Financial Indicators

Financial costs and profits are measured at the farm level in per hectare terms as follows:

Total Revenue
The models assume that farmers sell their entire yield. Total revenue is thus determined by multiplying total yield (kg/ha) by the farm gate price (VND/kg).

Production costs
Variable costs (excluding family labor): These costs vary by crop and management system and include all items that must be paid for by the farmer each season including seed, fertilizer, agri-chemicals, irrigation fees, tractor and/or combine hire, and hired labor.

Capital recovery costs: These costs measure the fixed cost or depreciation of all tools and equipment used to grow the crop with a useful life spread over more than one crop cycle.

Total costs = variable costs + capital recovery costs

Farmer profits
Gross margin = total revenue – variable costs

Net profit = total revenue – total costs

Farm labor
The approximate number of 6-hour workdays provided by family members and hired workers has been estimated for each crop model. In turn, these estimates are used to calculate:

Gross profit per day family labor

Net profit per day total labor

Rates of return
The financial rates of return to a farmer's variable and total expenditure are given by the following ratios. Enterprises with a high ratio provide a better rate of return than those with a low ratio.

Gross margin / variable cots

Net profit / total costs

Social Profitability (H)

20. As shown in Table 2, the second row of the PAM uses social prices. Among the differences with financial prices, social prices include the cost of all subsidies paid by government since these are a cost to the

economy. Similarly, social prices exclude the cost of taxes paid by farmers and other participants in the production chain since these represent a transfer from one sector to another. Social valuations therefore measure comparative advantage or efficiency in the agricultural commodity system. Efficient outcomes are achieved when an economy's resources are used in activities that create the highest levels of output and income. Social profits (H) are an efficiency measure because outputs (E) and inputs (F + G) are revalued in prices that reflect scarcity values or social opportunity costs. Social profits, like private profits, are the difference between revenues and costs, all measured in social prices: H = (E - F - G).

21. For outputs (E) and inputs (F) that are traded internationally, the appropriate social valuations are given by world prices. These are cif import prices for goods or services that are imported or fob export prices for exportables. World prices represent the government's choice to permit consumers and producers to import, export, or to produce goods or services domestically. The social value of additional domestic output is thus the foreign exchange saved by reducing imports or earned by expanding exports.

Policy Effects (I, J, K, and L)

22. The second identity of the PAM concerns the differences between private and social valuations of revenues, costs, and profits. For each entry in the matrix – measured vertically – any divergence between the observed financial (actual market) price and the estimated economic (social efficiency) price must be explained by the effects of policy or by the existence of market failures. This follows directly from the definition of social prices. Social prices correct for the effects of distorting policies – policies that lead to an inefficient use of resources. These policies may be introduced because decision makers are willing to accept some inefficiencies (and thus lower total income) in order to promote non-efficiency objectives such as the redistribution of income or the improvement of domestic food security.

23. Only government policy or market imperfections can cause a divergence between private and social prices. Unless the government enacts a protection policy, for example, each importable output and input will be available at its cif import price, which in turn becomes the domestic price so that A will equal E and B will be the same as F in Table 2. Consequently, any difference between A and E or between B and F is caused by some combination of trade restrictions, price control, tax/subsidy, or exchange rate policies. If A exceeds E, either domestic consumers are forced to pay higher than world prices or the government treasury is directly subsidizing production, causing an output transfer (I) equal to (A – E). Similarly, if B is greater than F, tradable inputs are taxed resulting in an input transfer (J) of (B – F). For domestic factors, the transfer (K) amounts to (C – G).

24. The net effects caused by policy and market failures (L in the matrix) is the difference between effects on outputs (I) and on costs (J and K), thus L = (I – J – K). The net effect can also be found by a comparison of private and social profits. By definition, these measures of net effects must be identical in the double-entry matrix: L = (I – J – K) = (D – H).

25. Table 3 summarizes and defines the policy effect measurements generated by the PAM. The full set of PAM indicators from the analysis is given in Appendix 2.

Table 3: Policy Effect Measurements

Indicator	Formula	Description
Net effect	L = D – H; or L = I – J - K	Net effects of government policies
Output effect	I = A – E	Effects generated by domestic price/border price differences
Tradable input cost effect	J = B – F	Effects generated by domestic price/border price differences
Domestic factor cost effect	K = C – G	Effects generated by actual price/shadow price differences

Comparison of Agricultural Activities Producing Different Outputs

26. The entries in the PAM allow comparison among agricultural activities that produce identical outputs. If interest focuses solely on a comparison of one jasmine rice operation with another, for example, the matrix entries provide all the information necessary for the analyst. Comparisons can be drawn readily by construction of PAM entries for two or more different systems that produce the same quality of rice.

27. Comparisons between different types of rice and other crops, however, are another matter. To permit the comparisons of systems that produce different outputs, some common numeraire must be generated. One such technique uses ratios in which both the numerator and the denominator of the ratio are PAM entries defined in domestic currency units per physical unit of the commodity.

Domestic Resource Cost Ratio (DRC)

28. Social profits (H) measure efficiency or comparative advantage. When systems producing different outputs are compared for relative efficiency, the Domestic Resource Cost Ratio (DRC) defined as G/(E - F), serves as a proxy measure for social profits. By elementary algebra it follows that the ratio equals 1 if social profitability (H) is 0, is greater than 1 if H is negative, and is less than on if, and only if, H is positive. Minimizing the DRC is therefore equivalent to maximizing social profits and, the lower the DRC, the greater the system's comparative advantage. In cross-commodity comparisons, DRC ratios replace social profit measures as indicators of relative degrees of efficiency.

29. Efficient activities can be defined equivalently as those for which social profitability is positive or for which the DRC is less than one. Similarly, if the DRC is greater than one, this shows that the production system consumes more domestic resources than the revenue it produces is therefore not socially efficient.

Nominal Protection Coefficient (NPC)

30. The Nominal Protection Coefficient (NPC) is a ratio that contrasts observed (private) revenue at import parity with a comparable world (social) price. This ratio therefore indicates the impact of policy (and of any market failures not corrected by efficient policy) that causes a divergence between the two prices. The NPC on tradable outputs, defined as (A/E), indicates the degree of output transfer. If the NPC is greater than one, policies are increasing the market price above the world price, thus providing a positive incentive to the producer. An NPC less than one, on the other hand, indicates a negative incentive (or disincentive) to the producer.

Effective Protection Coefficient (EPC)

31. The Effective Protection Coefficient (EPC) is another indicator of incentives and is the ratio of value added in private prices (A-B) to value added in world prices (E-F). Thus EPC = (A-B)/(E-F). This coefficient measures the net policy effect resulting from product market-output and tradable-input policies and therefore a more complete measure of policy effects than the NPC.

C. Main Assumptions

32. The main assumptions and specific procedures applied to this analysis of selected crops in Vietnamese agriculture are described below.

Current prices

33. Unless noted, the analysis is based on current prices, subsidies, and tax policies that prevailed at the time of data collection in August 2012. In order to convert foreign currencies to their Vietnamese dong (VND) equivalent, a financial exchange rate of USD 1.00 = VND 20,860 was used. The dong is free of restrictions for current payments and it was further assumed that the financial and economic exchange rates are equivalent.[4]

Location

34. The analysis of export-oriented rice in southern Vietnam is based on production in An Giang Province in the Mekong Delta (MKD), which is a major rice growing area and regarded as one of the best locations for producing rice in Vietnam. The decision to focus on An Giang therefore means that the base analysis of export rice should be interpreted as a "best case scenario" for Vietnam. To illustrate the efficiency of rice production in other, less well-endowed rice areas, a limited range of sensitivity tests was carried out for other MKD locations.

35. In northern Vietnam, the analysis of rice grown for domestic consumers is based on production in Nam Dinh in the Red River Delta (RRD). Along with adjacent provinces, Nam Dinh is one of the major rice growing areas in northern Vietnam and a leading supplier of rice to consumers in Hanoi and other northern cities. Production of maize and cassava, on the other hand, are based on data collected in Phu Tho in the northern midlands where the crops are used for home consumption, to supply domestic stock feed manufacturers, and for export to China. Maize and cassava are also grown in Nam Dinh, but mainly for home consumption and on a much smaller scale than in Phu Tho.

[4] According to the IMF's latest Article IV Report (July 2012), the macroeconomic balance approach indicates a current account norm of -2 percent of GDP, which implies a small undervaluation of 0.4 to 0.9 percent. The external stability and the equilibrium exchange rate approaches, on the other hand, suggest a modest overvaluation of the dong. In PAM analysis, if the exchange rate were over-valued (or under-valued) by any given percent, this would result in the same percent increase (or decrease), in the DRC, NPC, and EPC scores respectively. For example, if the dong were over-valued by 7 percent (i.e. VND 22,302 in economic terms per USD instead of VND 20,860 per USD), the DRC for jasmine rice grown with improved management on a medium-size MKD farm in the winter-spring season would increase from0.40 to 0.43 (i.e. from 0.40639 to 0.43484) while the NPC would go from 1.01 to 1.08 (i.e. from 1.0125 to 1.08338) and the EPC would go from 1.01 to 1.09 (i.e. from 1.0144 to 1.08541).

Farm sizes

36. The quantitative analysis of northern and southern agriculture also covers a range of different farm sizes as shown below.

- Southern Vietnam (An Giang)
    - Small-scale = 0.75ha family farm (7.5 cong)
    - Medium-scale = 1.5ha family farm (15 cong)
    - Large-scale = 5.0ha group-managed farm with outgrower support (50 cong)
- Northern Vietnam (Nam Dinh and Phu Tho)
    - Micro-scale = 0.17ha family farm (5 sao)

37. Different yield, price, and capital recovery cost assumptions apply to the analysis of each farm sector depending on the technologies and market linkages available to each type of producer. Whereas the analysis of small-, medium-, and micro-scale farms is based on production by individual farm households, the analysis large-scale rice in southern Vietnam is based on group management of a consolidated (5ha) plot with technical and material support from an outgrower company able to negotiate forward contracts with international buyers.

38. Large-scale rice production has recently attracted considerable interest as a strategy for achieving better economies of scale and increased mechanization at the farm level. In practice, most large-scale rice systems currently operated in Vietnam are organized by private marketing companies. Under these systems, participating farmers pool their land into a consolidated (large-scale) field in exchange for extension support and a pre-negotiated price from the marketing company. Because of forward negotiations with international buyers, these companies usually pay higher prices to farmers who, in turn, produce more yield per hectare as a result of the timely delivery of inputs and extension support provided by the company. While large-scale systems offer many apparent advantages, the opportunities for outgrower production are limited by the number of export firms (and by the milling capacity of each firm) interested and able to provide this package of support. In cases where farmers are not linked to an outgrower company, DARD officials in An Giang report that it has been very difficult to persuade farmers to organize themselves in groups merely for the supposed benefits of improved economies of scale.[5]

Capital recovery costs

39. For each category of farmer, fixed depreciation on all tools and other equipment with a useful life spread over more than one crop cycle has been estimated using the so-called *capital recovery cost* method. This cost is the payment per cycle that will repay the cost of each fixed

[5] The 'large field model' was officially introduced in Can Tho in the spring of 2011 and was the subject of a supportive resolution by the National Assembly in November 2011. For the 2011-12 WS crop, some 19,000 hectares were planted under this model, including examples in twelve of the thirteen Mekong Delta provinces. An Giang province accounted for about one-fourth of that total. The government would like to see a very substantial replication of the 'large field model' and to promote in these schemes Vietnam Good Agriculture Practices (VIETGAP) and other sustainability standards.

investment over its full useful life and provide an economic rate of return on the investment.[6] This approach has the advantage over the simple division of an input's value by its useful life as it accounts for the fact that if the farmer did not purchase the input, the money could have been invested in some other on- or off-farm activity.

40. As shown Table 4 below, micro- and small-scale farmers bear relatively higher capital recovery costs per crop cycle than medium- and large-scale farmers do. The fixed costs are especially high for very small micro-farms in northern Vietnam where very poor economies of scale mean the estimated capital recovery costs for one cycle of domestic rice are almost VND 2.9 million per hectare or equal to roughly 15% of total production costs for improved (reduced input) domestic rice. For the large-scale rice model in southern Vietnam, it is assumed that the group owns a row seeder. Full details of the capital recovery cost calculations are given in Appendix 1.

Table 4: Summary of Capital Recovery Cost Assumptions

	Farm size	Types of tools owned	Replacement Value (VND'000)		VND '000 per ha per cycle	Total % forex	Composite conversion factor
			Per farm	Per Ha			
An Giang (ordinary and jasmine rice)							
Small	0.75	Various hand tools, sprayer, rat traps, grain bags, motorbike.	14,384	19,178	677	27%	1.01
Medium	1.5ha	Similar items but in greater quantity to cover larger area	14,995	9,997	436	26%	1.01
Large	5ha	Similar to medium but over 5ha with group-owned row seeder	70,700	14,140	638	27%	1.01
Northern Vietnam (micro farms, various crops)							
Shared implements (all crops)	5 sao (0.17ha)	Various hand tools, sprayer, rat traps, grain bags, motorbike.	13,629	80,173	2,297	28%	0.99
Rice only tools	5 sao (0.17ha)	Sickle, small boat	440	2,588	597	5%	1.06
Maize only tools	2 sao (0.07ha)	Knives (to cut maize)	165	2,292	729	10%	1.02

Seasons

41. Due to varying agro-ecological and hydrological conditions, wide differences exist in the productivity of rice cultivation in different growing seasons. In southern Vietnam, the most productive season is the winter–spring (W-S) season, for which average yields can approach 6.5 tons/hectare. In recent years, the W-S crop has accounted for just under 50% of the annual paddy production of the MKD and is the primary source of rice sold as exports. The second most important season for rice in the MKD is the summer-autumn (S-A) season. This season is frequently impacted by extended periods of flood inundation resulting in lower average yields of

[6] Annual cost per hectare = purchase price of implement * per hectare share of use * capital recovery factor. CRF = (((1+i)^n)*i)/((1+i)^n-1) where i = real interest on savings and n = number of years in the implements useful life. For a full description of this methodology, see Monke and Pearson (1989).

only 4.7 tons/hectare in recent years. A third crop is sometimes grown during autumn-winter, but now accounts for less than 10% of the annual MKD output and is not covered by the analysis.

42. There is generally less difference in yield between the W-S and S-A seasons in northern Vietnam. Still, growing conditions are often very cold at the start of the W-S season leading farmers to use more seed because of poor germination. Each of the households interviewed for this study reported 10-15kg per sao higher yields (i.e. 278kg/ha) in the W-S season compared with S-A. In terms of price, farmers and traders in Nam Dinh reported that the S-A rice typically sells for 15-20% more per kg compared with (higher yielding) W-S rice, making the S-A rice more profitable overall.

Crop yields

43. Yield assumptions used in the base analysis for each crop and category of producer are drawn from a variety of data sources including information reported by the GSO, farmers, crop extension officers, outgrower companies, and DARD reports on results of efforts to promote improved (lower- input) rice production. These assumptions are summarized below. For each management variation, specific adjustments were made to account for the typical differences reported by crop experts between different size farmers, different seasons, and growing locations. In the case of large-scale rice, for example, it was assumed that contracted growers achieve around 400kg dry paddy per hectare higher yield than independent medium scale farmers due to the benefits of outgrower support and private extension advice. For jasmine rice, it was likewise assumed that yields are 5% higher compared with ordinary W-S export rice in the MKD due to most farmers using new seed.

Table 5: Yield Assumptions, base analysis (tons/ha)

	Winter-Spring		Summer-Autumn	
	Traditional	Improved	Traditional	Improved
An Giang				
Ordinary rice (export)				
Small farm	6.08	6.30	4.68	4.91
Medium farm	6.75	7.00	5.20	5.45
Large farm (outgrower)	n/a	7.40	n/a	5.75
Jasmine rice				
Small farm	6.38	6.62	n/a	n/a
Medium farm	7.09	7.35	n/a	n/a
Large farm (outgrower)	n/a	7.77	n/a	n/a
Nam Dinh, Phu Tho (mocro farms)				
Domestic rice				
Standard quality	4.73	5.20	4.45	4.89
Better quality	4.17	4.59	3.89	4.28
Feed maize				
Normal hybrid	4.4	n/a	n/a	n/a
New variety (VN4)	5.5	n/a	n/a	n/a
Cassava (fresh tubers)				
Traditio\nal variety	n/a	n/a	19.00	n/a
New variety (KM94)	n/a	n/a	30.00	n/a

Sources: Own estimates derived from expert interviews and various reports including Can Tho University, 2010; An Giang Plant Protection Company, 2012; An Giang Department of Agriculture and Rural Development, 2009 and 2012; Nam Dinh Department of Agriculture and Rural Development, 2012; and World Bank, 2012.

44. Because actual rice yields can vary greatly depending on location, farmer skill, seed type, annual growing conditions, and many other factors, a variety of sensitivity tests were carried out to show the effects of reduced yield on farmer profitability and economic efficiency. In reading the base analysis, it should be kept in mind that An Giang is one of the very best locations for growing rice in Vietnam and that farmers in other major rice growing areas in the MKD such as Kien Giang, Long An, and Soc Tran regularly receive 10-25% less yield on a per hectare basis. Sensitivity results indicative of these other locations are presented in Section IV.

Labor requirements

45. For each productive unit variation, the estimated number of days of family and hired labor required per hectare was estimated as shown in Table 6 and Table 7 below. All farmers use family and hired labor yet in different proportions depending on the availability of family workers, time available to complete sensitive tasks, access to laborsaving machinery, and availability of alternative on- and off-farm employment opportunities. The estimates used here considered each of these factors including the level of mechanization and type of tools owned by each category of farmer. They are based on a variety of data sources including first-hand farmer interviews and previous large-scale surveys of farm labor requirements by Can Tho University and the Cuu Long Rice Research Institute.

Table 6: Labor Assumptions for Rice (days/ha)

	Ordinary Rice						Jasmine rice		
	Winter-Spring			Summer Autumn			Winter-Spring		
	Hired	Family	Total	Hired	Family	Total	Hired	Family	Total
An Giang									
Small farm (3 cong = 0.3 ha)									
Traditional (high input)	31	29	60	27	32	59	35	39	74
Improved (reduced input)	24	31	55	23	31	54	27	41	68
Medium farm (1.5 ha)									
Traditional (high input)	21	19	40	17	22	39	29	30	59
Improved (reduced input)	21	23	44	19	25	44	26	35	61
Large farm/outgrower (5 ha)									
Improved (reduced input)	24	25	49	20	27	47	30	36	66
Nam Dinh									
Micro farm (5 sao = 0.17ha)									
Traditional (high input)	38	120	158	32	121	153	n/a	n/a	n/a
Improved (reduced input)	33	114	147	30	112	142	n/a	n/a	n/a

Table 7: Labor Assumptions for Rice Alternatives (days/ha)

	Hired	Family	Total
Maize (manual)			
Standard hybrid	24	141	165
VN4 hybrid	24	146	170
Maize (tractor)			
Standard hybrid	3	30	33
VN4 hybrid	3	30	33
Cassava			
Traditional variety	10	175	185
KM94 hybrid	15	204	219

46. In reviewing these tables, it will be noted that the labor requirements for northern crops (Nam Dinh micro-farm rice, maize, and cassava) are much higher compared with An Giang. In

the case of rice and maize, this is because northern farmers generally start their crop in a nursery and then transplant individual seedlings to the field after about a month. This procedure is very time consuming on a per hectare basis so represents a large cost to Vietnam even though nursery operations can still be regarded as acceptable for individual households because of the very small farm sizes. Farmers in the MKD, on the other hand, normally sow directly in the field so enjoy considerable labor savings. Likewise, northern farmers typically harvest rice (and other crops) by hand whereas medium-scale farmers in the south are increasingly using hired combine harvesters (as a result of rising labor costs and periodic labor shortages).

47. With regard to land preparation, over 98% of rice farmers in northern and southern Vietnam were said to use a hired tractor. Even though many fields are very small, especially in the north, manual preparation with hand hoes or animal traction was said to be extremely rare for rice. In the case of northern maize and cassava, on the other hand, a very different situation was reported whereby most farmers were said to use manual cultivation thereby contributing to the high labor estimates for these crops. The model for tractor-based maize in northern Vietnam is a hypothetical model and, in this case, the labor estimates are based on savings from tasks that can be mechanized including land cultivation, planting, and harvesting. Rather than transplant maize seedlings as farmers do for rice, the tractor model assumes that seeds are planted directly in the field, thereby contributing to labor savings.

48. Other than the factors noted already it was further assumed that proportionately more time is required for the same activities in the north (weeding, crop scouting, etc) because of the poor economies of scale associated with very small farm sizes in northern Vietnam. Given an average farm size of just five sao, for example, each hectare of farmland in the north is managed by 5-6 households. Moreover, each household's total holding is typically composed of 2-5 different plots that are no more than one or two sao each and are often 20-30 minutes apart by motorbike. Full details of the labor requirement assumptions are given in Appendix 1 where the totals for each crop and management variation are broken down by individual task.

Costs of labor

49. In the crop budgets, the financial charges for hired labor are based on the rates reported by key informants met during data collection. Specifically, these rates are VND 80,000 (USD 3.84) per 6-hour day in the Mekong Delta and VND 100,000 (USD 4.79) per 6-hour day in northern Vietnam. Family labor is not counted as a financial cost since farmers do not pay for this with an expenditure of cash.

50. For the economic analysis, on the other hand, the value of family labor must be counted. At this level, the approach taken was to value the opportunity cost of family labor at 60% of the hired labor rate since farmers generally do not have the opportunity to sell their labor every day of the year. Given the fast pace of economic growth in Vietnam, a limited range of sensitivity tests were carried out to show how the financial and economic competitiveness of rice and rice alternatives would stand up to an escalation in wage rates.

Producer prices

51. Producer price assumptions are based on reports from individual farmers, traders, milling companies, outgrower managers, and other key informants met during data collection. To reflect key differences that exist between the marketing arrangements of different categories of farmer, it was assumed that small-scale farmers in southern Vietnam sell to a private trader

whereas medium-scale growers sell to a cooperative. For the large-scale rice model, farmers were assumed to deliver dry paddy rice to the outgrower company's mill where they sell at prices some 20-30% higher than typically occurs via intermediaries in the growing areas. Details of these financial assumptions are show in Table 8 below.

Table 8: Producer Price Assumptions (VND per kg)

	Product Form	Selling Point	Winter-Spring	Summer-Autumn
An Giang				
Ordinary rice (export)				
Small	Dry paddy	Farm area (trader)	4,500	3,890
Medium-scale	Dry paddy	Farm area (co-op)	4,700	4,090
Large-scale (outgrower)	Dry paddy	Factory gate	5,650	5,040
Jasmine rice				
Smalll	Dry paddy	Farm area (trader)	5,900	n/a
Medium	Dry paddy	Farm area (co-op)	6,000	n/a
Large-scale (outgrower)	Dry paddy	Factory gate	6,400	n/a
Northern Vietnam (all micro)				
Domestic rice				
Standard quality	Dry paddy	Farm area (trader)	5,300	6,300
Better quality	Dry paddy	Farm area (trader)	6,800	7,800
Feed maize				
Traditional hybrid	Shelled grain	Farm area (trader)	6,000	n/a
New hybrid (VN4)	Shelled grain	Farm area (trader)	6,000	n/a
Cassava				
Traditional variety	Fresh tuber	Farm area (trader)	n/a	1,750
New variety (KM94) *	Fresh tuber	Farm area (trader)	n/a	2,013

* KM94 Cassava not yet being marketed, assume 15% higher price due to increased starch content.

Parity prices

52. As described, the policy analysis matrix requires agricultural outputs to be valued at their international parity price worked back to an equivalent product form at the farm gate.[7] Full details of these international price assumptions and the ratios used to convert milled rice to dry paddy equivalent at the farm gate are given in Appendix 1.

53. For the large-scale outgrower models in MKD, a somewhat higher fob price was assumed for ordinary and jasmine rice than with small- and medium-scale rice due to the company negotiating forward contracts with international buyers. A somewhat more favorable outturn ratio from dry paddy was also assumed for outgrower rice due to the use of a single variety improved seed and extension support provided by the company. To test the impact of this assumption on the efficiency analysis of large-scale rice, a limited range of sensitivity tests were conducted using the standard fob price and milling outturn assumptions used for other rice models (see discussion of the main results below).

54. For rice grown as an import substitute in northern Vietnam, the international parity calculations are based on the cost of bringing low-grade domestic rice from the Mekong Delta by boat to northern Vietnam to supply consumers in Hanoi. Vietnam imports very little ordinary rice for domestic consumers and this approach was considered the best way to measure the efficiency of northern production since surplus rice in the south could be used to feed northern

[7] Dry paddy rice, shelled maize, fresh cassava tubers, etc.

consumers.[8] Since this rice is still a domestic product, no import duty was charged as part of the import parity calculations.

55. For the analysis of maize and cassava in northern Vietnam, the approach taken to calculate import parity prices was to work the factory gate price quoted by large stock feed manufacturers back to the farm gate. For maize, this was the imported cif price for foreign grain less transport and handling costs from the factory to farm area. For cassava, the import parity price was likewise determined by taking the price paid for sliced dry cassava at the factory less transport to the farm area, less slicing costs, and finally by converting this value to fresh cassava equivalent which is the product sold by most farmers.

Estimation of economic conversion factors and foreign exchange proportions

56. Because the PAM requires the use of economic prices and separation of total costs according to their foreign exchange proportion, a special spreadsheet template was constructed for estimating these percentages. By entering data on economic transfers including rate of value added tax, import duty, and domestic subsidies as well as the assumed profit margins and domestic mark-ups taken by distribution agents, the template will calculate the foreign exchange content and economic conversion factors needed for PAM analysis. See Appendix 1 for details.

Irrigation

57. Bearing in mind that the technical specifications and costs of operating Vietnam's irrigation system varies greatly from province to province depending on local terrain, elevation, and source of water supply, the Department of Agriculture and Rural Development (DARD) in each province is generally responsible for maintaining the irrigation network at the primary supply and secondary distribution levels with individual farmers and farmer cooperatives taking over responsibility for delivery of water to the actual farm fields at the tertiary level. Whereas the financial costs paid by farmers for irrigation water are therefore easy to identify, the total economic costs including the costs of maintaining national reservoirs, pumping stations, distribution canals, canal locks, and other essential parts of total infrastructure are difficult to determine. The situation is further complicated by the fact that irrigation water can be used for many purposes including irrigation of crops with different water requirements, aquaculture, and even for salt production.

58. Given these complexities, the approach taken for this study was to divide the total annual irrigation budget attributable to crops reported by the DARD offices in An Giang and Nam Dinh provinces by the number of hectares irrigated to derive the government's share of total irrigation costs. For the improved (reduced input) rice models, the government's share of total economic costs in each province was reduced by 10% to account for the savings on irrigation. Full details of these calculations are given in Appendix 1. Irrigation costs only apply to rice since maize and cassava are grown as rain fed crops in Vietnam.

[8] Vietnam does import a considerable amount of unmilled paddy from Cambodia, with this either entering the domestic market in Southern Vietnam or becoming part of the Mekong Delta's rice exports. For the northern region, rice imports are primarily in the form of sticky rice from Laos used in the production of confectionery products.

Agriculture extension, crop research, and outgrower overheads

59. Similar to the approach for irrigation, the economic cost of government extension services and crop research were estimated by dividing the total extension budget for each province by the total number of hectares planted in that province. For improved (reduced rice) models, a further economic charge was applied to account for the costs of promoting the new methods. For large-scale rice, the costs of private extension services were estimated from information provided to the research team plus 20% overheads to account for other costs associated with organizing an outgrower program. Details of these assumptions are also given in Appendix 1.

Energy costs (fuel, transportation, electricity)

60. The conversion factors and foreign exchange proportions for fuel and electricity were derived with reference to a study of Vietnam's energy sector by UNDP.[9] Bearing in mind that the exact composition of energy costs in Vietnam is masked by a wide array of subsidies including transfer payments to loss-making state owned enterprises, a number of simplifying assumptions were made to reflect the approximate overall subsidy and foreign exchange components of fuel and electricity. Details of these assumptions are given in Appendix 1 and may be summarized as follows:

- **Electricity (used by rice mills, irrigation pumps, etc)**
    - 75% domestic costs; 25% foreign costs (based on various sources of supply)
    - 25% overall subsidy (based on UNDP comparison of current tariffs and tariffs that would be needed for the sector to be financially sustainable)
- **Fuel (used for all types of transportation, tractor operations, combine harvesting, etc)**
    - 90% domestic costs; 10% foreign costs (based on Vietnam being a net fuel exporter but with imported costs for machinery, refining technology, etc)
    - 20% overall subsidy (based on UNDP estimate of 12% subsidy at the pump plus 8% subsidy to cover revenue losses by state owned enterprises).

[9] UNDP, 2012.

III. BASE ANALYSIS

61. This section of the paper presents the main results of the analysis using the base assumptions described above. The full set of economic and financial indicators resulting from the analysis is presented in Appendix 2.

62. Until recently, many of the investment decisions and agricultural policies in Vietnam have been made with little consideration of factors other than output maximization. Although the analysis undertaken here only covers a limited range of crop alternatives and cannot point to optimal investment strategies for individual farmers or companies, it is hoped that the discussion illustrates the benefits of a systematic approach to agriculture sector analysis that considers the strengths and limitations of different crops and crop systems from a variety of perspectives. Having developed the spreadsheet template and prepared all other assumptions required for PAM analysis, it would be straightforward for local institutions to expand the analysis to cover a much broader range of crops as part of their future research and policy support for government.

Policy transfers

63. First, Table 9 below summarizes the PAM indicators for policy transfers. As described in the methodology section, when the NPC or EPC is greater than one this indicates that domestic policies are increasing the market price above the world price thus providing a positive incentive to the producer. NPCs measure the ratio of foreign revenue in social and economic terms whereas EPCs measure the ratio of domestic value added (foreign revenue minus imported costs) in financial and economic terms.

Table 9: NPC and EPC Results

	NPCs				EPCs			
	Winter-Spring		Summer-Autumn		Winter-Spring		Summer-Autumn	
	Trad.	Improved	Trad.	Improved	Trad.	Improved	Trad.	Improved
An Giang (export rice)								
Ordinary rice								
Small farm	1.018	1.018	1.019	1.019	1.024	1.023	1.027	1.025
Medium farm	1.018	1.018	1.019	1.019	1.023	1.022	1.026	1.025
Large farm (outgrower)	n/a	1.016	n/a	1.016	n/a	1.020	n/a	1.022
Jasmine rice								
Small farm	1.013	1.013	n/a	n/a	1.015	1.015	n/a	n/a
Medium farm	1.013	1.013	n/a	n/a	1.015	1.014	n/a	n/a
Large farm (outgrower)	n/a	1.012	n/a	n/a	n/a	1.014	n/a	n/a
Nam Dhin (domestic rice)								
Standard quality								
Micro farm	1.002	1.002	1.002	1.002	1.003	1.006	1.004	1.007
Better quality								
Micro farm	1.002	1.002	1.002	1.002	1.003	1.007	1.005	1.007

	NPCs	EPCs
Maize		
Manual cultivation		
Ordinary hybrid	1.001	1.001
VN4 hybrid	1.001	1.002
Tractor (hypothetical)		
Ordinary hybrid	1.001	1.003
VN4 hybrid	1.001	1.003
Cassava		
Ordinary variety	1.003	1.236
KM94 (high yield, high starch)	1.002	1.175

64. Although there are many subsidies in Vietnam that benefit farmers in direct and indirect ways including subsidized electricity and fuel, state-run irrigation networks up to the tertiary level, and crop research and extension programs to name but a few, the NPCs and EPCs above show surprisingly little net transfer in favor of farmers. In part, this is because several inputs are subject to import duty and/or domestic VAT that offset the benefits of the subsidy. As a result, the net transfer effects measured by the NPCs and EPCs suggest only 1-3% total subsidy at the farm level. With respect to the EPCs for cassava, these indicate a much higher element of subsidy because of farmers using manure from their own animals that has an obvious economic value but does not incur a financial cost.

65. In interpreting the NPC and EPC results, it should also be kept in mind that these PAM indicators measure revenue with reference to a commodity's international parity price including the costs of milling and delivery up to the export (or import) location. Because farmers are rarely (if ever) paid import or export parity at the farm gate, these coefficients do not measure the actual subsidy that occurs at the farm level. Taking the example of ordinary winter-spring rice grown on a medium size farm in An Giang (with traditional management technology) the farmer's financial cost for seed, chemicals and fertilizer (i.e. all variable costs excluding family and hired labor) works out to an estimated VND 18.9 million (USD 906) per hectare, against VND 19.7 million (USD 944) per hectare in economic terms. In these terms, the subsidy on farm-level costs works out to around 4.2% so is roughly twice as high compared with the NPC and EPC results above. If differences between the economic and financial costs of family and hired labor were taken into account, the total "subsidy" would be even higher at around 8.5% of the actual financial cost paid by farmers.

66. Given these discrepancies, a good area for future analysis would be to isolate policy transfers that occur at the farm level from those that occur at later value chain stages (milling, distribution, etc). This approach would allow policymakers to assess the cost of farm-level subsidies for Vietnam and impact of these subsidies on farmer profitability.

A. Export Rice in An Giang

Small farm rice

67. The average plantings of the nearly 1.6 million rice-growing households in the Mekong Delta are just under 1.2 hectares per family. The average paddy growing area in An Giang is slightly above this, yet there are a considerable number of growers—perhaps 35-40% who cultivate 0.75 hectares or less. Our 'small-scale' rice farm model refers to such farmers. Among the Mekong Delta provinces, An Giang now ranks second (behind Kien Giang) is annual paddy production, yet it has been associated with a range of technical and institutional innovations. It is one of five or six provinces that have accounted for the bulk of the Mekong Delta's expanded rice production over the past two decades and is one of the leading sources of the region's expanding rice exports. For the Mekong Delta as a whole, in recent years some 70% of rice production has gone for exports. In all likelihood, a similar if not somewhat larger share of the production in An Giang has been channeled abroad. Selected indicators from the analysis of small-farm rice operations in An Giang are summarized in Table 10 below.

Table 10: Selected Indicators, Small Farm Rice, An Giang

	DRC	VND '000 per Hectare						Gross Margin / Variable Costs	Net Profit / Total Costs
		Variable costs	Total Costs	Gross Margin	Net Profit	Gross profit per day family labor	Net profit per day total labor		
Ordinary export rice (SA)									
Traditional	1.06	15,845	16,522	2,360	1,684	74	29	0.15	0.10
Reduced input	0.79	12,765	13,442	6,315	5,639	204	104	0.49	0.42
Ordinary export rice (WS)									
Traditional	0.98	21,100	21,777	6,238	5,561	215	93	0.30	0.26
Reduced input	0.73	16,900	17,577	11,450	10,773	369	207	0.68	0.61
Jasmine rice (WS)									
Traditional	0.63	22,580	23,257	15,055	14,378	386	194	0.67	0.62
Reduced input	0.48	17,836	18,513	21,193	20,516	517	302	1.19	1.11

68. A number of important findings stand out from these data as follows:

- With current, high-input methods, the DRC for ordinary, small farm rice is near or above one showing that this system is barely efficient. Farmer profits are also very low at just VND 5.6 million (USD 267) per hectare in the optimal winter-spring season and only VND 1.7 million (USD 81) per hectare in the summer-autumn season. Given that the small farm model is based on each household cultivating only 7.5 cong the actual net profits per farm family are just 75% of these per hectare totals and work out to a total annual net profit of just VND 5.4 million (USD 261) per household per year from two rice crops. Outside An Giang or in other locations where farmers achieve lower yields than assumed for the base analysis, the results would be even less attractive than illustrated here.
- With improved (reduced input) management, the results for ordinary small-scale rice improve significantly but are still only marginally attractive in terms of total farmer income. As shown in the table above, the DRCs improve from 0.98 for 0.73 in the WS season and from 1.06 to 0.79 in the SA season as a result of adopting the reduced input recommendations. Total net profits also improve significantly and work out to an estimated VND 12.3 million (USD 590) per year from 7.5 cong of WS and SA rice total production. At this level, however, net profits are still only equal to just 46.8% of Vietnam's per capita gross income suggesting that investments in small-scale rice are unlikely to be a very good strategy for poverty reduction even with recommended technologies.[10]
- Jasmine rice is shown to be significantly more profitable and socially efficient with both traditional (high input) and improved (reduced input) management than ordinary rice indicating that a move towards higher-value, specialty varieties would be a good strategy for more and more growers. Although Vietnam is a major rice exporter, the quality of its rice is generally low and typically sells at a 10-15% discount to ordinary rice exported by Thailand. Until recent years, production of Jasmine and other aromatic rice varieties in the Mekong Delta was very small. However, with Thai rice policies resulting in steep price increases, an opportunity for Vietnam to capture a greater share of the

[10] 2011 GNI per capita, Atlas method (current US$) = USD 1,260 (World Bank data).

international market for aromatics has opened up and several companies have responded effectively.[11] Despite somewhat higher production costs for jasmine rice, the analysis shows that efforts to target higher-value markets for better quality rice and for specialty rice would likely be very rewarding in financial and economic terms.

Medium and large farm rice

69. The base results for medium- and large-scale rice in An Giang are summarized in the next table below. Key points that stand out from these data include:

- Compared with small-farm rice in An Giang, the results for medium- and large-scale farms are considerably more attractive from both the economic and financial perspectives. Whereas the DRCs for ordinary export rice were near or above one with traditional management on small-scale farms (indicating that production is socially inefficient even in one of Vietnam's best rice growing areas), the DRCs for medium- and large-farms are each below one. The DRCs for reduced input production on large and small farms are, in fact, reasonably attractive at a range of just 0.57 to 0.64 indicating that Vietnam enjoys a moderately strong comparative advantage in export rice if farmers adopt the recommended improvements. Similar to the results for small farm rice, the financial profits and rates of return also improve significantly from adopting reduced input practices.
- The results also show that large-farm production can be substantially more profitable for farmers organized into outgrower programs compared with independent, medium-scale production. Although the DRCs for large-farm rice are only moderately more attractive than the ones for medium-farm rice, the estimated net profits for outgrower rice are around 50% higher. Large-farm rice also appears to provide significantly better returns to labor and variable and total costs.

[11] In 2012, Vietnam's Jasmine rice exports were estimated at 584,000 tons, up from only 248,000 tons in 2010 (Data from Vietnam Food Association).

Table 11: Selected Indicators, Medium and Large Farm Rice, An Giang

	DRC	VND '000 per Hectare						Gross Margin / Variable Costs	Net Profit / Total Costs
		Variable costs	Total Costs	Gross Margin	Net Profit	Gross profit per day family labor	Net profit per day total labor		
Ordinary export rice (SA)									
Medium farm									
Traditional	0.83	15,025	15,461	6,243	5,807	284	149	0.42	0.38
Reduced input	0.64	12,265	12,701	10,026	9,590	401	218	0.82	0.76
Large farm									
Reduced input	0.59	13,014	13,652	15,966	15,328	591	326	1.23	1.12
Ordinary export rice (WS)									
Medium farm									
Traditional	0.77	20,100	20,536	11,625	11,189	612	280	0.58	0.54
Reduced input	0.60	16,461	16,897	16,439	16,003	715	364	1.00	0.95
Large farm									
Reduced input	0.57	17,894	18,532	23,916	23,278	957	475	1.34	1.26
Jasmine rice (WS)									
Medium farm									
Traditional	0.52	21,900	22,336	20,625	20,189	688	342	0.94	0.90
Reduced input	0.41	17,556	17,992	26,544	26,108	758	428	1.51	1.45
Large farm									
Reduced input	0.39	18,445	19,083	31,283	30,645	869	464	1.70	1.61

- While the benefits of large-farm rice appear significant, it must also be kept in mind that the opportunities to promote this type of production are limited by the capacity and interest of export companies to organize farmers into outgrower groups. As described in the methodology section, the large-farm analysis is based on higher parity prices because of the export company being able to negotiate forward contracts and having greater control over quality. It would therefore be unrealistic to assume this model can be replicated for all of Vietnam.
- If large-farm rice were analyzed using the same parity prices as medium-farm rice, the DRC for ordinary WS export rice would increase from 0.57 to 0.66 while farmer net profits would fall from VND 23.2 million (USD 1,112) per hectare to VND 18.8 million (USD 901) per hectare. While large-farm production would therefore remain somewhat more profitable compared with medium-scale ordinary WS rice, the efficiency score is actually higher indicating that improved economies of scale are not the main benefit of large-farm rice compared with the ability of export firms to control quality and negotiate better prices through forward contracting.
- With respect to jasmine rice, the results are again significantly more attractive compared with ordinary WS rice from the social efficiency and private profitability points of view. Together with the very good results for small farm jasmine rice, these findings underscore the potential benefit for Vietnam of moving toward the production of higher quality, aromatic varieties. Although the production costs (and skill requirements) are also higher for jasmine and may be an obstacle to some farmers, the estimated gross and net profits, as well as the returns to labor and all other production costs, are more attractive compared with ordinary rice.

B. Domestic Rice and Rice Alternatives in Northern Vietnam

70. Results from the analysis of import substitute rice and rice alternatives grown in northern Vietnam are summarized in Table 12. As shown, the analysis covers two types of domestic rice including a "standard" and "better quality" variety. Better quality rice was reported to attract a 23-28% price premium at the farm gate.

Table 12: Selected Indicators, Rice and Alternative Crops in Northern Vietnam

	DRC	VND '000 per Hectare						Gross Margin / Variable Costs	Net Profit / Total Costs
		Variable costs	Total Costs	Gross Margin	Net Profit	Gross profit per day family labor	Net profit per day total labor		
Import substitute rice (SA)									
Standard quality									
Traditional	1.18	15,424	18,317	12,599	9,705	104	63	0.82	0.53
Reduced input	1.02	15,277	18,171	15,547	12,653	139	89	1.02	0.70
Better quality									
Traditional	1.39	16,096	18,990	14,261	11,367	118	74	0.89	0.60
Reduced input	1.08	13,831	16,725	19,563	16,669	175	117	1.41	1.00
Import substitute rice (WS)									
Standard quality									
Traditional	1.31	20,238	23,132	4,810	1,916	40	12	0.24	0.08
Reduced input	0.97	16,276	19,170	11,277	8,383	99	57	0.69	0.44
Better quality									
Traditional	1.53	20,697	23,591	7,659	4,765	64	30	0.37	0.20
Reduced input	1.11	16,666	19,560	14,526	11,632	127	79	0.87	0.59
Import substitute maize									
Manual cultivation									
Ordinary hybrid	0.64	11,133	14,159	15,555	12,529	110	76	1.40	0.88
VN4 hybrid	0.52	11,237	14,263	21,763	18,737	149	110	1.94	1.31
Tractor cultivation (hypothetical)									
Ordinary hybrid	0.48	11,378	14,404	15,310	12,284	510	372	1.35	0.85
VN4 hybrid	0.38	11,482	14,508	21,518	18,492	717	560	1.87	1.27
Import substitute cassava									
Ordinary variety	0.89	14,561	16,858	18,689	16,392	121	99	1.28	0.97
KM94 (high starch)	0.72	30,863	33,159	29,512	27,216	160	137	0.96	0.82

71. Unlike the MKD where the WS season is more favorable than SA, the situation in northern Vietnam is reversed and the SA season is most favorable. Although rainfall patterns for rice are better in the north during the spring resulting in better yields for WS rice than SA, the very cold temperatures at the start of the winter season result in poor germination and farmers having to spend more money on seed. Farmers also reported using up to 50% more fertilizer in the WS season to encourage plant growth during the cold weather. Several other important findings stand out from the analysis as follows:

- Most DRCs for northern rice are near or above one indicating that production of rice as an import substitute in Nam Dinh is socially inefficient. Since 1995, only Thai Bhin and Hung Yen have achieved higher average yields than Nam Dhin in the Red River Delta while other provinces (ie. Vinh Phuc and Quang Ninh) have achieved less than 80% as

much yield per hectare. In the Northern Midlands, the average yield for all provinces is only 67% of the yield in Nam Dinh. The poor results for one of the best rice growing areas in Vietnam therefore provide a bleak picture for the social efficiency of using scarce land for substitute rice production. In other words, while rice is grown for household subsistence purposes in many northern households, if markets functioned better, it would be more efficient to move surplus rice production from the south to the north and utilize more farmland in the north for alternative crops (or livestock raising).

- Farmer profits are also shown to be much lower in Nam Dinh than in An Giang. Given that that most households in the north cultivate only around 5 sao (0.18 to ha) the total annual profits from one cycle of standard SA and WS rice work out to just VND 2.09 million (USD 100) per household with traditional management and 3.79 million (USD 181) per household with improved management. Obviously, such low levels of income cannot sustain a household and such households need to rely on other farm (i.e. different crop and livestock activities) and non-farm sources of income.
- Better quality rice is shown to provide more profit than standard quality rice, but still generates very little income given the very small farm sizes in northern Vietnam. Moreover, all DRCs for better quality rice are greater than one indicating the crop is socially inefficient. In other provinces that are less well suited to rice than Nam Dinh, the financial and economic results for better quality rice would be even worse than shown.
- Compared with rice, the results for import substitute maize and cassava are all much more attractive from the private and social perspectives. Unlike rice, all of the DRCs for these alternative crops are below one indicating that production is socially efficient. Moreover, with the exception of high-starch (KM94) cassava, the production costs are shown to be significantly less than for rice making these crops more affordable for poor households to grow. The estimated profits, returns to labor, and returns to total costs are also significantly better for these alternatives to rice. Thus far, Vietnam has given top priority to rice production with large parts of the country given to this activity on an almost exclusive (mono-crop) basis. While many factors need to be considered in planning a transition away from rice, the data provide strong reason to believe that other crops could be a better choice for individual farmers and the country as a whole as part of a gradual diversification strategy. This needs to be examined on an area-by-area basis, and take into account soil types, weather patterns, drainage conditions, etc.
- The analysis also shows that new technologies for maize and cassava can be especially attractive. With maize, for example, the VN4 hybrid costs nearly the same to grow as ordinary hybrid maize, but is associated with a much lower DRC and significantly more profit for the producer. A switch to tractor-based cultivation on larger plots (perhaps along the lines of large-scale rice in MKD) could also be a good strategy where the conditions are suitable. Although the estimated gross and net profits from tractor maize are slightly lower compared with manual cultivation, the DRC scores and daily returns to labor are much better when the crop is grown on a large plot using mechanical cultivation. With respect to cassava, the KM94 (high starch) variety costs around twice as much for farmers to produce due to greater requirements for fertilizer, but is also twice as profitable so is likely to be a good choice for families that only have a limited area available to cultivate.

IV. SENSITIVITY ANALYSIS

72. Having presented the main results using all base assumptions, this part of the paper presents the results for four categories of sensitivity analysis that looked at the impact of reductions in yield, reductions in price, higher fertilizer costs, and higher wage rates. The sensitivity analysis only covers selected enterprise variations since the effects of different yield and price assumptions will be similar for each model.

A. Sensitivity to Yield

73. One of the most important variables in the analysis is crop yield. Not only can the actual yields on individual farms vary greatly from the levels assumed for this analysis, but many parts of the country are less well suited to rice production than An Giang and Nam Dinh which were selected for the base analysis. Since 1995, for example, Can Tho Province has only achieved about 90% as much yield compared with An Giang while other provinces such as Kien Giang, Long An, and Soc Trang have each achieved less than 80% as much yield on an average annual basis. In northern Vietnam, Thai Binh has produced around 7% more yield per hectare compared with Nam Dinh since 1995, but many other provinces including Ha Nam, Ninh Binh, and Hai Phong have only achieved 90% as much yield while provinces such as Quang Ninh and Vinh Phuc have only produced 80% as much yield per hectare as Nam Dinh.[12]

74. To illustrate the impact of yield on the economic and financial results, a range of sensitivity tests for selected enterprise variations were carried out in which the base yields were reduced by 10% and 20%. For the export rice, a 10% yield reduction would be indicative of the current situation in Can Tho while a 20% is indicative of the situation in Kien Giang, Long An, and Soc Trang. In the north, a 10% reduction is indicative of the current situation in Ha Nam, Nin Binh and Hai Phong while the 20% reduction is indicative of the situation in Quang Ninh and Vinh Phuc.

75. The DRC scores for selected rice variations using different yield assumptions are set out below. As shown, the efficiency of rice growing drops off quickly with only a 10% reduction in yield. With 20% reduction in yield, the DRCs for ordinary (WS) export rice are all above one indicating that production is socially inefficient. In northern Vietnam, the DRCs for the most favorable SA season were already above using the base assumptions and become very unattractive when yields are less than assumed.

[12] Analysis of GSO data.

Table 13: Sensitivity of DRC to lower Yield

	Traditional			Improved		
	Base	10% less	20% less	Base	10% less	20% less
Ordinary export rice (WS)						
Small farm	0.98	1.14	1.36	0.73	0.84	0.98
Medium farm	0.77	0.89	1.05	0.60	0.68	0.79
Large farm	n/a	n/a	n/a	0.57	0.64	0.74
Jasmine rice (WS)						
Small farm	0.63	0.72	0.84	0.48	0.55	0.63
Medium farm	0.52	0.59	0.68	0.41	0.46	0.53
Large farm	n/a	n/a	n/a	0.39	0.44	0.50
Northern domestic rice (SA)						
Micro farm - standard	1.18	1.34	1.56	1.02	1.16	1.33

76. In terms of development strategy, these sensitivity results further underscore the importance for Vietnam of transitioning from traditional (high input) production to reduced input management. Even with a 20% reduction in yield, all of the scores for export rice remain below one indicating that production is still socially efficient (albeit only marginally so on small farms). The results also underscore the benefit of promoting new, higher-value export varieties like jasmine. For this crop, the sensitivity analysis still shows Vietnam would enjoy a reasonably strong of comparative advantage even with a 20% yield reduction.

77. The next table looks at the impact of reduced yield on a farmer's financial profits and shows that even a small loss of yield can have a significant impact on income. Given that many areas outside of An Giang already produce 10-20% less yield, these findings are a serious challenge for any strategy for livelihood improvements based on rice production. Improved (reduced input) methods are more profitable than traditional management (and less risky for farmers because of lower cost), but are still highly sensitive to reduced yield with profits falling by around 15-25% from just a 10% loss of yield.

Table 14: Sensitivity of Net Profit to lower Yield (VND '000 per ha)

	Traditional			Improved		
	Base	10% less	20% less	Base	10% less	20% less
Ordinary export rice (WS)						
Small farm	5,561	2,827	93	10,773	7,938	5,103
Medium farm	11,625	8,017	4,844	16,003	12,713	9,423
Large farm	n/a	n/a	n/a	23,278	19,158	15,038
Jasmine rice (WS)						
Small farm	14,378	10,615	6,851	20,516	16,613	12,710
Medium farm	20,189	15,937	11,684	26,108	21,698	17,288
Large farm	n/a	n/a	n/a	30,645	25,736	20,828
Northern domestic rice (SA)						
Micro farm - standard	9,705	6,903	4,101	12,653	9,571	6,488

B. Sensitivity to Price

78. The second sensitivity test was to consider the effects of a 20% reduction in world prices for rice. Despite some above normal international grain prices in recent years, this price reduction scenario is completely possible for rice in light of the current build up of very large rice stocks by the Thai government under its price guarantee scheme. The commercial release of such stocks could well result in a sharp drop in international prices for ordinary white rice, perhaps leading to a drop in Vietnamese prices from some $400-425 per ton to the low to mid-300s per ton.[13] Because output prices are not specifically subsidized, it was further assumed the drop in world price would also results in a 20% reduction in the farm gate price received by growers. The results of the sensitivity test for price are summarized in Table 15 below.

79. These data show that:

- Farmer financial profits and economic DRC scores are both very sensitive to price. As shown, many of the DRCs increase significantly and become higher than one with just a 20% fall in world price. The impact of lower prices is especially bad for small farm systems and for all categories of producer using traditional (high input) management.
- In terms of farmer income, small farmer net profits fall by 72% to 216% with traditional management and by 53% to 68% with improved management. On medium farms, profits drop by 57% to 73% with traditional management and by 41% to 47% with improved management. On farms under the large field model, the estimated net profits fall by 36% to 47% with jasmine experiencing the greatest reduction. In the north, the estimated net profits for micro farms fall by 41% and 49% with improved and traditional management respectively.

[13] In March 2013, the built up rice stocks in Thailand were estimated at 17.1 million tons. This was a stock level approximately double its size from a year earlier (e.g. 8.8 million tons) (Source: Thai Rice Exporters Association).

Table 15: Sensitivity to Price (20% lower export parity and farm gate)

	Base Analysis					20% lower Output Prices				
	DRC	VND '000 per Ha		VND '000 per day		DRC	VND '000 per		VND '000 per day	
		Gross Margin	Net Profit	Gross per day family	Net per day total		Gross Margin	Net Profit	Gross per day family	Net per day total
Ordinary export rice (WS)										
Small farm										
Traditional	0.98	6,238	5,561	215	93	1.41	770	93	27	2
Reduced input	0.73	11,450	10,773	369	207	1.01	5,780	5,103	186	98
Medium farm										
Traditional	0.77	11,625	11,189	612	280	1.08	5,280	4,844	278	121
Reduced input	0.60	16,439	16,003	715	364	0.81	9,860	9,424	429	214
Large farm										
Reduced input	0.57	23,916	23,278	957	475	0.77	15,554	14,916	622	304
Ordinary export rice (SA)										
Small farm										
Traditional	1.06	2,360	1,684	74	29	1.50	(1,281)	(1,957)	(40)	(33)
Reduced input	0.79	6,315	5,639	204	104	1.08	2,499	1,823	81	34
Medium farm										
Traditional	0.83	6,243	5,807	284	149	1.15	1,989	1,553	90	40
Reduced input	0.64	10,026	9,590	401	218	0.86	5,567	5,131	223	117
Large farm										
Reduced input	0.59	15,966	15,328	591	326	0.79	10,170	9,532	377	203
Jasmine rice (WS)										
Small farm										
Traditional	0.63	15,055	14,378	386	194	0.98	4,660	3,984	119	54
Reduced input	0.48	21,193	20,516	517	302	0.72	10,413	9,737	254	143
Medium farm										
Traditional	0.52	20,625	20,189	688	342	0.79	8,880	8,444	296	143
Reduced input	0.41	26,544	26,108	758	428	0.60	14,364	13,928	410	228
Large farm										
Reduced input	0.39	31,283	30,645	869	464	0.58	17,610	16,972	489	257
Northern domestic rice (SA) - standard										
Traditional	1.18	12,599	9,705	104	63	1.57	7,884	4,990	65	33
Reduced input	1.02	15,547	12,653	139	89	1.34	10,361	7,467	93	53

C. Sensitivity to Fertilizer Costs

80. The next sensitivity test was to look at the impact of a 50% increase in fertilizer prices. Just before the onset of the global financial crisis in 2008, for example, world fertilizer prices increased by as much as 108%. Although this proved to be a temporary blip with prices returning to near normal levels the following year, future price shocks could happen again particularly as global energy prices continue to rise.

81. Results of the fertilizer sensitivity test are shown in Table 16. Some key findings that stand out from this analysis include:

- Variable costs increase by 12-16% (VND 2.2 to 7.2 million per hectare) with the least effect felt by large-scale outgrower farmers and the greatest effect felt by independent, medium-scale farmers.
- Farmer net profits in An Giang decrease by 29-58% with traditional high-input management and by 9-31% with improved, reduced-input management. Large-scale farmers again do the best with just a 9% drop in net profits for ordinary rice and 24%

drop for jasmine rice. In all cases, the profits from jasmine rice are more sensitive to higher fertilizer prices because of the higher input requirements for this crop.

- Farmer net profits decrease by 9% to 58% with high input farmers experiencing the small-scale farmers experiencing the worst effects.
- Switching to reduced input technology naturally provides farmers a degree of protection from the risk of higher fertilizer prices because of using less of this input. With traditional (high input) management, for example, fertilizer accounts for 28-30% of a farmer's variable costs but only 22-25% of variable costs with reduced input management.

Table 16: Sensitivity to Fertilizer Costs (50% increase)

	Base Analysis					50% higher fertilizer prices				
	DRC	VND '000 per Ha		VND '000 per day		DRC	VND '000 per Ha		VND '000 per day	
		Variable Costs	Net Profit	Gross per day family	Net per day total		Variable Costs	Net Profit	Gross per day family	Net per day total
Ordinary export rice (WS)										
Small farm										
Traditional	0.98	21,100	5,561	215	93	1.19	24,325	2,336	104	39
Reduced input	0.73	16,900	10,773	369	207	0.85	19,480	8,193	286	158
Medium farm										
Traditional	0.77	20,100	11,189	612	280	0.92	23,325	7,964	442	199
Reduced input	0.60	16,461	16,003	715	364	0.70	19,040	13,424	603	305
Large farm										
Reduced input	0.57	17,894	23,278	957	475	0.62	20,094	21,078	869	430
Jasmine rice (WS)										
Small farm										
Traditional	0.63	22,580	14,378	386	194	0.83	25,805	7,569	211	102
Reduced input	0.48	17,836	20,516	517	302	0.62	20,416	14,219	363	209
Medium farm										
Traditional	0.52	21,900	20,189	688	342	0.68	25,125	12,914	445	219
Reduced input	0.41	17,556	26,108	758	428	0.52	20,136	19,328	565	317
Large farm										
Reduced input	0.39	18,445	30,645	869	464	0.50	20,963	23,390	667	354
Northern domestic rice (SA) - standard										
Traditional	1.18	15,424	9,705	104	63	1.32	17,785	7,344	85	48
Reduced input	1.02	15,277	12,653	139	89	1.02	15,277	12,653	139	89

D. Sensitivity to Labor Costs

82. The last category of sensitivity test was to look at the impact of a 50% rise in wage rates. In recent years there has been a run-up in labor costs, especially in the Mekong Delta, as fewer young people want to work in the rice sector and as alternative jobs have become available in the service and manufacturing sectors. A similar run-up in labor costs has been experienced in other locations for commercial agriculture, including for the coffee harvests in the Central Highlands region. The results for the simulated labor cost increase are summarized in Table 17.

83. Similar to the other sensitivity tests, these data show that the continued economic and financial profitability of rice could be significantly undermined by higher wage rates. Although most DRCs remain below one, the analysis shows that the competitiveness of jasmine rice is especially vulnerable to higher wage rates with the DRCs increasing by around 24-26% from the

increase in labor cost. Labor accounts for a lower share of total costs for ordinary rice and in this case, the DRCs only increase by 4-10% because of the higher wage rate.

84. In terms of farmer profits, jasmine rice is again shown to be the most vulnerable to an increase in wage rates with farmer net profits falling by 19-33% compared to just a 2-18% for ordinary rice. In northern Vietnam, net profits fall by 15% at the higher wage level with traditional management and by 11% with improved management.

Table 17: Sensitivity to Labor Costs (50% increase in wage rate)

	Base Analysis					50% Higher Labor Costs				
	DRC	VND '000 per Ha		VND '000 per day		DRC	VND '000 per Ha		VND '000 per day	
		Variable Costs	Net Profit	Gross per day family	Net per day total		Variable Costs	Net Profit	Gross per day family	Net per day total
Ordinary export rice (WS)										
Small farm										
Traditional	0.98	21,100	5,561	215	93	1.08	22,100	4,561	181	76
Reduced input	0.73	16,900	10,773	369	207	0.81	17,660	10,013	345	193
Medium farm										
Traditional	0.77	20,100	11,189	612	280	0.82	20,700	10,589	580	265
Reduced input	0.60	16,461	16,003	715	364	0.65	17,100	15,364	687	349
Large farm										
Reduced input	0.57	17,894	23,278	957	475	0.59	18,274	22,898	941	467
Jasmine rice (WS)										
Small farm										
Traditional	0.63	22,580	14,378	386	194	0.80	23,740	9,634	264	130
Reduced input	0.48	17,836	20,516	517	302	0.61	18,716	15,919	405	234
Medium farm										
Traditional	0.52	21,900	20,189	688	342	0.64	22,820	15,219	522	258
Reduced input	0.41	17,556	26,108	758	428	0.51	18,396	21,068	614	345
Large farm										
Reduced input	0.39	18,445	30,645	869	464	0.49	19,383	24,970	711	378
Northern domestic rice (SA) - standard										
Traditional	1.18	15,424	9,705	104	63	1.44	16,924	8,205	92	54
Reduced input	1.02	15,277	12,653	139	89	1.24	16,677	11,253	126	79

V. CONCLUSIONS

The findings from this analysis are supportive of the growing anecdotal and survey evidence regarding the low profitability of rice production in important growing areas, especially when farmers apply the traditional high inputs production practices. What is surprising is that such production, at least on the very small scale that commonly occurs in both the north and the south, may well be socially inefficient. That is, when taking into account some additional costs not directly borne by farmers, the social costs of this production may well exceed its value. This calculation was made WITHOUT taking into account the adverse environmental impacts of intensive rice cultivation in some areas—including the adverse effects of fertilizer and chemical run-off on fish populations and the quality of drinking water. Taking into account (adverse) environmental impacts would further skew the pattern.

At least from the An Giang models, there appear to be financial and economic benefits from growing rice on a somewhat larger scale—i.e. the so-called 'medium' farms and the clusters of farmers on somewhat larger plots. And, there appear to be strong benefits—for farmers and for society—of shifts to improved, lower input production models and, where market opportunities exist, toward specialty rice varieties such as aromatic ones whose commercial value is higher. These findings suggest potentially high returns on public programs or public-private partnerships in the MKD that would:

- Support some consolidation of landholdings and rice cultivation systems;
- Facilitate farmer adoption of lower input/sustainable rice production models
- Facilitate farmer adoption of specialty rice variety production under contract with downstream buyers; and
- Facilitate crop rotations and mixed farming models, especially among smaller farmers and those producing rice under less than optimal growing conditions (and in certain seasons).[14]

The results from the work undertaken in selected northern provinces are suggestive rather than conclusive. Yet, the findings from Nam Dinh and Phu Tho suggest that rice production there is not socially efficient, in contrast with the situation for maize and cassava. The latter two crops—grown for feed—are also more profitable for farmers, especially when they adopt improved varieties. The analysis points to the need for more comparative analysis of the social efficiency and farmer profitability of rice vs. alternative food and feed crops, although there is a strong hypothesis that the latter will be superior when compared with rice grown under traditional practices. Such comparisons are also needed in the Mekong Delta and other regions. There is a need to examine more broadly both the technical feasibility and economic/financial implications of potential shifts from paddy to alternative crops, in certain seasons.

As a result of long-term gains in productivity and crop intensification, Vietnam now enjoys a very large surplus in rice production—with exports now amounting to nearly one-third of production. With urbanization, income growth, and other factors, Vietnam's per capita and aggregate rice consumption has now begun to fall. Recent analysis suggests that this will continue for much of

[14] These recommendations are consistent with those provided in an earlier study (World Bank 2012) which called for distinguishing between 'core' and 'secondary' rice-growing areas within the Mekong Delta and applying different sets of strategies and public interventions to realize sectoral objectives and promote improved farmer welfare.

the next two decades before consumption levels off at a level some 10-15% below current national consumption. Under any realistic scenarios—including projected climate change impacts—Vietnam should remain in a very large rice surplus situation (of between 5 and 10 million tons per annum) for the foreseeable future. This favorable situation provides the country with potentially large room for maneuver to facilitate more flexible agricultural systems and to place more weight on considerations of economic efficiency, farmer welfare, and environmental impact in agricultural land use planning and decisions about public investment and support services in agriculture.

While past agricultural strategy gave predominant weight to rice production in lowland and delta areas and dedicated most irrigation and technical support to paddy production, the changing domestic consumption trends and the evolving economics of production of rice and alternative crops should drive a more diverse set of strategies—dependent upon local agro-ecological and socio-economic circumstances. Specialized rice production will likely remain the norm in some (favorable growing) areas, yet more diversified crop, livestock, and aquaculture patterns will be favored elsewhere. Together with more detailed analyses of changing consumption and food expenditure patterns, the types of analysis included in this paper—yet applied to a broader range of crop/animal enterprises—should prove beneficial for strategy and policy (re-) development.

Main References

An Giang Plant Protection Company (2012). The Founding Context of the FF Force and the Develpoment Process of the "Large Model Field", An Giang Plant Protection Company (AGPPC), Long Xuyen.

An Giang DARD (2012). Report on 1 Must 5 Reductions Program on 2011-12 Winter-Spring Season, Department of Agriculture and Rural Development (DARD) of An Giang Province, Long Xuyen.

_____ (2012b). Review of the Agricultural and Rural Development Activities in 2011 and Production Plan for 2012, Department of Agriculture and Rural Development (DARD) of An Giang Province, Long Xuyen.

Can Tho University (2010). Food Security Policy in the Mekong Delta (Draft Report), Le Canh Dung (team leader), Can Tho University, Mekong Delta Development Research Institute, Can Tho.

Cuulong Rice Research Institute (2012). Mekong Delta Rice Value Chain Efficiency, Socio-Economy Study Group, Cuulong Rice Research Institute, Can Tho.

Monke, Eric and Pearson Scott (1989), The Policy Analysis Matrix for Agricultural Development, Cornell University Press, Ithaca.

Nam Dinh DARD (2012). Report on Implementing the "3 Reductions 3 Increases" Model and SRI Techniques in High Quality Rice Production, Department of Agriculture and Rural Development (DARD) of Nam Dinh Province,Nam Dinh.

UNDP (2012). Fossil Fuel Fiscal Policies and Greenhouse Gas Emissions in Viet Nam, Subsidies and taxes in Viet Nam's Energy Sector, and their Effects on Economic Development and Income Distribution in the Context of Responding to Climate Change, United Nations Development Program (UNDP), Hanoi.

World Bank (2012). Vietnam Rice, Farmers and Rural Development: From Successful Growth to Sustainable Prosperity, The World Bank, Hanoi.

Appendix 1

Detailed Assumptions

LABOR ASSUMPTIONS, An Giang (Days per ha)

SMALL-SCALE FARMERS

For small farms, each task takes proportionately longer since done by different households.

An Giang: Small-scale, traditional (machine plow, broadcast seed, combine harvest)

	ORDINARY RICE						JASMINE RICE		
	Winter-Spring			Summer-Autumn			Winter-Spring		
	Hired	Family	Total	Hired	Family	Total	Hired	Family	Total
Land prep (machine)	2	1	3	2	1	3	2	1	3
* Planting (broadcast)	4	2	6	4	2	6	5	1	6
Thinning (select strong plants)	3	2	5	3	2	5	5	4	9
Weeding	5	3	8	5	3	8	5	3	8
Fertilizer and chemical app	11	2	13	7	2	9	12	6	18
Scouting, crop management	2	10	12	2	9	11	2	13	15
Harvesting (machine, incl lift fallen rice)	4	1	5	4	1	5	4	1	5
Drying	0	8	8	0	12	12	0	10	10
Total	**31**	**29**	**60**	**27**	**32**	**59**	**35**	**39**	**74**

An Giang: Small-scale, improved (reduced input, machine plow, row seeder, combine harvest)

	ORDINARY RICE						JASMINE RICE		
	Winter-Spring			Summer-Autumn			Winter-Spring		
	Hired	Family	Total	Hired	Family	Total	Hired	Family	Total
Land prep (machine)	2	1	3	2	1	3	2	1	3
Planting (row seeder)	2	1	3	2	1	3	2	1	3
Thinning (select strong plants)	2	1	3	2	1	3	3	2	5
Weeding	6	2	8	6	2	8	6	4	10
Fertilizer and chemical app	7	2	9	7	2	9	9	4	13
Scouting, crop management	2	15	17	2	15	17	2	18	20
Harvesting (machine, incl lift fallen rice)	3	1	4	2	1	3	3	1	4
Drying	0	8	8	0	8	8	0	10	10
Total	**24**	**31**	**55**	**23**	**31**	**54**	**27**	**41**	**68**

One extra day for management/scouting than medium size farm due to greater care.

MEDIUM-SCALE FARMERS

An Giang: Medium-scale, traditional (machine plow, broadcast seed, combine harvest)

	ORDINARY RICE						JASMINE RICE		
	Winter-Spring			Summer-Autumn			Winter-Spring		
	Hired	Family	Total	Hired	Family	Total	Hired	Family	Total
Land prep (machine)	2	1	3	2	1	3	2	1	3
Planting (broadcast)	3	1	4	3	1	4	3	1	4
Thinning (select strong plants)	2	1	3	2	1	3	6	3	9
Weeding	2	1	3	2	1	3	5	3	8
Fertilizer and chemical app	8	3	11	5	2	7	9	6	15
Scouting, crop management	0	3	3	0	3	3	0	5	5
Harvesting (machine, incl lift fallen rice)	4	1	5	3	1	4	4	1	5
Drying	0	8	8	0	12	12	0	10	10
Total	**21**	**19**	**40**	**17**	**22**	**39**	**29**	**30**	**59**

An Giang: Medium-scale, improved (reduced input, machine plow, row seeder, combine harvest)

	ORDINARY RICE						JASMINE RICE		
	Winter-Spring			Summer-Autumn			Winter-Spring		
	Hired	Family	Total	Hired	Family	Total	Hired	Family	Total
Land prep (machine)	2	1	3	2	1	3	2	1	3
Planting (row seeder)	1	1	2	1	1	2	1	1	2
Thinning (select strong plants)	6	5	11	7	4	11	8	6	14
Weeding	3	1	4	3	1	4	5	3	8
Fertilizer and chemical app	6	1	7	3	1	4	7	4	11
Scouting, crop management	0	4	4	0	4	4	0	9	9
Harvesting (machine, incl lift fallen rice)	3	1	4	3	1	4	3	1	4
Drying	0	9	9	0	12	12	0	10	10
Total	**21**	**23**	**44**	**19**	**25**	**44**	**26**	**35**	**61**

LARGE-SCALE FARMERS (OUTGROWER)

An Giang: Large-scale, improved (reduced input, machine plow, row seeder, combine harvest)

	ORDINARY RICE						JASMINE RICE		
	Winter-Spring			Summer-Autumn			Winter-Spring		
	Hired	Family	Total	Hired	Family	Total	Hired	Family	Total
Land prep (machine)	2	1	3	2	1	3	2	1	3
Planting (row seeder)	1	1	2	1	1	2	1	1	2
Thinning (select strong plants)	10	3	13	9	2	11	12	4	16
Weeding	4	1	5	4	1	5	6	3	9
Fertilizer and chemical app	4	1	5	2	1	3	6	3	9
Scouting, crop management	0	8	8	0	8	8	0	12	12
Harvesting (machine, incl lift fallen rice)	3	1	4	2	1	3	3	1	4
Drying	0	9	9	0	12	12	0	11	11
Total	**24**	**25**	**49**	**20**	**27**	**47**	**30**	**36**	**66**

LABOR ASSUMPTIONS, Northern Crops (Days per ha)

NORTHERN RICE

Nam Dinh: Micro-farm, traditional (machine plow, nursery, hand harvest)

	ALL TYPES OF RICE					
	Winter-Spring (Dec-May)			Summer-Autumn (June-Oct)		
	Hired	Family	Total	Hired	Family	Total
Land prep (machine)	2	1	3	2	1	3
Nuresery prep and water	0	11	11	0	11	11
Transplant	10	30	40	10	30	40
Weeding	0	10	10	0	8	8
Fertilizer and chemical app	0	18	18	0	16	16
Scouting, crop management	0	8	8	0	10	10
Hand harvest	26	30	56	20	30	50
Drying/market	0	12	12	0	15	15
Total	**38**	**120**	**158**	**32**	**121**	**153**

Nam Dinh: Micro-farm, improved - reduced input (machine plow, nursery, hand harvest)

	ALL TYPES OF RICE					
	Winter-Spring (Dec-May)			Summer-Autumn (June-Oct)		
	Hired	Family	Total	Hired	Family	Total
Land prep (machine)	2	1	3	2	1	3
Nuresery prep and water	0	11	11	0	11	11
Transplant	8	25	33	8	25	33
Weeding	0	10	10	0	8	8
Fertilizer and chemical app	0	10	10	0	8	8
Scouting, crop management	0	10	10	0	12	12
Hand harvest	23	35	58	20	32	52
Drying/market	0	12	12	0	15	15
Total	**33**	**114**	**147**	**30**	**112**	**142**

NORTHERN MAIZE

Phu Tho: Micro-farm, normal hybrid (hand plow, nursery, hand harvest)

	MAIZE					
	Normal Hybrid			VN4 Hybrid		
	Hired	Family	Total	Hired	Family	Total
Land prep (manual) - about 5 days/sao	9	61	70	9	61	70
Nuresery prep and water	0	5	5	0	5	5
Transplant	5	20	25	5	20	25
Weeding	5	15	20	5	15	20
Fertilizer and chemical app	0	8	8	0	8	8
Scouting, crop management	0	5	5	0	5	5
Hand harvest & shell	5	25	30	5	30	35
Pack and market	0	2	2	0	2	2
Total	**24**	**141**	**165**	**24**	**146**	**170**

NORTHERN CASSAVA

Phu Tho: Micro-farm, normal hybrid (hand plow, nursery, hand harvest)

	CASSAVA					
	Local Variety			KM94 Hybrid (high starch)		
	Hired	Family	Total	Hired	Family	Total
Land prep (manual) - about 5 days/sao	0	70	70	0	70	70
Planting	0	14	14	0	14	14
Fertilizer and chemical app	0	5	5	0	9	9
1st weeding	0	7	7	0	7	7
2nd weeding	0	4	4	0	4	4
Harvest and transport to house	10	55	65	15	80	95
Dry, slice, pack, market	0	20	20	0	20	20
Total	**10**	**175**	**185**	**15**	**204**	**219**

DERIVATION OF CAPITAL RECOVERY COSTS (VND/ha)

Notes:

1) Capital recovery factor or CRF = (((1+i)^n)*i)/((1+i)^n-1) where i = real interest on savings; n = number of cycles in the implement's useful life. Cost per cycle = value new * CRF * share of total use.

2) Commercial banks currently paying between 10-11% on 1 year fixed deposits with annual inflation at 8-9%, giving a 2% real return on savings from bank deposits. Because of GDP growth in Vietnam (about 6% pa), assume farmers could do better than to put their savings into a bank account. For these reasons, assume real interest on savings for CRF calculations = 3%.

Real Interest on Savings = **3%**

3) For grain bags, assume all farmers own 130 bags per ha (6.5 tons grain) - adjusted units per farm based on area cultivated so no further adjustment needed for farm area (always = 1)

An Giang, Small Farm (7.5 cong = 0.75ha)

Tools primarily used for rice (90%), small share (10%) allocated to vegetable garden around house with further adjustments for motorbike, bicycle/cart, other selected inputs.

	Units per	Unit Cost (new)		Useful Life	Total Cost per Farm		Farm Area	Total cost per Ha		%	Foreign Costs		Share of	Per Ha Capital Recovery per cycle (financial)		Conv	Per Ha Capital Recovery per cycle (economic)	
Implement	**Farm**	USD	VND '000	**(cycles)**	USD	VND '000	**(ha)**	USD	VND '000	**Forex**	VND '000	**CRF**	**Use**	USD	VND '000	**Factor**	USD	VND '000
Hoe	2	3.60	75.0	4	7.19	150.0	0.75	9.59	200.0	10%	20.0	0.269	90%	2.32	48.4	1.03	2.39	49.9
Shovel	2	5.75	120.0	10	11.51	240.0	0.75	15.34	320.0	10%	32.0	0.117	90%	1.62	33.8	1.03	1.67	34.8
Fork	1	5.99	125.0	8	5.99	125.0	0.75	7.99	166.7	10%	16.7	0.142	90%	1.02	21.4	1.03	1.06	22.0
Sickle	2	1.20	25.0	3	2.40	50.0	0.75	3.20	66.7	10%	6.7	0.354	100%	1.13	23.6	1.03	1.16	24.3
Bicycle/cart	1	23.97	500.0	10	23.97	500.0	0.75	31.96	666.7	10%	66.7	0.117	50%	1.87	39.1	1.03	1.93	40.2
Sprayer	1	33.56	700.0	25	33.56	700.0	0.75	44.74	933.3	20%	186.7	0.057	100%	2.57	53.6	0.98	2.52	52.5
Rat traps	15	0.58	12.0	3	8.63	180.0	0.75	11.51	240.0	5%	12.0	0.354	90%	3.66	76.4	1.00	3.66	76.4
Small boat (north only)	0	21.57	450.0	8	0.00	-	0.75	0.00	-	5%	-	0.151	100%	0.00	-	1.13	0.00	-
Motorbike	1	575.26	12,000.0	14	575.26	12,000.0	0.75	767.02	16,000.0	30%	4,800.0	0.089	20%	13.58	283.3	0.98	13.31	277.6
Grain bags (50kg)	98	0.22	4.5	6	21.03	438.8	0.75	28.04	585.0	10%	58.5	0.185	90%	4.66	97.2	1.07	4.99	104.0
Totals					**689.54**	**14,383.8**		**919.38**	**19,178.3**	**27%**	**5,199.2**			**32.44**	**676.6**	**1.01**	**32.68**	**681.7**

Total capital recovery per cycle per ha (VND '000)	**676.6**
Total % forex	**27%**
Composite conversion factor	**1.0075**

An Giang, Medium Farm (1.5ha)

Tools primarily used for rice (90%), small share (10%) allocated to vegetable garden around house with further adjustments for motorbike, bicycle/cart, other selected inputs.

Implement	Units per Farm	Unit Cost (new) USD	Unit Cost (new) VND '000	Useful Life (cycles)	Total Cost per Farm USD	Total Cost per Farm VND '000	Farm Area (ha)	Total cost per Ha USD	Total cost per Ha VND '000	% Forex	Foreign Costs VND '000	CRF	Share of Use	Per Ha Capital Recovery per cycle (financial) USD	Per Ha Capital Recovery per cycle (financial) VND '000	Conv Factor	Per Ha Capital Recovery per cycle (economic) USD	Per Ha Capital Recovery per cycle (economic) VND '000
Hoe	3	3.60	75.0	4	10.79	225.0	1.50	7.19	150.0	10%	15.0	0.269	95%	1.84	38.3	1.03	1.89	39.5
Shovel	3	5.75	120.0	10	17.26	360.0	1.50	11.51	240.0	10%	24.0	0.117	95%	1.28	26.7	1.03	1.32	27.5
Fork	2	5.99	125.0	8	11.98	250.0	1.50	7.99	166.7	10%	16.7	0.142	95%	1.08	22.6	1.03	1.11	23.2
Sickle	3	1.20	25.0	3	3.60	75.0	1.50	2.40	50.0	10%	5.0	0.354	100%	0.85	17.7	1.03	0.87	18.2
Bicycle/cart	1	23.97	500.0	10	23.97	500.0	1.50	15.98	333.3	10%	33.3	0.117	50%	0.94	19.5	1.03	0.96	20.1
Sprayer	1	33.56	700.0	25	33.56	700.0	1.50	22.37	466.7	20%	93.3	0.057	100%	1.28	26.8	0.98	1.26	26.3
Rat traps	25	0.58	12.0	3	14.38	300.0	1.50	9.59	200.0	5%	10.0	0.354	100%	3.39	70.7	1.00	3.39	70.7
Small boat (north only)	0	21.57	450.0	8	0.00	-	1.50	0.00	-	5%	-	0.151	100%	0.00	-	1.13	0.00	-
Motorbike	1	575.26	12,000.0	14	575.26	12,000.0	1.50	383.51	8,000.0	30%	2,400.0	0.089	20%	6.79	141.6	0.98	6.65	138.8
Grain bags (50kg)	130	0.22	4.5	6	28.04	585.0	1.50	18.70	390.0	10%	39.0	0.185	100%	3.45	72.0	1.07	3.69	77.0
Totals					**718.84**	**14,995.0**		**479.23**	**9,996.7**	**26%**	**2,636.3**			**20.90**	**436.0**	**1.01**	**21.16**	**441.4**

Total capital recovery per cycle per ha (VND '000)	**436.0**
Total % forex	**26%**
Composite conversion factor	**1.01**

Mekong Delta, Large Farm (5ha)

Tools for 5ha total production owend by multiple households; assume one sprayer and row seeder shared between households; share of total use as above for medium farm.

Implement	Units per Farm	Unit Cost (new) USD	Unit Cost (new) VND '000	Useful Life (cycles)	Total Cost per Farm USD	Total Cost per Farm VND '000	Farm Area (ha)	Total cost per Ha USD	Total cost per Ha VND '000	% Forex	Foreign Costs VND '000	CRF	Share of Use	Per Ha Capital Recovery per cycle (financial) USD	Per Ha Capital Recovery per cycle (financial) VND '000	Conv Factor	Per Ha Capital Recovery per cycle (economic) USD	Per Ha Capital Recovery per cycle (economic) VND '000
Hoe	10	3.60	75.0	3	35.95	750.0	5.00	7.19	150.0	10%	15.0	0.354	95%	2.42	50.4	1.03	2.49	51.9
Shovel	10	5.75	120.0	8	57.53	1,200.0	5.00	11.51	240.0	10%	24.0	0.142	95%	1.56	32.5	1.03	1.60	33.5
Fork	7	5.99	125.0	6	41.95	875.0	5.00	8.39	175.0	10%	17.5	0.185	95%	1.47	30.7	1.03	1.52	31.6
Sickle	10	1.20	25.0	3	11.98	250.0	5.00	2.40	50.0	10%	5.0	0.354	100%	0.85	17.7	1.03	0.87	18.2
Bicycle/cart	3	23.97	500.0	8	71.91	1,500.0	5.00	14.38	300.0	10%	30.0	0.142	50%	1.02	21.4	1.03	1.06	22.0
Sprayer	1	33.56	700.0	20	33.56	700.0	5.00	6.71	140.0	20%	28.0	0.067	100%	0.45	9.4	0.98	0.44	9.2
Rat traps	100	0.58	12.0	2	57.53	1,200.0	5.00	11.51	240.0	5%	12.0	0.523	100%	6.01	125.4	1.00	6.01	125.4
Small boat (north only)	0	21.57	450.0	5	0.00	-	5.00	0.00	-	5%	-	0.218	100%	0.00	-	1.13	0.00	-
Motorbike	5	575.26	12,000.0	14	2876.32	60,000.0	5.00	575.26	12,000.0	30%	3,600.0	0.089	20%	10.19	212.5	0.98	9.98	208.2
Grain bags (50kg)	650	0.22	4.5	6	140.22	2,925.0	5.00	28.04	585.0	10%	58.5	0.185	100%	5.18	108.0	1.07	5.54	115.5
Row seeder	1	62.32	1,300.0	10	62.32	1,300.0	5.00	12.46	260.0	10%	26.0	0.117	100%	1.46	30.5	1.06	1.55	32.3
Totals					**3389.26**	**70,700.0**		**677.85**	**14,140.0**	**27%**	**3,816.0**			**30.60**	**638.4**	**1.01**	**31.06**	**647.9**

Total capital recovery per cycle per ha (VND '000)	**638.4**
Total % forex	**27%**
Composite conversion factor	**1.01**

Northern Region, Micro Farm (5 sao = 0.17ha) - ALL CROPS

Tools primarily used for rice, small share allocated to vegetable garden around house.

Implement	Units per Farm	Unit Cost (new) USD	Unit Cost (new) VND '000	Useful Life (cycles)	Total Cost per Farm USD	Total Cost per Farm VND '000	Farm Area (ha)	Total cost per Ha USD	Total cost per Ha VND '000	% Forex	Foreign Costs VND '000	CRF	Share of Use	Per Ha Capital Recovery per cycle (financial) USD	Per Ha Capital Recovery per cycle (financial) VND '000	Conv Factor	Per Ha Capital Recovery per cycle (economic) USD	Per Ha Capital Recovery per cycle (economic) VND '000
Hoe	1	2.64	55.0	3	2.64	55.0	0.17	15.51	323.5	10%	32.4	0.354	100%	5.48	114.4	1.02	5.59	116.7
Shovel	1	5.75	120.0	8	5.75	120.0	0.17	33.84	705.9	10%	70.6	0.142	100%	4.82	100.6	1.02	4.92	102.6
Fork	1	5.75	120.0	6	5.75	120.0	0.17	33.84	705.9	10%	70.6	0.185	100%	6.25	130.3	1.02	6.37	132.9
Bicycle/cart	1	23.97	500.0	8	23.97	500.0	0.17	141.00	2,941.2	10%	294.1	0.142	50%	10.04	209.5	0.97	9.74	203.2
Sprayer	1	33.56	700.0	20	33.56	700.0	0.17	197.39	4,117.6	20%	823.5	0.067	100%	13.27	276.8	1.01	13.40	279.5
Rat traps	5	0.34	7.0	2	1.68	35.0	0.17	9.87	205.9	5%	10.3	0.523	100%	5.16	107.6	1.00	5.16	107.6
Motorbike	1	575.26	12,000.0	14	575.26	12,000.0	0.17	3383.90	70,588.2	30%	21,176.5	0.089	20%	59.91	1,249.8	0.98	58.71	1,224.8
Grain bags (50kg)	22	0.22	4.5	6	4.77	99.5	0.17	28.04	585.0	10%	58.5	0.185	100%	5.18	108.0	1.07	5.54	115.5
Totals					**653.38**	**13,629.5**		**3843.40**	**80,173.2**	**28%**	**22,536.4**			**110.11**	**2,296.9**	**0.99**	**109.44**	**2,282.8**

Total capital recovery per cycle per ha (VND '000)	**2,296.9**
Total % forex	**28%**
Composite conversion factor	**0.99**

Norhtern Region, Micro Farm (5 sao = 0.17ha) - RICE ONLY TOOLS

Tools primarily used for rice, small share allocated to vegetable garden around house.

Implement	Units per Farm	Unit Cost (new) USD	Unit Cost (new) VND '000	Useful Life (cycles)	Total Cost per Farm USD	Total Cost per Farm VND '000	Farm Area (ha)	Total cost per Ha USD	Total cost per Ha VND '000	% Forex	Foreign Costs VND '000	CRF	Share of Use	Per Ha Capital Recovery per cycle (financial) USD	Per Ha Capital Recovery per cycle (financial) VND '000	Conv Factor	Per Ha Capital Recovery per cycle (economic) USD	Per Ha Capital Recovery per cycle (economic) VND '000
Sickle	2	0.96	20.0	3	1.92	40.0	0.17	11.28	235.3	10%	23.5	0.354	100%	3.99	83.2	1.02	4.07	84.8
Small boat	1	19.18	400.0	5	19.18	400.0	0.17	112.80	2,352.9	5%	117.6	0.218	100%	24.63	513.8	1.07	26.35	549.7
Totals					**21.09**	**440.0**		**124.08**	**2,588.2**	**5%**	**141.2**			**28.62**	**597.0**	**1.06**	**30.42**	**634.6**

Total capital recovery per cycle per ha (VND '000)	**597.0**
Total % forex	**5%**
Composite conversion factor	**1.06**

Northern Region, Micro Farm (2 sao = 0.072ha) - MAIZE ONLY TOOLS

Tools primarily used for rice, small share allocated to vegetable garden around house.

Implement	Units per Farm	Unit Cost (new) USD	Unit Cost (new) VND '000	Useful Life (cycles)	Total Cost per Farm USD	Total Cost per Farm VND '000	Farm Area (ha)	Total cost per Ha USD	Total cost per Ha VND '000	% Forex	Foreign Costs VND '000	CRF	Share of Use	Per Ha Capital Recovery per cycle (financial) USD	Per Ha Capital Recovery per cycle (financial) VND '000	Conv Factor	Per Ha Capital Recovery per cycle (economic) USD	Per Ha Capital Recovery per cycle (economic) VND '000
Knives (cut maize)	3	2.64	55.0	3	7.91	165.0	0.07	109.86	2,291.7	10%	229.2	0.354	90%	34.95	729.2	1.02	35.65	743.7
Totals					**7.91**	**165.0**		**109.86**	**2,291.7**	**10%**	**229.2**			**34.95**	**729.2**	**1.02**	**35.65**	**743.7**

Total capital recovery per cycle per ha (VND '000)	**729.2**
Total % forex	**10%**
Composite conversion factor	**1.02**

PARITY PRICE ASSUMPTIONS

AN GIANG (Export)

	1st Grade (export) 5% broken, color graded					2nd Grade (export/domestic) 20-25% broken, semi-graded					Rice Bran (for animal feed)				
	USD/ton	VND/kg	Location	Losses	Outturn	USD/ton	VND/kg	Location	Losses	Outturn	USD/ton	VND/kg	Location	Losses	Outturn
Winter-Spring															
Ordinary rice (export)															
Small	420	8,761	fob intl. port	0.50%	50.0%	330	6,884	ex factory	0.25%	14.0%	250	5,215	ex factory	0.20%	11.0%
Medium-scale	420	8,761	fob intl. port	0.50%	50.0%	330	6,884	ex factory	0.25%	14.0%	250	5,215	ex factory	0.20%	11.0%
Large-scale (outgrower)	460	9,596	fob intl. port	0.40%	51.0%	340	7,092	ex factory	0.20%	15.0%	250	5,215	ex factory	0.20%	11.0%
Jasmine rice															
Smalll	620	12,933	fob intl. port	0.5%	48.0%	380	7,927	ex factory	0.25%	15.0%	250	5,215	ex factory	0.20%	11.0%
Medium	620	12,933	fob intl. port	0.5%	48.0%	380	7,927	ex factory	0.25%	15.0%	250	5,215	ex factory	0.20%	11.0%
Large-scale (outgrower)	640	13,350	fob intl. port	0.4%	49.0%	384	8,010	ex factory	0.20%	16.0%	250	5,215	ex factory	0.20%	11.0%
Summer-Autumn															
Ordinary rice (export)															
Small	409.5	8,542	fob intl. port	0.50%	50%	321.75	6,712	ex factory	0.25%	14.0%	250	5,215	ex factory	0.20%	11.0%
Medium-scale	409.5	8,542	fob intl. port	0.50%	50%	321.75	6,712	ex factory	0.25%	14.0%	250	5,215	ex factory	0.20%	11.0%
Large-scale (outgrower)	448.5	9,356	fob intl. port	0.40%	51%	331.5	6,915	ex factory	0.20%	15.0%	250	5,215	ex factory	0.20%	11.0%

NORTHERN RICE (Domestic Use)

	3rd Grade (domestic market) 15-20% broken, un-graded					4th Grade (domestic market) +25% broken, un-graded					Rice Bran (for animal feed)				
	USD/ton	VND/kg	Location	Losses	Outturn	USD/ton	VND/kg	Location	Losses	Outturn	USD/ton	VND/kg	Location	Outturn	Losses
Winter-Spring															
Domestic rice (import sub)															
Standard quality	396.0	8,261	fob MKD	0.25%	65.0%	313.50	6,540	fob MKD	0.25%	2.0%	250	5,215	ex factory	0.20%	11.0%
Better quality	405.9	8,467	fob MKD	0.25%	65.0%	321.34	6,703	fob MKD	0.25%	2.0%	250	5,215	ex factory	0.20%	11.0%
Summer-Autumn															
Domestic rice (import sub)															
Standard quality	386.1	8,054	fob MKD	0.25%	65.0%	305.66	6,376	fob MKD	0.25%	2.0%	250	5,215	ex factory	0.20%	11.0%
Better quality	395.8	8,255	fob MKD	0.25%	65.0%	313.30	6,536	fob MKD	0.25%	2.0%	250	5,215	ex factory	0.20%	11.0%

OTHER CROPS

	USD/ton	VND/kg	Location
Maize (for animal feed)			
Ordinary hybrid	345.2	7,200	cif factory gate
New variety (VN4)	345.2	7,200	cif factory gate
Cassava			
Traditional variety (animal feed)	225.3	4,700	cif factory gate
New variety (KM94) - high starch	259.1	5,405	cif factory gate

NOTES: KM94 is a new variety for bio-fuel but not yet in production, for indicative purpose assume 15% higher value than ordinary.
Traditional cassava = 20% starch
KM94 cassava = 28-30% starch

DERIVATION OF% FOREX AND CONVERSION FACTOR ASSUMPTIONS FOR PAM ANALYSIS

Notes:

(1) For transport and distribution, domestic subsidy based on fuel assumptions (20%)

(2) For rice seed, assume transport/distribution subsidy (20%) plus additional 5% to account for support to breeding stations.

(3) Apply MFN duty rates (can be 0% if from ASEAN Member State)

Input	Price Composition (%)			Economic Transfers			Net Transfer (% of retail)				Conv Factor	Remarks
	Profit	Domestic Costs	Imported Costs	VAT	Domestic Subsidy	Import Duty	VAT	Domestic Subsidy	Duty	Total Transfer		
			100%				-	-	-	-	**1.00**	Row to make sure formulas work
			100%				-	-	-	-	**1.00**	
Seed			**100%**				-	-	-	-	**1.00**	
Rice, ordinary (south)	15%	75%	**10%**	5%	25%	0%	4.76	(15.00)	-	(10.24)	**1.10**	Domestic, imported share for distribution, fert and chem
Rice, jasmine (south)	15%	75%	**10%**	5%	25%	0%	4.76	(15.00)	-	(10.24)	**1.10**	For now, same as ordinary (extra row in case new info on jasmine)
Rice - normal (north)	15%	40%	**45%**	5%	25%	0%	4.76	(8.00)	-	(3.24)	**1.03**	Imported, domestic share for tansport and distribution
Rice - better (north)	15%	20%	**65%**	5%	25%	0%	4.76	(4.00)	-	0.76	**0.99**	Imported, domestic share for tansport and distribution
Maize, hybrid	15%	75%	**10%**	5%	20%	0%	4.76	(12.50)	-	(7.74)	**1.08**	Domestic, imported share for distribution, fert and chem
Fertilizers			**100%**				-	-	-	-	**1.00**	
Nitrogen (N)	20%	70%	**10%**	5%	20%	0%	4.76	(11.67)	-	(6.90)	**1.07**	Domestic, imported share for electricity/fuel at local plant
Phosphorus (P)	20%	15%	**65%**	5%	20%	0%	4.76	(2.50)	-	2.26	**0.98**	Imported, domestic share for transport and distribution
Potassium (K)	20%	15%	**65%**	5%	20%	6%	4.76	(2.50)	3.68	5.94	**0.94**	" "
NPK blends	20%	30%	**50%**	5%	20%	0%	4.76	(5.00)	-	(0.24)	**1.00**	Domestic share for blending, transport and distribution
Urea (N)	20%	70%	**10%**	5%	20%	0%	4.76	(11.67)	-	(6.90)	**1.07**	Domestic, imported share for electricity/fuel at local plant
DAP	20%	15%	**65%**	5%	20%	0%	4.76	(2.50)	-	2.26	**0.98**	Imported, domestic share for transport and distribution
Rice composite (MKD)			**39%**								**1.01**	Composite N, DAP, K (see fertilizer page for details)
Agrichemicals			**100%**				-	-	-	-	**1.00**	
Pesticides	20%	15%	**65%**	5%	20%	3%	4.76	(2.50)	1.89	4.16	**0.96**	100% imported, domestic costs for transport & distribution
Fungicides	20%	15%	**65%**	5%	20%	3%	4.76	(2.50)	1.89	4.16	**0.96**	" "
Herbicides	20%	15%	**65%**	5%	20%	0%	4.76	(2.50)	-	2.26	**0.98**	" "
			100%				-	-	-	-	**1.00**	
Grain bags	20%	70%	**10%**	5%	20%	0%	4.76	(11.67)	-	(6.90)	**1.07**	
			100%				-	-	-	-	**1.00**	
Hand tools	20%	70%	**10%**	10%	20%		9.09	(11.67)	-	(2.58)	**1.03**	High share of domestic costs so lower cf on transport
Sprayers	20%	60%	**20%**	10%	20%	20%	9.09	(10.00)	3.33	2.42	**0.98**	
Tractor services	20%		**80%**				-	-	-	-	**1.00**	Tractor services based on cf for fuel?
Bicycle	20%	70%	**10%**	10%	20%		9.09	(11.67)	-	(2.58)	**1.03**	
Rat traps	10%	85%	**5%**	0%	0%		-	-	-	-	**1.00**	Made in farm area
Boat	15%	80%	**5%**	0%	20%		-	(13.33)	-	(13.33)	**1.13**	Made in farm area
Boat motor	20%	60%	**20%**	10%	20%		9.09	(10.00)	-	(0.91)	**1.01**	
Row seeder	20%	70%	**10%**	5%	20%	5%	4.76	(11.67)	0.48	(6.43)	**1.06**	
Rice transplanter	20%	10%	**70%**	10%	20%	0%	9.09	(1.67)	-	7.42	**0.93**	Imported from Korea
			100%				-	-	-	-	**1.00**	
Fuel (tractor op)			**10%**				-	-	-	-	**1.20**	See diesel/petrol page
Motorbike	20%	50%	**30%**	5%	10%	7.5%	4.76	(4.55)	2.09	2.31	**0.98**	
			100%				-	-	-	-	**1.00**	
			100%				-	-	-	-	**1.00**	

IRRIGATION ASSUMPTIONS (An Giang)

For all systems, assume 3% forex to account for imported pumps, fuel, dredging equipment, etc.

An Giang

1) Data reported during field visits

Farmer 1 (co-op)	180,000	per cong				
Farmer 2 (independent)	45kg paddy	per cong	4,450	per kg	200,250	per cong
AG-PPC Farmers	30kg paddy	per cong	5,650	per kg	197,750	per cong

An Giang DARD reports provincial cost = VND 164 billion to cover 640,000 ha per year after double cropping

164,000,000,000	Provincial budget (VND)
640,000	Ha
256,250	VND/ha (2 cycles)
128,125	VND/ha (1 cycle)

2) Assumptions for PAM analysis (costs per ha)

Small farm (pay private operator) - WS

2,000,000	Farmer's share (VND 200,000 per cong)
128,125	Government's share (traditional) - fixed for all seasons
2,128,125	Total economic cost (traditional)
1.064	Conv factor (traditional) - WS
115,313	Government's share with reductions (assume 10% less cost)
2,115,313	Total economic cost (reduced model)
1.058	Conv factor (improved) - WS

Small farm - SA

1,000,000	Farmer's share (50% of WS)
128,125	Government's share (traditional) - fixed for all seasons
1,128,125	Total economic cost (traditional)
1.128	Conv factor (traditional) - SA
115,313	Government's share with reductions (assume 10% less cost)
1,115,313	Total economic cost (reduced model)
1.115	Conv factor (improved) - SA

Medium (co-op member) - WS

1,800,000	Farmer's share (VND 180,000 per cong)
128,125	Government's share
1,928,125	Total economic cost
1.071	Conv factor (traditional) - WS
115,313	Government's share with reductions (assume 10% less cost)
1,915,313	Total economic cost (reduced model)
1.064	Conv factor (improved) - WS

Medium farm - SA

900,000	Farmer's share (50% of WS)
128,125	Government's share
1,028,125	Total economic cost (traditional)
1.142	Conv factor (traditional) - SA
115,313	Government's share with reductions (assume 10% less cost)
1,015,313	Total economic cost (reduced model)
1.128	Conv factor (improved) - SA

Large-Scale (company/outgrower service) - WS

1,977,500	Farmer's share (VND 197,750 per cong)
128,125	Government's share
2,105,625	Total economic cost
1.065	Conv factor
115,313	Government's share with reductions (assume 10% less cost)
2,092,813	Total economic cost (reduced model)
1.058	Conv factor (traditional)

Large farm - SA

988,750	Farmer's share (50% of WS)
128,125	Government's share
1,116,875	Total economic cost (traditional)
1.130	Conv factor (traditional) - SA
115,313	Government's share with reductions (assume 10% less cost)
1,104,063	Total economic cost (reduced model)
1.117	Conv factor (improved) - SA

IRRIGATION ASSUMPTIONS (Nam Dinh)

Assume 3% forex to account for imported pumps, fuel, dredging equipment, etc.

Nam Dhin

1) Financial charges paid to co-op

	VND/sao	VND/ha
In-field irrigation	11,000	305,800
Water pumping	10,000	278,000
Fortifying canals/drainage	12,000	333,600
Agriculture promotion fund	12,000	333,600
Total financial cost	**45,000**	**1,251,000**

2) Cost of provincial irrigation department

Total budget	190,000,000,000
% to crops (rice, etc)	73.4%
Budget for crops (ex salt/aquaculture)	139,460,000,000
Rice - spring ha	80,135
Rice - winter ha	82,336
Relay crops/other irrigated ha	40,618
Total approx hectares planted/irrigated per year	**203,089**
Cost to Govt per ha planted	**686,695**

Farmer's financial cost (amount paid to co-op)	1,251,000
Government's share	686,695
Total economic cost	1,937,695
Conv factor (traditional) - WS	1.549
Government's share with reductions (assume 10% less cost)	618,025
Total economic cost (reduced model)	1,869,025
Conv factor (improved) - WS	1.494

ELECTRICITY SUPPLY, % forex and conversion factors

Used for rice milling, pump operation, etc.

1. Percent Forex

Origins of electric supply in Vietnam

		Of which…		Overall breakdown	
	Total	Domestic	Imported	Domestic	Imported
Hydropower	25%	100%		25%	0%
Coal	17%	50%	50%	9%	9%
Gas turbine	47%	100%		47%	0%
Diesel and oil	3%	80%	20%	2%	1%
Imports	5%		100%	0%	5%
Other	3%	50%	50%	2%	2%
Total	**100%**			**84%**	**16%**

Source: UNDP, 2012.

Modified breakdown for PAM analysis based on imported costs of domestic production

		Of which…		Overall breakdown	
	Total	Domestic	Imported	Domestic	Imported
Hydropower	25%	90%	10%	23%	3%
Coal	17%	45%	55%	8%	9%
Gas turbine	47%	90%	10%	42%	5%
Diesel and oil	3%	70%	30%	2%	1%
Imports	5%		100%	0%	5%
Other	3%	30%	70%	1%	2%
Total	**100%**			**75%**	**25%**

Based on above, assume 25% overall forex share for electricity

2. Economic conversion factor

UNDP 2012 reports….

The average tariff for electricity in Vietnam is USD 0.07 per kWh.
The price will need to rise by USD 0.08 to 0.09 per kWh to allow the sector to operate on a financilly sustainable basis (i.e. USD 0.15 to 0.16 per kWh).
This is equal to a 114-128% subsidy on the overall cost of supplying electricity

Based on the above, assume 1.25 econoimc conversion factor for electricity costs.

EXTENSION AND RESEARCH ASSUMPTIONS

GENERAL FARMER EXTENSION (public sector)

An Giang

	Ha	VND
Total budget (VND)		**9,800,000,000**
Total hectares ag land	279,300	35,088
Total hectares paddy (incl. multi crops)	586,000	16,724
Total hectares all crops (incl multi crops)	640,000	**15,313**

Nam Dinh

	Ha	VND
Total budget (VND)		**3,920,000,000**
Total hectares ag land	93,600	41,880
Total hectares paddy (incl. multi crops)	160,000	24,500
Total hectares all crops (incl multi crops)	171,583	**22,846**

CROP RESEARCH AND PROMOTION OF NEW METHODS (public sector)

Analysis based on data from Nam Dhin (treat as indicative for all locations and all crops)

NOTES:
Nam Dhin Extn Dept only location that provided detailed data. Reported VND 200m total spending on crop research (survey of farm conditions, crop planning, field trials, etc) and VND 2,600m on promotion of new methods including free inputs to selected (demonstration) farmers. On this basis, charge per ha share of research to all crop models (traditional and improved) and per ha share of promotion budget to improved models only (i.e. adopting farmers). In practice, only a very few farmers actually get free (demonstration) inputs. The PAM therefore charges these as a financial cost to the farmer - with the overall per ha share of promotion charged as an economic cost in improved models only. Actual spending on research and promotion can vary greatly by province and crop and this approach only aims to account for these costs in very broad terms.

CROP RESEARCH - per ha share charged to all crop models

	Ha	VND
Total budget		**200,000,000**
Total hectares ag land	93,600	2,137
Total hectares paddy (incl. multi crops)	160,000	1,250
Total hectares all crops (incl multi crops)	171,583	**1,166**

PROMOTION OF NEW METHODS (per ha share charged to improved models only)
Farmers who participate in program get inputs at heavy subsidy. Since few farmers actually participate, the PAM models charge the

	Ha	VND
Total budget		**2,600,000,000**
Total hectares ag land	93,600	27,778
Total hectares paddy (incl. multi crops)	160,000	16,250
Total hectares all crops (incl multi crops)	171,583	**15,153**

OUTGROWER PROGRAMS (private sector)

For large scale rice and other crops grown with outgrower support from a private company (contract farming), additional costs apply.

PRIVATE EXTENSION

Private extension worker (per month)	4,250,000	
Private extension worker (per 4-month crop cycle)	17,000,000	
Each private extension covers 50ha		
Per hectare cost for complete 4-month crop cycle	**340,000**	VND per ha

OUTGROWER OVERHEADS

Estimate other program costs at 20% of private extension	**68,000**	VND per ha

DIESEL AND PETROL, % forex and conversion factors

1. Percent Forex

UNDP 2012 reports that Vietnam is currently a net exporter of refined petroleum products (but likely to import 1/3 by 2025).

For PAM analysis, assume for some imported costs of refining, distribution, etc.

Based on above, assume 10% overall forex share for fuel (near to medium-term estimate).

2. Economic conversion factor

UNDP 2012 reports….

UNDP 2012 reports the overall subsidy on the pump price of petrol is roughly 12%, excluding many non-transparent payments to cover revenue losses and other types of subsidy paid to state owned enterprises.Assume these other payments are roughly 8% of the pump price = 20% subsidy overall.

Based on the above, assume 1.20 econoimc conversion factor for fuel/transport costs.

Appendix 2

Full Set of Indicators

PAM Indicators

SUMMARY OF RESULTS

Rice yields = tons dry paddy/ha
WS = winter-spring season; SA = summer-autumn season
Farmer price in large-scale model is after delivery to factory, all other farmers sell at farm gate (cost of delivery included in parity price)
* = variation selected for sensitivity analysis

		Season	Location	Parity Basis	Mgt	Yield	DRC	NPC	EPC	VND '000 per Hectare				USD per Hectare			
										Output Effect (I)	Tradable Effect (J)	Domestic Effect (K)	Net Effect (L)	Output Effect (I)	Tradable Effect (J)	Domestic Effect (K)	Net Effect (L)
Ordinary Rice, Traditional (high input)																	
	Rice (ord)	Small	WS	An Giang	Export	Trad	6.08	0.98	1.02	1.024	442	32	(2,225)	2,635	21.2	1.5	(106.6)	126.3
*	Rice (ord)	Medium	WS	An Giang	Export	Trad	6.75	0.77	1.02	1.023	491	32	(1,745)	2,204	23.5	1.5	(83.6)	105.7
	Rice (ord)	Small	SA	An Giang	Export	Trad	4.68	1.06	1.02	1.027	340	(31)	(2,459)	2,830	16.3	(1.5)	(117.9)	135.7
	Rice (ord)	Medium	SA	An Giang	Export	Trad	5.20	0.83	1.02	1.026	378	(31)	(1,980)	2,388	18.1	(1.5)	(94.9)	114.5
Ordinary Rice, Improved (with reductions)																	
	Rice (ord)	Small	WS	An Giang	Export	Imp	6.30	0.73	1.02	1.023	458	2	(2,222)	2,678	22.0	0.1	(106.5)	128.4
*	Rice (ord)	Medium	WS	An Giang	Export	Imp	7.00	0.60	1.02	1.022	509	2	(1,838)	2,345	24.4	0.1	(88.1)	112.4
*	Rice (ord)	Large	WS	An Giang	Export	Imp	7.40	0.57	1.02	1.020	527	(22)	(2,777)	3,325	25.3	(1.0)	(133.1)	159.4
	Rice (ord)	Small	SA	An Giang	Export	Imp	4.91	0.79	1.02	1.025	357	(39)	(2,301)	2,696	17.1	(1.9)	(110.3)	129.3
	Rice (ord)	Medium	SA	An Giang	Export	Imp	5.45	0.64	1.02	1.025	396	(39)	(2,013)	2,448	19.0	(1.9)	(96.5)	117.4
	Rice (ord)	Large	SA	An Giang	Export	Imp	5.75	0.59	1.02	1.022	410	(60)	(2,627)	3,097	19.6	(2.9)	(125.9)	148.4
Jasmine Rice, Traditional (high input)																	
	Jasmine	Small	WS	An Giang	Export	Trad	6.38	0.63	1.01	1.015	463	14	(2,821)	3,270	22.2	0.7	(135.2)	156.8
*	Jasmine	Medium	WS	An Giang	Export	Trad	7.09	0.52	1.01	1.015	515	14	(2,377)	2,877	24.7	0.7	(113.9)	137.9
Jasmine Rice, Improved (with reductions)																	
	Jasmine	Small	WS	An Giang	Export	Imp	6.62	0.48	1.01	1.015	481	(5)	(2,766)	3,252	23.0	(0.3)	(132.6)	155.9
*	Jasmine	Medium	WS	An Giang	Export	Imp	7.35	0.41	1.01	1.014	534	(5)	(2,478)	3,018	25.6	(0.3)	(118.8)	144.7
*	Jasmine	Large	WS	An Giang	Export	Imp	7.77	0.39	1.01	1.014	553	(26)	(3,034)	3,613	26.5	(1.3)	(145.4)	173.2
Domestic Rice, Traditional (high input) - NORTHERN															-	-	-	-
	Rice (std)	Micro	WS	Nam Dinh	Import	Trad	4.73	1.31	1.002	1.003	58	(2)	(8,569)	8,630	2.8	(0.1)	(410.8)	413.7
	Rice (btr)	Micro	WS	Nam Dinh	Import	Trad	4.17	1.53	1.002	1.003	51	(7)	(8,576)	8,634	2.4	(0.3)	(411.1)	413.9
*	Rice (std)	Micro	SA	Nam Dinh	Import	Trad	4.45	1.18	1.002	1.004	54	(27)	(8,583)	8,665	2.6	(1.3)	(411.5)	415.4
	Rice (btr)	Micro	SA	Nam Dinh	Import	Trad	3.89	1.39	1.002	1.005	48	(29)	(8,587)	8,664	2.3	(1.4)	(411.7)	415.4
Domestic Rice, Improved (with reductions) - NORTHERN															-	-	-	-
	Rice (std)	Micro	WS	Nam Dinh	Import	Imp	5.20	0.97	1.002	1.006	64	(88)	(8,220)	8,371	3.0	(4.2)	(394.0)	401.3
	Rice (btr)	Micro	WS	Nam Dinh	Import	Imp	4.59	1.11	1.002	1.007	56	(92)	(8,225)	8,373	2.7	(4.4)	(394.3)	401.4
*	Rice (std)	Micro	SA	Nam Dinh	Import	Imp	4.89	1.02	1.002	1.007	60	(92)	(8,102)	8,253	2.9	(4.4)	(388.4)	395.6
	Rice (btr)	Micro	SA	Nam Dinh	Import	Imp	4.28	1.08	1.002	1.007	52	(83)	(8,055)	8,190	2.5	(4.0)	(386.1)	392.6
Maize for stock feed - NORTHERN															-	-	-	-
	Maize (manual)	Micro	WS	Phu Tho	Import	Trad	4.45	0.64	1.001	1.001	25	(25)	(7,235)	7,286	1.2	(1.2)	(346.9)	349.3
	Maize (tractor)	Micro	WS	Phu Tho	Import	Trad	4.45	0.48	1.001	1.003	25	(67)	(2,283)	2,375	1.2	(3.2)	(109.4)	113.9
	VN4-Maize (manual)	Micro	WS	Phu Tho	Import	Trad	5.50	0.52	1.001	1.002	31	(32)	(7,492)	7,555	1.5	(1.5)	(359.1)	362.2
	VN4-Maize (tractor)	Micro	WS	Phu Tho	Import	Trad	5.50	0.38	1.001	1.003	31	(74)	(2,299)	2,404	1.5	(3.5)	(110.2)	115.3
Cassava for stock feed - NORTHERN															-	-	-	-
	Cassava (ordinary)	Micro	SA	Phu Tho	Import	Trad	19.00	0.89	1.003	1.236	113	(6,278)	(13,875)	20,267	5.4	(301.0)	(665.2)	971.6
	Cassava - KM94	Micro	SA	Phu Tho	Import	Trad	30.00	0.72	1.002	1.175	179	(8,374)	(17,228)	25,780	8.6	(401.4)	(825.9)	1,235.9

Financial Indicators (VND '000)

SUMMARY OF RESULTS

Rice yields = tons dry paddy/ha
WS = winter-spring season; SA = summer-autumn season
Farmer price in large-scale model is after delivery to factory, all other farmers sell at farm gate (cost of delivery included in parity price)
* = variation selected for sensitivity analysis

								Farmer Price	Farmer Price	VND '000 per Hectare						Days per Hectare			VND '000 per day	
		Season	Location	Parity Basis	Mgt	Yield	DRC	(VND/kg)	(USD/kg)	Gross Revenue	Variable Costs	Fixed Costs	Total Costs	Gross Margin	Net Profit	Hired Labor	Family Labor	Total Labor	Gross per day family	Net per day total
Ordinary Rice, Traditional (high input)																				
	Rice (ord)	Small	WS	An Giang	Export	Trad	6.08	0.98	4,500	0.22	27,338	21,100	677	21,777	6,238	5,561	31	29	60	215.1	92.7
*	Rice (ord)	Medium	WS	An Giang	Export	Trad	6.75	0.77	4,700	0.23	31,725	20,100	436	20,536	11,625	11,189	21	19	40	611.8	279.7
	Rice (ord)	Small	SA	An Giang	Export	Trad	4.68	1.06	3,890	0.19	18,205	15,845	677	16,522	2,360	1,684	27	32	59	73.8	28.5
	Rice (ord)	Medium	SA	An Giang	Export	Trad	5.20	0.83	4,090	0.20	21,268	15,025	436	15,461	6,243	5,807	17	22	39	283.8	148.9
Ordinary Rice, Improved (with reductions)																				
	Rice (ord)	Small	WS	An Giang	Export	Imp	6.30	0.73	4,500	0.22	28,350	16,900	677	17,577	11,450	10,773	21	31	52	369.4	207.2
*	Rice (ord)	Medium	WS	An Giang	Export	Imp	7.00	0.60	4,700	0.23	32,900	16,461	436	16,897	16,439	16,003	21	23	44	714.7	363.7
*	Rice (ord)	Large	WS	An Giang	Export	Imp	7.40	0.57	5,650	0.27	41,810	17,894	638	18,532	23,916	23,278	24	25	49	956.6	475.1
	Rice (ord)	Small	SA	An Giang	Export	Imp	4.91	0.79	3,890	0.19	19,080	12,765	677	13,442	6,315	5,639	23	31	54	203.7	104.4
	Rice (ord)	Medium	SA	An Giang	Export	Imp	5.45	0.64	4,090	0.20	22,291	12,265	436	12,701	10,026	9,590	19	25	44	401.0	217.9
	Rice (ord)	Large	SA	An Giang	Export	Imp	5.75	0.59	5,040	0.24	28,980	13,014	638	13,652	15,966	15,328	20	27	47	591.3	326.1
Jasmine Rice, Traditional (high input)																				
	Jasmine	Small	WS	An Giang	Export	Trad	6.38	0.63	5,900	0.28	37,635	22,580	677	23,257	15,055	14,378	35	39	74	386.0	194.3
*	Jasmine	Medium	WS	An Giang	Export	Trad	7.09	0.52	6,000	0.29	42,525	21,900	436	22,336	20,625	20,189	29	30	59	687.5	342.2
Jasmine Rice, Improved (with reductions)																				
	Jasmine	Small	WS	An Giang	Export	Imp	6.62	0.48	5,900	0.28	39,029	17,836	677	18,513	21,193	20,516	27	41	68	516.9	301.7
*	Jasmine	Medium	WS	An Giang	Export	Imp	7.35	0.41	6,000	0.29	44,100	17,556	436	17,992	26,544	26,108	26	35	61	758.4	428.0
*	Jasmine	Large	WS	An Giang	Export	Imp	7.77	0.39	6,400	0.31	49,728	18,445	638	19,083	31,283	30,645	30	36	66	869.0	464.3
Domestic Rice, Traditional (high input) - NORTHERN																				
	Rice (std)	Micro	WS	Nam Dinh	Import	Trad	4.73	1.31	5,300	0.25	25,048	20,238	2,894	23,132	4,810	1,916	38	120	158	40.1	12.1
	Rice (btr)	Micro	WS	Nam Dinh	Import	Trad	4.17	1.53	6,800	0.33	28,356	20,697	2,894	23,591	7,659	4,765	38	120	158	63.8	30.2
*	Rice (std)	Micro	SA	Nam Dinh	Import	Trad	4.45	1.18	6,300	0.30	28,022	15,424	2,894	18,317	12,599	9,705	32	121	153	104.1	63.4
	Rice (btr)	Micro	SA	Nam Dinh	Import	Trad	3.89	1.39	7,800	0.37	30,358	16,096	2,894	18,990	14,261	11,367	32	121	153	117.9	74.3
Domestic Rice, Improved (with reductions) - NORTHERN																				
	Rice (std)	Micro	WS	Nam Dinh	Import	Imp	5.20	0.97	5,300	0.25	27,553	16,276	2,894	19,170	11,277	8,383	33	114	147	98.9	57.0
	Rice (btr)	Micro	WS	Nam Dinh	Import	Imp	4.59	1.11	6,800	0.33	31,192	16,666	2,894	19,560	14,526	11,632	33	114	147	127.4	79.1
*	Rice (std)	Micro	SA	Nam Dinh	Import	Imp	4.89	1.02	6,300	0.30	30,825	15,277	2,894	18,171	15,547	12,653	30	112	142	138.8	89.1
	Rice (btr)	Micro	SA	Nam Dinh	Import	Imp	4.28	1.08	7,800	0.37	33,393	13,831	2,894	16,725	19,563	16,669	30	112	142	174.7	117.4
Maize for stock feed - NORTHERN																				
	Maize (manual)	Micro	WS	Phu Tho	Import	Trad	4.45	0.64	6,000	0.29	26,688	11,133	3,026	14,159	15,555	12,529	24	141	165	110.3	75.9
	Maize (tractor)	Micro	WS	Phu Tho	Import	Trad	4.45	0.48	6,000	0.29	26,688	11,378	3,026	14,404	15,310	12,284	3	30	33	510.3	372.2
	VN4-Maize (manual)	Micro	WS	Phu Tho	Import	Trad	5.50	0.52	6,000	0.29	33,000	11,237	3,026	14,263	21,763	18,737	24	146	170	149.1	110.2
	VN4-Maize (tractor)	Micro	WS	Phu Tho	Import	Trad	5.50	0.38	6,000	0.29	33,000	11,482	3,026	14,508	21,518	18,492	3	30	33	717.3	560.4
Cassava for stock feed - NORTHERN																				
	Cassava (ordinary)	Micro	SA	Phu Tho	Import	Trad	19.00	0.89	1,750	0.08	33,250	14,561	2,297	16,858	18,689	16,392	10	155	165	120.6	99.3
	Cassava - KM94	Micro	SA	Phu Tho	Import	Trad	30.00	0.72	2,013	0.10	60,375	30,863	2,297	33,159	29,512	27,216	15	184	199	160.4	136.8

Financial Indicators (USD)

SUMMARY OF RESULTS

Rice yields = tons dry paddy/ha
WS = winter-spring season; SA = summer-autumn season
Farmer price in large-scale model is after delivery to factory, all other farmers sell at farm gate (cost of delivery included in parity price)
* = variation selected for sensitivity analysis

		Season	Location	Parity Basis	Mgt	Yield	DRC	Farmer Price (VND/kg)	Farmer Price (USD/kg)	USD per Hectare						Days per Hectare			USD per day	
										Gross Revenue	Variable Costs	Fixed Costs	Total Costs	Gross Margin	Net Profit	Hired Labor	Family Labor	Total Labor	Gross per day family	Net per day total
Ordinary Rice, Traditional (high input)																				
	Rice (ord)	Small	WS	An Giang	Export	Trad	6.08	0.98	4,500	0.22	1,311	1,012	32	1,044	299	267	31	29	60	10.3	4.4
*	Rice (ord)	Medium	WS	An Giang	Export	Trad	6.75	0.77	4,700	0.23	1,521	964	21	984	557	536	21	19	40	29.3	13.4
	Rice (ord)	Small	SA	An Giang	Export	Trad	4.68	1.06	3,890	0.19	873	760	32	792	113	81	27	32	59	3.5	1.4
	Rice (ord)	Medium	SA	An Giang	Export	Trad	5.20	0.83	4,090	0.20	1,020	720	21	741	299	278	17	22	39	13.6	7.1
Ordinary Rice, Improved (with reductions)																				
	Rice (ord)	Small	WS	An Giang	Export	Imp	6.30	0.73	4,500	0.22	1,359	810	32	843	549	516	21	31	52	17.7	9.9
*	Rice (ord)	Medium	WS	An Giang	Export	Imp	7.00	0.60	4,700	0.23	1,577	789	21	810	788	767	21	23	44	34.3	17.4
*	Rice (ord)	Large	WS	An Giang	Export	Imp	7.40	0.57	5,650	0.27	2,004	858	31	888	1,147	1,116	24	25	49	45.9	22.8
	Rice (ord)	Small	SA	An Giang	Export	Imp	4.91	0.79	3,890	0.19	915	612	32	644	303	270	23	31	54	9.8	5.0
	Rice (ord)	Medium	SA	An Giang	Export	Imp	5.45	0.64	4,090	0.20	1,069	588	21	609	481	460	19	25	44	19.2	10.4
	Rice (ord)	Large	SA	An Giang	Export	Imp	5.75	0.59	5,040	0.24	1,389	624	31	654	765	735	20	27	47	28.3	15.6
Jasmine Rice, Traditional (high input)																				
	Jasmine	Small	WS	An Giang	Export	Trad	6.38	0.63	5,900	0.28	1,804	1,082	32	1,115	722	689	35	39	74	18.5	9.3
*	Jasmine	Medium	WS	An Giang	Export	Trad	7.09	0.52	6,000	0.29	2,039	1,050	21	1,071	989	968	29	30	59	33.0	16.4
Jasmine Rice, Improved (with reductions)																				
	Jasmine	Small	WS	An Giang	Export	Imp	6.62	0.48	5,900	0.28	1,871	855	32	887	1,016	984	27	41	68	24.8	14.5
*	Jasmine	Medium	WS	An Giang	Export	Imp	7.35	0.41	6,000	0.29	2,114	842	21	863	1,272	1,252	26	35	61	36.4	20.5
*	Jasmine	Large	WS	An Giang	Export	Imp	7.77	0.39	6,400	0.31	2,384	884	31	915	1,500	1,469	30	36	66	41.7	22.3
Domestic Rice, Traditional (high input) - NORTHERN																				
	Rice (std)	Micro	WS	Nam Dinh	Import	Trad	4.73	1.31	5,300	0.25	1,201	970	139	1,109	231	92	38	120	158	1.9	0.6
	Rice (btr)	Micro	WS	Nam Dinh	Import	Trad	4.17	1.53	6,800	0.33	1,359	992	139	1,131	367	228	38	120	158	3.1	1.4
*	Rice (std)	Micro	SA	Nam Dinh	Import	Trad	4.45	1.18	6,300	0.30	1,343	739	139	878	604	465	32	121	153	5.0	3.0
	Rice (btr)	Micro	SA	Nam Dinh	Import	Trad	3.89	1.39	7,800	0.37	1,455	772	139	910	684	545	32	121	153	5.7	3.6
Domestic Rice, Improved (with reductions) - NORTHERN																				
	Rice (std)	Micro	WS	Nam Dinh	Import	Imp	5.20	0.97	5,300	0.25	1,321	780	139	919	541	402	33	114	147	4.7	2.7
	Rice (btr)	Micro	WS	Nam Dinh	Import	Imp	4.59	1.11	6,800	0.33	1,495	799	139	938	696	558	33	114	147	6.1	3.8
*	Rice (std)	Micro	SA	Nam Dinh	Import	Imp	4.89	1.02	6,300	0.30	1,478	732	139	871	745	607	30	112	142	6.7	4.3
	Rice (btr)	Micro	SA	Nam Dinh	Import	Imp	4.28	1.08	7,800	0.37	1,601	663	139	802	938	799	30	112	142	8.4	5.6
Maize for stock feed - NORTHERN																				
	Maize (manual)	Micro	WS	Phu Tho	Import	Trad	4.45	0.64	6,000	0.29	1,279	534	145	679	746	601	24	141	165	5.3	3.6
	Maize (tractor)	Micro	WS	Phu Tho	Import	Trad	4.45	0.48	6,000	0.29	1,279	545	145	691	734	589	3	30	33	24.5	17.8
	VN4-Maize (manual)	Micro	WS	Phu Tho	Import	Trad	5.50	0.52	6,000	0.29	1,582	539	145	684	1,043	898	24	146	170	7.1	5.3
	VN4-Maize (tractor)	Micro	WS	Phu Tho	Import	Trad	5.50	0.38	6,000	0.29	1,582	550	145	695	1,032	886	3	30	33	34.4	26.9
Cassava for stock feed - NORTHERN																				
	Cassava (ordinary)	Micro	SA	Phu Tho	Import	Trad	19.00	0.89	1,750	0.08	1,594	698	110	808	896	786	10	155	165	5.8	4.8
	Cassava - KM94	Micro	SA	Phu Tho	Import	Trad	30.00	0.72	2,013	0.10	2,894	1,480	110	1,590	1,415	1,305	15	184	199	7.7	6.6

Financial Indicators, per ton of product (VND '000 and USD)

SUMMARY OF RESULTS

Rice yields = tons dry paddy/ha
WS = winter-spring season; SA = summer-autumn season
Farmer price in large-scale model is after delivery to factory, all other farmers sell at farm gate (cost of delivery included in parity price)
* = variation selected for sensitivity analysis

		Season	Location	Parity Basis	Mgt	Yield	DRC	Farmer Price (VND/kg)	Farmer Price (USD/kg)	VND '000 per ton farm gate product						USD per ton farm gate product					
										Gross Revenue	Variable Costs	Fixed Costs	Total Costs	Gross Margin	Net Profit	Gross Revenue	Variable Costs	Fixed Costs	Total Costs	Gross Margin	Net Profit
Ordinary Rice, Traditional (high input)																					
	Rice (ord)	Small	WS	An Giang	Export	Trad	6.08	0.98	4,500	0.22	4,500	3,473	111	3,585	1,027	915	216	167	5	172	49	44
*	Rice (ord)	Medium	WS	An Giang	Export	Trad	6.75	0.77	4,700	0.23	4,700	2,978	65	3,042	1,722	1,658	225	143	3	146	83	79
	Rice (ord)	Small	SA	An Giang	Export	Trad	4.68	1.06	3,890	0.19	3,890	3,386	145	3,530	504	360	186	162	7	169	24	17
	Rice (ord)	Medium	SA	An Giang	Export	Trad	5.20	0.83	4,090	0.20	4,090	2,889	84	2,973	1,201	1,117	196	139	4	143	58	54
Ordinary Rice, Improved (with reductions)																					
	Rice (ord)	Small	WS	An Giang	Export	Imp	6.30	0.73	4,500	0.22	4,500	2,683	107	2,790	1,817	1,710	216	129	5	134	87	82
*	Rice (ord)	Medium	WS	An Giang	Export	Imp	7.00	0.60	4,700	0.23	4,700	2,352	62	2,414	2,348	2,286	225	113	3	116	113	110
*	Rice (ord)	Large	WS	An Giang	Export	Imp	7.40	0.57	5,650	0.27	5,650	2,418	86	2,504	3,232	3,146	271	116	4	120	155	151
	Rice (ord)	Small	SA	An Giang	Export	Imp	4.91	0.79	3,890	0.19	3,890	2,602	138	2,740	1,288	1,150	186	125	7	131	62	55
	Rice (ord)	Medium	SA	An Giang	Export	Imp	5.45	0.64	4,090	0.20	4,090	2,250	80	2,330	1,840	1,760	196	108	4	112	88	84
	Rice (ord)	Large	SA	An Giang	Export	Imp	5.75	0.59	5,040	0.24	5,040	2,263	111	2,374	2,777	2,666	242	109	5	114	133	128
Jasmine Rice, Traditional (high input)																					
	Jasmine	Small	WS	An Giang	Export	Trad	6.38	0.63	5,900	0.28	5,900	3,540	106	3,646	2,360	2,254	283	170	5	175	113	108
*	Jasmine	Medium	WS	An Giang	Export	Trad	7.09	0.52	6,000	0.29	6,000	3,090	62	3,151	2,910	2,849	288	148	3	151	140	137
Jasmine Rice, Improved (with reductions)																					
	Jasmine	Small	WS	An Giang	Export	Imp	6.62	0.48	5,900	0.28	5,900	2,696	102	2,799	3,204	3,101	283	129	5	134	154	149
*	Jasmine	Medium	WS	An Giang	Export	Imp	7.35	0.41	6,000	0.29	6,000	2,389	59	2,448	3,611	3,552	288	115	3	117	173	170
*	Jasmine	Large	WS	An Giang	Export	Imp	7.77	0.39	6,400	0.31	6,400	2,374	82	2,456	4,026	3,944	307	114	4	118	193	189
Domestic Rice, Traditional (high input) - NORTHERN																					
	Rice (std)	Micro	WS	Nam Dinh	Import	Trad	4.73	1.31	5,300	0.25	5,300	4,282	612	4,895	1,018	405	254	205	29	235	49	19
	Rice (btr)	Micro	WS	Nam Dinh	Import	Trad	4.17	1.53	6,800	0.33	6,800	4,963	694	5,657	1,837	1,143	326	238	33	271	88	55
*	Rice (std)	Micro	SA	Nam Dinh	Import	Trad	4.45	1.18	6,300	0.30	6,300	3,468	651	4,118	2,832	2,182	302	166	31	197	136	105
	Rice (btr)	Micro	SA	Nam Dinh	Import	Trad	3.89	1.39	7,800	0.37	7,800	4,136	744	4,879	3,664	2,921	374	198	36	234	176	140
Domestic Rice, Improved (with reductions) - NORTHERN																					
	Rice (std)	Micro	WS	Nam Dinh	Import	Imp	5.20	0.97	5,300	0.25	5,300	3,131	557	3,687	2,169	1,613	254	150	27	177	104	77
	Rice (btr)	Micro	WS	Nam Dinh	Import	Imp	4.59	1.11	6,800	0.33	6,800	3,633	631	4,264	3,167	2,536	326	174	30	204	152	122
*	Rice (std)	Micro	SA	Nam Dinh	Import	Imp	4.89	1.02	6,300	0.30	6,300	3,122	591	3,714	3,178	2,586	302	150	28	178	152	124
	Rice (btr)	Micro	SA	Nam Dinh	Import	Imp	4.28	1.08	7,800	0.37	7,800	3,231	676	3,907	4,569	3,893	374	155	32	187	219	187
Maize for stock feed - NORTHERN																					
	Maize (manual)	Micro	WS	Phu Tho	Import	Trad	4.45	0.64	6,000	0.29	6,000	2,503	680	3,183	3,497	2,817	288	120	33	153	168	135
	Maize (tractor)	Micro	WS	Phu Tho	Import	Trad	4.45	0.48	6,000	0.29	6,000	2,558	680	3,238	3,442	2,762	288	123	33	155	165	132
	VN4-Maize (manual)	Micro	WS	Phu Tho	Import	Trad	5.50	0.52	6,000	0.29	6,000	2,043	550	2,593	3,957	3,407	288	98	26	124	190	163
	VN4-Maize (tractor)	Micro	WS	Phu Tho	Import	Trad	5.50	0.38	6,000	0.29	6,000	2,088	550	2,638	3,912	3,362	288	100	26	126	188	161
Cassava for stock feed - NORTHERN																					
	Cassava (ordinary)	Micro	SA	Phu Tho	Import	Trad	19.00	0.89	1,750	0.08	1,750	766	121	887	984	863	84	37	6	43	47	41
	Cassava - KM94	Micro	SA	Phu Tho	Import	Trad	30.00	0.72	2,013	0.10	2,013	1,029	77	1,105	984	907	96	49	4	53	47	43