Background paper for the
Competitive Commercial Agriculture in Sub–Saharan Africa (CCAA) Study

DESCRIPTION OF METHODOLOGY AND PRESENTATION OF TEMPLATES FOR VALUE CHAIN ANALYSIS

PART 1: NARRATIVE TEXT

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LIST OF ABBREVIATIONS

CCAA	Competitive Commercial Agriculture in Africa
CF	Conversion factor
cif	Cargo, insurance and freight
DLV	Domestic landed value
DRC	Domestic resource cost ratio
DVA	Domestic value added
DVF	Domestic value at frontier
ECF	Emergent commercial farmer
EPC	Effective protection coefficient
FAM	Family farmer
fob	Free on board
Forex	Foreign exchange
LCF	Large commercial farmer
LCU	Local currency unit
NPC	Nominal protection coefficient
O&M	Operation and maintenance
PAM	Policy analysis matrix
R&M	Repairs and maintenance
SV	Shipment value
TLV	Total landed value
USD	United States Dollar
VDP	Value for duty purposes
ZAR	South Africa Rand

MAJOR DEFINITIONS

Domestic Value Added (DVA)	**=**	Domestic costs and mark-ups + Official duties and tax + Unofficial charges & extra costs
Shipment Value (SV)	**=**	Domestic value added + Foreign components

PRODUCT STAGES

1. Farm production	=	Farm gate product
2. Assembly	=	Assembled raw material
3. Processing	=	Processed raw material
4. International logistics	=	Traded commodity (Product 1, 2, 3)

COLOR CODING IN EXCEL TEMPLATES

	Orange cells are for text
	Green cells are for numbers
	Blue cells are for data drawn from a previous stage in the analysis
	Yellow cells highlight key results and other important information
	Grey (or black) cells are placeholders for assumptions that do not normally change
	White cells contain formulas and should not be altered

CCAA CURRENCY DESIGNATIONS

(Approximate financial exchange rates as of July 1, 2006)

Brazil Real (BRL)

USD 1.00	=	BRL = 2.20
BRL 5.00	=	USD 2.27

Mozambique Metical (MZM)

USD 1.00	=	MZM 25,800
MZM 50,000	=	USD 1.93

Nigeria Naira (NGN)

USD 1.00	=	NGN 128
NGN 500	=	USD 3.91

Thailand Baht (THB)

USD 1.00	=	THB 38.10
THB 100.00	=	USD 2.62

Zambia Kwacha (ZMK)

USD 1.00	=	ZMK 3,450
ZMK 10,000	=	USD 2.89

WEIGHTS AND MEASURES

1 hectare (ha) = 2.417 acres (ac)

1 kilogram (kg) = 2.204 pounds (lbs)

1,000 kilograms (kgs) = 1 metric ton (MT)

1 kilometer (km) = 0.62 miles

Any questions or comments on the methodology are very welcome by writing to the author at Box 35220, Lusaka, Zambia or by email to jck@zamnet.zm. Special arrangements have been made during the CCAA study to provide operational guidance for each participating country teams. Please do not hesitate to send your questions and feedback.

PART 1 – NARRATIVE TEXT

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PART 2 – SPREADSHEET TEMPLATES

The spreadsheet templates designed for CCAA value chain analysis are presented in seven separate Excel Workbooks as follows. One set of templates designated "sample" is provided with dummy data to show how the spreadsheets work. A blank set of templates to be used by each CCAA country team is also provided.

LIST OF SPREADSHEET PAGES

Book 1 - Country Data and Summaries

- 1.1 Country Data
- 1.2 Commodity Prices
- 1.3 Input Indicators
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- 6.3 Logistics analysis – Product 3
- 6.4 Logistics budget – Product 1
- 6.5 Logistics budget – Product 2
- 6.6 Logistics budget – Product 3

Book 7 – Policy Analysis Matrix

- 7.1 PAM template
- 7.2 Parity price examples

COMPETITIVE COMMERCIAL AGRICULTURE IN AFRICA (CCAA)

DEFINITION OF METHODOLOGY AND PRESENTATION OF TEMPLATES FOR VALUE CHAIN ANALYSIS

I. INTRODUCTION

1. This paper describes the methodology for quantitative value chain analysis under the Competitive Commercial Agriculture in Africa (CCAA) study. The primary objective of the CCAA study is to explore the feasibility of restoring competitiveness and growth in selected African countries by identifying key commodities, production systems, and marketing arrangements that are capable of underpinning rapid development of commercial agriculture. Competitiveness will be analyzed using primarily value chain analysis. The CCAA study is concerned with (1) qualitative features of the value chains for the selected commodities and products, including the policy, institutional, and organizational factors that affect costs and shape relationships among the various actors, and (2) quantitative information about selected value chains, in particular financial costs and time requirements. The methodology described in this paper has been designed to collect the quantitative information for selected "candidate commodities" at critical stages in the value chain beginning with input supply, through to farm production, assembly, processing, and international logistics. A set of original templates in seven interlinked Excel workbooks has been prepared to facilitate this analysis. Observations and results from this quantitative analysis must be couched within an analysis of the qualitative factors that affect the results.[1]

2. In Africa, the CCAA study will cover Mozambique, Nigeria, and Zambia. The analysis will focus on seven basic commodities plus a few additional commodities in each country thought to offer good potential for commercial development. The seven basic CCAA commodities are cassava, cattle, cotton, maize, rice, soybeans, and sugar. To establish international benchmarks of successful development, a parallel analysis of value chain performance will also be carried out in Brazil and Thailand. These assessments will allow production costs and other aspects of value chain performance in Africa to be compared on a global scale to help determine where the best opportunities for rapid growth in each target country can most likely be found. The analysis will cover three farm sectors in each country.

3. In addition to quantitative methods, the analysis in all countries will include a qualitative assessment of major policies, institutional, and organizational factors that affect costs and shape trading relations. The analytical approach described in this paper, therefore, represents just one part of the larger CCAA methodology. Further details on the major objectives and design features of the CCAA work are set out in the Summary Project Proposal prepared by World Bank staff.

A. Objectives

4. Within this context, the main objectives of the current paper are to:

- Describe essential value chain concepts and provide a standard methodology for quantitative analysis;

[1] For guidance on the qualitative analysis, country teams should refer to Annex 7 of Summary Project Proposal; particularly, but not exclusively, to pg. 7-15 to 7-17.

- Introduce a set of Excel spreadsheet templates developed specifically for the CCAA study; and

- Provide practical instructions for CCAA country teams to follow in working with the Excel templates.

5. To achieve these objectives, the paper is organized in five sections, of which the first is the current introduction. Section II provides an overview of major value chain concepts and definitions used for the quantitative analysis; Section III provides general instructions on how to work with the spreadsheet templates; and Section IV looks in detail at the specific function of individual workbooks and template pages. The paper concludes in Section IV with a few remarks on interpreting the quantitative results and future uses of the value chain templates.

B. Approach and Limitations

6. Broadly defined, quantitative value chain analysis is focused on the amount of money a customer is willing to pay for a firm's output. In an open economy, this price is determined competitively and flows upstream from the consumer to each producer and marketing company involved in the growing, collection, transformation, and delivery of that commodity to its terminal market. Supply chain analysis is a complementary concept applied to a network of companies across a given industry. Whereas value chain analysis looks at the upstream accumulation of value as a determinant of international competitiveness, supply chain analysis is a downstream concept that looks at the flow of goods from the supplier to consumer. Both concepts are concerned with the organization of value adding activities while competing in a particular industry, but the key analytical distinction comes in the flow of value between the supplier and consumer.

7. Value chain and supply chain analysis are also concerned with product differentiation and timeliness of delivery. These factors are major determinants of a commodity's final market price and total value that can be divided between participants in the production and marketing system. Seasonality is an especially important factor in agriculture since the prices of most farm commodities are cyclical depending on world production and patterns in consumer demand. Quality differences are likewise an important source of competitive advantage as is the ability of a country to supply guaranteed minimum quantities according to a specific time schedule. Interpretation of the quantitative value chain indicators, therefore, requires knowledge of conditions in other countries in order to pick the most relevant price with which to compare local production.

8. From these essential concepts, quantitative value chain analysis quickly becomes a multidimensional task that requires careful attention to a great many details and individual product differences. Towards this end, the quantitative methodology focuses on the measurement of accumulated production costs, private financial returns, and time requirements at each stage of the value chain. The Excel workbooks have been designed to calculate standard indicators for each of these aspects of value chain performance so that the results for different commodities, farm systems, and countries can be compared as equally as possible. These measurements of cost components, private profitability, and time requirements are drawn from standard per hectare or per ton budgets for farm production, crop assembly, industrial processing, and logistics to the final delivery point that each CCAA country team will need to prepare. Where important differences exist, either between farm sectors or by processing technique and product quality, additional workbooks will need to be filled in so that the results for each enterprise variation can be compared. The templates are designed to handle both export commodities and import substitutes.

9. A list of the Excel workbooks developed for the CCAA study is given in Table 1. The workbooks are organized in a logical sequence that roughly follows the major stages of the commodity value chain.

Table 1: List of Excel Workbooks

	Name / Product Stage	Function
Book 1	Country Data and Summaries	Driving data and analytical summaries
Book 2	Input Costs	Analysis of input prices & derivation of conversion factors for enterprise budget construction
Book 3	Farm Production	Crop budget and analytical summary of farm production
Book 4	Assembly	Assembly budget and analytical summary of raw material assembly
Book 5	Processing	Processing budget and analytical summary of raw material processing
Book 6	Logistics	Logistics budget and analytical summary of international or domestic trade for up to three finished commodities
Book 7	PAM Analysis	Supplementary templates for construction of the Policy Analysis Matrix and parity price calculations

10. Further details on the specific function and use of each book are provided in the discussion that follows. Before proceeding, however, it is useful to note some of the limitations of quantitative analysis.

11. First, because agriculture practices vary widely between individual value chain participants, the spreadsheet templates are best used to generate indicative results only. Country analysts must strive to ensure that the production budgets reflect realistic conditions to the greatest extent possible, but even the best constructed models are unlikely to provide a definitive picture of all costs and returns. Specific levels of input use, actual yields, production outturns, and overhead costs can all vary greatly from one participant to another and the models are best used to provide a general picture of value chain processes only. By extension, this means the models alone cannot be used to identify optimal development strategies. Profitability, risk, operating costs, and investment requirements are critical to value chain performance, but only tell part of the story. Many other demand-side factors, including regional market conditions, price trends, seasonality, and consumer preferences all need to be considered in deciding which enterprises to promote and how best to allocate scarce investment resources.

12. It should also be stressed at the outset that the results for one country can only be compared with those from another country in a limited sense. While the spreadsheet templates are designed to produce a standard set of indicators, any number of seemingly minor differences in how one country team values specific production factors can have an important bearing on the final results. Rather than strive for the exacting levels of detail and consistency between countries, the best approach is to aim for a general picture of international competitiveness and relative cost levels only. In practice, this makes the analyst's task much easier since there will be times when data limitations mean that a "best guess" of some budget coefficient has to be used instead of an exact figure. This is entirely consistent with the indicative nature of the spreadsheet analysis, but must be kept in mind when interpreting the results.

13. Finally, it should be emphasized that the spreadsheet templates are a new creation and have not yet been tested in a fully operational sense. Great care has gone to produce a set of templates that are logical and transparent. As a new approach, however, lessons also need to be drawn from the experience of working with the materials so that the spreadsheet templates can be further refined and developed. Analysts will need to use their own discretion when working with the methodology and should not feel locked into a rigid process.

II. CONCEPTS AND DEFINITIONS

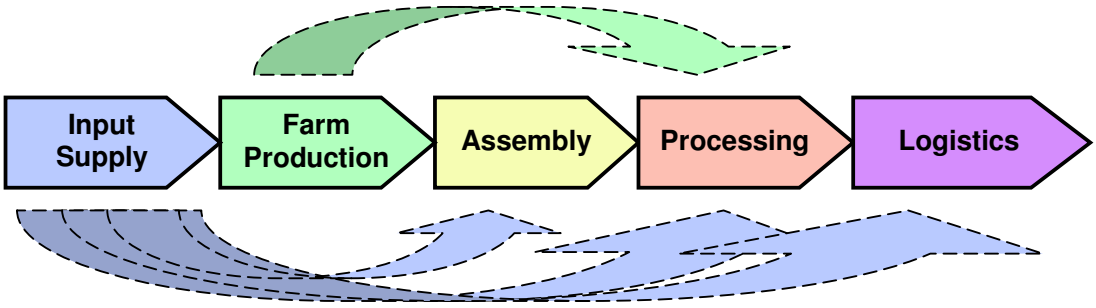
14. Before describing how to use each of the seven Excel workbooks, it is important to review some basic value chain concepts and definitions. Notwithstanding the methodological limitations noted above, it is important that all country teams begin with a common understanding of the analytical process in order to produce the best data set possible.

A. Stages of the Value Chain

15. Value chain analysis has gained considerable popularity in recent years. Although many approaches are taken, value chains essentially represent enterprises in which different producers and marketing companies work within their respective businesses to pursue one or more end-markets. Value chain participants sometimes cooperate to improve the overall competitiveness of the final product, but may also be completely unaware of the linkages between their operation and other upstream or downstream participants. Value chains therefore encompass all of the factors of production including land, labor, capital, technology, and inputs as well as all economic activities including input supply, production, transformation, handling, transport, marketing, and distribution necessary to create, sell, and deliver a product to a certain destination.

16. The main stages of an agricultural value chain as defined for the quantitative methodology are illustrated in the figure below. In this diagram, dashed arrows flow from input supply to all other stages to show that this is a crosscutting function that affects all participants, not just at the farm level. A dashed arrow is also drawn from farm production to processing to show that some farmers may deliver their crop directly to a factory, thereby fulfilling the assembly function as well. This can either happen as part of a vertically integrated supply chain managed by a large company or because the scale or proximity of an individual's production to the factory justifies direct delivery.

Figure 1: Stages of the Value Chain



17. It is useful to review some of the main activities that occur at each stage of the value chain. These include the following.

- **Input supply.** This stage is concerned with the sourcing of raw materials required for agriculture production, processing, and trade. Inputs may either be procured locally or imported. The final value of an input at its place of use includes all manufacturing costs, transportation costs, customs duty and tax, and unofficial payments incurred up to that point. The efficiency of a country's input supply system therefore has a major bearing on the performance of the entire value chain.

- **Farm production.** This stage is concerned with primary agriculture production and ends with the sale of a raw commodity at the farm gate. These transactions may occur literally at the farm gate or at some other point where the farmer hands over ownership of the product to the next value chain participant. Depending on

the crop, some type of primary processing (such as the shelling or bagging of dry grain) may take place at the farm level.

- **Assembly.** This stage involves the collection of agricultural produce from many farmers and delivery of the raw material to a factory for industrial processing or packaging. In the case of livestock operations, assembly is defined in a broader sense to include the feedlot process for delivery of fattened animals to an abattoir. Bagging and simple grading of crops can also occur at this stage depending on arrangements made at the first point of sale.

- **Processing.** The processing stage involves the transformation of agriculture raw materials into one or more finished internationally traded goods. Raw commodities, of course, are also traded and this stage may not apply to every crop. The spreadsheet templates have been designed to accommodate the production of up to three goods from a single raw material.

- **Domestic and international logistics.** The logistics stage is concerned with the delivery of traded commodities to their final market destination. This may either be a foreign market in the case of exports, or a local market for import substitutes. For import substitutes, the logistics stage ends at the domestic level, but the analysis is still concerned with the cost of importing a like product from the nearest or most competitive country.

18. **Price build-up from stage to stage.** In value chain analysis, all inputs and outputs carry forward their inherited value from the previous stage. This point may seem obvious enough, but is important to stress in value chain analysis where the focus is on cost levels at different stages as a key determinant of international competitiveness. The competitiveness of Zambian soybeans as an import substitute, for example, depends on the efficiency of the input supply system, farm production, assembly, processing, and logistics costs up to the final domestic market. The accumulated value at the delivery point must then be compared with the cost of bringing similar quality soybeans into the country from the best alternative source By looking at the cost composition at each stage of the value chain and comparing these costs with world standards, value chain analysis not only shows if the country is internationally competitive, but also helps to identify key stages where costs can most effectively be reduced.

19. **Product transformation.** Throughout the value chain agriculture products take on many different forms. In the most basic sense, this may simply be the difference between a recently harvested farm product with high moisture content and one that has been assembled in a warehouse and dried for several months. As described, most agriculture raw materials also undergo some type of industrial processing to produce one or more final traded commodities. This may involve any number of processes such as the milling of dried maize (to produce maize flour and maize bran), crushing or solvent extraction of soybeans (to produce soybean oil and soybean cake), or ginning of seed cotton (to produce lint and cottonseed). Again, this point on product transformation may seem obvious enough, but the fact that a single agriculture commodity can take on different forms at each stage of the value chain means that great care is needed to track the accumulated value across products in a consistent manner.

20. For this study, the approach taken is to use ***conversion ratios*** as a simple tool for quantifying a product's transformation. These ratios are applied at the assembly stage to allow for crop drying and product losses and at the processing stage to allow for the transformation of a single raw material into a maximum of three finished goods. By applying the correct ratios to any agriculture commodity, it is possible to work forward or backward within that commodity's value chain to determine its equivalent value in a different form.

- ***For example*:** If an assembler must buy 1.1 MT of maize at the farm gate to remain with 1 MT to sell after six months of drying and product losses, the conversion ratio to assembled raw material would be 0.909 or 91% (1 ÷ 1.1 = 0.909). By simple arithmetic, it follows that one ton of assembled raw material, excluding collection and delivery costs, is equivalent to 1.1 MT of maize at the farm gate.

- ***Another example:*** If a ginnery expects to produce 410kg of lint for every ton of seed cotton delivered to its factory gate, the conversion ratio from assembled raw material to processed product would be 0.410 or 41% (410 ÷ 1,000 = 0.41). In a cotton value chain, this is called the "ginning outturn". By simple arithmetic, it follows that one ton of processed lint includes all the value of 2.44 tons of assembled seed cotton at the factory gate.

21. Further instructions on the determination of individual conversion ratios required to complete the spreadsheet templates are provided as embedded comments in the Excel workbooks.

B. Price Components

22. In addition to looking at the build-up of total costs at each stage, quantitative value chain analysis is also interested in the type of costs incurred as a product accumulates its value. This helps to identify areas where new policies or process innovations could have the greatest impact on international competitiveness.

23. Because a country is only able to influence prices within its own borders, the analysis is particularly interested in the composition of domestic costs. These costs include legitimate local business expenses and mark-ups, official customs duties and taxes, and any number of unofficial payments that sometimes have to be made to facilitate a particular operation. A product's total value at any given stage in the value chain, therefore, is equal to the sum of all domestic prices and imported cost components. For the CCAA study, these costs are measured in terms of **Domestic Value Added (DVA)** and **Shipment Value (SV)**, which constitute the main value chain indicators as follows.

Domestic Value Added (DVA)	=	Domestic costs and mark-ups + Official duties and tax + Unofficial charges and extra costs	[1]
Shipment Value (SV)	=	Domestic Value Added + Foreign components	[2]

24. DVA and SV are measured according to equations [1] and [2] respectively on a per ton basis at each stage of the value chain for the following products.

Farm production	Farm gate product
Assembly	Assembled raw material
Processing	Processed raw material
International logistics	Traded commodity (Product 1, 2, 3)

25. For cross-country CCAA comparisons, the final calculation of SV for each traded commodity is the most comprehensive measure of actual and potential competitiveness. For a given product or commodity produced in a specific country, international competitiveness is determined by comparing the SV at the final destination (sale point) with a benchmark. The benchmark will usually be the cost–insurance–freight (cif) reference price for the product or commodity at the specified destination.

26. By looking at the composition of SV, including the elements of DVA that contribute to this total figure, the country analyst can gain further insight where costs can most effectively be reduced. If some cost accounts for a very large share of total value, or is significantly higher than the international benchmark, then new policies or other investments focused on reducing this cost would likely be an effective strategy for improving trade competitiveness. Similarly, by looking at the build-up of SV (and DVA) from stage to stage, the analyst can gain insight to the competitiveness of individual participants. If farm production, for example, accounts for a disproportionately large share of final shipment value (either in absolute terms or compared with an international benchmark) then policy interventions or other investments focused on this stage of the supply chain may be required.

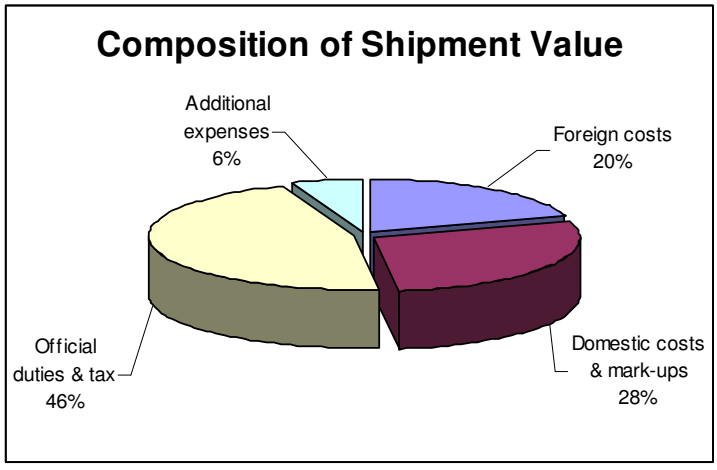
27. An example of how the spreadsheet templates measure DVA and SV is given in Table 2. As shown, the spreadsheet calculates each value chain indicator in local currency and US dollar terms on a per ton basis and by the percent contribution of each cost component to total DVA and SV. By comparing these indicators across stages of the value chain, the analysis provides considerable insight to the build-up of a commodity's total value and international competitiveness. All prices in the DVA and SV calculations are expressed in observed financial terms.

Table 2: Sample Calculations of DVA and SV

	ZMK per MT	USD per MT	% of DVA	% of SV
Domestic costs	173,872	52.69	35.3%	28.4%
Duties and tax	284,805	86.30	57.8%	46.5%
Additional expenses	34,208	10.37	6.9%	5.6%
Total DVA	**492,885**	**149.36**	**100.0%**	**80.4%**
Foreign costs	120,148	36.41	24.4%	19.6%
Total SV	**613,033**	**185.77**	**124.4%**	**100.0%**

28. To assist with interpretation, the spreadsheets also produce a graphic illustration of the main value chain indicators as shown in Figure 2.

Figure 2: Graphic Representation of Main Value Chain Indicators



29. **Interpretation of value chain indicators.** Bearing in mind many other factors must be taken into account in deciding which enterprises to promote and how best to allocate scarce investment resources, several conclusions could be drawn from these data. In the example above, the numbers show that duties and tax account for a very large share of total costs suggesting that a reduction in the

cumulative tax burden may be one of the most effective strategies for improving international competitiveness.

30. The measurements of DVA and SV may also be compared, both in an absolute and relative sense, with international benchmarks established by successful competitors. This is one of the main features of the CCAA value chain analysis and each country report will want to compare the financial values and percent build-up of DVA and SV with the most relevant import or export parity price against which the country must compete. If increased production substitutes for imports, then an import parity price should be used. Import parity prices are determined by first finding the price the country is most likely to pay in order to import the commodity and then by adding transportation costs to obtain the landed price in domestic cif terms. If increased production will be exported, then an export parity price is to be used, determined by subtracting international transport costs from the international price to give the domestic fob equivalent.

31. Depending on the stage of the value chain being analyzed, additional calculations to convert the parity price to a farm gate, assembly point, or into factory processing-level equivalent may be needed. For analysis of finished internationally traded commodities, the import or export parity price may be compared directly with the domestic product's final SV. In all cases, the objective should be to compare domestic production with the parity price for an equivalent product. A few examples of parity price calculations are provided in Book 7 together with some important instructions on the selection of the correct parity price basis.

C. Price Decomposition

32. The CCAA value chain methodology begins at the financial level with enterprise budgets for each stage of production. These budgets provide all the information to show if the production and marketing of an agriculture commodity is profitable for individual value chain participants. To calculate DVA and SV, however, budget prices must be broken down into their constituent parts.

33. Similar to the use of conversion ratios to track a product's transformation from stage to stage, the CCAA spreadsheet templates employ a variety of ***conversion factors*** (cfs) to calculate each component of DVA and foreign share of total SV. In all cases, the process of price decomposition begins with a known financial price actually encountered by value chain participants. At the farm production stage, these prices include the cost of seed, fertilizer, chemicals and other farm inputs; at the assembly stage, the main prices include transport and storage and so on throughout the process.

34. The spreadsheet templates use four different cfs as follows. Specific instructions on how to calculate each coefficient are provided as embedded comments in the Excel workbooks. It is important to follow these instructions carefully. Book 2 in particular has been designed to help calculate reliable conversion factors and should be used for this purpose.

- **% Forex.** This conversion factor is an expression of foreign costs as a share of total SV. In Table 2 above, the % forex is 19.6% or 0.196. This coefficient allows the analyst to calculate both the foreign and domestic share of total costs beginning with an input's known financial (shipment) value.

- **Domestic tax.** This conversion factor is an expression of domestic duties and tax as a share of total DVA. In Table 2, the cf for tax works out to 0.577, which is the total amount of tax divided by DVA (86.30 ÷ 149.36 = 0.577 or 57.7% of total DVA). If the total tax rate as a share of DVA is known, this coefficient may be applied directly. If the total tax is only known as a share of shipment value, additional calculations are needed to derive the appropriate cf. Again, the templates in Book 2 are designed to help make these calculations and should be used to derive appropriate conversion factors.

- **Domestic extras.** Like the cf for domestic tax, the cf for extras is an expression of unofficial costs as a share of total DVA. In Table 2, the cf for extras works out to 0.069, which is the total amount of unofficial payments divided by DVA (10.37 ÷ 149.36 = 0.069 or 6.9% of total DVA). Again, if the total amount of unofficial payments as a share of DVA is known, this coefficient may be applied directly. If the value of unofficial payments is only known as a share of total SV, however, additional calculations are needed.

- **Foreign CF.** The foreign cf is used for economic analysis of value chain performance and is derived by dividing the economic exchange rate by the financial exchange rate. The resulting coefficient is multiplied by the foreign share of total SV to determine the value of imported inputs in economic terms. The economic value of domestic inputs can already be determined since this is equal to total DVA less domestic taxes and unofficial extras and can be determined by the other cfs.[2]

35. An example of how conversion factors are used by the spreadsheet templates is provided in Table 3 below. As in all CCAA templates, the analyst is only required to fill in the shaded cells; the rest of the spreadsheet page contains formulas that must be left alone. The convention of color coding is explained later. For now, what it is important to note is that standard enterprise budget assumptions (quantities and unit prices) are entered on the left side of the worksheet page. These coefficients are then multiplied to determine the total per hectare cost for each input (or, in the budgets for other stages, the coefficients are multiplied to calculate per ton costs). Next, the total input prices are multiplied by each conversion factor to calculate the main value chain indicators and total economic equivalent in foreign and domestic terms.

Table 3: Example of Price Decomposition Using Standard Conversion Factors in a per Hectare Budget.

					CONVERSION FACTORS				FINANCIAL PRICES (per ha)						ECONOMIC PRICES (per ha)		
							Domestic CFs			Domestic							
Input	Qty/ Ha	Unit	Unit Price	Total Cost/Ha	% Forex	Foreign CF	Tax	Extras	Foreign	Costs	Tax	Extras	DVA	Total SV	Foreign	Domestic	Total Econ
									-	-	-	-	-	-	-	-	-
Compound D	4	bag	25.30	101.20	65.0%	0.848	0.381	0.046	65.78	20.31	13.50	1.61	35.42	101.20	55.81	20.31	76.12
Urea	4	bag	18.75	75.00	65.0%	0.848	0.381	0.046	48.75	15.05	10.00	1.20	26.25	75.00	41.36	15.05	56.41
									-	-	-	-	-	-	-	-	-
									-	-	-	-	-	-	-	-	-
Subtotal FERTILIZER				**176.20**					**114.53**	**35.36**	**23.51**	**2.81**	**61.67**	**176.20**	**97.18**	**35.36**	**132.53**

D. Summary of Cost Categories

36. From the budget information, the spreadsheet templates prepare a summary of total costs by category as shown in Table 4. By looking at the relative contribution of different categories of inputs to total price build-up, it is possible to identify areas where specific policies or other investments could have the greatest impact on international competitiveness.

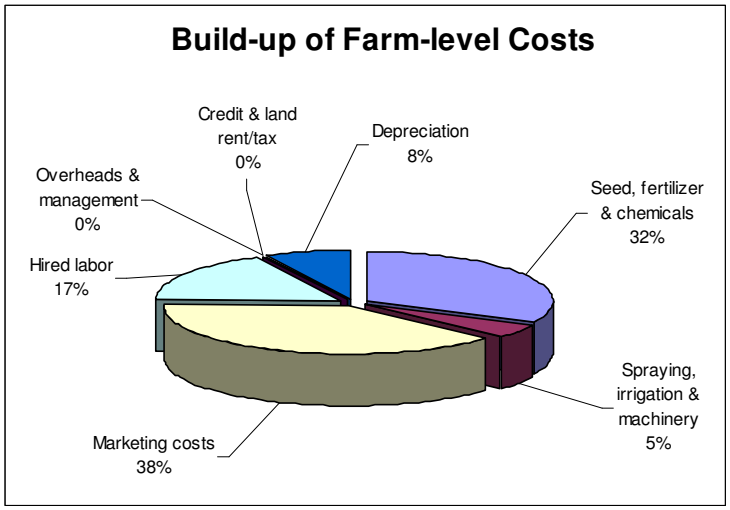
[2] Because the analysis of SV and DVA is carried out in financial prices, economic calculations are supplemental to the value chain analysis. Through the decomposition of DVA into its three constituent parts, however, the economic value of domestic inputs is already known. Having come this close to determining the total economic price, a provision is also made for the conversion of foreign prices to their economic equivalent using the foreign cf as described. These additional calculations are needed for the Policy Analysis Matrix (PAM).

37. Table 4: Example of Cost Summary by Input Category at Farm Production (LCU per ton farm product)

	Total per ton SV farm gate	% of total SV	Domestic Value Added (DVA)				Total DVA as % SV	Foreign Value	Foreign as % SV
			costs	taxes	extras	total DVA			
Variable Costs									
Seed	4,905	1.7%	1,601	1,065	127	2,793	57%	2,112	43%
Fertilizer	78,261	27.2%	15,704	10,440	1,248	27,391	35%	50,870	65%
Chemicals	9,811	3.4%	3,203	2,129	254	5,587	57%	4,225	43%
Spraying costs	2,609	0.9%	1,002	367	65	1,435	55%	1,174	45%
Irrigation costs	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Machinery O&M	10,435	3.6%	10,435	-	-	10,435	100%	-	0%
Packing materials	100,000	34.8%	60,356	16,000	3,644	80,000	80%	20,000	20%
Selling expenses	10,870	3.8%	4,051	2,693	322	7,065	65%	3,804	35%
Hired labor	48,913	17.0%	39,130	9,783	-	48,913	100%	-	0%
Family labor	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Overheads & m'gemt	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Seasonal credit	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Land rent/tax	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Total Variable Costs	**265,804**	92.4%	**135,482**	**42,477**	**5,660**	**183,619**	**69%**	**82,185**	31%
Fixed Investments	**21,739**	7.6%	**6,233**	**4,141**	**495**	**10,870**	**50%**	**10,870**	50%
TOTAL	**287,543**	100.0%	**141,715**	**46,618**	**6,156**	**194,489**	**68%**	**93,054**	32%
Totals in USD	87.13	100.0%	42.94	14.13	1.87	58.94	68%	28.20	32%

38. The spreadsheet templates also produce a graphic summary of cost structure as shown in the next example again from the farm production stage.

Figure 3: Graphic Representation of Cost Build-up



39. As shown by the sample data, seed, fertilizer, and chemicals together with marketing costs account for an estimated 70% of total cost structure. Policy interventions or new investments that help reduce these expenditures (without sacrificing quality or timeliness of delivery) could therefore be an effective strategy for improving trade competitiveness. Further insight to how well the production and marketing process is organized can also be gained by comparing the summary data for each stage with international benchmarks. While value chain analysis alone cannot be used to predict optimal cost structures, if one cost component is significantly higher than the international benchmark, further examination of the reasons behind this outcome may be in order.

40. Because the type of costs incurred at different stages vary, the templates for farm production, assembly, processing, and logistics are designed to accommodate different cost categories as shown in Table 5. When preparing the enterprise budgets, CCAA country teams should endeavor to collect detailed cost information for each of the following types of costs. Not all costs will pertain to every crop or production system in which case the space for that component should be left blank as

indicated by the examples above. Some modification of the cost categories may also be needed for the analysis of livestock operations as described later in the section on working with the templates.

Table 5: Categories of Variable Costs by Value Chain Stage

Farm Production	Assembly	Processing	International Logistics
Seed	*Components brought forward plus…*	*Components brought forward plus…*	*Components brought forward plus…*
Fertilizer			
Chemicals			
Spraying costs	Purchase from grower	Purchase from assembler	Purchase from processor
Irrigation costs	Packaging	Energy & machine operation	Loading & re-loading
Machinery O&M	Storage & depot costs		Storage
Packing materials	Vehicle O&M	Packing & consumables	Transport to delivery point
Selling expenses	License fees	Storage	
Hired labor	Crop levies	Repairs & maintenance	Duties & tax
Family labor	Hired labor	Vehicle O&M	Clearing fees
Overheads / management	Overheads / management	Hired labor	Licenses & permits
Seasonal credit	Interest	Overheads & licenses	Other overheads
Land rent / tax		Interest	Interest

E. Financial Costs and Profitability

41. **Basic Indicators.** Beyond the analysis of cost structures and price components, the quantitative analysis is also interested in the private costs and returns that accrue to value chain participants. Agriculture production and marketing begins with the decisions private investors make and it is important to have a sense of the underlying costs and profitability of competing enterprises and marketing systems. Because the value chain analysis is constructed around enterprise budgets, these measurements are easy to make. The main templates are designed to calculate total variable costs, investment costs, gross profit, and net profit as shown below.

Table 6: Sample Calculation of Basic Financial Indicators

FARM PRODUCTION	Per Hectare		Per Ton	
	ZMK	USD	ZMK	USD
Gross revenue (yield * price)	**1,035,000**	**313.64**	**450,000**	**136.36**
Production costs				
Variable costs	611,349	185.26	265,804	80.55
Investment costs	50,000	15.15	21,739	6.59
Total costs	**661,349**	**200.41**	**287,543**	**87.13**
Farmer income				
Gross margin (revenue - var costs)	**423,651**	**128.38**	**184,196**	**55.82**
Net profit (gross margin - invest costs)	**373,651**	**113.23**	**162,457**	**49.23**

42. Each Excel workbook includes a similar table summarizing basic financial indicators for that stage. These indicators are measured in different terms following the value chain conventions listed below. At the assembly, processing and logistics stages, the cost of commodity purchases is also recorded in the summary table in addition to basic variable cost and total investment cost data. For the purpose of calculating gross margin, commodity purchases are treated as a variable cost.

Farm Production	Farm gate product	Per Ha; per MT
Assembly	Assembled raw material	Per Ha; per MT
Processing	Processed raw material	Per MT; share from Product 1, 2, 3
Logistics	Traded commodity 1, 2, 3	Per MT processed raw material; per MT traded commodity

43. **Supplemental indicators.** A great many more financial indicators can be calculated from the basic summary information. Two especially useful indicators are gross and net rate of return. These measures show the rate of return to an investor's outlay of cash and the ability of the enterprise to cover its long-run depreciation costs respectively and are especially useful in comparing different enterprises. Enterprises with a high ratio provide a better return than those with a low ratio. These financial measures are calculated on Template 1.8 after the summary cost and profitability data are entered in the correct cells.

- **Gross rate of return** = gross profit / total variable costs.
- **Net rate of return** = net profit / total production costs.

44. It is also helpful to look at the returns to hired labor and personal management. These indicators are calculated automatically in Book 3 for farm production, but otherwise need to be computed separately when / if there is a particular interest in this aspect of value chain performance.

- **Return per day hired labor** = Gross (or net) return / days total employment.
- **Return per day total labor =** Gross (or net) return / days total employment and family management.

45. With even more detailed budget information, further calculations based on the cash and imputed share of total costs and returns to cash outlay could be prepared. These methods are useful when the focus is on a detailed examination of investment opportunities and growth strategies within a particular sector. CCAA analysts are encouraged to be creative with the methodology and calculate additional indicators as needed. For more general value chain discussion, however, the basic financial data together with some supplemental calculations of gross and net returns and returns to labor provide the all the essential information needed to interpret basic performance.

F. Time Requirements

46. The final dimension of the quantitative methodology is to look at the time required to complete each stage. This differs from the analysis employment generation (days worked) and focuses instead on the number of elapsed calendar days at each stage of the value chain as a measure of international competitiveness. More specifically, the analysis asks: how many calendar days are required to procure all the inputs for farm production; how long does it take to assemble one ton of raw material for industrial processing; and how many days are required for international shipping and so on.

47. Provision has been made in the spreadsheet templates to record the estimated time required for different activities. An example for the input supply stage is shown below. In practice, of course, time requirements can vary significantly from one operator to another depending on the individual's business model, personal connections, and other priorities. As with other aspects of the value chain analysis, the objective is not to provide a definitive measurement of time spent at each stage, but to take an indicative look at the efficiency of different procedures as an additional benchmark of international competitiveness. Together with the measurements of DVA and SV and financial costs and profitability information, the analysis of accumulated time requirements will provide a more complete picture on the competitiveness position of each participating country.

48. To make the data easier to interpret, time requirements are grouped together in phases (for an example, see Table 7). The definition of each phase varies slightly at different stages of the value chain (Table 8). Time requirements from the farm production through to international logistics, for example, pertain to the production and marketing of specific finished products; time requirements at the input stage relate to procurement of individual raw materials. Other key definitions of time requirements are set out below.

Table 7: Sample Calculation of Time Requirements for Input Supply

	Days Req		Days Elapsed	% of total
Procurement	8			
Transport to frontier	3	Phase I	11	52%
Customs duty & excise				
VAT or other sales tax				
Domestic clearing (official)	3			
Extra procedures	1	Phase II	4	19%
Wholesale chain	2			
Retail chain	3			
Transport to place of use	1	Phase III	6	29%
		TOTAL	21	100%

Phase I covers procurement & transport to border; Phase II covers border formalities and unofficial procedures; Phase III = local supply chain and transport to place of use.

Table 8: Classification of Time Requirements by Value Chain Stage

	Phase I	Phase II	Phase III
Input Supply	Procurement and transport to border	Border formalities and unofficial procedures	Local supply chain and transport to place of use
Farm Production*	Input procurement	In-field management	Marketing and overheads
Assembly	Farm gate procurement of raw material	Storage and delivery	Marketing and overheads
Processing	Input procurement	Factory operations and storage	Marketing and overheads
Logistics	Local procedures	International transit	Marketing and overheads

Note: At the farm production stage, an additional provision is made for recording the days from planting to crop maturity.

G. Policy Analysis Matrix

49. Beyond the consideration of price build-up, private costs and profitability, and time requirements, the data generated by the value chain analysis can also be used to complete the Policy Analysis Matrix or PAM. This is a standard methodology developed in the late 1980s for measuring private and economic profits, social efficiency, and policy transfers.[3] Nearly all of the data required for PAM construction will have been generated already by the preceding value chain analysis. This method may, therefore, be used to gain additional insight to value chain performance.

50. The PAM is a product of two accounting identities. The first defines *profitability* as the difference between revenues and costs. The other measures the effects of government interventions or divergences (market failures) as the difference between observed financial prices and prices that

[3] For a complete discussion of PAM methodology, see Monke and Pearson, *The Policy Analysis Matrix for Agricultural Development*, Cornell University Press, Ithaca (1989).

would exist if the divergences were removed. By filling in the elements of the PAM for agriculture activities, it is possible to measure both the extent of policy effects and inherent economic efficiency (or comparative advantage) of the activity.

51. From these measures, the PAM may be used to calculate the following indicators. Further details of this methodology and calculation of key indicators are provided in Annex 3.

- **Domestic Resource Cost Ratio (DRC).** A DRC is a proxy measure of social profits (H) and is calculated by dividing the economic value of domestic factor costs (G) by the total economic revenue (measured by parity price calculations) less the economic value of tradable input costs (E - F). Hence, DRC = G / (E - F). 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 1 if, and only if, H is positive. Minimizing the DRC is thus equivalent to maximizing social profitability; the lower the DRC the greater the system's comparative advantage.

- **Nominal Protection Coefficient (NPC).** The NPC is a ratio that contrasts observed (private) commodity prices with a comparable world (social) price. This ratio indicates the impact of policy transfers (and of any market failure not corrected by efficient policy) that causes a divergence between the two prices. The NPC on tradable outputs is therefore defined as private revenue (A) divided by social revenue (E) minus 1 or NPC = (A/E)-1. An NPC greater than zero shows that policies are increasing the market price above the world price, thus providing a positive incentive to the producer. A NPC ratio less than zero indicates a negative incentive (or disincentive) to the producer.

- **Effective Protection Coefficient (EPC).** The ECP is another measure of incentives and is the ratio of value added in private prices (A-B) to value added in world prices (E-F) or EPC = [(A-B) / (E-F)]. This coefficient measures the net policy effect of output and tradable input policies.

52. **Parity price calculations.** Importantly, the PAM bases its measurements of private and social profitability on an export or import parity price for the commodity being analyzed. As described, parity price calculations are also needed for the interpretation of final SV and DVA indicators. The choice of which price to use depends on whether the country is (at the margin) a net exporter or net importer of the commodity being analyzed.

- ***In the case of exports***, the appropriate parity price is determined either as a direct fob export price quoted on the local market or, more accurately with respect to the global and long-term perspective of value chain analysis, by finding the final imported price in the foreign market where the country is looking to compete and then subtracting all transport and handling costs from that location back through international transport to the start of the logistics stage.

- ***In the case of imports***, the appropriate parity price is either the locally available cif import price for an equivalent foreign good or may be determined by finding the fob export price for that commodity in a foreign market and adding all transport and handling costs from that location to the point of use.

53. Additional export or import parity prices can be calculated back through the processing stage to the assembly point or farm gate. The fact that parity prices can be measured at different stages along the value chain is an important consideration when carrying out supplemental PAM analysis. In this case, there needs to be a clear decision about what stage the PAM analysis is focused on so that cost data are compared with an equivalent parity price for that stage.

H. Enterprise Variations

54. As set out in the CCAA Summary Project Proposal, the quantitative analysis should focus on three farm systems distinguished by unique management and labor characteristics. These systems are not defined in terms of total size or legal status, but by their management system and labor supply as follows. In all cases, the emphasis is on commercial potential rather than subsistence production. The design of the CCAA study calls for a focus on commercial agriculture as set out below. For each sector, the most important location with commercial potential should be chosen for analysis.

- **Family Sector Farmers (FAM)** are characterized by agriculture operations where family members double as managers. These operations have no permanent full-time hired workers and may rely only on seasonal labor hired at peak production times.

- **Emergent Commercial Farmers (ECF)** are also characterized by the presence of family members who double as managers, but may include 1-3 full-time hired workers. Additional hired labor may also be used at peak production times.

- **Large Commercial Farmers (LCF)** are managed by fully specialized managers who may either be a family member or hired professional. These farms operate using three or more full-time hired workers and additional seasonal labor at peak production times.

55. In analyzing each sector, important differences also occur after the farm production stage. Family sector farmers, for example, may only have access to small itinerant traders at assembly whereas a large commercial grower may have a formal contract and rigid delivery schedule to adhere to. There may also be significant differences in product quality that need to be taken into account at the processing stage. Rain fed smallholder cotton, for example, could have a much shorter staple length than irrigated commercial cotton resulting in a different ginning outturn and lower value product. Some processes in the value chain will naturally converge thereby simplifying the analysis, but these and other important differences between farm sectors should be kept in mind when working with the template materials. The analyst's objective is not to model all possible variations, but to focus on major distinctions that characterize value chain performance and opportunities for improvement by different sectors at each stage.

III. WORKING WITH THE TEMPLATES

56. Having set out the basic concepts applied by the quantitative methodology, this section now provides an overview of how to work with the template materials. Section IV then takes a more detailed look at the contents of each individual workbook.

A. Organization of Books

57. As described at the outset, seven interlinked Excel workbooks with various template pages have been developed for the CCAA study. Book 1 is a covering book with driving data and summary pages; Book 2 is for the analysis of input costs; Books, 3, 4, 5, and 6 are the main analytical books covering different stages of value chain production; Book 7 is for supplemental PAM analysis and calculation of parity prices. An overview of the workbooks is given below; more detailed instructions on how to work with each page within the different workbooks follows.

- **Book 1: Country Data and Summaries.** This book is a covering file. It includes driving data linked to other files and is meant to be built-up with summary information created in other analytical pages.

- **Book 2: Input Costs.** This book is used for the input analysis. It includes blank spreadsheet templates that are used to derive the conversion factors needed for enterprise budget analysis. A template is also provided for the derivation of annual depreciation costs using the capital recovery method.

- **Book 3: Farm Production.** This book is used for the farm level analysis ending at the first point of sale. It includes a budget template and analytical summary page. Data are expressed in per hectare and per ton terms for a single farm gate product.

- **Book 4: Assembly.** This book is used for the analysis of rural marketing and transportation between the farm gate and processing point. It includes a budget template and analytical summary page. Data are expressed in per ton of assembled raw material terms.

- **Book 5: Processing.** This book is used for analysis of the processing stage beginning with the delivery or assembled raw material and transformation into a maximum of three finished products with different characteristics and value. Data are measured per ton of processed raw material.

- **Book 6: International Logistics.** This book is used for analysis of the final delivery stage, which may be a domestic destination for import substitutes or foreign destination for exports. Separate production budgets and analytical calculations of DVA and SV are made for each finished commodity produced at the processing stage. Data are expressed in per ton of traded product terms.

- **Book 7: PAM Analysis.** This final book is a supplement to the main analysis. It contains a template for PAM analysis and calculation of import and export parity prices.

58. **Exceptions for cattle.** For cattle value chains that include a feedlot operation, "assembly" takes on a somewhat different meaning. Broadly defined, the assembly stage is still concerned with the collection of a farm product (in this case, weaner calves or some other animal for fattening) and delivery of a raw material for industrial processing (finished beef ready for slaughter), but also involves additional production costs. Book 4, therefore, is still the most logical place for this operation to be examined, but some modifications of the spreadsheet template will be needed to account for different cost categories. Country analysts may either attempt to modify the spreadsheet to match their specific needs, or request a specific template to match these conditions. The most important aspects of this spreadsheet design are first to capture the correct values carried forward from farm production and second to create appropriate categories for different types of variable costs.

B. Conventions of Workbook Design and Use

59. Two sets of spreadsheet templates are provided with this paper. The first set includes sample numbers that were used during the spreadsheet design to make sure the calculations work. Examining this set of partially filled-in templates will help each country team to understand how the templates work. The second set of workbooks does not include sample data. These blank templates are the best starting point for teams to prepare the country analysis. Several #DIV/0! errors will appear the first time the blank set of books are opened. These errors will go away as soon as the exchange rate assumption and other data are entered.

60. A set of the blank workbooks should be saved in a separate folder at the start of the analysis. New copies of each workbook can then be opened and saved with a unique name as the analysis is built up to cover different production and marketing systems. Only one copy of Book 1 is needed to record the main country assumptions and summary of results. Eventually there should be active links

running to and from Book 1 and the other analytical workbooks. Multiple copies of every other book will be needed for each crop and management variation covered.[4]

61. **Types of pages.** Each workbook contains one or more of the following types of pages.

- **Template Driver.** Page 1.1 is the only template driver. This page is used to record the country name and exchange rate assumptions. These data are linked to all other workbook pages; hence the name "template driver".

- **Summary Page.** Book 1 includes 6 summary pages for recording various results from the analysis of different enterprises. Pages 1.3 to 1.7 correspond to the main stages of value chain production from input supply, to farm production, assembly, processing, and logistics. Page 1.8 summarizes the results for each stage by commodity and sector.

- **Template.** Template pages are used for the main analysis. A new copy of each template must be created and saved with a distinct name for each enterprise variation covered. Most of the raw data required for the analysis will be entered on a template page.

- **Summary Template.** Summary templates are a hybrid of summary page and template page. First and foremost, these worksheets take data from the associated production budget or other workspace and calculate standard value chain indicators, conversion factors, and measures of private cost and profitability from these data. Time requirements are also measured by the summary templates, but these data must be entered manually (as on a "template page" rather than "summary page" – hence, the hybrid nature of these templates).

- **Sample Page.** Page 7.2 provides a few examples of parity price calculations required for PAM analysis and interpretation of final SV and DVA components.

62. **Embedded comments.** Several important comments are embedded in the worksheet pages as indicated by a small red triangle in the upper right corner of some cells. These comments contain important instructions and other detailed guidelines for working with the template materials. Country analysts should follow these guidelines as closely as possible. It is highly recommended to read all comments carefully before working with the spreadsheet materials.

63. **Color coding.** Each workbook follows a convention of color coding to help guide the analyst as follows. Country analysts should only need to enter data in the shaded cells; cells without shading contain formulas and should be left alone.

Orange cells are for text
Green cells are for numbers
Blue cells are for data drawn from a previous stage in the analysis
Yellow cells highlight key results and other important information
Grey (or black) cells are placeholders for assumptions that do not normally change
White cells contain formulas and should not be altered

[4] Even for the input analysis, individual templates from Book 2 are perhaps best saved in different files. Depending how each team structures their input analysis, there might be one book with copies of the templates used for domestic inputs, one book for the analysis of imported inputs, and one book for the derivation of investment costs. The most important is to use a transparent naming system that others can easily understand.

64. **Automatic links.** Excel allows the user to paste links between different workbooks and between pages within a workbook so that information will be updated automatically. The blank set of CCAA templates only includes links to Book 1 (Page 1.1) where the analyst is required to enter the country name and exchange rate assumptions. These data are linked to all other books and will update automatically each time the templates are used.

65. To preserve the templates in their generic form and create a set for individual country analysis, follow these procedures:

a) Be sure all seven blank CCAA workbooks are open.

b) Enter the country name and exchange rate assumptions on Page 1.1

c) The new country name, currency designation, and exchange rate assumptions will change automatically in all other templates.

d) Save each of the seven books with a unique name for your country. For example:

Book 1 – Zambia Country Data and Summaries
Book 2 – Zambia Input Prices
Book 3 – Zambia Farm Production
And so on…

e) Verify that the correct links to the newly saved book have been established by looking in Row 1 of each template (where the country name is recorded) and in Rows 3 and 4 (where the currency designation and exchange rate information appear). These cells should not only display the correct country name and exchange rate assumptions from Page 1.1, but also specify a direct link to the newly named driving workbook. If the Book 1 were named "Book 1 – Zambia Country Data and Summaries", the references in rows 1, 3 and 4 should now appear as followings.

Row 1 (country name):

='Book 1 – Zambia Country Data and Summaries.xls'!country

Rows 3 & 4 (currency designation):

= 'Book1 – Zambia Country Data and Smmaries.xls'!LCU

Rows 3 & 4 (financial and economic exchange rates):

= 'Book1 – Zambia Country Data and Smmaries.xls'!ExR_financial

= 'Book1 – Zambia Country Data and Smmaries.xls'!ExR_econoimc

66. At the start of the analysis, there will be no other active links between the books other than to the country name and exchange rate assumptions on Page 1.1. As the analyst creates multiple copies of each template page, active links to the other workbooks can be created at that stage. In order to do this correctly, each linked book must be saved with a unique name. For example, as the analyst completes the study of family sector maize in Zambia: Books 3, 4, 5, and 6 could be saved as follows. There would be a corresponding set of books for ECF Maize, LCF Maize, and all other commodities.

Book 3 – Zambia Farm Production, FAM Maize

Book 4 – Zambia Assembly, FAM Maize

Book 5 – Zambia Processing, FAM Maize

Book 6 – Zambia International Logistics, FAM Maize

67. Having given each book a unique name, active links may be created between any worksheet as required. Excel will always track the links between the source and destination cell specified. The use of links provides an easy way to carry forward measurements of DVA, SV, and essential conversion factors from one stage to the next. Key results may also be copied as links to the summary pages in Book 1. Investing a little time to create active links between the correct books will save considerable effort later on updating the numbers every there is a minor adjustment at some stage of the analysis.

68. The easiest way to create an active link is to press the "=" key in the destination cell, switch to the correct cell in the source workbook (or worksheet within the same book), and press Enter. As long as the source and destination books have been given unique names related to the value chain being analyzed (or are contained within the same book), the destination cell will be updated automatically with correct information every time the source and destination books are both open. Excel will also ask if you want to update the automatic links each time a workbook is opened. As long as the source and destination books are named correctly, this will be safe to do. If problems arise, links can be verified, updated, or broken by selecting the "Links…" from the Excel "Edit" menu. More detailed instructions on creating and working with automatic links are provided in the Excel help pages.

69. **Values brought forward.** The measurements of DVA, SV and four conversion factors need to be carried forward from each stage of the value chain analysis to the next. These measurements are calculated on the "analysis" page of Books 3, 4, 5, and 6 and are used on the budget page of the next book. As described, the easiest way to carry these values forward is to create active links between appropriately named workbooks. Source numbers that need to be linked are highlighted in yellow on each "analysis" page (pages 3.1, 4.1, and 5.1). The destination cell on the budget page in the next book is clearly indicated by the template design. The next section of this paper also provides a step by step example of how values are carried forward from book to book.

70. **Named cells.** Cell references in Excel are usually expressed by their position in the spreadsheet grid (cell A1, A2, B1, B2, etc.). Excel also allows cells to be given a unique name describing the cell's contents or function. Important cells in the CCAA templates have sometimes been named using this feature. The cell in Page 1.1 with the country name, for example, is named "country". By referencing this name in any other book, the value in the "country" cell will appear. Similarly, the cells for the financial and economic exchange rates are named "ExR_financial" and "ExR_economic" respectively; the currency designation is named "LCU".

71. Using this feature, it is possible to carry out mathematical operations based on the names alone. Just as Excel might contain the formula (=A1/A2), for example, so too can Excel calculate a result for the formula (=ExR_economic/ExR_financial). To look up the source data used in a named calculation, click on the dropdown arrow in the name box in the upper left corner of Excel and select the indicator you wish to query. Excel will jump to the source cell to show where the number is from.

72. **Template drivers.** Another feature of Excel is the ability to create customized dropdown menus. These menus are used in Page 1.1 for the country name, and in other places where it is appropriate to select from a list of standardized values. These menus are made using the "data validation" feature in which Excel looks up the range of possibilities from a named list. These lists are made on a page called "template drivers", which is included in each of the seven CCAA workbooks, but has been hidden to protect the menu structure. Country analysts should not need to change these lists, but if for some reason the need arises, hidden pages may be revealed from the "Format" menu by selecting "Sheet" and then "Unhide".

73. **Page formats.** All pages have been formatted to print to fit to a single sheet of A4 paper.[5] The workbook name will appear as a header; the sheet name will appear as a footer. Every effort has been made to provide enough column width for numbers and text to appear in spaces (cells) provided. If some entry or result does not fit (i.e. the cell appears as ####), the font size or number of decimal points may need to be reduced. As a last resort, the column width may also be increased, but this may have undesired consequences for the appearance of the rest of the sheet. This problem is most likely to occur in countries with a very high exchange rate. In these cases, therefore, another equally acceptable solution to save space would be to always express local currency values (and exchange rates) in thousands of units.

74. **Data for pie and bar charts.** The data used to prepare pie and bar charts is most frequently hidden behind the chart itself. If there is ever some need to verify the source data or change a label, the best procedure is to click on the chart and drag it to a new location to reveal the hidden data. The chart can then be moved back to its original location after the changes have been made.

C. Build-up of Value Chain Indicators from Stage to Stage.

75. To help users understand how value chain indicators are calculated from stage to stage, this section provides a practical example showing how values are carried forward beginning with input supply, though to the farm production, assembly, processing, and logistics stages. This example is based on completely hypothetical data.

76. **Determination of input prices and required conversion factors.** The example begins in Table 9, which is copied from Book 2. This book includes 6 templates that have been designed to calculate individual price components and conversion factors for inputs. As shown in Part B of Table 9, the example follows the price build-up of the herbicide Round-up imported from South Africa. The analysis begins with a known price for an entire consignment (equivalent to a container load of 30,000 one liter bottles) at the factory gate in Durban. Using simple assumptions that are entered in the green cells in Part C about the cost of transportation to the border, customs charges, clearing fees, and other components of the final price at the place of use, the spreadsheet calculates the foreign and domestic share of total costs. Domestic costs are further broken down by legitimate costs and mark-ups, official tax and duty, and unofficial extras. The foreign exchange content (% forex) and required conversion factors are then calculated from these data as shown in the highlighted yellow cells.

77. Other templates in Book 2 follow a similar format and allow the analyst to work backward and break-down the price components beginning with a known price at the place of use for imported and domestic inputs. Each item should be entered in a separate sheet. Because similar inputs will encounter the same taxes and delivery costs, it is not necessary to repeat the input analysis for each individual item. Agrichemicals from South Africa, for example, will all have roughly the same foreign exchange content and will encounter the same type of official and unofficial costs thereby allowing the same conversion factors to be applied. A simpler method for calculating the required conversion factors is also provided in Book 2 (page 2.5) as explained in Part IV.

[5] The one exception is Page 1.2, which will print on multiple sheets of A4.

Table 9: Example of the Derivation of Required Conversion Factors Using the "Price Build-up" Method from Book 2

B. PRODUCT DESCRIPTION

Input:	**Round-up**	**Consumer unit:**	**liter**
Source country	South Africa	Value chain stage at use	Farm level - all sectors
Place in source country	fob Durban	Type of final purchase	Retail
Consignment size at source	5,000 cases x 6 1lt bottles	Place of final purchase	Mkushi
Importer	Wholesaler	Location of wholesale (if any)	Lusaka
Currency in source country	ZAR	Place of consumption	Mkushi
Consumer units per consignment	30,000	Distance from place of purchase	25km

C. PRICE BUILD-UP

C.1 Price at Origin (conversion to LCU)

ZAR	174,000	per consignment	ZAR	5.80	per consumer unit	**Price at origin in LCU**		
ZAR per USD 1.00	5.80	financial	USD	1.00	per consumer unit (fin)	ZMK	**3,300**	per consumer unit (fin)
ZAR per USD 1.00	6.00	economic	USD	0.97	per consumer unit (econ	ZMK	2,707	per consumer unit (econ)

C.2 Driving assumptions and Financial Build-up

Item	Value Assumption		% Foreign	Domestic Taxes	Item Cost	% of final price	Financial Build-up	Value Stage
Price at origin			100.0%		**3,300**	29%	3,300	Price at origin
Plus transport to frontier	15.0%	(% of price at origin)	100.0%		495	4%	3,795	Value for duty purposes (VDP)
Plus customs duty & excise	25.0%	(% of VDP)	0.0%		949	8%	4,744	Duty paid price
Plus VAT or other sales tax	17.5%	(% of duty paid price)	0.0%		830	7%	5,574	Domestic value at frontier (DVF)
Plus clearing fees	5.0%	(% of DVF)	0.0%	17.5%	279	2%	5,853	Domestic landed value (DLV)
Plus additional charges	5.0%	(% of DLV)	0.0%		293	3%	6,145	Total landed value (TLV)
Plus wholesale mark-up	50.0%	(% of TLV)	25.0%	45.0%	3,073	27%	9,218	Wholesale price
Plus retail mark-up	20.0%	(% of wholesale price)	10.0%	45.0%	1,844	16%	11,061	Retail price
Plus transport to place of use	2.0%	(% of retail price)	50.0%	65.0%	221	2%	**11,283**	SV at point of use

D. CALCULATION OF FOREIGN CONTENT AND ECONOMIC TRANSFERS ZMK per liter

	Financial Prices					Domestic Tax Transfers	Economic Prices		
		Domestic			Total				Total
	Foreign	Official	Extras	DVA	SV		Foreign	Domestic	Economic
Price at origin	3,300	-	-	-	3,300		2,800	-	2,800
Transport to frontier	495	-	-	-	495		420	-	420
Customs duty & excise	-	949	-	949	949	949	-	-	-
VAT or other sales tax	-	830	-	830	830	830	-	-	-
Domestic clearing fees	-	279	-	279	279	49	-	230	230
Extra charges	-	-	293	293	293		-	-	-
Wholesale mark-up	768	2,304	-	2,304	3,073	1,037	652	1,267	1,919
Retail mark-up	184	1,659	-	1,659	1,844	747	156	913	1,069
Transport to place of use	111	111	-	111	221	72	94	39	133
TOTAL (SV at point of use)	**4,858**	**6,132**	**293**	**6,425**	**11,283**	**3,683**	**4,122**	**2,449**	**6,571**
Totals in USD	1.47	1.86	0.09	1.95	3.42	1.12	1.25	0.74	1.99

Key Factors

% foreign	43.06%
foreign cf	0.848
domestic conv factors (CFs)	
tax as % DVA	0.573
extras	0.046
economic	0.381

78. **Use of CFs in budget construction.** In the next book, the values calculated in Book 2 are copied into the budget template (Page 3.2). Based on the assumptions in Table 9, the final price of Round-up works out to ZMK 11,283 per liter at the farm gate. As shown this value is entered in the column for unit prices on the left side of the spreadsheet template. In Table 10, the farmer uses two liters of Round-up per hectare (as indicated in the green column) giving a total price per hectare of ZMK 22,566. The other conversion factors ("% forex", "tax as % DVA", and "extras") highlighted in Table 9 are also copied (or linked) to the appropriate blue cells as shown. This process is repeated for all types of costs in the enterprise budget.

Table 10: Example of Input Coefficients Carried Forward to a per Ha Enterprise Budget

						CONVERSION FACTORS			FINANCIAL PRICES (per ha)						ECONOMIC PRICES (per ha)		
							Domestic CF			Domestic							
Input	Qty/ Ha	Unit	Unit Price	Total Cost/Ha	% Forex	Foreign CF	Tax	Extras	Foreign	Costs	Tax	Extras	DVA	Total SV	Foreign	Domestic	Total Economic
Chemicals																	
				-					-	-	-	-	-	-	-	-	-
				-					-	-	-	-	-	-	-	-	-
Round-up	2	liter	11,283	22,566	43.06%	0.848	0.573	0.046	9,717	4,897	7,367	585	12,849	22,566	8,244	4,897	13,142
				-					-	-	-	-	-	-	-	-	-
				-					-	-	-	-	-	-	-	-	-
Subtotal CHEMICALS				**22,566**					**9,717**	**4,897**	**7,367**	**585**	**12,849**	**22,566**	**8,244**	**4,897**	**13,142**

79. **Summary of cost components.** Once the budget template has been filled in, individual costs are automatically summarized by category as shown in Table 11 (copied from Book 3, Page 1). Because the summary of farm production costs is expressed in per ton of farm gate product terms, the

total value of chemicals works out to less than shown the per hectare budget template. In this example, a yield of 2.3 MT/ha has been assumed so the total chemical price per ton works out to ZMK 9,811 (22,566 ÷ 2.3 = 9,811).

Table 11: Example of Cost Components Drawn from a Detailed Enterprise Budget (converted to per MT terms)

	Total per ton SV farm gate	% of total SV	Domestic Value Added (DVA)				Total DVA as % SV	Foreign Value	Foreign as % SV
			costs	taxes	extras	total DVA			
Variable Costs									
Seed	4,905	1.7%	1,601	1,065	127	2,793	57%	2,112	43%
Fertilizer	78,261	27.2%	15,704	10,440	1,248	27,391	35%	50,870	65%
Chemicals	9,811	3.4%	2,129	3,203	254	5,587	57%	4,225	43%
Spraying costs	2,609	0.9%	1,002	367	65	1,435	55%	1,174	45%
Irrigation costs	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Machinery O&M	10,435	3.6%	10,435	-	-	10,435	100%	-	0%
Packing materials	100,000	34.8%	60,356	16,000	3,644	80,000	80%	20,000	20%
Selling expenses	10,870	3.8%	4,051	2,693	322	7,065	65%	3,804	35%
Hired labor	48,913	17.0%	39,130	9,783	-	48,913	100%	-	0%
Family labor	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Overheads & management	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Seasonal credit	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Land rent/tax	-	0.0%	-	-	-	-	#DIV/0!	-	#DIV/0!
Total Variable Costs	**265,804**	92.4%	**134,408**	**43,550**	**5,660**	**183,619**	**69%**	**82,185**	31%
Fixed Investments	**21,739**	7.6%	**6,233**	**4,141**	**495**	**10,870**	**50%**	**10,870**	50%
TOTAL	**287,543**	100.0%	**140,642**	**47,692**	**6,156**	**194,489**	**68%**	**93,054**	32%
Totals in USD	87.13	100.0%	42.62	14.45	1.87	58.94	68%	28.20	32%

80. **Summary of Value Chain Indicators.** The next step in the process is to summarize the value chain indicators by type of cost. This is done in Table 12 where the totals from Table 11 are simply rearranged in a different format. From these totals, the conversion factors required for the next level of analysis are now calculated. Consistent with the conventions of workbook design, these key results are highlighted in yellow.

Table 12: Example of Value Chain Indicators and Conversion Factors to be Carried Forward from Farm Production to Assembly

E. VALUE CHAIN INDICATORS (financial prices per ton at the farm gate)

	ZMK per MT	USD per MT	% of DVA	% of SV
Domestic costs	140,642	42.62	72%	49%
Duties and tax	47,692	14.45	25%	17%
Additional expenses	6,156	1.87	3%	2%
Total DVA	**194,489**	**58.94**	**100%**	**68%**
Foreign costs	93,054	28.20	48%	32%
Total SV	**287,543**	**87.13**	**148%**	**100%**

foreign conv factors (cf)		**domestic conv factors (cf)**	
% foreign	32.36%	tax as % DVA	0.245
foreign cf	0.846	extras	0.032

81. **Carrying values forward to subsequent stages.** After the farm production stage comes the assembly stage. Because value chain analysis requires all prices to be tracked according to the type of cost, the accumulated value components from farm production must now be transferred (or carried forward) to the assembly budget.

82. In this example, the figures for DVA and SV are copied (or linked) to the blue cells in Part B of the next enterprise budget (ZMK 194,489 and ZMK 287,543 respectively for DVA and SV as shown above). The % forex, foreign CF, tax as % DVA, and extras CF are likewise copied (or linked) to the blue cells in Part C. The first row of Part C.1 in Table 12 then multiplies the total price paid to the farmer (ZMK 450,000 per MT) by the amount of farm gate product required to yield 1MT of assembled raw material (in this case, 1.1 MT after product drying and losses as shown in Part B of

Table 13). This gives the total payment to the farmer (1.1 MT x ZMK 450,000 per ton = ZMK 495,000 total purchase), which is then multiplied by each conversion factor to give the individual price components carried forward from the previous stage. The second row of Part C.1 in Table 12 in turn calculates the incremental price components (taxes and extra charges) associated with the actual farm gate transaction.

Table 13: Example of Values Brought Forward from Farm Production to Assembly for 1.1 MT of Assembled Raw Material.

B. QUALITATIVE DESCRIPTION AND MAIN ASSUMPTIONS

Crop	**Maize**		**Type of trader**	**Formal trader**
Price paid to farmer	**450,000**	**per MT**	Collection point	Mkushi depot
Farmer's product (form when purchased)	grain in 50kg bags		Delivery point	Lusaka
DVA at farm gate (before sale)	194,923	per MT farm product	Delivered to	Domestic miller
SV at farm gate (before sale)	287,978	per MT farm product	Delivery distance	140km
Assembler's product (form when sold)	grain in 50kg bags		Farm sector	FAM
Farmer's product required for 1MT assembled raw material	1.10		Farm location	Mkushi
Price received by assembler	**650,000**	**per MT**		

C. VARIABLE INPUT COSTS (ZMK per metric MT assembled product)

						CONVERSION FACTORS			FINANCIAL PRICES (per MT assembled)						ECONOMIC PRICES (per MT)		
						Foreign	Domestic CF			Domestic				Total			
Input	Qty/MT	Unit	Unit Price	Total Cost/MT	% Forex	CF	Tax	Extras	Foreign	Costs	Tax	Extras	DVA	SV	Foreign	Domestic	Total Economic
C.1 Farm Gate Purchase																	
Carry-forward of financial and economic components of DVA & SV					32.31%	0.846	0.245	0.032	102,360	155,067	52,578	6,771	214,416	316,775	86,583	155,067	241,649
Price paid to farmer	1.10	MT	450,000	495,000			0.833	0.952		54,475	99,000	24,750	178,225	178,225		54,475	54,475
	Subtotal CROP PURCHASE			**495,000**					**102,360**	**209,541**	**151,578**	**31,521**	**392,640**	**495,000**	**86,583**	**209,541**	**296,124**

83. Once the budget for assembly is complete, a similar summary of costs components like the one in Table 11 will be produced. These costs are then further summarized by the main value chain indicators as shown in Table 14 from which the measures of DVA, SV and each conversion factor are calculated in order that these values may be carried forward budget page in the next book.

Table 14: Example of Value Chain Indicators and Conversion Factors to be Carried Forward from Assembly to Processing

E. VALUE CHAIN INDICATORS (financial prices per ton assembled)

	ZMK per MT	USD per MT	% of DVA	% of SV
Domestic costs	258,039	78.19	52%	42%
Duties and tax	200,638	60.80	41%	33%
Additional expenses	34,208	10.37	7%	6%
Total DVA	**492,885**	**149.36**	**100%**	**80%**
Foreign costs	120,148	36.41	24%	20%
Total SV	**613,033**	**185.77**	**124%**	**100%**

foreign conv factors (cf)		**domestic conv factors (cf)**	
% foreign	19.60%	tax as % DVA	0.407
foreign cf	0.844	extras	0.069

84. Table 15 is copied from the budget template for processing. In addition to recording DVA and SV, this page includes space to enter the conversion ratio from raw material to each finished product.

Table 15: Example DVA and SV Carried Forward to the Budget for Processing

Crop	**Maize**					
Price paid to assembler	**650,000**	**per MT**				
Product form (when delivered)	maize in 50kg bags					
DVA at factory gate (in)	492,885	per MT raw material				
SV at factory gate (in)	613,033	per MT raw material				
Product #1	Mealie Meal		**#1 Sold to**	local retailer		
Conversion ratio (%)	90%	outturn from 1MT raw material				
Price received by processor	800,000	per MT	Delivery point	Lusaka		
	250	USD per MT	Delivery distance	0km		
Product #2	Maize Bran		**#2 Sold to**	feed manufacturer		
Conversion ratio (%)	10%	outturn from 1MT raw material				
Price received by processor	6,720,000	per MT	Delivery point	Lusaka		
	2,100	USD per MT	Delivery distance	0 km		
Product #3			**#3 Sold to**			
Conversion ratio (%)		outturn from 1MT raw material				
Price received by processor		per MT	Delivery point			
	-	USD per MT	Delivery distance			

85. Table 16 is also copied from the budget template for processing and shows how the conversion factors from Table 14 are used at this level of analysis.

Table 16: Use of Conversion Factors Carried Forward from Assembly to Processing

C. VARIABLE INPUT COSTS (LCU per MT)								
						CONVERSION FACTORS		
	Qty/		Unit	Total	%	Foreign	Domestic CF	
Input	**Ha**	**Unit**	**Price**	**Cost/MT**	**Forex**	**CF**	Tax	Extras
C.1 Raw Material Purchase								
Carry-forward of financial and economic components of DVA & SV					19.60%	0.844	0.407	0.069
Price paid t	1	MT	-	650,000			0.833	0.952
Subtotal CROP PURCHASE				**650,000**				

86. At the end of the budget analysis, a summary of costs by major category similar to Table 11 is produced. From these data, the main value chain indicators for processing are calculated. These indicators are expressed in per ton of processed raw material terms and per ton of finished good terms. Because the logistics analysis focuses on the trade of finished commodities, it is the per ton finished good measurement of DVA and SV that must be carried forward. Conversion factors by price component are the same for each finished product.

Table 17: Sample Value Chain Indicators to be Carried Forward from Processing to Logistics

F. VALUE CHAIN INDICATORS FOR PROCESSED ITEMS (per MT finished good)	ZMK per MT	USD per MT	% of DVA	% of SV
Product #1 Mealie Meal	Raw material for 1MT product			**1.11**
Domestic costs	163,445	49.53	27%	22%
Duties and tax	371,084	112.45	61%	49%
Additional expenses	74,342	22.53	12%	10%
Total DVA (out)	**608,871**	**184.51**	**100%**	**81%**
Foreign costs	143,455	43.47	24%	19%
Total SV (out)	**752,327**	**227.98**	**124%**	**100%**
Product #2 Maize Bran	Raw material for 1MT product			**10.00**
Domestic costs	1,471,005	445.76	27%	22%
Duties and tax	3,339,756	1,012.05	61%	49%
Additional expenses	669,081	202.75	12%	10%
Total DVA (out)	**5,479,842**	**1,660.56**	**100%**	**81%**
Foreign costs	1,291,098	391.24	24%	19%
Total SV (out)	**6,770,940**	**2,051.80**	**124%**	**100%**
Product #3 -	Raw material for 1MT product			**#DIV/0!**
Domestic costs	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Duties and tax	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Additional expenses	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Total DVA (out)	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
Foreign costs	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Total SV (out)	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

87. Next, Table 18 shows how these values are carried forward to the budget for logistics. Similar to the procedure in Table 16, the corresponding conversion factors from processing are coped to the budget for this stage.

Table 18: Example DVA and SV Carried Forward to the Budget for Logistics

B. QUALITATIVE DESCRIPTION AND MAIN ASSUMPTIONS		
Crop	**Maize**	
MT of crop to give 1MT traded product	1.11	
Traded Product #1	**Mealie Meal**	
Price paid to processor	**799,986**	**per MT Mealie Meal**
Product form (when purchased)	mealie meal in 25kg bags	
DVA final commodity at factory gate (out)	608,594	per MT Mealie Meal
SV final commodity at factory gate (out)	752,327	per MT Mealie Meal
Price received at delivery point	900,000	per MT Mealie Meal

88. **Summary of indicators at each stage.** Finally, after tracking the cost structure and value chain components through each stage of the production and marketing process, the results for each commodity can be recorded on the crop summary page in Book 1 (Page 1.8). This summary template calculates various indicators showing the build up and composition of SV from stage to stage and may serve as the basis for cross-country comparisons.

Table 19: Example of Final Analytical Results

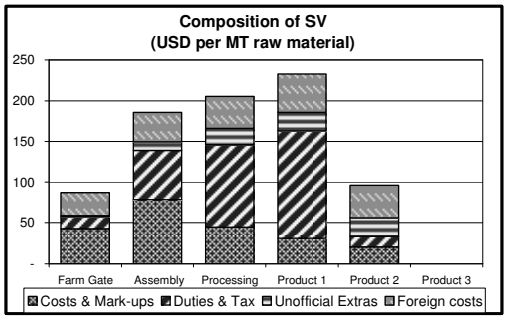
D. VALUE CHAIN INDICATORS (Per MT)

D.1 Value Chain Indicators for 1MT Raw Material (including value from previous stages)

	FARM GATE PRODUCT		ASSEMBLED RAW MATERIAL		PROCESSED RAW MATERIAL		TRADED COMMODITIES (Share from 1 MT raw material)					
							Mealie Meal		Maize Bran		none	
	ZMK	USD	ZMK	USD	ZMK	USD	ZMK	USD	ZMK	USD	ZMK	USD
Domestic Value Added												
Costs & mark-ups	140,642	42.62	258,039	78.19	147,101	44.58	103,424	31.34	68,699	20.82	-	-
Official duties & tax	47,692	14.45	200,638	60.80	333,976	101.20	434,201	131.58	42,426	12.86	-	-
Additional costs	6,156	1.87	34,208	10.37	66,908	20.28	75,098	22.76	73,338	22.22	-	-
Total DVA	**194,490**	**58.94**	**492,885**	**149.36**	**547,985**	**166.06**	**612,723**	**185.67**	**184,462**	**55.90**	**-**	**-**
Foreign costs	93,054	28.20	120,148	36.41	129,360	39.20	155,595	47.15	132,275	40.08	-	-
Total Shipment Value	**287,544**	**87.13**	**613,033**	**185.77**	**677,345**	**205.26**	**768,317**	**232.82**	**316,737**	**95.98**	**-**	**-**

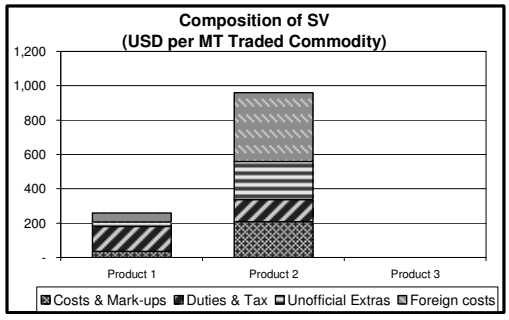
D.2 Value Chain Indicators for 1MT Final Traded Commodity

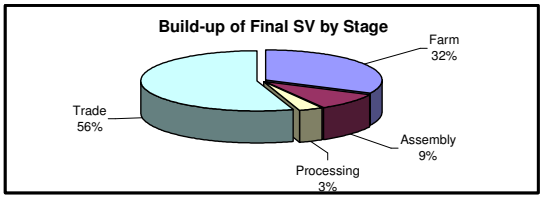
	TRADED COMMODITIES (1 MT Final Traded Product)					
	Product 1		Product 2		Product 3	
	ZMK	USD	ZMK	USD	ZMK	USD
Domestic Value Added						
Costs & mark-ups	114,916	34.82	686,986	208.18		-
Official duties & tax	482,445	146.20	424,258	128.56		-
Additional costs	83,442	25.29	733,378	222.24		-
Total DVA	**680,803**	**206.30**	**1,844,622**	**558.98**	**-**	**-**
Foreign costs	172,883	52.39	1,322,747	400.83		-
Total Shipment Value	**853,686**	**258.69**	**3,167,369**	**959.81**	**-**	**-**



D.3 Incremental Value Chain Indicators by Stage (1MT Raw Material) see note -->

	Domestic Value Added (DVA)				Foreign	Total
	Costs	Tax	Extras	Total DVA	Costs	SV
ZMK per MT processed raw material						
Farm	140,642	47,692	6,156	**194,490**	93,054	**287,544**
Assembly	117,397	152,946	28,052	**298,395**	27,094	**325,489**
Processing	(110,938)	133,338	32,700	**55,100**	9,212	**64,312**
Trade	25,022	142,650	81,528	**249,200**	158,509	**407,709**
USD per MT processed raw material						
Farm	42.62	14.45	1.87	**58.94**	28.20	**87.13**
Assembly	35.57	46.35	8.50	**90.42**	8.21	**98.63**
Processing	(33.62)	40.41	9.91	**16.70**	2.79	**19.49**
Trade	7.58	43.23	24.71	**75.52**	48.03	**123.55**





IV. DESCRIPTION OF WORKBOOKS

A. Country Data and Summaries (Book 1)

89. Book 1 includes eight worksheets. The first worksheet is the "template driver" and is used to record the country name and foreign exchange rate assumptions. The next seven pages are summary pages. There should be only one copy of Book 1 when the country analysis is complete. Active links may be created to and from this book to summarize the results or to track major assumptions as required.

90. **Template driver (Page 1.1).** The country name and exchange rate assumptions are entered on this page. As described above, these assumptions (or driving data) are linked to every other workbook page.

91. **Commodity price assumptions (Page 1.2).** This page is used to summarize commodity price assumptions and is a particularly good place to record or track these data when building the analysis. Once a new workbook has been created for each commodity, active links may be established between Page 1.2 and the appropriate enterprise budget. Depending on the analyst's preference Page 1.2 could either be the source or destination of these active links.

92. **Summary indicators (Pages 1.3 to 1.7).** These pages are used to record key results for each enterprise variation at different stages of the value chain. Data are only entered in columns with a

shaded header; the other cells contain formulas and will update automatically as the results are entered; as more rows are needed, copy and paste the formulas below. These summary pages in are arranged in landscape format in which the results for each variation are recorded in a single row only. Once the results for all variations have been entered, the data can be ranked by different indicators to show which are the most and least profitable, which have the highest or lowest DVA or SV, etc. These rankings are made using the "Sort" command under the "Data" menu.

93. **Crop summary (Page 1.8).** This page is used to record the results for a single commodity (FAM maize, for example) throughout the entire value chain. Space is provided for farm level, assembly, processing, and international logistics indicators for up to three finished products. Value chain indicators, cost and profitability data, and time requirements are all recorded on this single page. The template includes two bar charts showing the composition of total SV throughout the stages and for each final product; a pie chart summarizes the build-up of total SV by stage.

B. Input Analysis (Book 2)

94. Book 2 includes 6 templates designed for the analysis of individual price components and determination of annual investment costs. There are three types of template in this book. A separate copy of each template should be saved to a new (operational) workbook before use.

95. **Input price components (Pages 2.1 to 2.4).** The first four pages of Book 2 are used to calculate value chain price components and standard conversion factors for individual inputs. These pages also include space for estimating time requirements for different stages of input procurement.

96. Each page begins with a known price for an individual input and calculates standard value chain indicators based on simple assumptions (or best guesses) about dealer mark-ups, transportation costs, duty and tax payments, and other costs incurred between the point of production and place of use. *Build-up pages* begin with a known price at the factory; *break-down pages* begin with a known price at the place of use. Different calculations also required for the analysis of imported inputs and domestic goods as indicated.

97. Only one page needs to be filled in for each input. The choice of which template to use depends on whether the input is a domestic or foreign good and whether the price is known at the source of supply or final place of use. Because like inputs will accumulate similar types of costs as they amass their final shipment value at the point of use, the input analysis does not need to be carried out for every item. Instead, the analysis may be done for groups of inputs from a similar source with the same tax structure (imported chemicals from South Africa, fertilizer from Europe, and so on).

98. Careful attention must, however, be given to the fact that individual value chain participants sometimes gain access to inputs in very different ways. A small family farmer, for example, may only have access to fertilizer from a local retail shop whereas a large commercial farmer might import fertilizer directly from a foreign supplier. This is a key feature of the value chain analysis and means that different conversion factors must sometimes be used when preparing the budgets for different farm sectors or other types of producers and traders.

99. **Simple conversion factors from SV (Page 2.5).** Because detailed price build-up or break-down information is not always available (or cannot easily be guessed), Page 2.5 provides a space to calculate conversion factors using a more simple methodology beginning with each input's final shipment value. Detailed instructions on how to use this page are provided in the spreadsheet template.

100. **Investment costs (Page 2.6).** Template 2.6 uses a modular approach to calculate annual investment costs on a per hectare or per ton basis as required. These costs need to be included in each enterprise budget for all durable inputs with a useful life spread over more than one production cycle.

101. The method adopted for this purpose is to calculate the so-called ***capital recovery cost*** of each fixed investment. This cost is the payment that will repay the cost of a fixed input over its useful life and provide an economic rate of return on the investment. 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 value chain participant did not purchase the input, the money could have been invested in some other productive enterprise. [6]

102. To complete Template 2.6 the analyst will need to make realistic assumptions (or best guesses) about the opportunity cost of capital and other data as follows.

- List of durable inputs used at each stage of production
- Replacement value of each input
- Number of years in each input's useful life
- Unit share of total annual use

103. An example of how Template 2.6 uses this information to calculate the annual capital recovery cost is given below for a set of emergent farmer equipment shared over 10ha using 4% as the assumed opportunity cost of capital. As shown, the total replacement value of the equipment is ZMK 3.68 million (USD 1,117) and the capital recovery cost (or annual depreciation cost) used for budget construction is ZMK 34,540 per hectare per year.

Table 20: Example of Derivation of Annual Investment Costs

Description and Quantity	Useful Life (yrs)	Replacement Value		CRF	Share of Use	Annual Depreciation Cost (SV)	
		ZMK	USD			ZMK	USD
Ox cart	15	800,000	242.42	0.0899	0.10	7,195	2.18
Ox plow (2 @ ZMK 480,000 each)	10	960,000	290.91	0.1233	0.10	11,836	3.59
Ox cultivator	10	480,000	145.45	0.1233	0.10	5,918	1.79
Bicycle (1)	6	350,000	106.06	0.1908	0.10	6,677	2.02
Hoe (4 @ ZMK 30,000 each)	4	120,000	36.36	0.2755	0.10	3,306	1.00
Shovel/fork (2 @ ZMK 55,000 each)	5	110,000	33.33	0.2246	0.10	2,471	0.75
Hand spryer (1)	5	230,000	69.70	0.2246	0.10	5,166	1.57
Watering can (1)	3	35,000	10.61	0.3603	0.10	1,261	0.38
Ax (1)	5	60,000	18.18	0.2246	0.10	1,348	0.41
Wheelbarrow (1)	3	225,000	68.18	0.3603	0.10	8,108	2.46
Buckets and other small tools	3	225,000	68.18	0.3603	0.10	8,108	2.46
Allowance for spare parts, other bits	2	90,000	27.27	0.5302	0.10	4,772	1.45
TOTAL ECF farm equipment		**3,685,000**	**1,117**			**34,540**	**10.47**

104. Estimating a precise opportunity cost of capital can be a complex exercise. For this study, however, a great deal of precision is not really needed as long as the assumption for each country is applied consistently. One recommended approach is to look at the nominal rate of savings on a bank deposit or Treasury Bill purchase and to subtract annual inflation. Even more simply, a best guess of the real annual return to capital may be used. In most developing countries, this is usually somewhere between 2% and 5% annually.

[6] Annual cot 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 implement's useful life. See Annex 2 for more detailed information on the derivation of this formula.

C. Enterprise Budget Analysis (Books 3, 4, 5, 6)

105. Books 3, 4, 5, and 6 are the main analytical workbooks. These books cover each stage of value chain production and include two worksheet each (except for Book 6, which includes two worksheets for each of three possible final products). The first page is an analytical summary of costs and returns, the second page a budget template where the analyst records the detailed input costs, conversion factors, output assumptions, and prices. Individual copies of each book will need to be created for every product and enterprise variation analyzed. Each book should be saved with a unique name so that active links can be established between that book and other worksheet pages as described above.

106. **Enterprise budgets.** Enterprise budgets are composed of revenues, variable costs, and annual capital recovery costs for fixed investments. Space is provided in the budget templates to record these key assumptions together with the appropriate conversion factors and conversion ratios for product transformation as required. In Book 6 there are three budget templates for the analysis of international logistics for different finished products. Spaces are also provided for a specific qualitative description of the production system being analyzed (location, management level, transaction point, delivery distance, etc.). Space is also provided for additional notes and queries.

107. Consistent with the convention of following different product forms throughout the value chain, the enterprise budgets for each stage are also constructed in different terms. The farm level budget is a per hectare crop budget; the budget for assembly is for the collection of one MT of assembled raw material; the processing budget is for the transformation of one MT of assembled raw material; and the logistics budget is for the international trade (or local delivery) of one ton of finished product. Other important instructions for enterprise budget construction are included in the embedded comments on each sheet.

108. **Analytical summary.** The corresponding analysis page in Books 3, 4, 5, and 6 use data from the budget page to calculate all essential value chain and private cost and profitability indicators. The analysis of time requirements is also carried out on the summary page, but these data must be entered manually as indicated by the shaded cells. Data from these pages are carried forward to the next level of analysis and should also be recorded on the summary pages in Book 1.

D. Policy Analysis Matrix (Book 7)

109. The final workbook is for supplemental PAM analysis. This Book contains two sheets. The first sheet includes space to calculate an export or import parity price and a place to record essential of value chain costs for PAM analysis. The PAM is then calculated and used to generate DRC, NPC and EPC as described in Section II above. The second sheet in Book 7 is not specifically linked to the analysis and provides a few examples of parity price calculations only. Even if PAM analysis is not carried out, Template 7.1 may still be used for parity price calculations required to interpret the final measurements of SV and DVA.

V. CONCLUSIONS AND NEXT STEPS

110. This methodology paper set out to describe essential value chain concepts and to introduce a set of Excel spreadsheet templates developed specifically for quantitative analysis under the CCAA study. It is hoped that the research teams will find these materials are a powerful and flexible tool for country level value chain analysis. It is also hoped that lessons will be learned from the experience of working these materials so that the spreadsheets can be further refined and developed for wider application. This is the first time the templates have been put to use, and some deficiencies will almost certainly be discovered. Any and all comments on how the templates could be improved will be very welcome.

111. Indeed, while the templates have been designed for maximum flexibility, CCAA teams may find that some part of the structure is not suited to their specific requirements. This is particularly true for the analysis of cattle, where some modification of cost categories in Book 4 will likely be needed. As an ongoing project, any questions about the templates should be sent to the author, who will be happy to provide advice or prepare a modified template to meet these requirements as necessary.

ANNEX 1

PARTIAL LIST OF DATA REQUIREMENTS

This list is intended to help country teams focus their efforts in the data collection part of the CCAA study. This is not an exhaustive list of data requirements and is mainly intended to familiarize country teams with the type of information required to complete the spreadsheet templates.

Production Budgets
Crop budgets for each commodity and farm sector
Assembly budget (with variation by marketing system?)
Processing budget (with variation by product quality?)
Logistics budget (with variation by market destination?)

Input Prices
Seed
Fertilizer
Chemicals
Stock feed
Veterinary
Tractor operating costs
Vehicle operating costs
Irrigation costs
Packing materials
Hired labor
Family labor
Management
Marketing expenses
Depot charges
Fuel costs
Transport costs for standard routes (local and international)

Investment Costs
Farm implements
Storage facilities
Vehicles
Office equipment
Buildings

Conversion Ratios
Typical product losses at assembly
Processing outturns (milling yield, ginning outturn, oil extraction rates, etc)

Price Build-up
Customs duty
Tax rates
Tax rates on fuel
Council levy
Transport costs from source
Wholesale mark-up
Retail mark-up
Final delivered price

Time Requirements (calendar days)
Input procurement
Production time
Crop maturity
Transit time for standard routes (local and international)
Overheads and marketing

Parity Prices
Final delivered price (in the main export market for exports, or most likely alternative source of supply for import substitutes)
Transport costs to / from these international markets.
Other price build-up information

ANNEX 2

DERIVATION OF CAPITAL RECOVERY COSTS[1]

1. The derivation of a capital recovery cost can be illustrated in a few steps. *A* is defined as the annual payment sufficient to repay the cost, *Z*, of the fixed input at the end of its useful life of *n* years. If one puts amount *A* into an investment earning rate of return *i*, the total value of one's annual payment at the end of the fixed input's life will be

$$A(1 + (1 + i) + (1 + i)^2 + \ldots + (1 + i)^{n-1}) = Z \qquad [1]$$

2. The term $A(1 + i)^{n-1}$ is the value of the initial deposit at the end of *n* years, the term $A(1 + i)^{n-2}$ is the value of the second deposit at the end of *n* years, and so on until the end: The term $A(1)$, which represents the value for the *n*th year payment. This formula calculates the amount of capital necessary to repay the cost of the fixed input.

3. Because the fixed input is required to earn a positive rate of return, the necessary value of the output produced by the fixed input is not just Z but $Z(1 + i)^n$. Therefore, the annual cost-equivalent calculation is expressed by

$$A(1 + (1 + i) + (1 + i)^2 + \ldots + (1 + i)^{n-1}) = Z\,(1 + i)^n \qquad [2]$$

4. This expression can be altered by rearrangement of the terms to

$$A = (Z)\,(1 + i)^n/(1 + (1 + i) + (1 + i)^2 + \ldots + (1 + i)^{n-1}) \qquad [3]$$

5. Equation [3] can be written as

$$A = Z\left[(1 + i)^n i \,/\, (1 + i)^n - 1\right] \qquad [4]$$

6. The bracketed term on the right hand side of equation [4] is the capital recovery factor. By applying this factor to the purchase price of the fixed input, the analyst can calculate the annual equivalent value for any fixed input.

7. Annual equivalent values also depend on capital cost (Z) and useful life (*n*). Replacement cost is used as the estimate of initial capital cost to maintain consistency with the long-run perspective of the budget analysis. Existing farms utilize many different vintages of capital equipment and, as a result, fixed costs may vary substantially from farm to farm. Still, all capital stock must be replaced eventually, and current costs of fixed inputs become important to the continued operation of the farm. Useful lives of fixed inputs vary among farms as well, depending on intensity of use as well as owner maintenance practices.

8. For example, the capital recovery factor for an input with a 7 year life where the opportunity cost of capital is 5% is determined as follows

$$\text{CRF} = A = \left[((1+ 0.05)^7\, 0.05) \,/\, ((1 + 0.05)^7 - 1)\right] = 0.1728 \qquad [5]$$

[1] For more detailed information on this methodology see Monke and Pearson (1989), *The Policy Analysis Matrix for Agricultural Development*, Cornell University Press, Ithaca; or Gittinger JP (1982), *Economic Analysis of Agricultural Projects*, Economic Development Institute of the World Bank, 2nd Edition, Johns Hopkins University Press, Baltimore and London. This Annex draws heavily on these works.

9. Or, if the opportunity cost of capital were assumed to be 3%, and the implement had a 12 year life, the capital recover factor would be

$$\text{CRF} = A = \left[((1+ 0.03)^{12}\ 0.03) \,/\, ((1 + 0.03)^{12} - 1)\right] = 0.10046 \qquad [6]$$

10. A complication to the calculation of annual equivalent values arises when the fixed input serves a larger number of units of the activity than is covered by the per hectare budget. Only a portion of the annual equivalent costs of the fixed input should be allocated to the per hectare budget. Consequently, the annual capital cost per hectare is determined by the product of the net initial cost, the capital recovery factor, and the per hectare share of annual use. As illustrated in equation [7] a tractor with a useful life of 12 years that is shared over 50 hectares and costs USD 10,000 to replace would have an annual per hectare capital recovery cost of USD 20.06 assuming 3% opportunity cost of capital.

$$10{,}000 \times \left[((1+ 0.03)^{12}\ 0.03) \,/\, ((1 + 0.03)^{12} - 1)\right] \times (1/50) = 20.06 \qquad [7]$$

ANNEX 3

THE POLICY ANALYSIS MATRIX[2]

1. 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.

2. The PAM is based on a familiar equation:

Profit = revenue – cost [1]

3. As presented below, the PAM has four columns. The first is for revenue, the second and third for costs, and the last one 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 are divided into their tradable and domestic factor components. Revenue and tradable input values are measured with respect to an import or export parity price, which is the amount a country either saves or earns from the production system being analyzed.

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

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

5. **Financial Indicators.** The data entered in the first row of the PAM 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 the underlying economic costs and valuation plus the effects of all policies and market failures. In the PAM, private profits (D) are the difference between revenues (A) and costs (B+C).

[2] For more detailed information on this methodology see Monke and Pearson (1989), *The Policy Analysis Matrix for Agricultural Development*, Cornell University Press, Ithaca

6. **Economic Indicators.** The second row of the PAM uses social prices. These valuations measure comparative advantage or economic 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 re-valued in prices that reflect scarcity values and opportunity costs. In this respect, social profits (H) represent the total net revenue generated by the production system.

7. The entries in the PAM allow comparison among agricultural enterprises that produce identical outputs. If interest focuses solely on a comparison of one cotton operation with another, for example, the matrix provides all information necessary for the analyst. Comparisons between cotton and groundnuts, however, are another matter. To permit the comparison of systems that produce different outputs, some common numeraire must be generated.

8. **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.

9. By elementary algebra it follows that the ratio equals 1.0 if social profitability (H) is 0, is greater than 1.0 if H is negative, and is less than 1.0 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. Efficient activities can be defined equivalently as those for which social profitability is positive or for which the DRC is less than 1.0.

10. **Policy transfers.** 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 observed private prices and estimated social prices must be explained by the effects of policy or by market failures. This follows directly from the definition of social prices which correct for the effects of distorting policies.[3]

11. In cross-commodity comparisons, the effective protection coefficient (EPC) is a measure of policy effects and incentives to the producer. Specifically, EPC is defined as the ratio of value added in private prices (A-B) to value added in world prices (E-F). Thus: EPC = (A-B)/(E-F). An EPC greater than 1.0, therefore, shows that policies are increasing market prices above the world price providing a positive incentive to the producer. Likewise, an EPC less than 1.0 indicates a negative incentive (or disincentive) to the producer.

12. The PAM is also used to calculate Nominal Protection Coefficients (NPC = A/E) which indicate the impact of policy (and any market failures not corrected by efficient policy) that cause a divergence between the observed commodity price and a comparable world (social) price.

[3] These policies are often introduced because decision makers are willing to accept some inefficiencies (and thus lower total income) in order to further non-efficiency objectives such as the redistribution of income or improvement of domestic food security.