



## IMPROVEMENT IN THE ESTIMATION OF AGRICULTURE VALUE ADDED -THEORETICAL MODEL

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### Abstract

This paper aim to significantly improve the estimation of value added of crops based on Agriculture Work In Progress (WIP) model. The WIP model is based on costs on Agriculture by crop using the smallest unit area measurement, where information on crops calendar, which consists the rainfall seasons, input costs and average yield per acre are collected. Then the derived crop matrix is used for splitting its total input costs into agriculture calendar year, the estimates of Gross Value Added (GVA) both at current value and volume terms are obtained from the system. Ultimately, the WIP techniques provides methodology for calculating crop output at more detail level in the National accounts statistics for providing gross output and intermediate consumption by crop in line with the system of National accounts SNA 2008, and gives a better estimates of crop value added in the Agriculture activity.

**Keywords:** National accounts statistics, Agriculture Work in Progress Model, Gross value added.

### Introduction:

The crop work in progress has been highlighted as deficiency in the current methodology used in compilation of national accounts estimates, since the period of crop production normally does not match the accounting period of measuring outputs of crops on a quarterly basis, the production usually occurs on continuous basis. The value added of crops through this approach are estimated from the benchmark year using Agriculture Sample Census Surveys which are scientifically done, it is expected that Agriculture Gross Domestic Product (GDP) estimates are comprehensive and consists of both market and non-market crop estimates.

### The Problem:

Measuring output of crops on a quarterly basis is problematic considering that harvests of crops are largely confined to a single quarter although production occurs on a continuous basis. The most challenging conceptual issue is in regard to time of recording. Long production cycles in agriculture pose problems because of the shorter accounting period (three months). Hence, Quarterly National Annual manual recommends that cost structure of crop production should be used to allocate the crop forecasts into the respective quarters. GDP have been estimated indirectly by extrapolating benchmark GVA without showing the estimates of gross output and intermediate consumption, hence there is a need to modify the existing compilation worksheets and increase the use of more representative volume and price indicators and adjustments to the methodology for quarterly constant and current price GDP estimates.

### Data and Variables used.

The agriculture WIP model incorporate data provided by the Ministry of Agriculture (MOA) as well as data from the Agriculture Surveys (AGS) conducted by National Bureau of Statistics once in five years and other information based on studies conducted by Food Agriculture Organization, The volume of crops used in compilation are the following maize, paddy, sorghum/ millet, Other cereals, Cassava, Irish potatoes, Sweet potatoes, Other roots and tubers, Beans and other pulses, dried, oil seeds Other vegetables, Bananas, Other fruit, Cashew nuts, Coffee, Cotton, Tea, Tobacco and Other cash crops. The Consumer Price Index (CPI) is used to provide corresponding price indices.

### Methodology:

The agriculture survey data on harvested quantities for each type of major crop by season have been used as the benchmark volumes. The estimates have been interpolated back and extrapolated forward using the Ministry of Agriculture annual output volume estimates for major food crop types. The AGS data have been used as a cross-check for the series but not used directly as measures of total output. Both AGS season data have been used to apportion output by season (i.e. long rains and short rains) and to adjust the series from the at harvest approach to the WIP approach. The harvest output for each season has been allocated to the months covered by each season using the amount of inputs each month as a percentage of total inputs during the season. An allowance of 5 percent for post-harvest loss has been included for each crop.

### Estimation of intermediate consumption: (IC)

The constant and current price values of annual IC for food crops have been derived using the annual I/O ratios from the benchmark and the updated benchmarks based on the AGS data. The I/O ratios for intervening years have been interpolated between the two benchmarks, with the benchmark being used for annual IC for onwards. The annual I/O ratio has then been applied to the output value by season and then allocated to the months covered by each season using the amount of IC each month as a percentage of total IC during the season. The I/O ratios developed are based on inputs per hectare cultivated and output per hectare during the two seasons. Ideally, the constant price IC needs to be applied to hectares planted per season, not the harvest output. The annual gross value added (GVA) estimates are derived by deducting IC from GO values for both the current price and the constant price estimates for each major crop type in the relevant crop worksheets. The current and constant price GO, IC and GVA for all crop types are then linked to the summary worksheet and the implicit price deflators are then derived. The work in progress worksheets combine crop calendar, production output, input costs and annual current and constant price, crop calendar consist two seasons' short rainfall and long rainfall season, and input costs per crop then crop matrix is used for splitting its total production costs into agriculture calendar year.

### Examples of WIP Worksheets

<b>Costs of Productions for Maize 2007-08 - 1 Hectare</b>				
<b>s/n</b>	<b>Activity</b>	<b>Number</b>	<b>Price</b>	<b>Total</b>
1	Land Preparation (Labor)	2 units	2,258	4,516
2	Land Preparation - tractor (IC)	1 unit	1,782	1,782
3	Seeds (IC)	10 units	1,360	13,598
4	Planting (Labor)	2 unit	2,258	4,516
5	Fertilizer (IC)	1 unit	238	238
6	First Fertilizing (labor)	1 unit	2,258	2,258
7	Weeds Removal (labor)	1 unit	2,258	2,258
8	Fungicides/herbicides/insecticides (IC)	1 unit	1,164	1,164
9	Second Fertilizing and Pest Control (Labor)	2 units	2,258	4,516
10	Irrigation	1 unit	367	917
11	Harvesting and drying (labor)	4 units	2,258	9,031
12	Packets / sacks (IC)	13	1,500	19,500
13	Transportation (IC)	1 unit	5,188	5,188
	<b>Total</b>			<b>69,480</b>

	TZs		Kgs
Output per hectare	340,125		1,332
Operating Surplus	270,645		1,332
Farm gate price per ton	255,308		
Farm gate price per Kg	340,125		
Intermediate consumption	42,387		12.5%
Gross value added per hectare	297,738		87.5%



**Maize - Long Rain Season:**

Inputs/Land	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total costs
Land Preparation (Labor)		2,258	2,258										4,516
Land Preparation - tractor (IC)		891	891										1,782
Seeds (IC)			13,598										13,598
Planting (Labor)			4,516										4,516
Fertilizer (IC)				119	119								238
First Fertilizing (Labor)				2,258									2,258
Weeds Removal (Labor)				2,258									2,258
Fungicides/herbicides/insecticides (IC)				582	582								1,164
Second Fertilizing and Pest Control (Labor)					4,516								4,516
Irrigation (IC)				183	183								367
Harvesting and drying (Labor)						2,258	2,258	2,258	2,258				9,031
Packets / sacks (IC)						4,996	4,996	4,996	4,996				19,983
Transportation (IC)						1,297	1,297	1,297	1,297				5,188
<b>Total inputs:</b>	-	3,149	21,262	5,400	5,400	8,551	8,551	8,551	8,551			-	69,413
<b>Total intermediate consumption:</b>	-	891	4,489	884	884	6,293	6,293	6,293	6,293			-	42,320
Total inputs (apply to output) distribution)			35.17%			27.88%			36.96%			0.00%	100.0%
Total intermediate inputs (apply to IC) distribution)			36.34%			19.05%			44.61%			0.00%	100.0%

**Maize - Short Rain Season:**

Inputs/Land	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Costs per
Land Preparation (Labor)										2,258	2,258		4,516
Land Preparation - tractor (IC)										891	891		1,782
Seeds (IC)										4,533	4,533	4,533	13,598
Planting (Labor)										1,505	1,505	1,505	4,516
Fertilizer (IC)	48										95	95	238
First Fertilizing (Labor)	753										753	753	2,258
Weeds Removal (Labor)	753										753	753	2,258
Fungicides/herbicides/insecticides (IC)											582	582	1,164
Second Fertilizing and Pest Control (Labor)											2,258	2,258	4,516
Irrigation (IC)											183	183	367
Harvesting and drying (Labor)	3,010										3,010	3,010	9,031
Packets / sacks (IC)	6,661										6,661	6,661	19,983
Transportation (IC)	1,729										1,729	1,729	5,188
<b>Total inputs:</b>	12,954			-		-	-		-	9,187	25,211	22,062	69,413
<b>Total intermediate consumption:</b>	8,438			-		-	-		-	5,424	14,675	13,784	42,320
<b>Total inputs (apply to output distribution)</b>			<b>18.66%</b>			<b>0.00%</b>			<b>0.00%</b>			<b>81.34%</b>	<b>100.0%</b>
<b>Total intermediate inputs (apply to IC distribution)</b>			<b>19.94%</b>			<b>0.00%</b>			<b>0.00%</b>			<b>80.06%</b>	<b>100.0%</b>

**Maize - Annual average:**

Inputs/Land	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total costs
Land Preparation (Labor)	-	1,129	1,129	-	-	-	-	-	-	1,129	1,129	-	4,516
Land Preparation - tractor (IC)	-	445	445	-	-	-	-	-	-	445	445	-	1,782
Seeds (IC)	-	-	6,799	-	-	-	-	-	-	2,266	2,266	2,266	13,598
Planting (Labor)	-	-	2,258	-	-	-	-	-	-	753	753	753	4,516
Fertilizer (IC)	24	-	-	59	59	-	-	-	-	-	48	48	238
First Fertilizing (Labor)	376	-	-	1,129	-	-	-	-	-	-	376	376	2,258
Weeds Removal (Labor)	376	-	-	1,129	-	-	-	-	-	-	376	376	2,258
Fungicides/herbicides/insecticides (IC)	-	-	-	291	291	-	-	-	-	-	291	291	1,164
Second Fertilizing and Pest Control (Labor)	-	-	-	-	2,258	-	-	-	-	-	1,129	1,129	4,516
Irrigation (IC)	-	-	-	92	92	-	-	-	-	-	92	92	367
Harvesting and drying (Labor)	1,505	-	-	-	-	1,129	1,129	1,129	1,129	-	1,505	1,505	9,031
Packets / sacks (IC)	3,331	-	-	-	-	2,498	2,498	2,498	2,498	-	3,331	3,331	19,983
Transportation (IC)	865	-	-	-	-	649	649	649	649	-	865	865	5,188
<b>Total inputs:</b>	<b>6,477</b>	<b>1,574</b>	<b>10,631</b>	<b>2,700</b>	<b>2,700</b>	<b>4,275</b>	<b>4,275</b>	<b>4,275</b>	<b>4,275</b>	<b>4,593</b>	<b>12,605</b>	<b>11,031</b>	<b>69,413</b>
<b>Total intermediate consumption:</b>	<b>4,219</b>	<b>445</b>	<b>7,245</b>	<b>442</b>	<b>442</b>	<b>3,146</b>	<b>3,146</b>	<b>3,146</b>	<b>3,146</b>	<b>2,712</b>	<b>7,337</b>	<b>6,892</b>	<b>42,320</b>
Total inputs (apply to output distribution)	9.3%	2.3%	15.3%	3.9%	3.9%	6.2%	6.2%	6.2%	6.2%	6.6%	18.2%	15.9%	100.0%
Total intermediate inputs (apply to IC distribution)	10.0%	1.1%	17.1%	1.0%	1.0%	7.4%	7.4%	7.4%	7.4%	6.4%	17.3%	16.3%	100.0%

BY QUARTER

Total inputs (apply to output distribution)

Total intermediate inputs (apply to IC distribution)

OUTPUT (per hectare)

IC

GVA

I-O Ratio

Q1

26.9%

28.1%

91,543

1,909

79,634

13.0%

Q2

13.9%

9.5%

47,409

4,031

43,378

8.5%

Q3

18.5%

22.3%

62,847

9,439.3

53,408

15.0%

Q4

40.7%

40.0%

38,326

16,941.2

121,385

12.2%

340,125

42,320

12.4%

	Unit	Q1 2001			Q2 2001			Q3 2001			Q4 2001			2001			
		Quantity	Price 1 TSH/kg	Value (Million)	Quantity	Price TSH/kg	Value (Million)	Quantity	Price TSH/kg	Value (Million)	Quantity	Price TSH/kg	Value (Million)	Quantity	Price TSH/kg	Value (Million)	
1	Area Cultivated	000ha											3,300		1,299		
	Long Rains	000ha											2,599		1,246		
	Short Rains	000ha											701		1,498		
2	Area harvested	000ha															
	Long Rains	000ha															
	Short Rains	000ha															
3	Production	000 tons	1,309	104.89	137,330	920	104.89	96,493	1,207	104.89	126,619	852	104.89	89,365	4,288	104.89	449,807
	Long Rains	000 tons	1,111			920			1,207		-		3,238		-		
	Short Rains	000 tons	198			-			-		852		1,050		-		
4	Post harvest loss	000 tons	65.465	0.050	6,867	45.998	0.050	4,825	60.359	0.050	6,331	42.600	0.050	4,468	214.421	0.050	22,490
5	Net Production	000 tons	1243.830		130,464	873.953		91,668	1146.814		120,288	809.396		84,897	4073.993		427,317
6	Sales																
7	Own consumption																
8	Own capital formation																
9	Total Output		1243.830	104.89	130,464	873.953	105	91,668	1146.814	105	120,288	809.396	105	84,897	4073.993	105	427,317
	Long Rains		1,055		110,705	874		91,668	1,147		120,288	-		-	3,076		322,661
	Short Rains		188		19,759	-		-	-		-	809		84,897	998		104,656
0	Intermediate Inputs				10,732			5,023			11,763			6,667		0.0800	34,185
	IC/GO Ratio 2007	0.1244															
	Long Rains IC		0.3497		9,027	0.1946		5,023	0.4557		11,763	0.0000		-	1.0000		25,813
	Short Rains IC		0.2037		1,705	0.0000		-	0.0000		-	0.7963		6,667	1.0000		8,372
	GVA/GO Ratio 2007	0.8756															
1	GVA at current prices				119,732			86,645			108,525			78,230			393,131
17	Output at constant prices				255,212			179,319			235,306			166,074			835,910
18	IC at constant prices				20,994			9,826			23,010			13,042			66,873
19	GVA at constant prices				234,217			169,493			212,295			153,032			769,037
	Deflators 2007=100		104.89		51.12	104.89		51.12	104.89		51.12	104.89		51.12	104.89		51.12



### **Challenges and Plans for Improvement.**

One of the major challenges is only appropriately designed sample surveys of agricultural households can provide data that are of adequate quality, also Agriculture Survey is being done periodically once in every five year, thus the methodology depend on extrapolating methods which depends on value added from the benchmark.

Lack of producer prices from primary markets required for preparing National Accounts which includes GDP, thus the use of Consumer Price Index (CPI) has been used indirectly to as producer price data.

Lack of suitable annual or sub-annual data from MOA or other data sources

Ways to improvement includes include introducing short term survey. i.e Agriculture survey on yearly basis and other special studies including data verification on prices in order to improve data quality.

### **In Concluding Remarks:**

The WIP techniques provides methodology for calculating crop output at more detail level in the National accounts statistics for providing Gross output and Intermediate consumption and Value added by crop in line with the system of National accounts SNA 2008, and gives a better estimates of crop value added in the Agriculture activity.

### **ABBREVIATIONS**

AGS	AGRICULTURE SURVEY
B-I	BENCHMARK-INDICATOR APPROACH
BM	BENCHMARK
CPI	CONSUMER PRICE INDEX
GDP	GROSS DOMESTIC PRODUCT
GO	GROSS OUTPUT
GVA	GROSS VALUE ADDED
HBS	HOUSEHOLD BUDGET SURVEY
IC	INTERMEDIATE CONSUMPTION
I/O RATIOS	INPUT TO OUTPUT RATIOS
MOA	MINISTRY OF AGRICULTURE
NBS	NATIONAL BUREAU OF STATISTICS
QNA	QUARTERLY NATIONAL ACCOUNTS
WIP	WORK-IN-PROGRESS

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