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An Analysis of the Proposed Agricultural Accounting Component for CLASS

I. Introduction

The approach taken in this analysis can be discussed in two topics: (a) the general features of the model and communication between the model and the accounting routine, and (b) the conceptual framework used in order to obtain generalizability and to facilitate computation.

The Model and Communication

The accounting routines are viewed as being used with a model which has the following general features:

1. Geographically the country under study is divided into a number of regions.

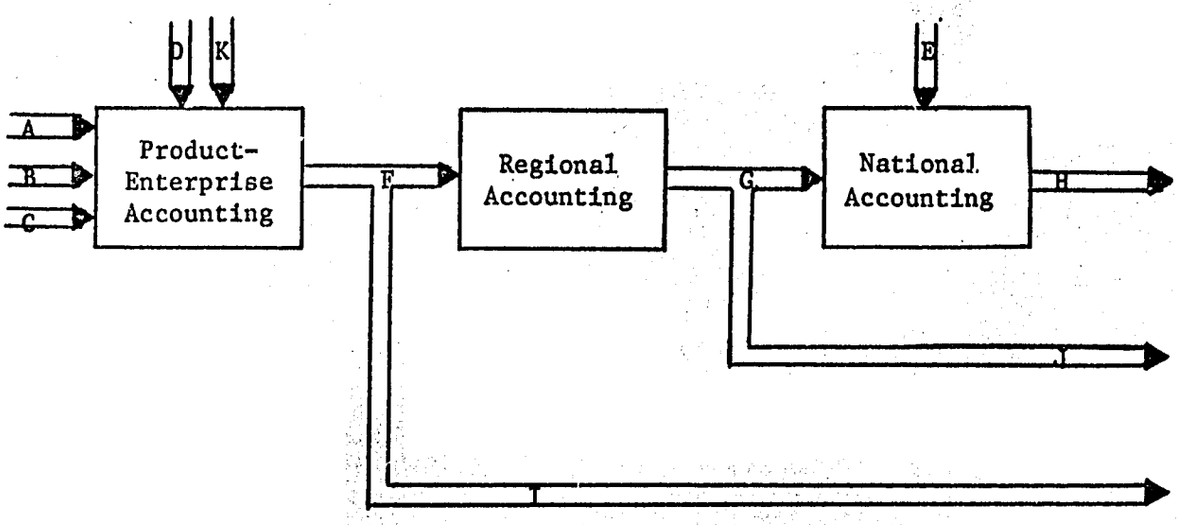
2. The national economy is divided into two sectors, agriculture and nonagriculture.

3. The agricultural sector is made up of two sets of enterprises, crop enterprises and livestock enterprises.

4. Enterprises may then be classified as single product or multi-product enterprises. This will produce four classes of enterprises: (1) crop-single product; (2) crop-multiproduct; (3) livestock-single product; and (4) livestock-multiproduct. However for the purposes of these accounting routines classes (1) and (2) are combined into the single class "single product enterprise."

It is expected that the routines will be called at the end of each simulation time cycle and the calculationsand output from the accounting routine will refer to one time cycle only.

The following diagram shows the flow of information from the model through the accounting routines and back to the next time cycle of the model or to the printer as final output (or both).



A = Input from crop production model

B = Input from livestock production model

C = Exogenous parameters (constants, etc.)

D = Input from population model

E = Input from nonagricultural model (not yet included)

F = Outputs from product-enterprise accounting which are used as inputs into regional accounting

G = Outputs from regional accounting which are used as inputs into national accounting

H = Outputs from national accounting to the next time cycle and/or to printer

I = Outputs from product-enterprise accounting to the next time cyc and/or to printer

J = Outputs from regional accounting to the next time cycle and/or to printer

K = Inputs from market models

The Approach

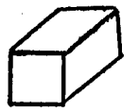
It was observed that the calculations involved in the accounting functions were repetitious. This, together with the desire for a set of routines

which are general in the sense that they can be used with a model of any size, suggested that intensive use of the array and DO loop features of the FORTRAN language would be useful.

Although FORTRAN arrays and mathematical matrices have much in common, the two concepts should not be confused. FORTRAN arrays are merely a set of ordered storage locations in the computer. The elements of an array may be operated upon in any way. Only when the programmer determines that an array is to be operated on as a mathematical matrix does a FORTRAN array represent a mathematical matrix. In the development of the accounting routines there is no need to conduct matrix algebra, as such. Each element of an array is treated separately and no interdependence exists. Arithmetic operations between arrays are conducted on an element to element basis. For instance, if we wish to multiply one array with another, the first element of one array is multiplied by the first element of the second array and the result is the first element of the resulting array and so on for each of the elements in the arrays.

Geometrically, the concepts of single variables and arrays in FORTRAN can be represented as follows:

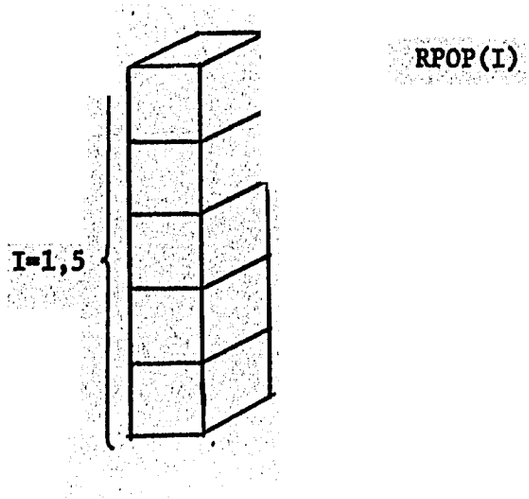
1. A FORTRAN variable:



TPOP

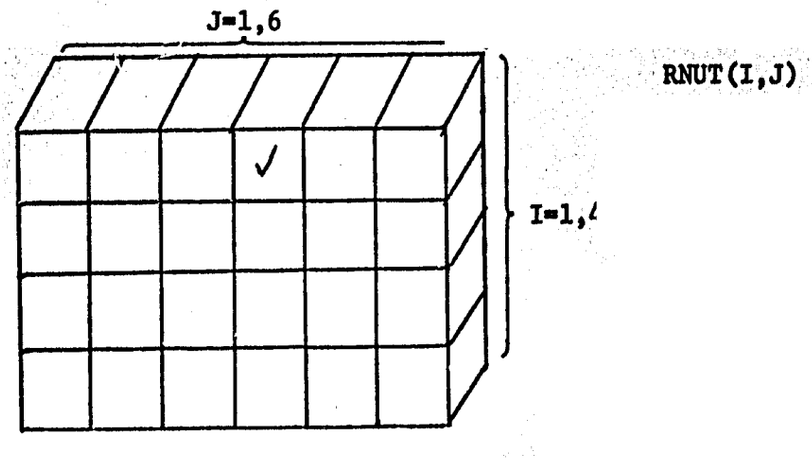
A single variable contains one number only and is represented by a FORTRAN variable name such as TPOP.

2. A FORTRAN single dimensioned array:



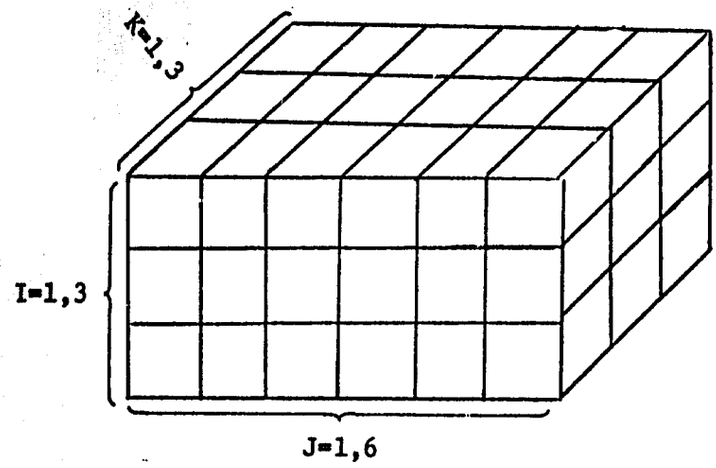
A single dimensioned array is an ordered set of single variables or elements all represented by a FORTRAN variable name which is indexed, such as RPOP(I). In this illustration "I" can have any value from 1 to 5; RPOP(1) representing the first element, RPOP(2) the second, etc.

3. A FORTRAN double dimensioned array



A double dimensioned array is an ordered set of single dimensioned arrays represented by a variable name and two indices, such as RNUT(I,J). In this case I can have any value from 1 to 4 and J can have any value from 1 to 6. The reference RNUT(1, 4) would refer to the value stored in the first row of the fourth column of the array RNUT.

4. A FORTRAN triple dimensioned array:



EXP(I,J,K)

A triple dimensioned array is an ordered set of double dimensioned arrays represented by a variable name and three indices, such as EXP(I,J,K). In this example I can range in value from 1 to 3, J from 1 to 6, and K from 1 to 3. The term EXP(2,4,3) represents the value stored in the second row of the fourth column of the third tier of the array EXP.

Theoretically arrays can have more dimensions and in fact some FORTRAN compilers allow up to 9 dimensions, however many smaller computers and some large ones only allow 3. Therefore the current CLASS programming standards do not allow the use of arrays over three dimensions.

The FORTRAN DO loop is a useful mechanism for performing mathematical operations with corresponding elements in arrays. For instance the programmer can specify that each element in array A be multiplied by its corresponding element in array B and the result divided by each corresponding element in array C. This allows for the specification of a large amount of calculation with a minimum of programming.

If the arrays are chosen in such a way that the sizes of the dimensions of the arrays represent the size of the model, then specifying the dimensions as single variables and assigning them values each time the accounting component is used with a different model, quickly determines the necessary sizes of all of the arrays used in the accounting component. This provides considerable generalizability with a minimum of effort.

Sections III and IV list the inputs, outputs and indices which are used in the computations of the various accounts. Section III is a list of variable and array names used as inputs to and outputs from the accounting component. Each name in the list is defined in terms of what it represents in the real world and what it represents in terms of the computer. In terms of the real world the name is defined as follows:

1. What it represents (e.g., rural population, expenditures on inputs, number of enterprises, etc.)
2. The units in which the quantities are to be measured (e.g., numbers of people, units of value, or a number of enterprises, etc.)

3. For those variables which represent the size of the model (number of regions, enterprises, etc.), some simple relationships among them are included, for instance NENT = NSENT + NMCENT + NMLENT (total number of enterprises = number of single product enterprises + number of multi-product crop enterprises + number of multi-product livestock enterprises).
4. Also included is the origin of the values represented by the name. For example the values in the array PRP are determined in the market model.

In terms of the computer, the following information is provided:

1. The type of FORTRAN structure it represents (single variable, single dimensioned array, or double dimensioned array, etc.)
2. The sizes of each dimension if it is an array.

Section IV presents a list of indices used in the computations and represents the various dimensions of arrays. The maximum values of these indices define the size of the model.

II. Ordering of Elements in Arrays

In several cases it is necessary to use only some of the elements of an array in a calculation. For example in calculating value added, the acquisition costs of only those factors of production which do not receive the residuals of wages, rents, profits and interest, are to be deducted from the gross income. Therefore it is often desirable to keep the various classifications of elements of arrays together in a predetermined position in the dimension. The following conventions will be followed:

1. For all arrays with a dimension NENT, the information about the enterprises will be entered in the following order:

Array Index Number	Enterprise Classification
1 to NSENT	single product enterprises
NSENT + 1 to NSENT + NMCENT	multi-product crop enterprises
NSENT + NMCENT + 1 to NENT	multi-product livestock enterprises

2. For all arrays with a dimension NINP, the information about the inputs will be entered in the following order:

Array Index Number	Input Classification
1 to NNRINP	Inputs not receiving the residual wages, rents, profits and interest.
NNRINP + 1 to NINP	Inputs receiving the residual wages, rents, profits and interest.

3. For all arrays with a dimension NAPRD, the information about the agricultural products will be entered into the array in the following order:

Array Index Number	Product Classification
1 to NSENT	products of single-product enterprises
NSENT + 1 to NSENT + NCPROD	products of multi-product crop enterprises
NSENT + NCPROD + 1 to NAPRD	products of multi-product livestock enterprises

III. Variables Used in Accounting Routin

1. NREG
   - -Number of Regions
   - -Single Variable
   - -Units - Regions
   - -Origin - C

2. NENT
   - -Number of Agricultural Enterprises
   - -NENT = NSENT + NMCENT + NMLENT
   - -Single Variable
   - -Units - Enterprises
   - -Origin - C

3. NLPROD
   - -Number of Livestock Products from Multi-product Livestock Enterprises
   - -Single Variable
   - -Units - Products
   - -Origin - C

4. NCPROD
   - -Number of Crop Products from Multi-Product Crop Enterprises
   - -Single Variable
   - -Units - Products
   - -Origin - C

5. NAPRD
   - -Number of Agricultural Products
   - -NAPRD = NCPROD + NLPROD + NSENT
   - -Single Variable
   - -Units - Products
   - -Origin - C

6. NINP
   - -Number of Inputs
   - -Single Variable
   - -NINP = NNRINP + NRINP
   - -Units - Inputs
   - -Origin - C

7. NNUT
   - -Number of Nutrients
   - -Single Variable
   - -Units - Nutrients
   - -Origin - C

8. RINP
   - -Amount of Input Used in Each Enterprise in the Region
   - -Triple Dimensioned Array
     Maximum Sizes of Dimensions (NREG, NENT, NINP)
   - -Units - Units of Input
   - -Origin - A & B

9. PRINP
-Price of Inputs
-Double Dimensioned Array
Maximum Sizes of Dimensions (NREG, NINP)
-Units - Units of Value
-Origin - K

10. RNUT
-Amount of Nutrients in Agricultural Products
-Double Dimensioned Array
Sizes of Dimensions (NAPRD, NNUT)
-Units - Units of Nutrient (varies with nutrie
-Origin - C

11. PRP
-Farm Price of Agricultural Products
-Double Dimensioned Array
Sizes of Dimensions (NREG, NAPRD)
-Units - Units of Value
-Origin - K

12. PFLOSS
-Farm Loss (proportion)
-Single Variable
-Units - None (pure number)
-Origin - A & B

13. PCCON
-Rural Consumption of Agricultural Products per Person
-Double Dimensioned Array
Sizes of Dimensions (NREG, NAPRD)
-Units - Units of Product
-Origin - C

14. RPOP
-Rural Population by Regi
-Single Dimensioned Array
Size of Dimension (NREG)
-Units - People
-Origin - D

15. RTAX
-Producer Profit Tax Rates
-Double Dimensioned Array
Sizes of Dimensions (NREG, NENT)
-Units - None (pure number)
-Origin - C

16. OUTS
-Output from Single Product Enterprises
-Double Dimensioned Array
Sizes of Dimension (NREG, NSENT)
-Units - Units of Product
-Origin - A & B

17. NMCENT -Number of Multi-product Crop Enterprises
-NMCENT = NENT - NSENT - NMLENT
-Single Variable
-Units - No. of Enterprises
-Origin - A

18. NMLENT -Number of Multi-product Livestock Enterprises
-NMLENT = NENT - NSENT - NMCENT
-Single Variable
-Units - Number of Enterprises
-Origin - B

19. OUTCM -Output from Multi-product Crop Enterprises
-Triple Dimensioned Array
Sizes of Dimensions (NREG, NMCENT, NCPROD)
Units - Units of Product
Origin - A

20. OUTLM -Input from Multi-product Livestock Enterprise
-Triple Dimensioned Array
Sizes of Dimension (NREG, NMLENT, NLPROD)
-Units - Units of Product
-Origin - B

21. NNRINP -Number of Inputs which do not Receive Wages, Profits, Rents or Interest
-NNRINP = NINP - NRINP
-Single Variable
-Units - Inputs
-Origin - C

22. NRINP -Number of Inputs which Receive Wages, Profits Rents or Interests
-NRINP = NINP - NNRINP
-Single Variables
-Units - Inputs
-Origin - C

23. EXP -Expenditures on Inputs
-Triple Dimensioned Array
Sizes of Dimensions (NREG, NENT, NINP)
nits - Units of Value
rigin - F

24. TNUT -Amount of Nutrients Available from Enterprise
-Triple Dimensioned Array
Sizes of Dimensions (NREG, NENT, NNUT)
-Units - Varies with Nutrient
-Origin - F

25. YGA
-Gross Income from Agriculture
-Double Dimensioned Array
Sizes of Dimensions (NREG, NENT)
-Units - Units of Value
-Origin - F

26. RCONC
-Rural Consumption of Agricultural Products
-Double Dimensioned Array
Sizes of Dimensions (NREG, NAPRD)
-Units - Units of Each Product
-Origin - I

27. YC
-Total Money Income from Agriculture
-Double Dimensioned Array
Sizes of Dimensions (NREG, NENT)
-Units - Units of Value
-Origin - F

28. PFT
-Profit from Agriculture
-Double Dimensioned Array
Sizes of Dimensions (NREG, NENT)
Units - Units of Value
Origin - F

29. VALAD
-Value Added in Agricultural Enterprises
-Double Dimensioned Array
Sizes of Dimensions (NREG, NENT)
-Units - Units of Value
-Origin - F

30. PTAX
-Producer Tax on Agricultural Profit
-Double Dimensioned Array
Sizes of Dimensions (NREG, NENT)
-Units - Units of Value
-Origin - F

31. RCNUT
-Nutrients Consumed by the Rural Population
-Triple Dimensioned Array
Sizes of Dimensions (NREG, NAPRD. NNUT)
-Units - Varies with Nutrients
-Origin - F.

32. PFTN
-Profit, Net of Producer Taxes
-Double Dimensioned Array
Sizes of Dimensions (NREG, NENT
-Units - Units of Value
-Origin - F

33. NSENT
-Number of Single Product Enterpri
-Single Variable
-NSENT = NENT - NMCENT - NMLENT
-Units - Number of Enterprises
-Origin - C

REXP -Total Regional Expenditures on Inp
-Single Dimensioned Array
Size of Dimension (NREG)
-Units - Units of Value
-Origin - G

35. RTNUT -Total Amount of Nutrients Available in Regions
-Double Dimensioned Array
Sizes of Dimensions (NREG, NNUT)
-Units - Varies with Nutrient
-Origin - G

36. RYGA -Gross Income from Agriculture in Regions
-Single Dimensioned Array
Size of Dimension (NREG)
-Units - Units of Value
-Origin - G

37. RYC -Total Money Income from Agriculture in Regions
-Single Dimensioned Array
Size of Dimension (NREG)
-Units - Units of Value
-Origin - G

38. RPFT -Profit from Agriculture in Regions
-Single Dimensioned Array
Size of Array (NREG)
-Units - Units of Value
-Origin - G

39. RVALAD -Value Added in Agriculture in Regions
-Single Dimensioned Array
Size of Array (NREG)
-Units - Units of Value
-Origin - G

40. RPTAX -Producer Taxes on Agriculture in Region
-Single Dimensioned Array
Size of Array (NREG)
-Units - Units of Value
-Origin - G

41. RRCNUT -Nutrients Consumed by Rural Population, by Region
-Double Dimensioned Array
Sizes of Dimensions (NREG, NNUT)
-Units - Varies with Nutrients
-Origin - G

42. RPFTN -Profit in Agriculture, Net of Producer Taxes, in Regions
-Single Dimensioned Array
Size of Dimension (NREG)
-Units - Units of Value
-Origin - G

43. AEXP
-Total Agricultural Expenditure on Agricultural Inputs
-Single Dimensioned Array
Size of Dimension (NREG)
-Units - Units of Value
-Origin - G

44. ATNUT
-Total Amounts of Nutrients Available from Domestic Agriculture
Single Dimensioned Array
Size of Array (NNUT)
Units - Varies with Nutrient
Origin - H

45. AYGA
-Gross Income from Agriculture
-Single Variable
-Units - Units of Value
-Origin - H

46. AYC
-Total Money Income from Agriculture
-Single Variable
-Units - Units of Value
-Origin - H

47. APFT
-Profits from Agriculture
-Single Variable
-Units - Units of Value
-Origin - H

48. AVALAD
-Value Added in Agriculture
-Single Variable
-Units - Units of Value
-Origin - H

49. APTAX
-Producer Taxes on Agricultural Profits
-Single Variable
Units - Units of Value
Origin - H

50. ARCNUT
-Domestically Produced Nutrients Consumed by the Rural Population
-Single Dimensioned Array
Size of Dimension (NNUT)
-Units - Varies with Nutrient
-Origin - H

51. APFTN
-Agricultural Profit, Net of Producer Loses
-Single Variable
-Units - Units of Value
-Origin - H

IV. Indices Used in Accounting Routines

Index	Maximum Value
i = Region Number	NREG
j = Enterprise Number	NENT = NSENT + NMCENT + NMLENT
l = Multi-product Livestock Enterprise Number	NMLENT = NENT - NSENT - NMCENT
m = Agricultural Product Number	NAPRD = NCPROD + NLPROD + NSENT
n = Input Number	NINP = NNRINP + NRINP
o = Nutrient Number	NNUT
q = Multi-product Crop Enterprise Number	NMCENT = NENT - NSENT - NMLENT
r = Single-product Enterprise Number	NSENT = NENT - NMCENT - NMLENT
t = Multi-product Crop Enterprise, Product Number	NCPROD
u = Multi-product Livestock Enterprise, Product Number	NLPROD

V. Agricultural Product-Enterprise Accounting

A. Inputs to and Outputs from the Product-Enterprise Accounting Component

Inputs	Origin	Outputs
RINP	A & B	EXP
PRINP	K	TNUT
OUTCM	A	RNUT
OUTLM	B	YGA
NREG	C	RCONC
NSENT	C	YC
NNUT	C	PFT
OUTS	A & B	VALAD
NMCENT	C	PTAX
NMLENT	C	RENUT
NCPROD	C	PFTN
NLPROD	C	
NAPRD	C	
PRP	K	
PFLOSS	C	
PCCON	C	
RPOP	D	
RTAX	C	
NINP	C	

B. Calculations for Product-Enterprise Accounting

1. Total Expenditures for Inputs (Region, Enterprises, Inputs)

$$EXP_{ijn} = RINP_{ijn} * PRINP_{in}$$

where:

$i = 1,NREG$

$j = 1,NENT$

$n = 1,NINP$

- Amount of Nutrients Available (Region, Enterprise, Nutrient)

a. Single Product Enterprises

$$TNUT_{ijo} = OUTS_{ir} * RNUT_{mo}$$

where:

$i = 1,NREG$

$j = 1,NSENT$

$o = 1,NNUT$

$r = 1,NSENT$

$m = 1,NSENT$

b. <u>Multi-product Crop</u>

$$TNUT_{ijo} = \sum_{\substack{t \\ m}} (OUTCM_{iqt} * RNUT_{mo})$$

where:

$i = 1,NREG$

$j = NSENT + 1,\ NSENT + NMCENT$

$o = 1,NNUT$

$q = 1,NMCENT$

$t = 1,NCPROD$

$m = NSENT + 1,\ NSENT + NCPROD$

c. <u>Multi-product Livestock</u>

$$TNUT_{ijo} = \sum_{\substack{u \\ m}} (OUTLM_{ilu} * RNUT_{mo})$$

where:

$i = 1,NREG$

$j = NSENT + NMCENT + 1,NENT$

$o = 1,NNUT$

$l = 1,NMLENT$

$u = 1,NLPROD$

$m = NSENT + NCPROD + 1,NAPI$

3. Gross Income from Agriculture (Region, Enterprise)

a. Single Product Enterprises

$$YGA_{ij} = PRP_{im}*(OUTS_{ir}*(1 - PFLOSS_m))$$

where:

$i = 1,NREG$

$j = 1,NSENT$

$m = 1,NSENT$

$r = 1,NSENT$

b. Multi-product Crop

$$YGA_{ij} = \sum_{t,m}(PRP_{im}*(OUTCM_{iqt}*(1 - PFLOSS_m)))$$

where:

$i = 1,NREG$

$j = NSENT + 1, NSENT + NMCENT$

$m = NSENT + 1, NSENT + NCPROD$

$t = 1,NCPROD$

$q = 1,NMCENT$

c. Multi-product Livestock

$$YGA_{ij} = \sum_{u,m}(PRP_{im}*(OUTLM_{ilu}*(1 - PFLOSS_m)))$$

where:

$i = 1,NREC$

$j = NSENT + NMCENT + 1,NENT$

$m = NSENT + NCPROD + 1,NAPRD$

$l = 1,NMLENT$

$u = 1,NLPROD$

Total Money Income from Agriculture (Region, Enterprise)

First find amount of rural consumption

$RCONC_{im} = PCCON_{im} * RPOP_i$

where:

$i = 1, NREG$

$m = 1, NAPROD$

a. Single-product Enterprises

$YC_{ij} = (OUTS_{ir} - RCONC_{im}) * PRP_{im}$

where:

$i = 1, NREG$

$j = 1, NSENT$

$r = 1, NSENT$

$m = 1, NSENT$

b. Multi-product Crop

$YC_{ij} = \sum_{t,m} ((OUTCM_{iqt} - RCONC_{im}) * PRP_{im})$

where:

$i = 1, NREG$

$j = NSENT + 1, NSENT + NMCENT$

$q = 1, NMCENT$

$t = 1, NCPROD$

$m = NSENT + 1, NSENT + NCPROD$

c. Multi-product--Livestock

$YC_{ij} = \sum_{u} ((OUTLM_{iiu} - RCONC_{im}) * PRP_{im})$

where:

$i = 1,NREG$

$j = NSENT + NMCENT + 1,NENT$

$l = 1,NMLENT$

$u = 1,NLPROD$

$m = NSENT + NCPROD + 1,NAPRD$

5. Profits from Agriculture (Region, Enterprise)

$$PFT_{ij} = YC_{ij} - \sum_{n} EXP_{ijn}$$

where:

$i = 1,NREG$

$j = 1,NENT$

$n = 1,NINP$

6. Value Added in Agricultural Enterprises (Region, Enterprise)

$$VALAD_{ij} = YGA_{ij} - \sum_{n} EXP_{ijn}$$

where:

$i = 1,NREG$

$j = 1,NENT$

$n = 1,NNRINP$

7. Producer Taxes on Agricultural Profit (Region, Enterprise)

$$PTAX_{ij} = RTAX_{ij} * PFT_{ij}$$

where:

$i = 1,NREG$

$j = 1,NENT$

8. Nutrients Consumed by the Rural Population (Regions, Agricultural Product, Nutrients)

$$RCNUT_{imo} = RCONC_{im} * RNUT_{mo}$$

where:

$l = 1,NREG$

$n = 1,NAPRD$

$o = 1,NNUT$

9. <u>Profit, Net of Producer Taxes (Region, Enterprise)</u>

$$PFTN_{ij} = PFT_{ij} - PTAX_{ij}$$

where:

$i = 1,NREG$

$j = 1,NENT$

VI. Regional Agricultural Accounting

A. Inputs to and Outputs from Regional Accounting Components

Inputs	Origin	Outputs
EXP	F	REXP
TNUT	F	RTNUT
YGA	F	RYGA
RYC	F	RRYC
PFT	F	RPFT
VALAD	F	RVALAD
PTAX	F	RPTAX
RCNUT	F	RRCNUT
PFTN	F	RPFTN

Calculations for Regional Accounting

1. Total Expenditures and Demand for Inputs (Region)

$$REXP_i \quad \sum_{\substack{m \\ j}} EXP_{ijm}$$

where:

$i = 1,NREC$

$j = 1,NENT$

$m = 1,NINP$

2. Amount of Nutrients Available (Region, Nutrient)

$$RTNUT_{io} = \sum_j TNUT_{ijo}$$

where:

$i = 1,NREG$

$j = 1,NENT$

$o = 1,NNUT$

3. Gross Income from Agriculture (Region)

$$RYCA_i = \sum_j YCA_{ij}$$

where:

$i = 1,NREG$

$j = 1,NENT$

4. <u>Total Money Income from Agriculture (Region)</u>

$$RYC_i = \sum_j YC_{ij}$$

where:

$i = 1,NREG$

$j = 1,NENT$

5. <u>Profits from Agriculture (Region)</u>

$$RPFT_i = \sum_j PFT_{ij}$$

where:

$i = 1,NREG$

$j = 1,NENT$

6. <u>Value Added in Agricultural (Region)</u>

$$RVALAD_i = \sum_j VALAD_{ij}$$

where:

$i = 1,NREG$

$j = 1,NENT$

7. <u>Producer Taxes on Agricultural Profit (Region)</u>

$$RPTAX_i = \sum_j PTAX_{ij}$$

where:

$i = 1,NREG$

$j = 1,NENT$

8. <u>Nutrients Consumed by the Rural Population (Region, Nutrient)</u>

$$RRCNUT_{is} = \sum_{m} RCNUT_{ims}$$

where:

$i = 1,NREG$

$m = 1,NAPRD$

$s = 1,NNUT$

9. <u>Profit in Agriculture Net of Producer (Region)</u>

$$RPFTN_{i} = \sum_{j} PFTN_{ij}$$

where:

$i = 1,NREG$

$j = 1,NENT$

VII. National Agricultural Accounting

A. Inputs to and Outputs from National Accounting Component

Inputs	Origin	Outputs
REXP	G	AEXP
RTNUT	G	ATNUT
RYGA	G	AYGA
RPFT	G	APFT
RVALAD	G	AVALAD
RPTAX	G	APTAX
RRCNUT	G	ARCNUT
RPFTN	G	APFTN
RVALAD	G	

B. Calculations for National Accounting

1. Total Agricultural Expenditures on Agricultural Inputs

$$AEXP = \sum_i REXP_i$$

where:

$i = 1,NREG$

2. Amount of Nutrients Available from Domestic Agriculture (Nutrients)

$$ATNUT_o = \sum_i RTNUT_{io}$$

where:

$i = 1,NREG$

$o = 1,NNUT$

3. Gross Income from Agriculture

$$AYGA = \sum_i RYGA_i$$

where:

$i = 1,NREG$

4. <u>Total Money Income from Agriculture</u>

$$AYC = \sum_i RYC_i$$

where:

$$i = 1,NREG$$

5. <u>Profits from Agriculture</u>

$$APFT = \sum_i RPFT_i$$

where:

$$i = 1,NREG$$

6. <u>Value Added in Agriculture</u>

$$AVALAD = \sum_i RVALAD_i$$

where:

$$i = 1,NREG$$

7. <u>Producer Taxes on Agricultural Profit</u>

$$APTAX = \sum_i RPTAX_i$$

where:

$$i = 1,NREG$$

8. <u>Domestically Produced Nutrients Consumed by the Rural Population (Nutrients)</u>

$$ARCNUT_o = \sum_i RRCNUT_{io}$$

where:

$$i = 1,NREG$$

$$o = 1,NNUT$$

9. <u>Agricultural Profit, Net of Producer Taxes</u>

$$APFTN = \sum_{i} RPFTN_i$$

where:

$$i = 1,NREC$$