The Current State of Cost of Production Estimates

A review of Country Practices in Ethiopia, Mali and Zambia.

Peter Lys

December 2010

Acknowledgements

The author would like to acknowledge the support of the Economic Statistics Division of the FAO in Rome for their support as well as the national consultants (Dr. Girma Tadesse country expert from Ethiopia, Dr. Lamissa Diakite country expert from Mali and Michael Isimwaa country expert from Zambia, who were engaged to prepare the country reports and without whose support, this study would have been impossible to prepare. The author would also like to acknowledge and thank the International Food Policy Research Institute for financing the study. Any errors or omissions are the sole responsibility of the author.

Introduction

The project was commissioned by the ESS section of FAO following recommendations made during the 21st African Commission on Agriculture Statistics held in Accra, Ghana, 28 – 31 October 2009, where the FAO and International Food Policy Research Institute were invited to "*conduct a study of country experiences in collecting and compiling cost of production statistics and agricultural price statistics and document these experiences.*"

The study was framed by the ESS of the FAO so as to prepare a synthesis document on the state of cost of production data in the three countries, namely Mali, Ethiopia and Zambia. National consultants were engaged to document country practices in the subject countries while the international consultant was to oversee and comment on their work and synthesize the three studies. The document, to be prepared in two parts, first summarizes the reports prepared by the national consultants hired in the pilot countries and second, identifies the main data gaps with respect to an ongoing program of cost of production data and to make recommendations aimed at filling these gaps.

The report will begin with a brief overview of what is meant by cost of production for agriculture commodities. This will be followed by a brief description of the agriculture in the selected countries. Next, will be a description of the characteristics of the countries agriculture statistics system. A description of the main agriculture surveys is presented with current practices described. Then country experiences with producing cost of production is described. This is followed by an assessment of these practices. Finally, recommendations and options for future work in this area are presented.

Cost of Production Defined: Theory and Uses

Many countries have long established an ongoing cost of production program for agriculture commodities. This is because of the importance of agriculture to national economies, the desire to see fair returns to producers and households engaged in agriculture production and the role domestic agriculture plays in national security.

The value of estimating cost of production are many and include but are not limited to providing planners with base line information for planning purposes, allowing comparisons with other regions or countries, permitting modeling and partial equilibrium analysis, analyzing the impact of technological adaptation, evaluation of farm management practices, determining the relative importance of various inputs, assessing the financial situation for both the farm operator/farming unit, measuring the change of input use over time. When appropriately designed, national cost of production studies can provide a direct link between commodity production practices and the financial status of the farm and the operator's household. Data can also provide insight into many aspects of the agriculture sector and its contribution to the national economy. Cost of production data are often used to set local market prices and for establishing support levels for farm commodity production in some countries.

The theoretical basis of estimating cost of production is well established and has its roots in micro economic theory. In simplistic terms, estimating the cost of production is the measurement of all economic costs associated with the production of the commodity. While the theory is well established, measurement difficulties make the task at hand more challenging. Among the obstacles to overcome, is the treatment of non-purchased inputs and labour, the measurement of depreciable capital and of inputs used for more than one output (commodity). Extending the cost of production analysis to estimate net returns involves capturing transaction prices where they exist, or imputing for them where they do not. Finally, when attempting to extend the analysis to make inferences at the national level, then additional complexities arise in assuring the representativeness of the units of observation and the measurement issues become correspondingly more complex.

The generally accepted methodology for calculating the cost of production is to measure output as the product of area, yield and price. Area is defined as area under cultivation for the commodity in question, yield as the harvested product per unit area and price being the unit value of the product in the market place inclusive of subsidies and net of transportation costs.

Costs can be thought of as either purchased and include inputs such as seed, fertilizer, pesticides, hired capital expenses such as machinery or livestock etc; labour, depreciation on owned machinery and buildings, and the imputed opportunity cost of owned capital and unpaid labour used in the production process.

As one can readily determine, the concepts used to measure the cost of production are generally well known and easily articulated, estimating the cost of production accurately reduces the problem to one of determining the quality of the base measures especially for the imputed variables such as unpaid labour, shared output assumptions and depreciation rates.

Notwithstanding these difficulties, solutions for these obstacles do exist and combined with prudent assumptions, an ongoing program of cost of production can be put into effect.

Country Background

The countries chosen for the study were Ethiopia, Mali and Zambia. Agriculture in these countries contributes significantly to the national income and employment for each country.

Table 1[1]

	Ethiopia	Mali	Zambia
Agriculture GDP as a % of national GDP	45	35	18-20
Agriculture Work Force % of national workforce	80	70	50

Ethiopia[2]

Ethiopia is a country with an area of 1.12 million km^2, characterized by rugged mountainous terrain and plains. Its altitude ranges from 4620 meters above sea level at Mt. Ras Dashen to 116 meters below sea level at Dallol Depression. The country has diverse climatic conditions and different soil types.

[1] Taken from Country Reports
[2] Country Report Ethiopia, Dr. Girma Tadesse

The country is the third most populous country in Africa. According to the 2004 Population and Housing Census, the projected total population in July 2010 is estimated to be 79,352,918 million and of which 85 per cent are rural.

Natural resources, mainly land and forest have been the bases for the economic activity of the vast majority of the people.

Agriculture is the leading economic sector of the country, which provides the necessary means of livelihood for more than 85 percent of the nation's population. Subsistence smallholder mixed farming is prevalent throughout the highlands while livestock farming is predominant in the pastural lands.

The agriculture sector accounts for approximately 45 percent of Gross Domestic Product (GDP) and provides employment for 80 percent of the population. About 90% of export earnings are generated from agricultural products. The major agricultural commodities include coffee, hides and skins, oilseeds, pulses, live animals and flower. The crop production is estimated to contribute on an average 60 percent, livestock accounts for 27 percent and forestry and other sub-sectors account for 13 percent of the total agricultural value.

The total land area under private peasant holdings is estimated to be about 16 million hectares and operated by more than 13 million agricultural households and about 14 million agricultural holders. The average holding sizes per household and holder are 1.18 and 1.15 hectares, respectively. On the other hand, the average cropland area is about 0.96 hectare per household and 0.93 hectare per holder.

Regarding grain crops, from the cereal group, Teff (indigenous crop to Ethiopia only), maize, wheat, barley, sorghum and millet are dominant which cover about 80 percent of area under grain crops and from pulses, Faba beans, haricot beans, field peas, chick peas, lentils and vetch are widely grown, covering about 13 percent of the area under grain crops. From oilseeds, Niger seed, linseed sesame and rape seed cover the remaining 7 percent. To a lesser degree, vegetables, root crops and permanent crops are growing and contribute the nation's economy. Among this group, coffee, and chat (a stimulant plant) are the major contributors to the export economy.

Mali

Mali has a land area of 1241138 KM2 of which 60% is arid. The climate is characterized by a long dry season and a rainy season lasting 2 months in the North and 5-6 months in the South. Average rainfall varies from an average of 100 mm in the North up to 1100 in the south. The population of Mali is

about 14.5 million inhabitants of which most are rural. The sector represents more than 35% of GDP, engages more than 70% of the population and 75% of exports. Rice, wheat, millet, maize and sorghum are the most important cereal crops.

Zambia[3]

Zambia has a vast and diverse renewable resource endowment. The country has a total land area amounting to 752,614 square kilometers or 75 million hectares. Of Zambia's total land area, 58 percent or 42 million hectares is classified as having medium to high potential for agricultural production. The country has annual rainfall amounts ranging between 800mm in the south to 1400mm in the north. The rainfall pattern is generally very suitable for the production of a broad range of crops, fish, and livestock. It is estimated that only 14 percent of total agricultural land is currently being utilized. (MACO, National Agricultural Policy, 2007)

The agricultural sector is a major component of the Zambian economy and its continued growth remains central to future prospects of the country for years to come. Agriculture generates between 18 – 20 percent of the Gross Domestic Product (GDP) and provides direct livelihood for more than 50 percent of the population. The sector absorbs about 67 percent of the labour force and remains the main source of income and employment for rural women who constitute 65 percent of the total rural population. Increase in rural incomes can therefore result in overall poverty reduction and increased food security.

Existing reports, such as the Living Conditions Monitoring Survey of 1998 by the Central Statistical Office (CSO), indicate that Zambia is faced with high levels of poverty, with overall poverty of 72.9 percent of the national population in 1998. According to the Living Conditions Monitoring Survey, the national poverty level was estimated to have dropped to 68 percent of the total population in 2004 and further dropped slightly to 64 percent in 2006.

Income levels have also drastically declined with low formal employment. Given the abundant natural resource base, agriculture offers the greatest potential for generating growth and increasing employment and incomes. Smallholder farming represents a large potential resource for increased agricultural production and poverty reduction. However, realizing this potential requires an enabling and conducive policy environment as well as strategies that can result in very efficient and highly productive agricultural practices.

[3] Country Report, Zambia, Michael Isimwaa

Concerted efforts have been made since 1992 to liberalize the agricultural sector. Notable policy measures undertaken include the liberalization of agricultural marketing for all inputs and products including exports, the privatization of all former agro "parastatals" and increased private sector participation in commodity marketing and input supply and restructuring of the Ministry of Agriculture and Cooperatives (MACO). There is however an unfinished policy agenda for the sector given existing major constraints and challenges. These include; poor service delivery particularly for small-scale farmers, marketing constraints especially in outlying areas as a result of poor infrastructure notably feeder roads, a void in agricultural finance and credit, weak regulatory framework and poor enforcement of legal framework, unfavourable world and regional markets

Notwithstanding the emphasis on the development of small-scale farmers, a conducive environment will be provided for the growth of the large-scale farming sector in order to maximize the synergies between the two. Focus will be on providing public goods that are needed for efficient growth such as rural infrastructure, basic research, disease epidemic and pest control. Agribusiness will be encouraged to strengthen linkages with small-scale farmers through increased private sector participation in agricultural service delivery.

The role of the public sector will increasingly be confined to policy formulation, enforcement of legislation, regulation and inspection, maintenance of the national strategic food reserves, provision of market information, financing the control of pests and diseases of national economic importance, provision of agricultural services i.e. research and extension in partnership with the private sector, provision of targeted support to outlying areas and underprivileged farmer groups, promoting capacity building within public and private organizations and monitoring and evaluation of overall sector performance including projects and programmes. Government will continue with the policy of liberalization of the agricultural sector and ensure that the private sector plays the leading role in input supply, output marketing and agro-processing.

Agriculture Statistics

The three countries have different institutional arrangements to collect and to disseminate official statistics for agriculture. What is common across all studied are the use of a Census as the basis for sampling, the use of a regional infrastructure to launch collection efforts. .

Ethiopia

In Ethiopia, the production of agricultural statistics has evolved over time with significant developments occurring since 1974. Today, agriculture statistics are the responsibility of the Central Statistics Agency and the main survey vehicle is the Rural Integrated Household Survey Program which is a national integrated survey program.

The Rural Integrated Household Survey Program evolved from the National Agriculture Sample survey and is a program of statistical enquiries that includes a series of socio-economic surveys including a series of agricultural sample surveys, the quinquennial Household Income Consumption and Expenditure Survey, the quinquennial Demographic Health Survey and the monthly prices survey. On an ongoing basis, the agriculture survey program has five major components:

- The crop production (forecast) sample survey where data on area, expected yields and expected production are collected.

- The Main Season Agricultural Sample Survey where data on land use, seeded area, measured crop yields, post harvest production, applied quantities of fertilizer, seed and pesticides by crop type

- The Livestock sample survey where data on livestock numbers by type, age, sex and purpose are collected.

- The Belg Season (short rainy season) sample survey where data are collected on crop area, production and applied farm inputs during the short rainy season.

- The Large and medium scale commercial farms where similar data are collected from large and medium scaled operations.

On an ad hoc basis, the predecessors to the Rural Integrated Household Survey Program formed the basis for launching cost of production enquiries.

The Central Statistics Agency created a statistical infrastructure that has 25 branch offices with approximately 4000 field staff to facilitate the collection and production of agriculture statistics.

Samples are drawn from a list frame that is based on the 2006 Cartographic Census but there are plans to combine to use an area frame to support surveys in the future once the area frame is completed.

The sample design for the annual agricultural sample surveys are of a two stage stratified cluster design with the first stage being a sample of enumeration areas and the second stage being households.

Data are collected by trained field staff in the regional offices and completed forms are submitted to head office for data processing.

Once the data are obtained in head office, data are manually edited, and captured into electronic form.

Mali

In Mali, the responsibility for the production of agriculture statistics has evolved over time and today there are several official organizations that play a role in the production of national statistics for agriculture. The national statistics system in Mali is decentralized and consists of an interdependent set of organizations that together contribute to the production of national and sectoral statistics for Mali.

A national plan exists for setting priorities for information and statistics. Consultations with stakeholders and users are frequent to ensure that the program remains relevant and current. There is a four year plan for national statistics that was put into effect in 2006. Built on five pillars, the national plan has as goals to produce relevant and accurate statistics necessary to describe the country, that the statistics thus produced, contribute to analysis and are accessible, to improve the human resources, to improve the efficiency of the system, and to secure, medium and long term funding.

The Institute National de Statistics (INSTAT) formerly known as the Department of National Statistics and Informatics (DNSI) is the official statistics arm for Mali. INSTAT is responsible for conducting the population censuses (the most recent of which was conducted in 2009 and is being processed ... the last published census was conducted in 1998) as well as household budget surveys, surveys on poverty and on the labour force.

Many organizations are involved in the estimation of agriculture statistics with most agriculture statistics collected by the Agriculture Statistics and Planning department within the Department of Agriculture. From 1960-1990 the Institute of Rural Economy (IER), conducted farm surveys and made results available to Institute of National Statistics and Informatics (DNSI) and

ministry of Agriculture for decision making. The IER also conducted Cost of Production Surveys the results of which were used to set national farm commodity prices when agriculture markets were controlled by the government. Once markets were liberalized, the need to set prices disappeared and regular cost of production studies were no longer done except on a special studies basis.

The main agriculture survey conducted in Mali is the Annual Agriculture Trends Survey done jointly with the Department of Agriculture, the Institute of Rural Economy (IER) and the Institute National de Statistics (INSTAT) formerly known as the Department of National Statistics and Informatics (DNSI). The Government of Mali is actively promoting a durable modern competitive sector and has made food self sufficiency a goal. Data are collected to support this goal.

The survey collects data from farm operations four times annually. Data collection methods include both objective (for land area and crop yield estimates) and personal interviewer techniques. The survey covers the major agricultural commodities produced including the main cereal crops (millet, sorghum, rice, maize, acha, and wheat), the main industrial crops, (cotton, peanuts, sugar cane) as well as beans and ground peas. Questions on purchased farm inputs and farm machinery and repairs are also in scope for the survey.

The sample design is a multistage probability design based on the 1998 census. The sampling frame will be revised when the 2009 census results are available. For the EAC, the actual sample size was 6000 farms distributed across eight administrative regions.

The first contact with farms is made during the July-September period. At this time, information is asked of farm and farm operator characteristics, land area, land preparation, crop land seeded by crop type, last year's production and disposition and farm held stocks. The second contact takes place beginning in mid September and confirms the data requested in the first visit and asks respondents to predict crop production. The timing of the third visit is weather dependent and has as its purpose the establishment of plots for the objective area and yield measurements. After harvest, (usually by mid October), the final contact with farm operations is made. This contact collects data livestock numbers, spending on farm inputs, and farm capital.

Data are collected by trained personnel from the regional statistics offices as well as the regional staff from the department of agriculture.

Quality measures are calculated and can be considered good at national levels and acceptable at regional levels for major variables. Contributing the data quality is the fact that the estimates are reviewed by an expert panel consisting of statisticians and agricultural economists. This review panel meets twice a year to review the estimates.

Data are disseminated in multiple formats including publications, and special requests. It should be noted that results from the last two years have been suspended as the survey has suffered from unspecified operational and technical difficulties.

Zambia

Official statistics on food and agriculture in Zambia are produced jointly by the Central Statistics Office and the Ministry of Agriculture and Cooperatives and are for the most part, based on field surveys.

The main relevant surveys carried out in Zambia are:

- Crop Forecasting Survey (CFS), carried out annually from March to May
- Post Harvest Survey (PHS), carried out annually from September to November
- Living Conditions Monitoring Survey (LCMS), with two modules that are carried out every two years and every five years.
- Household Budget Surveys (HBS), carried out every five years
- Vulnerability Assessment and Analysis (VA), conducted every year.

By and large, estimates are derived from sample surveys and are produced for crop land (area), production and sales for major food and cash crops including maize, sorghum, millet, sunflower, groundnuts, mixed beans, soybeans, cotton, tobacco, cassava, sweet potatoes and rice. For large scale operations, units are surveyed with certainty- a best practice.

The list from which the samples are drawn are based on the 2000 Census of Population and Housing which contained a small agricultural component, but not sufficient to serve as a robust list for taking agriculture surveys. The population census will be again conducted in 2010 which will increase the quality of all surveys that use it as a sampling frame. The last agriculture census was conducted in 1992. There are plans to conduct another agriculture census in 2012. Despite the limitations of the survey frame, research has demonstrated that the representativeness of the agriculture surveys is acceptable.

Data are collected by field enumerators and are subject to high levels of response errors. Small farms operators typically do not keep standard records and growing conditions make recall surveys difficult to administer. No objective measures are used to confirm land area and crop yields, mainly due to resource considerations. Increased interviewer training is reducing response errors over time.

Country Experiences with Cost of Production Estimates

All three of the pilot countries have experience in the conduct and production of cost of production for agricultural commodities. As can be expected, the experiences vary by approach and by country. None has a continuing program to produce cost of production estimates on an ongoing or regular basis.

Country Practices-Ethiopia

The approach taken by Ethiopia has been to conduct separate and country wide cost of production surveys. Surveys were conducted with mixed success in 1974, 1977, 1979 and lastly in 1986. There has been no attempt to survey cost of production since the 1986 survey.

The main purpose of the surveys was to produce cost of production estimates for field crops at national and some instances, regional levels. The content of the surveys extended to include most major field crops grown in Ethiopia. The requisite material, labour and capital use and expenditure questions were included on the questionnaires.

The statistical processes enveloping the surveys evolved following each survey occasion. Modifications were made to sampling, content and data collection methods to overcome deficiencies observed during previous survey iterations and also in recognition of structural changes in the sector and resource limitations.

Generally, the sampling and estimation methods were in line with accepted practices for producing cost of production estimates.

Cost of Production 1974/75 Sample Survey

This survey targeted approximately 700 agricultural households using simple random sampling algorithm. The survey was designed to produce national estimates, but attempts were made to produce sub-national estimates. A two part questionnaire was administered with the first part asking detailed questions on area under crops, labour (valued at local hiring rates) and oxen (valued at daily rental rates) required to clear land for subsequent planting and the use of material inputs (volumes and unit costs). Part I data are taken from the National Agriculture Sample Survey.

Part II of the survey contained detailed questions on crop production and revenue for the 10 major field crops produced in Ethiopia (teff, barley, wheat, maize, sorghum, millet, haricot beans, field peas, faba beans and chick peas). Revenue was imputed using prevailing market prices multiplied by production in volume terms. Prevailing market prices were obtained at local markets.

Data were collected via field enumerators with direct measurement tools used for collecting area and crop yields. Field staff verified the reported data for internal consistencies. Supervisory staff conducted random re-interviews to verify that the initial data collection were conducted appropriately. Nearly one half of all questionnaires were so verified. The use of direct measurement and subsequent re-interviewing can be regarded as a best practice.

Following the data collection in the field, questionnaires were returned to head office for subsequent processing. Survey forms were groomed in preparation for the next steps of the process. Any missing data fields or outlier values were resolved manually by trained staff. The forms were not captured electronically. Estimates were produced manually and results were published in paper form about five months after the reference period closed.

Cost of Production 1977/78 Sample Survey

Sampling strategies for the 1977 cost of production surveys were changed to recognize the land reforms acts implemented by the government prior to the 1975 crop year. The Ethiopian government created more than 20,000 Peasant Associations (a Peasant Association represents approximately 16,000 hectares and has between 500 -1000 households) which can be thought of as sub divisions within an agricultural district. There are 14 such administrative regions within Ethiopia.

The 1977 iteration of the survey used a multi stage sample design selecting first districts, then peasant associations within districts and then individual households. The survey only included 10 of the 14 administrative regions on

the sampling frame and hence was not national in scope. The survey was designed to produce estimates at the regional level.

As was the case with the 1974 survey, there were a number of questions targeting labour used for land preparation, seeding, harvesting; the variety of material inputs, the quantities used and their associated costs, as well as labour, oxen and transportation costs.

Crops that were covered by the survey were extended to include horse beans, lentils, niger seed and vetch.

Another significant change for this survey concerned the data collection. Respondent interviews replaced objective measurement for area under crops and crop yields. This resulted in some response bias and adjustment factors had to be developed to overcome this. Once interviews were completed, the survey enumerator verified the questionnaires and returned the forms to head office for subsequent processing.

Head office processing consisted of 100% verification of questionnaires by trained personnel. As before, imputations for strange or missing values were done manually. Estimation (manual) was done according to accepted practices in line with sampling and estimation theory. Estimates were disseminated approximately six months after the reference period.

Cost of Production 1979/80 Sample Survey

The 1979/80 cost of production sample survey had as its major objective the estimation of the cost of production for major crops in Ethiopia at the national and regional level. As before, it utilized data obtained from the Agriculture Sample Survey and a questionnaire targeting the variables specific for estimating cost of production. Crops covered were teff, barley, wheat, maize, sorghum, millet, horse beans, chick peas, haricot beans, field peas, lentils, linseed and vetch.

Similar to the 1977/78 survey iteration, the 1979/80 survey used Peasant Associations, agriculture households and crop fields as the targeted sampling units. Coverage was extended to 12 of 14 regions. Estimates were to be produced at the national and regional level. A multi stage random sample was drawn with 400 Peasant Associations drawn at the first stage, then; a random sample of 25 holdings was selected at the second stage and finally, 9300 crop fields selected at the third stage.

Part I of the questionnaire (again taken from the National Agriculture Sample Survey), had questions on land preparation, production expenses, labour, equipment/capital use, and transportation costs. The second questionnaire had questions on the quantities and values of material inputs used for crop production.

Data were collected using field enumerator staff. Returning to the best practice employed in 1974/75, land devoted to crops and associated yields were measured objectively.

Data collection was overseen by trained supervisors who confirmed that procedures were followed, and performed consistency checks and checks for missing variables. Whole record non response was dealt with by reweighting the sample. In one of the 12 regions, non response was sufficiently high as to cause estimates for that region invalid.

As before, the survey was processed manually. Estimation was performed according to sound survey methodology.

As before, the survey results were published six months after the end of the reference period.

In his report, the national consultant from Ethiopia noted several limitations associated with this particular survey iteration. In particular, the 1979/80 survey suffered from a higher level of non response than other surveys. This was especially true in one region and estimates for this region could not be produced. There was equipment failure that resulted in a high (nearly 15%) error rate for land area measurement. Finally, there were some examples of response errors associated with recall and answerability associated with the material input questions.

The 1986 Cost of Production Survey

The approach taken to produce cost production estimates for 1986 represented a radical departure from previous attempts. In lieu of designing a conventional sample survey aimed at farm households, the method employed was to leverage the office staff from regional agricultural offices to complete the questionnaires.

There were three significant changes to the methodology employed compared to previous attempts at producing cost of production estimates. First, the data collection was sourced to the regional agricultural officers rather than collected directly from farm operators. Second, the practice of objective

measurement for land area and crop yields was abandoned. Third, administrative records were used to supplement data collection.

The change in method was premised on the assumption that the district agricultural officers worked sufficiently close with the farmers in their region that they were in a good position to provide accurate data on material inputs as well as other data required to compute cost of production. Upon completion of the exercise and in the validation phase of the program, it was determined that the data collected suffered significant quality problems and the results from this effort were never released.

Country Practices-Mali

Mali has a long history of calculating cost of production for agriculture commodities. Until 1986, prices for agricultural commodities were state controlled and based on the results of an ongoing program of cost of production studies. Consequently the application of cost of production methodologies has become quite evolved. Cost of production estimates are the responsibility of the Institute of Rural Economy and while no longer produced regularly are produced on special needs basis. In 2009, funding was received to conduct a cost of production survey for rice, sorghum, millet and maize. The sample size was 4000 units divided across eight regions for millet, maize and sorghum and 2500 units for rice. The units were not randomly selected. The national consultant produced and provided national and regional cost of production estimates were produced for maize, rice, millet and sorghum.

Data collected for the cost of production studies includes all of the requisite baseline requirements for the calculation including data on area, yields (crop yields are interview based and not objectively measured), farm inputs (fertilizer, insecticides, herbicides fungicides and organic manure), agricultural implements number per farm, purchased prices, parts and repair labour by crop under study.

The cost of production questionnaires also contain variables on material inputs (both volumes and costs), material and equipment used, purchases and prices for farm inputs, data on yields and crop management techniques. All labour inputs are enumerated and valued at market rates in the nearest village. Capital inputs materials are also "fully enumerated" and capital life spans are obtained via interviews with respondents. Valuations use prices prevailing in local markets. Equipment repair via blacksmith questionnaires prices according to piece and material type. Total animal costs including

veterinarian charges are also enumerated and depreciation schedules by type and age of animal are used. These are in accordance with internationally accepted practices for calculating cost of production.
Data are collected by enumerators that are recruited and trained in survey taking practices in agriculture surveys. Enumerators are typically highly trained and are often rural development officers, economists or sociologists with degrees. Data collection takes place four times per year depending on the questions to be asked at that time.

Because there is no longer an ongoing program, studies are done on a special needs basis and sample sizes vary according to client needs. Typically sample sizes vary between 300 and 1000 selected farms and can be larger if nationally representative results are required. They are usually but not always randomly selected.

To reduce non sampling error, supervisors oversee the data collection operations. Reducing non sampling errors greatly improves the quality of the resultant estimates. To further assist with quality control, researchers or their assistants travel into the field twice a month to verify data that have been recorded and assist with the preparation of questionnaires for data capture.

Questionnaires are captured by data capture specialists in head office and verified by editing clerks.

Analytical tables and results are disseminated through reports.

Country Practices-Zambia

In Zambia, the main approach taken to compute cost of production is through the estimation of cost of production financial models sometimes also referred to as farm budgets. Sponsored by the World Bank and with the support from the Department of Agriculture and Cooperatives, this method collects data from a number of sources to calculate gross margins for major crops in Zambia.

Estimates of gross margins are based on standard average costs and prices determined at local levels for major crops and livestock enterprises. Margins are computed for three agricultural regions in Zambia. Crops covered include maize, mixed beans, soybeans, paprika, tobacco, cotton, sunflower, ground nuts, tomatoes, rapeseed and cabbage.

The data used in the calculation of the margins come from several sources including surveys and local information provided by agriculture extension staff employed throughout the country.

Local staff collects regional prices for crops and livestock as well as prices for material inputs.

Survey data used in the models are obtained by local enumerators from selected respondents. No objective measurement techniques are used and the data are subject to recall bias. Data collected are limited to the labour costs (for land preparation, seeding, weeding, harvesting and shelling/threshing), material inputs (seed, fertilizer, and chemicals), and crop production valued at local market prices. An average cost per standardized land area (hectare) is computed for the crop under consideration. The average cost multiplied by the land area in question to arrive at an enterprise cost. This is then subtracted from a revenue estimate obtained as the product of the crop yield and area devoted to a particular crop.

This method is incomplete in several respects. First as a measure of cost of production, it is incomplete. It does not properly take into account all revenues and all costs. The interaction between shared expenses is not reflected in the estimate of costs nor is the cost of capital explicitly accounted for. The method relies on the expertise of the local extension worker for the computations and the generation of the cost estimates. Finally, since data collection and estimation are not based in statistical sampling, the quality of the ensuing estimates can not be assigned quality measures. This is a significant drawback to this method.

This method does have some merit in that it is relatively easy and inexpensive to produce, maintain and is consistent over time. It has the potential to be a good planning tool for farmers.

Significantly, the 2009/10 agricultural survey collected by the Central Statistics Office was expanded to include many of the variables required to calculate the cost of production for the significant agricultural commodities produced in Zambia. Results while not yet available, but based on the content and the methods employed, should provide statisticians with a much more reliable data base with which to compute cost of production.

Assessment-Cost of Production Practices

All of the countries reviewed have some and in some instances, considerable experience in the calculation of cost of production estimates. Like their statistical systems, each country has pursued different strategies to arrive at cost of production estimates within their country. Each approach has strengths and weaknesses. And while the approaches and methods can vary greatly by country, each has some practices that can be considered best.

Today, none of the countries within the scope of the review have an ongoing cost of production data program. Zambia has an ongoing program to estimate financial margins, but the approach taken is more akin to the calculation of farm budgets and the data are not based in scientific enquiry. In Mali, administratively determined prices led to the creation of the capacity to estimate cost of production estimates on a regular basis until 1986 when commodity markets were liberalized. However since then, markets for agricultural commodities were liberalized and the requirement for this activity on an ongoing basis subsided. Nevertheless, the capacity to resume COP in Mali remains in the agriculture research offices. Ethiopia was the only country reviewed which does not have recent experience with the conduct of cost of production surveys with 1986 being the last attempt.

Despite these observations, my assessment suggests that there is much to build on if the decision to go forward with calculating cost of production estimates is taken.

As noted, Zambia added questions to the 2009/2010 post harvest survey to allow cost of production to be calculated for maize, cotton and several other commodities. Although not explicit in the country report from that country, my expectation is that attempts will be made to derive cost of production for some crops.

Mali has an ongoing program through its agriculture research service. In fact, the national consultant from Mali provided cost of production estimates for maize, sorghum, rice and millet and this formed part of the country report from Mali.

Ethiopia stands as the only country where there is no recent experience with the collection or production of cost of production data. However, in Ethiopia, the basic survey infrastructure exists to collect the additional variables in future survey occasions.

General Comments on Current Cost of Production Methodologies

Sampling frames

All countries use a list frame for sample selection which is based on previous censuses. Lists can quickly get out of date especially if there is turnover and churning in the sector. For agriculture surveys, it is not uncommon to supplement list frames with area frames to account for potential shortcomings in the list register. This approach while superior to simple list derived samples, does lead to complexity in survey design and higher ongoing costs as both survey frames must be prepared and maintained and the methodology must take measures to eliminate duplication. Ethiopia plans to implement a multi-frame design for the Rural Integrated Household Survey once the cartographic census of 2006 has been completed. This can be considered a best practice. The sample frame used in Zambia is approaching the end of its useable life. At present the 2000 census of population and housing is used as the sample frame for agriculture surveys. While there are some agriculture questions on the census, key stratification variables such as land area under crops were not asked and therefore unavailable for use. The use of a list that is out of date and that does not have useful stratification variables can be problematic in a number of ways. An out of date list can lead to biased estimates unless procedures are in place to ensure that new entrants and units that no longer exist are properly accounted for. Lack of good stratification variables can lead to unnecessarily high survey costs for given target levels of precision. The country report from Zambia indicates that the 2010 population census is being processed and that there are plans to conduct a 2012 Census of Agriculture. Both would improve the sample frames for all future agriculture surveys including cost of production surveys.

In Mali, studies are done on an as needed basis and samples are not always derived randomly. This can lead to bias in the results, but at a minimum, preclude the estimation of quality measures. The Malian government is conducting a Census in 2010 which could serve as a sampling frame for future agricultural enquiries.

Questionnaires

All countries have annual agricultural surveys that collect base data required to estimate area yield and production for agriculture commodities, the departure point for cost of production. Additionally, questions on material inputs are asked. Because Mali conducts special studies for cost of production, questionnaires are available and complete. In Zambia, the 2009/2010 post harvest agriculture survey was modified to include questions required to calculate cost of production for maize, cotton and other agriculture

commodities. There are significant data gaps in the data elements covered by Ethiopia for calculation of cost of production.

Data Collection

All countries use trained enumerators to collect data from farms. Enumerators are located in regional centers and are close to the respondents. This is a recommended practice especially given that many of the respondents cant complete questionnaires on their own and for the most part, do not keep records. This practice has the added advantage that some editing in the field can be conducted by the enumerators which will improve response and reduce non sampling errors. Using researchers as interviewers, as is the practice in Mali, is a best practice, although would likely add to survey costs.

Both Ethiopia and Mali verify that data collection procedures are being followed through the use of interviewer supervisors.

Analysis

A best practice was noted in Mali where teams of experts convened twice a year to review the estimates. This has the advantage of having a "second" set of eyes look at the data and to probe survey takers on estimates that appear odd. This should be done when the data are near final and before the data are published.

Some country specific observations on the current state of cost of production estimation practices

Ethiopia

Ethiopia's most recent attempt to determine the cost of production was in 1986 when rather than use a sample survey, the methodology was to use regional agriculture extension workers to estimate input use and prices based on their individual knowledge and farm practices in the local area. This approach was misguided as it relied extensively on the personal opinion of the field extension workers. In addition, because the attempt was made to compute costs at a high level of geographic level (province), expert opinion smoothed over the variability that would normally be observed from location to location.

The approach proved not to be successful when analysis revealed wide discrepancies in the calculated cost of production and current market prices. These differences were so large that the data were never released.

Mali

While there remains expertise in the Malian Agriculture Department to support an ongoing cost of production program, there is insufficient infrastructure upon which to build it on. Cost of production estimates are produced on an ad hoc basis, most recently for the 2009 crop year for maize, rice, sorghum and millet. As noted earlier, the conceptual underpinnings of the estimates are sufficient but the statistical underpinnings for the sample selection are inadequate to produce estimates of known quality.
What is missing is a robust survey vehicle, national in scope, upon which to collect the requisite data. Technical and operational problems persist with the main annual agricultural survey making results from the last two survey iterations un-publishable. Addressing this issue must have priority over the calculation of ongoing measures of cost of production.

Zambia

The use of gross margins in lieu of an established cost of production program, while holding promise in some respects (ease of computation and cost) omits many of the key variables required for cost of production. It relies on the judgments of the agriculture extension workers and is not based on collected evidence, making conclusions nebulous. In some respects it suffers from some of the same problems noted in the 1986 Ethiopian experience.

Recommendations

Cost of production data can provide useful information to farmers, governments and policy makers. It can inform on a broad range of issues about agricultural resource use, production practices and inputs, farm costs and financial conditions, and well-being of farm households. In addition, an effective cost of production program can inform on the management tools and equipment utilized in the production process. It will also inform on what it costs to produce agricultural commodities and the income position of the farm household. Properly designed, a cost of production survey can also serve as a tool to generate macro level estimates for the farm sector.

The three countries reviewed each have some of the necessary elements required to implement a regular cost of production program despite the fact that none have all of the basic elements in place. Promising is the fact that in Zambia cost of production questions were added to the main agriculture

survey thereby giving that country the capacity to estimate cost of production for at least a few agriculture commodities.

A Vision for Producing Cost of Production Estimates

An ongoing program to estimate cost of production should be built upon a foundation of scientific surveys based on sound methodology. This ensures that the estimates obtained will be representative of the target population and measures of reliability can be derived giving users an idea of how much faith to put into the results.

The sample frame from which the sample is taken should be complete and up to date.

The questionnaires should contain all of the variables required to estimate all economic costs associated with producing the commodity under consideration. This extends to the collection of land measurement, crop yields and the corresponding purchased inputs required to produce these outputs. In addition, data must be collected on farm management practices so as to accurately estimate unpaid labour and the opportunity costs of capital used in the production process.

Ideally, data should be collected by trained skilled enumerators that have some background in the target sector. This becomes more important if record keeping or literacy of respondents is suspect or as the complexity of the survey increases. Data collection by the regional statistical arms of the Agriculture Departments or by the national statistics offices could handle the collection with proper training.

Objective measurements should be considered to reduce non sampling errors for important variables such as land area and crop yields.

Like all survey processing, methods to ensure data quality at all stages of production need to be developed. This would include consistency and validity edits, procedures for dealing with non- response. Ideally a re-interview program to inform on collection issues in the field would be part of the quality program.

To reduce respondent burden and costs, the program ideally will build on existing survey programs to take advantage of questions that are already being asked of the same target population and an existing survey processing infrastructure.

The additional data required for cost of production would be asked for some and not all commodities. This would be another initiative aimed at reducing response and processing loads. A collection cycle would need to be established to cover all important commodities within a "reasonable" period of time. The determination of what to survey when will be a function of the pace of structural change within the sector. In "off" years, the previously calculated estimates can be updated with output and input price data and adjusted for current volumes based on land area and yield estimates from the ongoing core survey. If transnational comparisons are a requirement, then agreements will be necessary on the sequence and rotation patterns for the cost of production products.

Before releasing results, data should be analyzed by experts and compared with related indicators to ensure their validity.

If results are to be compared across countries, then agreements on concepts need to be documented. In addition, countries should agree on a calendar for collecting similar crops for the same crop year.

Survey taking is an iterative process and a program of continuous improvement should be designed and implemented. The goal of the continuous improvement program would be to conduct research into all aspects of the survey program (questionnaire content, collection techniques, data validation, estimation and analysis) with the goal of arriving at recommendations to improve overall results. The research conducted by this group should have a clear and articulated research agenda complete with predetermined research priorities.

Going Forward

As noted, there are several initiatives that are currently underway that can be used as the departure point for an ongoing program for commodity cost of production. These initiatives include the 2009/10 post harvest agriculture survey in Zambia, the recent Censuses of Populations and Housing in both Zambia and Mali, and the ongoing Rural Integrated Household Survey Program in Ethiopia. In addition, based on the country reports received, there would appear to be sufficient expertise in the understanding of cost of production concepts to allow for a program to go forward.

Some personal observations for consideration:

- Calculate the cost of production for maize in Zambia based on the results of the 2009/10 post harvest agriculture survey. Concepts used should be in line with those contained in the Commodity Costs and Returns Handbook, published by the American Agriculture Economics Association Task Force on Commodity Costs and Returns, published on February 1, 2000. The results can and should be compared with the gross margins that are produced on an ongoing basis and also with the cost of production estimates produced for Mali by the country statistician. These estimates can then be used as the benchmark for future year's estimates. Updates to prices, land area and crop yields can be used to apply to the 2009/10 estimate. This approach would be similar to that taken by the USDS for the Annual Resource Management Survey.
- Evaluate the ongoing annual agriculture survey program in Mali to identify and prescribe solutions to the technical and operational issues that have inhibited the production of annual agricultural statistics.
- Modify Ethiopia's annual Rural Integrated Household Survey program by adding questions on material input expenses, labour input volumes and costs as well as the measurement of land preparation and harvest costs. The national consultant from Ethiopia suggested that the main agricultural survey conducted annually between September and January would be suitable and appropriate for this modification.

Of course all of these suggestions are subject to resource and operational constraints and could be discussed in the eventuality that there is an expert group meeting on the future in producing cost of production estimates. Participation at this meeting should be extended to have with representatives from the countries in scope for the study, working consultants and users/stakeholders.

Annex 1 References:

Agricultural Cost of Production Survey 2005,Republic of Mauritius, Ministry of Finance and Economic Development, Central Statistics Office
March 2008.

Agriculture Resource and Management Survey (Various links USDA web site: http://www.ers.usda.gov/Briefing/ARMS/).

Commodity Costs and Returns Estimation Handbook, A Report of the AAEA Task Force on Commodity Costs and Returns, February 1, 2000, Ames, Iowa.

- COST OF CROP PRODUCTION SURVEY IN ETHIOPIA, Dr. Lamissa Tadesse (national consultant), October 2010.

Draft Report Background material* for a review paper on Cost of production/farm income of crops and livestock products *Paper presented for Discussion at the workshop on review of Cost of Production Data, held at FAO, Rome, Italy, October 8-9, 2004.

Etude sur les enquettes des statistics agricoles et des couts de production agricole au Mali, rapport final, Dr Lamissa DIAKITE, National consultant, Octobre 2010.

FRAMEWORK FOR COST OF AGRICULTURAL PRODUCTION IN ZAMBIA, COUNTRY REPORT, Michael Isimwaa (national consultant) October 2010.

Global Strategy to Improve Agricultural and Rural Statistics, Report of the Friends of the Chair on Agricultural Statistics, United Nations Economic and Social Council Statistical Commission, Forty-first Session, 23-26 February 2010.

Report from the 21st session from the African Commission on Agriculture Statistics, Accra, Ghana, 28-31 2009, November 2009.

Statistics Canada, Survey Methods and Practices, Catalogue no. 12-587-X

Annex 2 , Terms of Reference- National Consultants

Food and Agriculture organization of the United Nations

Terms of Reference for Consultant/PSA

Job Title	National Consultant		
Division/Department	Statistics Division (ESS)		
Programme/Project Number			
Location			
Expected Start Date of Assignment		**Duration:**	30 days
Reports to	**Name:**	***Title:***	

The National Consultant will work under the overall supervision of the Senior Statistician, FAO Statistics Division, and the guidance of the International Consultant to carry out the following duties:

- Work with the International Consultant to identify a focus set of agricultural commodities for the study.
- On the basis of the cost of production framework designed by the International Consultant, assess the availability of data in the country with regards to the variables identified in the framework
- Document the metadata(including methods, sources ,questionnaire design, survey and sampling frames) used by the relevant national institutions involved in producing cost of production statistics.
- Assess the quality of the cost of production data.
- Communicate with the International Consultant during all stages of the study.
- On the basis of the above, prepare a country report summarizing the findings.

Expected Outputs: The main output of the consultancy will be a country report which would address some of the important issues involved in cost of production statistics such as the methodology for collection, compilation, validation (including estimation procedures and averaging over various stages of sampling), dissemination, availability and quality of	Required Completion Date:

Job Title	National Consultant		
Division/Department	Statistics Division (ESS)		
Programme/Project Number			
Location			
Expected Start Date of Assignment		**Duration:**	30 days
Reports to	**Name:**	***Title:***	

the cost of production data in the country.

Required Competencies

Qualifications and Experience: University degree in Statistics, Economics or Agricultural Economics. Three to five years of experience in the area of food and agricultural statistics. The consultants should have sound knowledge of, and experience in, computing cost of production and price statistics. S/he should have significant experience in accessing data and assessing data quality produced by the country. Good communication skills (both written and verbal).

Annex 3, TERMS OF REFERENCE- International Consultant

The Consultant will work with FAO's Statistics Division under the overall guidance of the Director and the direct supervision of a Senior Statistician. S/he will be responsible for developing a framework for documenting the collection and compilation of data on cost of production (COP) and price statistics related to food and agricultural products and for preparing a synthesis document. S/he will supervise the work of the national consultants for the three pilot countries of Mali, Ethiopia and Zambia. In particular, s/he will undertake the following duties:

- Meet with concerned staff in FAO's Statistics Division for a briefing on activities and expected outputs of the consultancy.
- Identify a set of principal commodities common to the three pilot countries and related to which the study will be carried out.
- Prepare a detailed framework outlining activities to be undertaken by national consultants to document national statistical activities related to COP and price statistics for the selected commodities. In particular, the activities to be documented will include:
    - i) Collecting, processing, validating and disseminating of data.
    - ii) Treatment of missing data.
    - iii) Recording and disseminating of metadata.
    - iv) iv) Computation of related indicators, if any.

- Provide regular guidance and supervise the work of the national consultants.
- Prepare a synthesis document based on the reports submitted by the national consultants. The synthesis document should be in two parts. Part one should highlight the main practices carried out individually by the pilot countries related to COP and price statistics. Part two should identify the main gaps with respect to these activities and make recommendations aimed at filling these gaps. This document will be presented at an expert consultation to be held later this year.
- Submit an interim report by 25th June 2010 and the end of assignment report to FAO's Statistics Division at the end of the 90 day period.
-

Qualification and Experience: Advanced university degree in Statistics or Economics. At least seven years of experience in the area of food and agricultural statistics. The consultant should have sound knowledge of, and good experience in, computing cost of production and price statistics. S/he should have good experience of coordinating activities related to different national institutions.

Travel: The consultant will travel for one working week (5 days) to Rome, Italy.

Duration: The duration of the assignment is for 30 days on When Actually Employed (WAE) basis over a 90 day period.

Annex 4 INTERIM REPORT FOR OUTPUT 10

This interim report presents the activities undertaken with regard to Output 10 of the above project. The objective of Output 10 is to conduct a study on collecting and compiling cost of production and agricultural price statistics for (2-3) pilot countries and to organize a jointly-convened expert consultation on these topics in 2010.

ACTIVITIES IMPLEMENTED DURING THE REPORTING PERIOD

In accordance with the work plan related to project output 10, following activities were implemented:

1. Based on the terms of reference prepared by FAO, an international consultant was recruited for the consultancy. The main tasks of the consultant are to develop a framework for documenting the collection and compilation of data on cost of production statistics related to food and agricultural products in the three project countries and to prepare a synthesis document based on the country studies.

2. Three pilot countries were identified for the study; these are: Ethiopia, Mali and Zambia.

3. A list of commodities to be included in the study was identified for each study country by concerned staff in the Statistics Division of FAO (Annex 1). Using data available in FAOSTAT, the top commodities in terms of quantity or value of production were selected for each country.

4. A preliminary framework outlining the structure and variables desired for compiling cost of production statistics was prepared by the international consultant in consultation with the concerned staff in the Statistics Division of FAO.

5. Based on the terms of reference prepared by FAO, three national consultants were identified, one each in the three project countries.

6. The national consultants are assessing the availability of data in their country with regards to the variables identified in the framework and for the commodities identified.

PLAN FOR THE NEXT PERIOD

In the coming period, following activities will be implemented:

1. The list of commodities to be included in the study will be finalized, based on data availability.

2. The national consultants will document the metadata (including methods, sources, questionnaire design, survey and sampling frames) used by the relevant national institutions involved in producing cost of production statistics and will assess the quality of the cost of production data for the commodities.

3. Based on the findings of the studies, three country reports will be prepared, one each by the national consultants.

4. The international consultant will prepare a synthesis document based on the country reports submitted by the national consultants. The synthesis document will highlight the main practices carried out individually by the pilot countries with regard to cost of production and price statistics. It will also identify the main gaps with respect to these activities and make recommendations aimed at filling these gaps.

5. The synthesis document will be presented for review and discussion at an expert consultation to be held later this year.