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**Agriculture in Quarterly National Accounts:
Allocation of Output to Non-Harvest Quarters?**

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I. INTRODUCTION

The recording of agricultural output in the quarterly national accounts poses specific problems that relate to the allocation of output to non-harvest quarters. This paper will discuss these problems and various solutions. Problems in this respect are caused by the fact that the output of a crop may only be realized in a distinct harvest period, while the growth of agricultural products often takes place during several accounting periods. It is not straightforward if this output should only be attributed to the harvest period, or also to non-harvest periods. If output is to be reallocated to non-harvest periods, the question arises to what quarters and on what basis. Furthermore, it should be considered what the consequences would be for other variables.

No generally accepted methodology is available concerning these reallocations. The 1993 *System of National Accounts (SNA)* states that in principle crops should be also allocated to non-harvest periods, but is not fully conclusive. Furthermore, it leaves many practical questions unanswered, and no internationally accepted handbook is yet available that addresses these.²

One could argue that quarterly accounts are not very useful in agricultural economies. Proponents of this view would point out that in such economies quarterly accounts do not support business cycle analyses. They would argue that in these countries short-term economic growth as measured through gross domestic product (GDP) is dominated by exogenous factors (such as hours of sunshine or inches of rain) rather than by underlying economic forces. However, other uses of quarterly accounts data are sufficiently important to outweigh this argument. First, an important application concerns the use of the structural information included in the quarterly accounts for the formulation of economic and financial policies. In this respect, it should be noted that a mature set of quarterly accounts will include information concerning expenditures on GDP, a breakdown of value added by industry and by components, and national income and savings data. Second, quarterly GDP can be used as a denominator for key indicators such as the government debt, the fiscal deficit, and the quantity of money.

Furthermore, it can be noted that quarterly national accounts often serve to forecast annual data such as GDP for a current year, and provide a first estimate of these data before the annual accounts become available. Also, quarterly national accounts are virtually indispensable in periods of rapid inflation, because under these circumstances the axioms underpinning the national accounts (such as price homogeneity within the accounting period) become untenable on an annual basis.

This paper will take the usefulness of quarterly accounts for granted, even in predominantly agricultural economies, and it will focus on the specific problems that arise in this context. First it will discuss the pros and cons of reallocating output to non-harvest quarters and subsequently alternative methods to carry out reallocation. Subsequently, the paper will discuss reallocation of other quarterly accounts variables. Finally, it will discuss some presentation devices that may help somewhat to mitigate the problems users may have with the uncertainties resulting from reallocations.

II. Pros and cons of attribution to non-harvest quarters

The 1993 *SNA* supports the allocation of agricultural output to non-harvest quarters in principle, but recognizes the practical problems involved. In paragraph 6.99 it states "In agriculture ... it may sometimes be necessary to estimate the value of work-in-progress in advance of the production process being

²The problem does not only concern agriculture but also animal husbandry, forestry, and fisheries. In an indirect way, it may also affect other industries, especially industries processing perishable natural products. However, for simplicity reasons, this paper will focus on agriculture.

completed and the value of the finished products being known." It also states, in paragraph 6.100 that "There may be circumstances in which the uncertainties attached to the estimation of the value of work-in-progress in advance of the harvest are so great that no useful analytical or policy purpose is served by compiling such estimates." For practical work on the quarterly accounts, therefore, the formulations do not appear fully conclusive, and a further examination of the pros and cons of attribution to non-harvest quarters seems appropriate. This examination will focus on two issues, viz., (1) the recording of production, and (2) what constitutes the "uncertainties" that paragraph 6.100 alludes to.

To put the discussion into proper perspective, an observation has to be made concerning the timing of the compilation of the quarterly accounts. Often several versions of quarterly account are released, e.g., an early version shortly after the end of the reference quarter, a first revision one quarter later, and a final version to achieve consistency with the annual accounts. In some countries, quarterly accounts are only compiled after the annual accounts have been produced, and thus fully on an *ex post* basis; this is sometimes called *quarterization* of the annual accounts. However, the more general case is that quarterly accounts are compiled during the ongoing year. To distinguish the latter situation from *quarterization*, this paper will call these quarterly accounts "early estimates." The compilation of early estimates clearly has advantages from an informational point of view, but poses problems that an *ex post* approach would not have. This paper will focus on the early estimates.

2.1 The recording of production

Concerning the recording of production, two issues have particular relevance in this context, viz., (1) time of recording, and (2) aggregation. In respect of **time of recording**, the national accounts have a firm and longstanding tradition of accrual accounting, implying that transactions have to be recorded at the time they take place, and not necessarily at the time of the concomitant money flows.

In respect of production, accrual accounting has given cause to the notion of work-in-progress, an accounting device ensuring attribution of output to the periods in which production has actually taken place. It is precisely the notion of work-in-progress that causes the dilemma of the allocation of agricultural output (crops) to non-harvest quarters.

The notion of work-in-progress is well-established, not only in the national accounts, but also in business accounting. In the 1993 SNA, the rationale for work-in-progress can be found in the following two quotations: "Production can be best described in general terms as an activity in which an enterprise produces an output" (paragraph 6.6), and "For simplicity, the output of most goods or services is usually recorded when their production is finished. However, when it takes a long time to produce a unit of output, it becomes necessary to recognize that output is being produced continuously..." (paragraph 6.39.) Thus, the rationale for work-in-progress is the ongoing production process in which inputs are used.

This rationale seems full applicable to agriculture: long before harvest time inputs have to be made (fertilizer, seeds) and there is an ongoing production process involved in raising the crop (pest control, irrigation, etc.) However, other arguments can be mentioned that plead against the application of the work-in-progress notion to agriculture.

These arguments relate in particular to the artificiality of the construct. To some extent the recording of work-in-progress distorts the view of income generation and saving because output does not generate money flows before it is sold. This seems in particularly applicable to a non-monetized or largely non-monetized activity as agriculture, especially when it is on a subsistence basis or on small family scale. In these situations, labor is often largely supplied on a family basis and intermediate inputs may be self-produced. Admittedly, the standard national accounts concepts also apply to these situations. (For instance, one could argue that a subsistence farmer's crop on the field is his work-in-

progress, that from the production of this work-in-progress he derives a mixed income, that he saves all this income because he is living from last year's crop, and that he depletes these savings at the time of the actual harvest.) However, this would seem too far-fetched to many.

Regarding **aggregation**, two issues should be considered, viz., (1) aggregation of products, and (2) aggregation of units. Concerning products, note that agricultural producers often engage in various crops with different growing and harvesting patterns. If this is the case, the seasonal pattern of total output of these producers may be much less pronounced than output of individual products.

Concerning units, an obvious point worth emphasizing is that national accounts are primarily concerned with aggregates, and not with individual units. An important consequence in this context is that differences between individual units concerning the timing of production cycles disappear at the level of an industry group for the total economy. For instance, this may occur in countries with climatic differences between regions allowing harvesting in one region at the time that other regions engage in pre-harvest activities. In these cases, the spread of crops over the year is much more reflective of an ongoing production process.

2.2 Uncertainties

In many aspects, agriculture is a more uncertain business than other industries, in particular because of the ever present threat of natural disasters wreaking havoc on crops on the field. Although disasters occasionally also affect other industries, they generally do not have the widespread effects they may have in agriculture. Therefore, the recording of disasters in the national accounts merits particular examination for agriculture, and particularly for early quarterly accounts.

The 1993 SNA makes a distinction between losses from disasters and catastrophic losses. Disasters such as fires are seen as normal risks of business, and if inventories are lost as a result of such phenomena this is to be treated as loss of output. For instance, if a fire destroys inventories of work-in-progress in a furniture factory the output related to these inventories is zero. However, if an event is deemed a catastrophe, output remains unchanged and the catastrophic loss of inventories has to be recorded in the other changes in volume of assets accounts. Thus, catastrophic losses do not affect the value of production.

Applied to quarterly agricultural output, these recommendations imply that waste of crops due to normal events (such as inclement weather) are to be recorded as loss of output, and that loss of crops due to catastrophic losses have to be recorded as other changes in volume of assets; these losses would not affect the output estimate. This applies both to the output of harvest and non-harvest quarters: If the potential or estimate harvest output is attributed to non-harvest quarters the allocation should be exclusive of the waste of crops due to normal events, but inclusive of crops lost through catastrophes.

From this, two uncertainties arise. First, in the case of normal losses either an estimate has to be made of these losses before allocating output to non-harvest quarters, or revisions have to be made after the losses become known. Second, the distinction between a normal event and a catastrophic loss is somewhat arbitrary, and the 1993 SNA does not provide solid ground on which to base a distinction.³

³ In the 1993 SNA, several statements are made to identify catastrophic events, but the outcome of these statements is not entirely clear. On the one hand paragraph 12.36 seems to restrict catastrophic events to singular events of a general nature. Examples given include "major earthquakes, volcanic eruptions, tidal waves, exceptionally severe hurricanes, drought, and other natural disasters." Paragraph 12.37 supports

2.3 Conclusion

The spectrum of countries for which allocation of agricultural output to non-harvest quarters would be useful may be limited because, at the level of the total economy, crop cycles may smooth out over the year. Also, the artificiality of recording crops in the field as work-in-progress argues against such allocation. In addition to this, the uncertainties mentioned above considerably reduce the value of making such allocations. Furthermore, as the next sections will show, to achieve allocation further uncertainties have to be overcome. All in all, this leads to the conclusion that in most cases the quotation from paragraph 6.100 of the 1993 SNA would apply "... no useful purpose is served by compiling such estimates" (see page 2 for the full quotation.)

III. Alternative allocation methods

If it is decided that the harvest output of a particular crop has to be allocated to non-harvest quarters, the next question to be answered is how to achieve allocation. Several methods could be developed to allocate a harvest output to pre-harvest periods; this paper will discuss three, viz., (1) seasonal adjustment methods, (2) a cost-plus-markup approach, and (3) crop estimates.

Before discussing these alternatives, a basic question has to be answered; viz., to what non-harvest periods output should be allocated. The 1993 SNA recommends that allocation should be made to "quarters in which production takes place." (See paragraph 10.107.) It may not always be self evident to what quarters this pertains. For instance, in countries where all cultivation activities cease during winter, it could be argued that nevertheless production activities take place during these periods. In support of this, it could be mentioned that the agricultural enterprises remain in operation, and land, labor, and fixed capital assets are tied-up even if they are not used. Furthermore, payments (such as rent) may be made during this period. However, the 1993 SNA defines production as "... a physical process, ... , in which labor and assets are used to transform inputs of goods and services into outputs of other goods and services." (See paragraph 1.20). This implies that in non-growth quarters no production takes place, and that no allocation should be made to these quarters. A practical consideration in support of this is that deciding what output should be allocated would be difficult if a non-cultivation period is followed by several crops.

3.1 Seasonal adjustment

Proponents of non-allocation may argue that the distortions that non-allocation may cause to seasonal production patterns can be removed through *ex post* seasonal adjustments. However, as argued before, *ex post* quarterization has less value from an informational point of view.

An alternative would be to use seasonal adjustment methods (such as the Census X-12) to forecast output for periods before a harvest. However, this would imply a modeling approach that is not based on observed data from the periods under consideration. Also, it could be noted that multiplicative seasonal adjustment methods do not affect periods with a zero output (thus leaving non-cultivation periods without an attributed output), and that additive methods have

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this as it refers to "abnormal flooding." On the other hand, the latter paragraph also includes droughts, without further qualification. It is not particularly clear why the latter should always be deemed catastrophic events, and flooding only if it is abnormal. To achieve consistency, a general criterion should be used, and it is recommended here to limit catastrophic events to abnormal, unfrequent occurrences. This recommendation is supported by the discussion in the 1993 SNA of losses of fixed assets as presented in paragraph 6.178, which also uses as the frequency of the occurrences as the criterion .

no other result than imputing an average output. Furthermore, it can be noted that in view of the many fundamental and practical problems with seasonal adjustment procedures this kind of data is seen by many as analytical data.

3.2 Estimates based on costs

The 1993 SNA recommends a costs-plus-markup approach that provides first estimates based on costs, to be followed by a revision at the time the eventual value of the crop becomes known. ⁴ The costs include labor, intermediate use, and fixed capital consumption. Other outlays concerning production (such as rents) can be seen as covered through the mark-up.

Consumption of fixed capital can be seen as taking place on a continuous basis, no matter the use of the fixed capital assets. This would imply allocation of output to all quarters even if no production takes place. However, this would not agree with the above interpretation of the 1993 SNA's views on production and it is recommended here to restrict the allocation of fixed capital consumption to production quarters.

It should be put to the test whether a costs-plus-markup approach is practicable in countries in which agricultural activities are mainly family based. In such a situation, a good deal of the inputs (e.g., labor, seed for sowing, fixed capital assets) is not provided through the market, but within the household enterprise. The related costs are not expressed as a monetary value, and thus seem a weak basis for an output estimate. Furthermore, it can be argued that in these circumstances labor inputs are largely supply driven and do not have a strong relation to output. (This applies, in particular, to small-scale family farming that, for several reasons, is often over-labor intensive. ⁵) On a practical note it can be added that, even if data are available on the acquisition of intermediate goods, it seems unlikely that much is known about the timing of their use.

3.3 Crop estimates

A third method for output attribution is to first estimate a certain crop and subsequently attribute this estimate to pre-harvest quarters. The main two problems to be solved for this approach are (1) the estimate of the eventual crop and (2) the attribution of this output to the non-harvest quarters.

3.3.1 The estimate of the eventual crop

An estimate of the eventual crop is needed because, obviously, during pre-harvest quarters no observed output data are available. One alternative for the estimate of the eventual crop would be to first estimate the volume of a crop, and subsequently value this volume at a relevant price. A volume estimate could be based on an estimate of the acreage under cultivation for a particular crop, combined with yield estimates. The acreage under cultivation estimates could be based on surveys, or on aerial and satellite photography; yield estimates could be based on average crop yields, and revised on the basis of expert views as needed. It may be surmised that in many agricultural countries this kind of information is available.

Concerning the relevant price, in theory two alternatives could be considered: (1) the average price of the crop during the period that it is

⁴See paragraph 10.107 that states "In any case, provisional estimates of additions to work in progress can always be calculated on the basis of costs plus a mark-up and revised when the value of the harvested crop becomes known." See also paragraph 6.96 that refers to examples of intermediate consumption and compensation of employees.

⁵This makes the recommendation of paragraph 6.96 of the 1993 SNA to reallocate output for unincorporated enterprises "in proportion to the unpaid hours worked by the owner(s)" somewhat impractical.

marketed, and (2) the price at the time of the harvest. The average price during the time a crop is on the market will include a service element (relating to storage) and an inflation element, and is not suitable for these reasons. Therefore, for the valuation of the eventual crop, the price at the time of the harvest seems the most appropriate (this does not mean that it should also be applied to the pre-harvest periods; see below).

Alternatives for the estimate of the price of the crop at harvest time would be prices on forward markets, world-market prices, or the previous crop's prices corrected for general inflation. Future markets' prices may not always be locally available and may also turn out to be off the mark. World-market prices may be less relevant for less developed markets and for products that are predominantly consumed domestically. Therefore, among the various alternatives, a harvest price estimate based on the price of the previous crop adjusted with some general inflation indicator seems the most appropriate.

Alternatives for such a general inflation indicator would include the consumer price index (CPI) and the implicit deflator of gross domestic expenditures. In either case, exclusion of prices of imported goods is recommended.

3.3.2 The attribution of the eventual crop to non-harvest quarters

Three alternatives for a quarterly attribution would be (1) a straight line interpolation, (2) an attribution as a function of inputs over time, and (3) an even attribution to the relevant quarters. Straight line interpolation has an intuitive appeal, as it resembles a growth-pattern over time. However, this method will probably entail negative value added and income flows in early periods, which seems counterintuitive. Also, there seems no theoretical sound reason to attribute less output to earlier periods.

A more subtle method would be an attribution as a function of inputs over time. This would emphasize production in the planting and the harvest season, which intuitively seems realistic. Above it has been argued that the correlation between inputs and outputs may be weak, but this seems less of a problem for the allocation of an independently estimated output than for the estimation of the output itself. However, it may be problematic to collect data on all relevant outlays, which should encompass (including transactions in kind) labor, intermediate inputs, consumption of fixed capital, and rent.

The third method--the even attribution of production to all relevant quarters--does not have an obvious rationale either, but does not pose any of the problems mentioned above. Because of the many uncertainties surrounding estimates and basic data, this may be the most straightforward method.

In applying this method, a distinction should be made between constant price data and current price data. For constant price data, the most straightforward method would be to use the quantity estimate of the new crop--as allocated to the quarters--as a volume indicator. For the current price estimates of the pre-harvest quarters, the estimated price of the crop at harvest time cannot be used directly, because this would include holding gains in the estimates. A simple method to bypass this problem would be a straight line interpolation between the previous crop's harvest price and the expected harvest price of the crop under cultivation. If the harvest price of this crop is to be estimated based on the last crop's price adjusted for general inflation, an obvious refinement would be to apply the same method for the quarterly allocations.

Whatever the method of allocation, revisions will be necessary as observed data become available after the harvest. Concerning prices, it follows from the preceding paragraph that the earlier estimates cannot simply be replaced by the harvest price, because that would introduce an inflationary element in the valuation that should be treated as holding gains. Therefore, the prices of the pre-harvest allocations should be revised so general inflation is excluded (e.g., through a straight line interpolation between last and current crops' prices).

IV. Allocation of Other Variables

Thus far, this paper has focussed on the allocation of output to non-harvest quarters. However, because a mature set of quarterly accounts also will cover other variables, the effects on these variables should also be examined. There is no universally accepted practice to suggest what variables quarterly accounts should comprise. The position taken here is that a mature set of quarterly accounts will include information concerning expenditures on GDP, a breakdown of value added by industry and by components, and national income and savings data.

The SNA accounts affected by allocation of output to non-harvest quarters include the Goods and Services Accounts, the Production Accounts, the Generation of Income Account, the Distribution of Income Accounts, and the Use of Income Account. From the variables of the Goods and Services Account, evidently total output is affected by an allocation of agricultural output. Furthermore, changes in inventories are affected, because this is the category under which work-in-progress is classified in the system. Taxes and subsidies on products are affected by the allocation of output if they are on an accrual basis, because the changed timing of the output also impacts on the periods over which the taxes and subsidies accrue. Regarding intermediate use, output allocation does not have a direct impact, because in principle inputs should be recorded in the quarters in which they are actually made. However, in practice not much information will be available on when the use of intermediate inputs in agriculture takes place, and allocation of intermediate inputs consistent with the output allocation may be most practical. Fixed capital accumulation is not affected because crop outputs do not concern fixed capital assets. ⁶

Concerning the allocation of consumption, it can also be argued that it is not affected by an allocation of output to quarters, because work-in-progress does not become available for use outside the producing unit. However, allocation of consumption should be considered for other reasons. In particular, if wages and other primary incomes are paid in kind a decision has to be made concerning the time of recording.

Especially with subsistence farming, wages may be paid out of the crop after the harvest. The same applies to rents, which are often paid on a sharecropping basis in which the landlord receives part of the crop after the harvest. Also, the operating surplus of the farmer and the disposable income that results after income distribution transactions have been settled, may be in kind rather than in money.

The delayed incomes as such do not pose a conceptual problem, although collecting the relevant data may be difficult. Conceptually, the deferral of wages and rents generates a financial claim of the beneficiaries on the farmer and a liability of the latter. These claims and liabilities are redeemed at the time of payment; viz., at harvest time. In practice, the recording of these claims and liabilities at the time they are generated may be hampered by lack of data, in which case an even distribution over relevant non-harvest periods is a next best solution.

A more fundamental problem concerns consumption out of these incomes in kind. In particular, this affects income in kind of food crops. Income in kind of non-food crops will probably be monetized upon receipt, but food products are likely to be retained fully or partly for final consumption of the households. ⁷

⁶This would be different if dairy and cattle farming would be taken into consideration, because livestock is to be regarded as fixed capital assets if it is raised for breeding or further production (e.g., milk, wool).

⁷ The sales by recipients out of income in kind may be to other households, but may also involve wholesale and retail trade as an activity.

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This poses a problem for the time of the recording of final consumption by households.

Concerning the time of recording of this final consumption, the 1993 SNA states that "In practice, the System measures household consumption only by expenditures and acquisitions" (see paragraph 9.40). If this would be applied literally, for subsistence farming this would mean that the bulk of final consumption from the crop would be concentrated in the harvest quarters, which does not seem realistic. It should be noted that the above quotation is from a 1993 SNA paragraph dealing with consumption of consumer durables, and the arguments underpinning this practical recommendation do not apply to subsistence farming. For this reason, and because of the unrealistic outcome that would result, here another approach is recommended.

This recommended approach is to allocate the final household consumption expenditure out of incomes in kind to the periods in which the products are used up. This implies that households are seen as building up a stock of goods at the time of the harvest, which they deplete over the period to the next harvest. In national accounts terminology this would imply changes in inventories. (Note that these changes in inventories would affect post-harvest periods, in contrast to the allocations discussed above.) Again, if data on the spread of the consumption over time are lacking, an even spread over the relevant quarters seems an acceptable next-best solution.

On the Production Account, the allocation of output, intermediate use, and taxes and subsidies on products clearly also affects the allocation of value added to quarters.

The Generation of Income Account will obviously show the allocation of taxes and subsidies on products as carried over from the Production Account. However, concerning the composition of value added the situation is less clear. Here, two alternatives are possible, viz., (1) to allocate the changes in value added fully to operating surplus/ mixed income, or (2) to allocate the changes in value added both to wages and operating surplus/mixed income. If wages are actually paid in the period that labor is hired, no allocation needs to be made to this category, and the effects of output allocation on value added would be fully absorbed by operating surplus/mixed income. However, if wages are paid only after the harvest, as may happen in subsistence farming, attribution of changes in value added to mixed income/operating surplus only would severely distort the picture of the economy. As argued above, these wages should be allocated to the period in which the labor has been provided, and the deferred payments should be recorded through financial transactions.

Concerning the Primary Distribution of Income Account, it can be noted that the effects on wages, taxes and subsidies on products, and operating surplus/mixed income will directly carry over to this account. However, as quarterly accounts as defined here do not consider transactions between domestic sectors and because external transactions are not likely to be affected by an allocation of agricultural output, this account does not need further consideration in this respect. The changes in value added and taxes on products through the allocation to non-harvest quarters directly find their way into the closing balance of this account, viz., national income.

The Distribution of Income Accounts would also only show the effects on the balance of this account for the total economy, viz., national disposable income.

Concerning the Use of Income Accounts, the outcome would depend on the choice concerning the allocation of consumption. If consumption is not to be

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Then, trade margins should also be estimated. However, as this is not a specific problem for quarterly accounts, this will not be further discussed here.

allocated, the changes in disposable income would be fully absorbed by national saving. If consumption is to be allocated, as argued for subsistence farming, both consumption and saving would be affected.

V. Presentation

One general disadvantage of allocations to non-harvest quarters is that they would introduce extra uncertainty to the accounts; therefore, if a country chooses to apply this, special care in the presentation of the data is needed to mitigate the problems users may have with the uncertainties resulting from reallocations.

Three suggestions can be made in this respect. First, it is recommended that the methodology be documented carefully and the documentation be widely accessible, so that users are able to form their opinion. Although this will not enhance the reliability of the figures, it will at least enable a view on whether they are sufficiently reliable for various purposes. Second, to serve users who deem the allocations insufficiently reliable or do not care for allocations anyway, these allocations should be specified and quantified. Third, the data could be presented inclusive and exclusive of the allocations or, if users prefer, of agriculture altogether.