Complex agricultural establishment survey: the case of the sugar-ethanol sector in Brazil[1]

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1. Introduction

The current ongoing agricultural survey of IBGE is based on records and subjective studies. The record studies collect livestock farming data and agricultural inventories, while the subjective studies collect data on agricultural, cattle farming and forest production, and plant extractivism at a local level, and do a monthly follow-up of the agricultural production at state level. In this system, the records studies investigate panels of specialized units, mostly agro-industrial. In the subjective studies the investigation unit is the county and information is generally obtained indirectly from enquiries and meetings with specialists or by consulting administration records, but also involves collecting information from farming units. The system of agricultural studies is completed with the ten-yearly Agricultural Census.

These studies cover three different investigation units: the agricultural and cattle farming units; the county; and the industrial establishment (local unit) that processes agricultural products. Although there is no case where the company is an investigation unit, in every case complex establishment s are key informing units.

The types of complex establishment s that raise major challenges for data collection and making records compatible with the information required by the aforementioned studies are related to (a) corporations operating in more than one activity and (b) those with a large number of physical operating units. Special attention should also be paid to cases of large corporate agricultural establishments or absentee individual producers, for which the relevant information should be collected from different places in far-off urban centers and even in a different federative state. This type of collection is known as decentralized collection.

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In addition to complexities relating to data collection, certain forms of organization result in accounting records that do not always imply perfect adjustments for building the required estimates.

The most frequent case and which typically can bring together these special characteristics is that relating to verticalization of the agricultural sugar and ethanol plants. For this reason it was decided to adopt it as a case study to illustrate these questions, occupying most of the paper.

A further item reiterates some aspects of interest, referring to ongoing survey with the agro-industries.

2. The verticalization process in the sugar-ethanol agro-industry and its impacts on collecting statistical information.

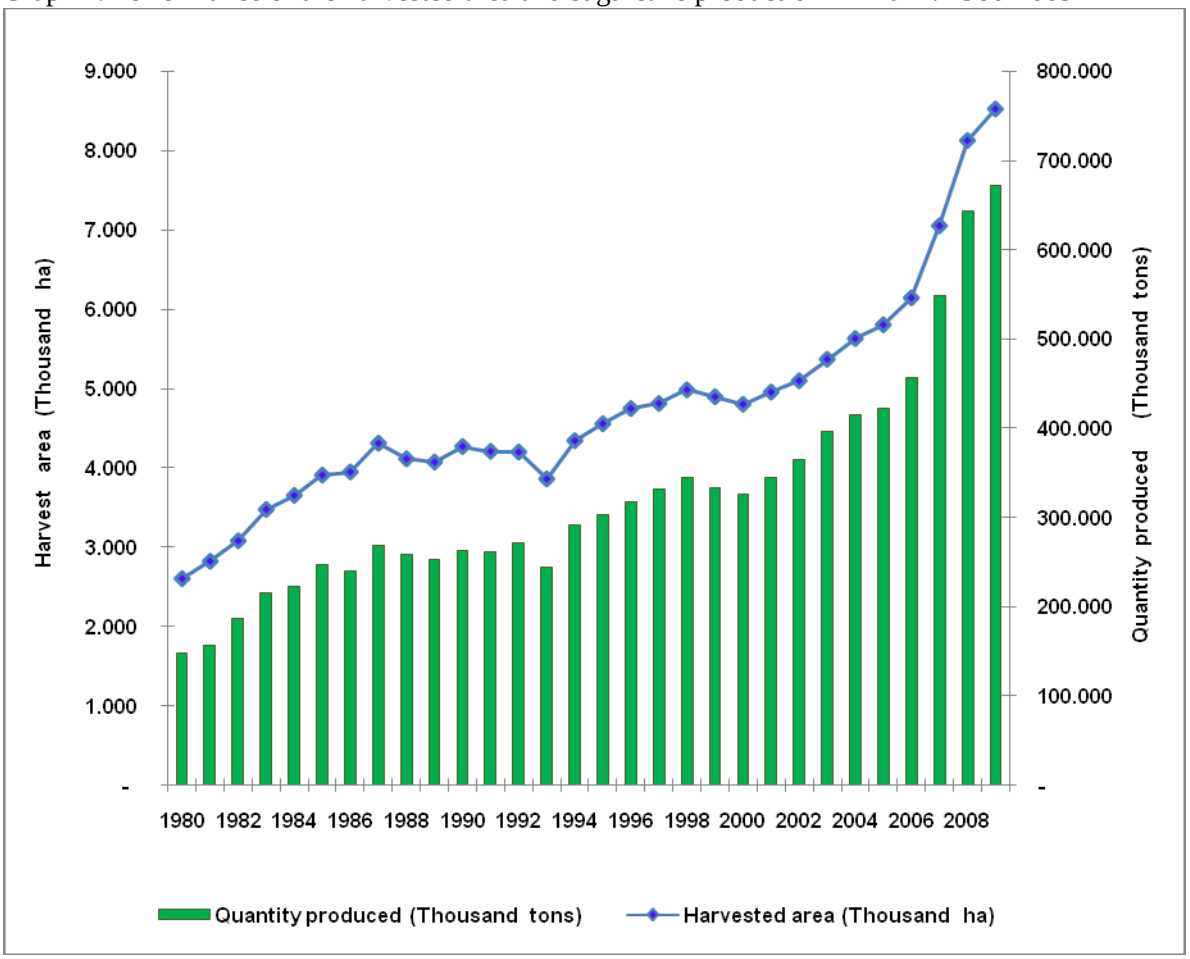
2.1 Context of the sugar-ethanol sector

Today sugarcane occupies around 9% of the country's occupied land, and is the third most important crop on occupied territory after soy and corn, and the second in production value. Brazil is the largest world sugarcane producer with a planted area of 8.8 million hectares and average productivity of 78,854 kg/ha, reaching a production of 671.4 million tonnes (IBGE, 2009), representing around 33% of global production. And Brazil is also the largest sugar producer and exporter and second largest ethanol producer, behind only the USA.

Graph 1 shows the evolution of the collected area and production over the last 30 years, with emphasis on growth since 2003 when flex-fuel cars came on the market, creating a series of new investments in the country. It should be emphasized that although the spread of the cropping area is mainly responsible for the increased production, the productivity of the sugar plantations also increased as a result of years of survey in the different sectors relating to the sugar-ethanol sector.

The need to expand the crop and increase production, associated with environmental concern, led to the gradual ban on the burning of sugarcane plantations to facilitate the harvest. However, the yield of the manual harvesting of raw sugarcane (unburned) is much smaller, increasing costs and is rejected by rural workers due to higher risks of accident. The result is more mechanization of the sugarcane harvest and a considerable drop in labor in sugarcane harvesting.

Graph 1. Performance of the harvested area and sugarcane production in Brazil: 1980-2009



Source: IBGE, Municipal Agricultural Production, 1980-2009.

Brazil has several advantages in ethanol production compared to other countries: sugarcane is a feedstock with a cutting edge in yield for ethanol production, compared with corn, cereals and beet; it covers wide areas of land suitable for this crop; it produces cane throughout the year, thanks to there being two different harvests; and has an infrastructure set up since the 1970s for production of this biofuel. It also has the lowest production cost per liter compared to other producer countries (Table 1).

Table 1. Cost of ethanol production (US$/Liter)

Country	Production cost/l	Feedstock
Brazil	0.22	Sugarcane
USA	0.30	Corn
Canada	0.33	Corn
European Union	0.45	Cereals
European Union	0.53	Beet molasses

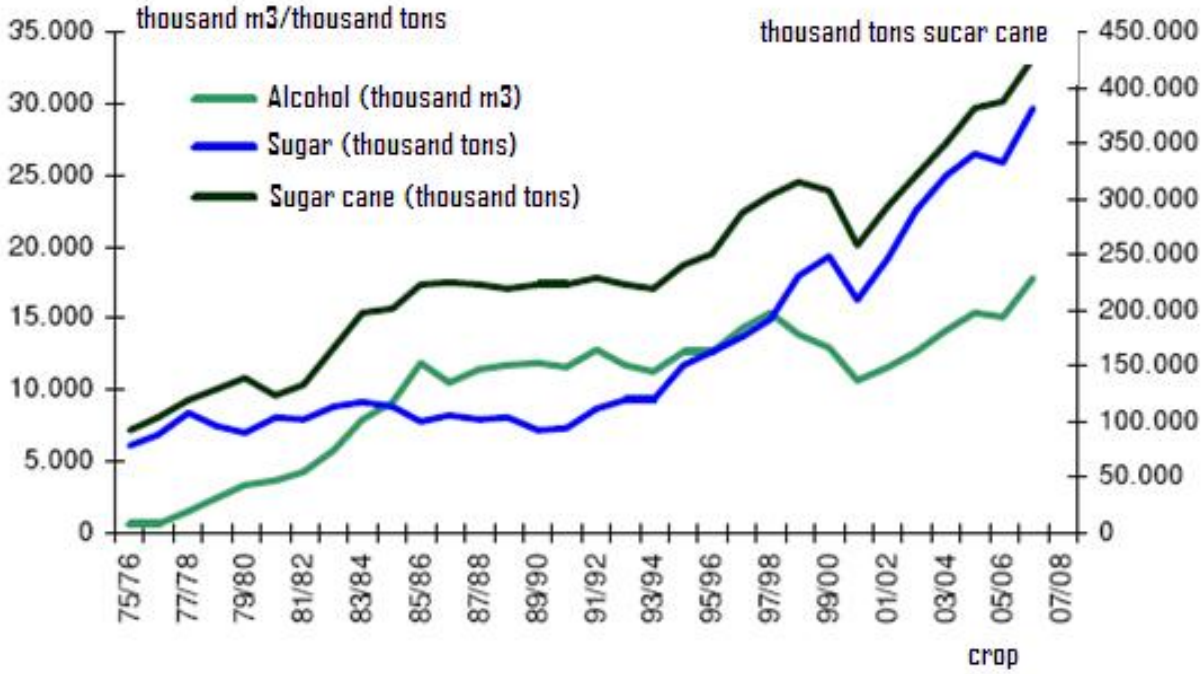
Source: ICONE, 2007.

If allocated to only making ethanol, each tonne of crushed sugarcane would give 89 liters of hydrated ethanol or 85 liters of anhydrous ethanol. Allocated to sugar production alone, it would yield 118 kg of sugar and 10 liters of waste molasses alcohol. However, in a normal market operating system, the national average yield per tonne of crushed sugarcane provides

71 kg of sugar, 42 liters of ethanol or 11.5 tonnes of total recoverable sugar (TRS) per hectare of sugarcane crop (UNICA, 2004).

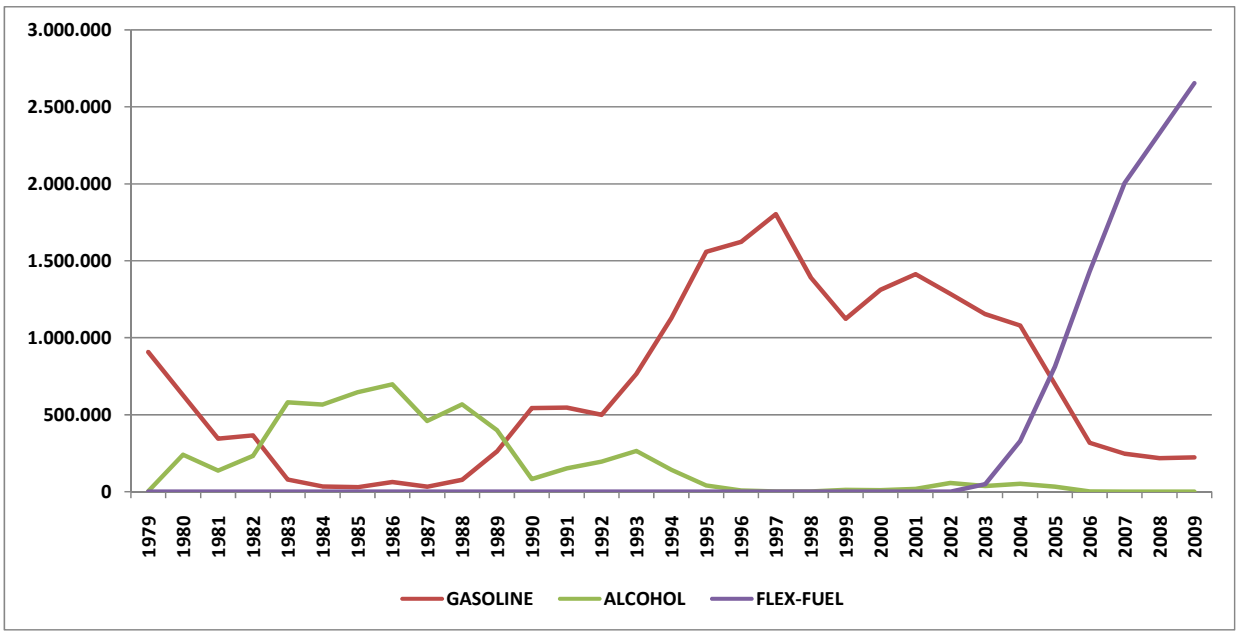
Since 2003, the sugar-ethanol agro-industry has been growing fast, as summarized in Graphs 2 and 3, which show the performance of sugarcane, ethanol (anhydrous and hydrated) and sugar production, respectively, and the behavior of hydrated ethanol-run vehicles.

Graph 2- Performance of sugarcane, bioethanol and sugar production in Brazil.



Source: BNDES, CGEE, FAO & CEPAL, 2008

Graph 3 - Performance of hydrated bioethanol-run vehicles and their share in new vehicle sales



Source: National association of the producers of motors vehicles - Brazil / ANFAVEA.

The production system involves more than 400 plants, with a unit capacity of between 600,000 and 7 million tonnes of processed sugarcane a year. An average plant has capacity for crushing around 1.4 million tonnes a year. The ten largest plants are responsible for 15% of all feedstock processed, while the 182 smallest units process half the sugarcane, indicating low economic concentration. From the viewpoint of the production profile, Brazilian plants can be classified in three types of facility: sugar mills, which produce only sugar; sugar mills with attached distilleries, which produce sugar and ethanol; and the facilities that produce only ethanol, or independent distilleries. The large majority of facilities is made up of sugar mills with attached distilleries (around 60% of the total), followed by a considerable number of independent distilleries (around 35%) and by some units that process only sugar. Brazilian plants work on average with 80% sugarcane from their own land and leased land either from shareholders and farming companies with some association with the plants. The remaining 20% is supplied by 60,000 or so independent farmers, most of them using less than two farming modules (BNDES, CGEE, FAO & CEPAL, 2008).

In the 2006-2007 harvest figures, sugarcane agribusiness, which includes the production of sugarcane, sugar and ethanol, had a turnover of around R$ 41 billion in 2007, corresponding to direct and indirect billing. Thirty million tonnes of sugar and 17.5 billion liters of ethanol were produced, 19 million tonnes of sugar exported (USD 7 billion) and three billion liters of ethanol (USD 1.5 billion) produced, representing 2.65% of the Gross Domestic Product (GDP). R$ 12 billion was also collected in taxation and charges and annual investments of R$ 5 billion were made in new agro-industrial units (BNDES, CGEE, FAO & CEPAL, 2008).

2.2 – Verticalization of the sector

More recently, as a result of the general changes occurring in the sugar-ethanol agro-industry, two new trends are visible: the drop in number of suppliers and increase in the practice of leading land by the plants, in quite a peculiar form of outsourcing and completely different from that prevailing in another institutional context (Guedes, 2000). This last aspect is a clear sign of a new type of relationship between suppliers and mill owners whose pivot are social practices and relations based on and over land ownership and use.

One of the observed changes worth mentioning is vertical integration, which can be defined as the process by which a company internalizes all or part of its economic activities (production, trading, sales, etc.). There are two kinds of vertical integration: 1 – Forward integration, where the company begins to produce new articles or services closer to the end consumer, and 2 – backward integration, where it begins to produce goods or services that it would previously procure from third parties. This integration may also be partial or total.

In the case of the Brazilian sugar-ethanol agro-industry, the predominant form of economic coordination consists of cases of partial backward vertical integration, since the mills/ distilleries produce most (but not all) of the feedstock used in industrial processing (Guedes, 2000). The purpose of this type of integration is to reduce the uncertainty in relation to the supply of feedstock, guaranteeing quantity and quality by the deadlines adapted to its production process, reducing supplier influence. Moreover, when adopting verticalization, the company manages to have greater bargaining power in the procurement of inputs and obtaining investment credit. In short, verticalization has become a competitive strategy of the economic groups operating in the segment.

Until 1968, the Statute of Sugarcane Cropping provides 60% maximum limit of the companies' own cane, in order to maintain suppliers, mainly small farmers. At that time, the concept of supplier was broader and included company shareholders. As a result, the share of sugarcane itself increased when incentive programs for ethanol production were adopted after the oil crises in the 1970s (Carvalho & Vegro, 2001).

Interest in controlling the supply of sugarcane is also justifiable due to the large participation of this input in the industrial cost of end products: around 57% for sugar and 61% for ethanol, hydrated and anhydrous, as estimated by the FGV Foundation (FGV) (Consecana Handbook, mentioned by BURNQUIST, 1999).

An earlier motivation for verticalization was the increase in capital value, initially for exercising political power and more recently used as a value reserve considering the galloping inflation prevailing until 1994. Land ownership was also a condition for obtaining bank loans at lower interest rates than those charged in the market, which were the core of the agricultural policy from the 1970s to early 1980s (Carvalho & Vegro, 2001).

In Brazil, vertical integration in the sugarcane agro-industry is the result of agricultural policies that benefit the large properties in detriment to the small farms. The functionality of the large property lay in the fact that it provided a series of benefits and privileges based on an instrumentalized agricultural policy (Álvaro, 1986).

The sugarcane sales transactions between producers and plants are one of the most important and conflicting points in the sugarcane agro-industrial system, where notably the parties do not behave as partners, seeking long-term stable relationship, with division of risks and margins. In most cases an extremely short-term view is apparent for immediate results.

The assets involved in this transaction are very specific. Sugarcane has a high locational specificity, since sugarcane at over 50 km from the plant is not economically attractive for processing, considering the transportation costs. In addition to locational specificity, there is time specificity, since burnt cane needs to be crushed quickly otherwise it loses quality. This causes this transaction to be quite delicate due to the factors involved.

This high specificity causes the transaction to vary considerably between production and crushing. It is found that the only form that does not exist in the spot market is the farmer looking for the plants interested in procuring cane after burning. The other forms exist and are listed below:

- Plants that own land for planting sugarcane, using their management structure, under their decision-making command, characterizing vertical integration.

- Farmers' land leased by Plants, with sugarcane cropping where the Plant has total control but does not own the assets involved in production (land). It is the Plant that manages the crop and the land owner undertakes some kind of monitoring of the area's conservation. The lease can also be the other way round, namely, a specialized farmer producing on land owned by Plants acting as their supplier. This lease is normally known as rural partnership for tax purposes. Leases ("partnerships") also occur between farmers.

- Specialized farmers: they are the sugarcane producers, specializing in production (they do not do crushing), and are bound "contractually" (albeit informally) to the Plants. Activities by the farmers are manual hoeing, anti-fire corridors triple operation (sub-soiling, fertilization and harrowing) and application of herbicides. The harvest and planting can also be done by the producers or Plant contractors.

2.3 – Difficulties in collecting information in complex establishment s in the case of sugarcane

While in the 2001-2002 harvest 306 sugar-ethanol agro-industries operated in Brazil, 418 units were registered by the end of 2008 in the Agro-energy and Sugarcane Department of the Ministry of Agriculture, Cattle Farming and Supply, although not all of them were operating (MAPA, 2009). At the same time, there was a more intense process of mergers and takeovers (M&T), and from 1996 to 1999 only seven M&T of sugar-ethanol agro-industries were found, less than two a year, while between 2000 and 2007 this figure soared to 80, an annual average of 10 (KPMG quoted by ALMEIDA, 2008).

These M&T caused some changes in the data collection procedures, either in the ongoing surveys or agricultural censuses. A sugar mill is a key informer for agricultural and industrial surveys, requested several times a year by the different sectors of IBGE to provide information on its activities. Some economic groups have a number of plants, concentrating

the information in a single office to which the statistics institute must refer to undertake its surveys. If on one hand the collection agent has an easier job, since information on several plants is concentrated in only one office, to save on resources and time in travel, on the other hand, access to this information very often is not an easy task, requiring special collection procedure, training and interview schedules.

The advance of the Brazilian agricultural sector in the last decade was portrayed by the 2006 Agricultural Census. In this edition decentralized collection was more pronounced, and most often undertaken in large agricultural establishments. This modality permitted collection outside the establishment when the administrative headquarters or home address of the individual farmer was in another country or state. In such cases, the new collection address was noted down and transferred to the portable computer (PDA) of a census taker for the supervisor allocated to the corresponding collection area. However, sometimes the address did not correspond to that informed by the census taker, either due to a mistake by the latter or the infomer, involving a series of extra procedures to complete the questionnaire, very often unsuccessful, affecting the quality of the information.

In the Agricultural Census all farming establishments contained in a census setor are investigated. However, a plant may have several agricultural establishments spread over various sectors, and even counties, making it hard and even unfeasible to collect informaiton at a census level. Accordingly, the Agricultural Census Technical Management (GTA), in order to mitigate the problem, instructed the collection network when undertaking the survey in the industries that information that can be separated, and should be distributed by counties where the establishments are located. However, some information referring to the structure of the establishments, occupied people, farming implements and machinery, and so on, were entered in a single questionnaire referring to the county where the plant is installed.

So, in order to guarantee the quality of the census information, some states adopted complementary procedures that were not described in the survey handbooks, leading to a lack of uniformity in the collection methods. In some states, for example, census takers were previously instructed not to collect information about sugarcane in establishments linked to the plants, since the census for them would be taken by permanent IBGE employees already familiar with agricultural surveys. These procedures require good supervision and extra controls in order to prevent losses in the surveys, such as sub-numbering, faulty coverage or double counting, inadequate allocation of production, and so on.

In the ongoing surveys adaptations are also made in the form of collecting information, providing a lack of uniformity in the collection method. The plant normally is an informer of current agricultural statistical surveys, but presents sugarcane production spread over various counties, which sometimes do not coincide with the jurisdiction area of the data collection agencies. In such cases, information referring to the counties subordinate to other agencis have to be forwarded to their agencies in charge, hindering the entry of data in the collection systems.

Another drawback is obtaining information from the autonomous sugarcane suppliers that have no previous contact with the industries, and may freely negotiate between the plants. In this case, when the plants do not have information from suppliers, they forward a list of

suppliers that are interviewed by collection agents, but this procedure is not adopted in all of the Brazilian states.

2.4 – Implications and limitations of combination of company records and establishing in estimates of the sugar-ethanol agro-industrial complex

The new series of national accounts – reference 2000 – made public by IBGE in March 2007, introduced a series of improvements. One of the most important refers to the change between a National Accounts System (SCN), which was being estimated basically by extrapolating indices of volume and weight, and the new system referenced by annual surveys of the industry, trade and services and other sources, which supply data at current prices and thereby establish a benchmark that permits control of the performance of the SCN series, preventing characteristic biases in the use of volume and price indices.

Implementation of the new series culminates in the review process of the system of so-called economic surveys started in 1996, which suspended the economic census and instituted the Central Corporate Roll (CEMPRE) and new bases of structural surveys, for formatting an economic survey system (GÓES, 1996).[3] The information of industrial production is today collected by PIA-Empresa, which integrates the Economic Statistics System and, like the Annual Surveys of Trade, Non-financial Services and Construction, adopts a model of annual sample construction.

However, the same alteration did not occur in the case of agriculture. In the SCN, the Agricultural Census, which considers the establishment as an investigation unit, supplies the key parameters for building the base-year, and the process of estimating annual data still uses extrapolation of the current data by volume and price indices, obtained from current surveys. The production information of agriculture, forestry and production and cattle farming, are used to build both the volume indices of production and of intermediary consumption and formation of fixed capital (SISTEMA... [2007?]).

PIA-Empresa, which investigates the sugar-ethanol industry, has only one selection unit – the Industrial Company – and two investigation units – Industrial Companies and these companies' production Local Units (LU).

All industrial companies with one occupied person or more are in the sphere of PIA-Empresa, which defines a universe of around 300,000 companies a year. The selection methodology defines two sample strata with a certain stratum consisting of companies with 30 or more occupied people, and a sampled stratum for the other companies. In relation to the base year 2009, for example, the total sample has 52,000 companies, 37,000 of which are in the certain stratum and 15,000 in the sample stratum. Different questionnaire models are applied to the companies in these two strata: the Complete for the certain stratum (204 items) and the Simplified in the sampled stratum (59 items).

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[3] Economic Survey System without including agriculture.

The PIA-Empresa methodology indicates that, although the information is collected at the level of the Production Local Units, like those accounted by the companies for the purpose of disclosure, there will always be compatiblization between the values collected at company level and the sum of its Production Local Units in the common variables. It is worth mentioning that, even if the same investigated variable has a different total at the level of the local production units than that observed at company level, the sum of this variable is equal to that of the company by a allocation process that takes into account the relative participation of each LU in the total of the values originally stated.

At the LU level a higher feedstock consumption value (CMP) is stated than that obtained at company level. This behavior is probably due to the fact that at the LU level the recorded values correspond to the total feestock (basically sugarcane) actually consumed in each LU, while at the company level feedstock consumption is obtained from the values of feedstock procurement[4]. It is worth mentioning that at company level the value of the actual production, sugarcane that has been planted and harvested in its operation is not counted in this variable. The costs of the portion of the actual production produced and consumed in the year are calculated in the survey as personnel costs and other costs relating to agricultural production (diesel, fertilizer, agrochemicals, etc). Accordingly, when attributing the MP variable (feedstock), the same consumption found in the company is now attributed to the production LUs and the other sugarcane production costs are then considered (shared) in the variable of other costs and expenses. However, with the performance of this collection in the suvey's series, it is common to observe that the informers themselves already undertake this prior allocation and appropriate the CMP found at company level in the LUs; in other words, the allocation generated basically by the MP procurmenet volume.

In the estimates of agriculture based on calculation by establishment, the total sugarcane production is calculated, whether sugarcane in the verticalized production of the plants or suppliers, as the sector's output. On the other hand, CMP estimates, calculated at company level, in the case of the sugar mills, eventually include expenses relating to their agricultural production activities, not listed or may be listed in order to make them compatible in building proper information of intermediary consumption. The result is that intermediary consumption relating to sugar mills is overestimated and the added value of this segment underestimated.

3. Other cases: Complex establishments and survey of information relating to cattle farming for industrial companies

In Brazil, agro-industry relating to cattle farming has been quite dynamic since early 2000. In recent years, there have been a number of mergers and takeovers of companies in the sector, resulting in the activity's concentration in large companies.

In the meat sector, Brazil is world leader and has the largest companies in the segment. Moreover, the operating area of these companies has increased. Cold storage companies are now including leather processing and industrializing milk, in addition to egg production and

[4] In the case sugar-cane the inventory variation is not relevant.

chicken for slaughter. At the same time as these increased activities and local units, those companies now centralize statistical information in their administrative headquarters.

In the IBGE statistics of the livestock farming agro-industry, this has resulted in adaptations to the data collection system (including information technology), in which the investigation unit is the local unit. If, on one hand, a larger volume of data is obtained from consulting only one informer, guaranteeing uniformity and consistence of information at a lower collection cost than multiple investigation units, on the other hand, the collection work has been centralized in only one office of the institute, and there is still the need to coordinate between the different technical teams involved in different states and counties for follow-up and analysis of the data collection.

In the production of hens' eggs from specialized poultry farms integrated with the food industry, there is sometimes the added difficulty of obtaining data for each poultry farm, in order to estimate the county's production. For the integrating team, information of total egg production from its integrated farms is sometimes the only available information, at least for IBGE.

Mergers and concentrated production have also occurred among dairy companies, and there are cases of data collection only in company headquarters.

Since the surveys of animal slaughter, milk procured by the dairy companies, leather procured by the tanneries and the hens' egg production have strictly the same timetable, the result is that some few companies will have to answer more than thirty questionnaires every quarter, currently by personal interview or sending data by email. In these cases, the on-line questionnaire currently at the planning stage will be very valuable. Direct importing of management files created by the companies for the data entry system of statistical surveys, with a personalized data capture system for each company may be an alternative for reducing the demand load for survey informers.

4. Conclusions

The sugar-ethanol sector is the largest example of complex establishment s in agricultural statistics in Brazil. The ongoing census statistics have sought to adapt to properly collecting and addressing the data, changing the usual collection procedures and checking systems. Nevertheless, work *a posteriori* is very often necessary to properly allcoate the data obtained in the surveys.

In the Agricultural Census the information from the sugar-ethanol sector had a special collection procedure. The plants have serveral agricultural establishments spread over several sectors, making it unfeasible to collect at census level, causing impacts on planning the sample surveys.

In the industrial surveys, this agro-industry still has characteristics that result or may result in overestimating intermediary consumption and underestimating the added value, consequently underestimating the sector's participation in the GDP.

In the agro-industry's statistics for livestock farming, a similar trend is visible to that which occurs in the sugar-ethanol sector, the statistical information of the local units of the companies being centralized in their administrative headquarters.

Considering the differences in structuring the agricultural and industrial survey systems, particularly with regard to the investigation unit, the intense verticalization of the agro-industrial companies is a major challenge for making information compatible and adapting it to guarantee coherence and consistency of the sectoral estimates.

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