Les emplois directs et indirects liés à l'élevage français

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Measuring indirect employment linked to livestock farming
An assessment of the dependency to livestock farming based on economic and territorial constraints

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INTRODUCTION & RESEARCH QUESTION

In 1993, in France, unemployment rose above 10 % of the active population for the first time. Twenty years later, after a drop at the end of the 1990s and a second drop in the mid-2000s, unemployment once again rose above this threshold. In addition to the difficulties that it creates for the unemployed, high unemployment rates weaken the economy and diminish social cohesion. Today, employment is therefore a crucial signal in evaluating not only the vitality of a sector of activity, but also the economic and social services it provides to society. It is therefore essential to accurately evaluate the number of jobs created by different economic sectors.

Considering this situation, employment generated by agriculture and livestock farming appears as one of its main socioeconomic impact.

The percentage of the French active population working in the agricultural sector has fallen from 31 % in 1955 to 4 % today. This can notably be explained by increased labour productivity: a greater quantity of products is created by fewer people. However, some of these agricultural jobs—seemingly destroyed—were in fact absorbed by other specialised sectors of activity orbiting around production. Indeed, French farms have also in recent decades undergone "vertical specialisation", shrinking their field of activity by delegating some tasks previously done on farms to outside businesses: seed production, making cattle feed, fertiliser and farm implements, processing and sales activities, etc. In other words, the drop in the number of farm workers was accompanied by job creation in agriculture-related sectors: there are many jobs related to agricultural production in upstream and downstream industries, services and institutions. Evaluating agricultural employment alone therefore does not account for the sector's complexity and overall dynamic. Agriculture and livestock's contribution to economic activity and employment must be measured based on a wider concept than that of active farm workers, taking into account the indirect jobs whose existence is linked to that of farms.

This evaluation is particularly important for the French livestock-farming sector, which receives important public aid. Recent works on livestock related services (Ryschawy *et al* 2014) have shown that it contributes to maintaining environmental quality, patrimony, but also economic vitality by creating direct and indirect jobs that are mainly impossible to offshore. Taking into account those indirect jobs is even more important in rural areas, where upstream and downstream activities that depend on livestock farms are sometimes the main source of local employment. Therefore, not only do they contribute to the local economy, but they are also essential in maintaining a strong social network in some areas.

The several crises livestock farmers have been through during the last few years have reinforced this observation. At a time where many farmers are in great financial trouble, it is even more essential to be able to quantify and to identify all jobs that depend on the presence of livestock operations in France.

However, at the national scale no detailed and reliable data had been collected about the amount and the kind of indirect jobs depending on livestock farming. The diversity of existing studies—conducted in very different frameworks and at very different scales, using methods and sources that are rarely clearly specified—did not provide a clear vision of agriculture- or livestock-related

jobs. Even more, no methodological framework ensured a reliable way to identify indirect jobs; estimating them is, indeed, particularly tricky because not all these jobs depend on France's livestock sector in the same way. We therefore needed a thorough assessment of the interdependency between the economic activities along the livestock value chain that would take into account specific economic and geographical constraints. Unfortunately, most available methods were based on the observation of existing commodity and financial flows, which only provides a static and short-term vision of economic dependency (Caporaso 1978, Mentzer 2001).

The GIS Élevages Demain therefore addressed these issues by undertaking an exploratory study on livestock-related jobs with a twofold objective: develop a solid and rigorous method to identify and quantify indirect jobs, and apply this method to French livestock operations, drawing a distinction between different types of operations.

1. THEORETICAL FRAMEWORK & METHODOLOGY

1.1 Choosing a job-assessment method

Employment is usually examined by sector or by field, and most statistics are available by this format. However, compiling those statistics would not allow us to get the complexity of the whole employment linked to a precise activity. We would indeed experience a lack of detail in statistical sources, which means that a great amount of additional investigation or data reprocessing would be necessary.

But even more important is the definition of the perimeter of the study. Existing job-studies, whatever the field, do not report any precise and recognized method to identify and describe which operator should be considered as indirect employment. Two different approaches exist to evaluate indirect jobs: macroeconomic analysis and mesoeconomic surveys.

The most common macroeconomic analysis is based on an Input-Output matrix from national accounting that depicts all inter-industry economic operations within the national economy. This method is based on a global approach of national economic systems; economic flows of value added and salaries are examined and converted into jobs (Daucé and Léon 2003, Bossard and Daucé 2004, Gohin and Rault 2013). Economic simulations can then be performed to measure the employment variations induced by shocks. But even though this method offers a great advantage by being scientific and repeatable, it does not allow a detailed description of the operators in the perimeter.

The second approach relies on a very different method. A central activity is identified, and the method uses censuses to empirically identify activities and jobs linked to them. Those interdependency links that can be more or less strong. The number of jobs is then quantified within this activity sphere. This gives a great level of details on the operators and jobs that are considered. Plus, it is much easier to understand for the reader, and offers more flexibility than a macroeconomic analysis.

The downside of this method choice is the definition of the activity sphere perimeter. Jean-Claude Bontron described the agricultural sphere as all « *activities that keep with [the agricultural sector] close interdependency links, or those whose a large part of intermediate expenditure comes from this sector* » *(*Bontron et Brochot 1984*).* However, no precise definition

of those interdependency links is proposed. Consequently, most studies using this method have no repeatable or consistent way to define their perimeter and usually only rely on an empirical census. The diversity of context and means of those studies leads to a strong heterogeneity in the application and interpretation of the activity sphere concept. Bono and Touzard offered in 1999 a more detailed method for an evaluation of agriculture-related jobs. They suggest to analyze the characteristics of each operator's connection to the agricultural sector: is the relationship market-oriented or not? What is the operator's level of dependency to agriculture? Its rank in the relationship sequence? The type of economic unit (household, firm, administration…)? The value of their exchanges? This method has been applied on the Languedoc-Roussillon region. This approach was the first one to offer a perimeter definition based on a dependency analysis.

Our study is based on a similar pattern, using a mesoeconomic survey completed by an analysis of the links between livestock operations and each category of operators. The scope of our study does not include induced jobs nor externality-related jobs such as tourism. We therefore focused our analysis of each operator relationship with livestock farms on indirect jobs and their dependency to livestock operations. To achieve this goal, we needed to develop further the dependency definition and evaluation.

1.2 Indirect activities dependency

Measurement of indirect employment is not the only kind of study that calls for a definition of the perimeter of impacted operators. This is actually a central point in many methodologies: economic models, computable general equilibrium, multicriteria assessment methods, life cycle analysis etc. This perimeter is usually determined on the basis of existing flows between operators. Those flows can be material or financial (with the exception of social life cycle analysis (sLCA), in which the perimeter is determined on the potential social consequences on different operators). Consequently, for economic studies, the perimeter is usually determined by the existence of a client-supplier relationship.

As our perimeter definition is based on the dependency concept, we should define what this term means exactly: the fact that an operator is dependent on livestock operations indicates that a change in livestock-related activities would affect this operator's activity level, or even its existence and, thus, its jobs. The dependency is taken into account in regard to the French livestock sector in this study. It is therefore linked to the national territory. The degree of this dependency is function of the probability that all jobs would be affected, by taking into account the probability of the operator being affected, but also the extent of the potential consequences. In other words, we seek to determine whether these jobs have a stronger or weaker chance of being preserved in the event of a reduction in or the disappearance of the French livestock sector.

A simple observation of existing economic flows would only provide a static and short-term vision of this dependency (Caporaso 1978). The fact that operators are exchanging goods and services alone does not necessarily mean that they are interdependent, as those goods and services may be substituted. Moreover, it does acknowledge the role of neither opportunities (such as flexibility and adaptations abilities) nor specific constraints, such as territorial links. All those factors yet play a major role in the dependency of an operator to another (Mentzer et al. 2001). Besides, dependency can be of various intensities. The evaluation is therefore not only

about its existence, but also its degree. An evaluation by financial flows would lead to a dummy variable for dependency, the operator either having an economic link or not. In this case, there is no way to quantify a level of dependency. Dependency is also a multidimensional concept: economic relationship, geographical component, client-supplier type of relationship, crossed capital participations… All those dimensions need to be analyzed and characterized.

This led us to believe that indirect employment and economic dependency could not be expressed by the single existence of a financial flow. In order to rank the jobs according to the level and the nature of their dependency on livestock farming, we needed to build a quantitative, multicriteria and dynamic method. That way, we would be able to fully assess the economic dependency between a category of operators and livestock operations, allowing us to measure and describe indirect employment.

Various theoretical and methodological references have provided the basic concepts to describe dependency. A first phase of general bibliography gave us a fair overview of the existing approaches in this field, by studying "filières" definitions (Temple 2011, Fontan 2006), systemic approaches (Donnadieu *et al* 2003) and social life cycle analysis (sLCA) methods (Macombe 2013, Wu 2014). This evaluation of the dependency to a specific activity has been rooted in the industrial organization economics. The transaction cost theory (Williamson 1985 and 1996) and the incomplete contracts theory (Tirole 1999, Masten *et al* 2000) largely contributed to identify the different economic dependency components. Other works helped us build this evaluation, such as up or downstream regulation (Montfort Dutailly 1983, Kh Sekkat 1987).

This research was compared and synthesized, which led to identify three major components in the dependency: the livestock's relative importance for the activity, the operator's adaptation capacities, and the territorial constraints weighing on the operator.

a. Livestock's relative importance for the activity (short-term effects)

The first component of dependency is the relative weight of livestock farming in the economic balance of operators. The description of the existing situation provides information on immediate response to a change, before the operator has had time to adapt. The more livestock-related activities are a big part of all operators' activities, the more a change in livestock farming activity would have direct and meaningful consequences on its activity level. This component therefore describes potential short term effects of a change in the overall livestock activity.

To evaluate this short term dependency level, several measurable criteria have been identified (Table 1). Those criteria are slightly different whether the operator is a client or a supplier of livestock farms.

Table 1: Assessment of short-term dependency for the upstream section of operators

Indicator	Evaluation	Grade
Share of sales related to livestock(supplier)/ Share of the activity related to its products (client)	Share of the turnover	% converted in a 0 to 5 grade
Share of operators specialized in livestock or its products	Share of operator with exclusive or majority livestock-related activity	% converted in a 0 to 5 grade
Diversity of outlets (supplier) / Share of animal products in final product (client)	Likert scale	0 to 5 grade
TOTAL	Aggregation	0 to 15 grade

The first indicator is the share of sales that are intended for the livestock farms. This share is assessed based on the global activity of all operators from the category. It is measured in share of the turnover or of the production. For downstream operators, it is the share of the activity that is related to animal products that is taken into account.

Second indicator reflects the share of specialized operators? The goal is to determine if, within the operators category, the livestock-related activity is assigned to a few specialized operators, or if on the contrary many mixed operators provide their goods and services not only to livestock farmers but also to other sectors. This indicator is evaluated based on the share of operators whose activity is exclusively or predominantly livestock-related. If this information is not directly available, it can be assessed based on expert opinion.

To complete this first component, we assess the diversity of the operators' outlets. This indicator is not about the share of the livestock-related activity, but the width of their clients scope. Their outlets can be very specific, if they provide goods or services that are meant only for the agricultural or livestock sectors, or on the contrary very wide, supplying all kinds of economic sectors. This diversity scale has been assessed on a Likert scale based on expert opinion. For all downstream operators, this indicator is the share of animal products in the final product.

b. Adaptation capacities (medium-term effects)

In the event of a change in the livestock farms activity level, related operators will have to adapt to the new situation, whether they are clients or suppliers of those farms. Their adaptations capacities to this economic change will therefore determine their medium and long term survival. Even though livestock is a big part of their activities, if they are able to adapt quickly by turning to another market or by turning around their own activity, those operators will not be very dependent. These adaptation capacities are determined by the operators characteristics, based on the flexibility of the production process and the capacity of conversion into alternative production lines, but also by the economic context.

To assess the capacities of an operator to convert into another activity, we used the asset specificity theory (Williamson 2008). To provide goods and services to livestock farms, each operator uses its assets: material assets (buildings, equipment) or immaterial assets (qualified

workforce, brand image, network…). The more those assets are specific to the transaction with the livestock sector, the more those operators are dependent. Williamson does not provide concrete ways to assess this specificity. We chose to use a simple Likert scale based on expert opinions. This specificity has been considered in regard of livestock operations in general and of one particular sector within livestock operations (dairy, meat, cattle, pigs…).

Table 2: Assessment of adaptation capacities

Indicator	Evaluation	Grade
Asset specifity to one particular livestock sector (dairy, meat, eggs…)	Likert scale	0 to 5 grade
Asset specificity to livestock operations	Likert scale	0 to 5 grade
Absence of relevant market for reconversion and/or export (suppliers)/import (clients)	Likert scale	0 to 5 grade
TOTAL	Aggregation	0 to 15 grade

Assets adaptation capacities are necessary but not sufficient to get to an operator a full adaptation capacity. The supply and demand level on potential substitution markets has to be considered. The existence of a relevant market is essential to develop a new activity. Those substitution markets can also be abroad, to export toward livestock farms abroad or import from them. In that case, the reconversion can be optional. This ability of this market to absorb the operators production or to provide enough goods to those operators is evaluated on a Likert scale.

c. Territorial constraints

At last, we identified a *geographical component* playing a part in economic dependency: the territorial constraints existing between an operator and the location of farmers. The more those territorial constraints are strong, the more the difficulties to find other clients are strong, and the less the possibility of offshoring the activity is conceivable (Dervillé, 2012).

Those constraints can be the result of transport costs, but can also reflect temporal constraints associated to the perishable character of livestock products. They match Williamson's site specificity and time specificity. Their consideration is particularly important given the territorial integration of all agricultural activities. The importance of transport costs of agricultural products, and even more animal products, makes this component crucial. This cost variability is mainly function of the density and the perishable character of the products (Chatelier and Gaigné 2012).

This component is directly assessed by the average distance that is considered as a maximum for operational and/or economic reasons. This distance is ranked from 0 to 5 on a scale going from « no impact of the location whatsoever » to « maximum distance of a few kilometers between livestock farmers and operator ».

Territorial constraints will not only affect the ability to adapt to change. It will also determine on which level the change, from a local to a global trend, will be decisive. Regardless of the importance of the change, the scale on which it will impact the operator can be characterized.

Table 3: Territorial constraints evaluation

0	1	2	3	4	5
No impact of location	France level	Great region level (< 400 km)	Department level (<100 km)	Small agricultural territory level (<40 km)	Maximum of a few kilometers

1.3 Quantification of indirect jobs: a 3-steps process

Identify the operators – How value chains in the broad sense are organised and operate was studied in order to identify the different operators in the livestock sector: agrifood industries, but also veterinarians, farm building construction companies, and even agricultural schools. A map of activities and operators was drawn up empirically based on bibliographic research and information from experts. This made it possible to catalogue all jobs orbiting, near or far, around livestock value chains and their products. Over 185 categories of operators linked to livestock farming have been identified. Those were all potentially dependent to livestock farming.

Evaluate dependency – To determine which of them were to be considered as indirect employment, economic dependency of each group of operators has then been assessed. Each of three dependency components resulted in a score, and those three scores were aggregated in order to assign an overall dependency score to each of these operators.

Those data were then statistically treated to break down the operators into four groups, using an agglomerative hierarchical clustering of data. The lowest level of dependency has been considered as *not significantly dependent* to French livestock farming, resulting in excluding about 50 operators. Other groups were identified as strong, medium and mild dependency. This allowed us to rank the 135 operators remaining based on their level of dependency.

Quantify jobs – For each dependent operator, the volume of jobs was evaluated with the help of various methods based on available data: use of statistics (from INSEE, SSP, MSA, collective labour agreements, etc.), professional surveys, conducting direct surveys, assessment via an economic approach, etc. In order to obtain a reliable estimate that did not exclude any of the operators concerned but avoid double counting, sources were cross-checked and reprocessed. For each livestock-dependent operator, the number of livestock-related jobs (in number of people and in FTE) was determined. In the case of mixed activities (for example, veterinarians who also treat household pets), only the share of the activity linked to livestock was taken into account.

2. RESULTS

2.1. Livestock-related jobs in France: 3.2 % of all jobs in France

The total of direct and indirect jobs related to French livestock farming is about 703 000 FTE, which corresponds to 882 000 people, not including temporary workers and seasonal workers in agriculture. Adding temporary employment, we have 724,000 FTE linked to livestock, or 3.2% of all jobs in France in early 2010s.

Amongst those jobs, under one half is located on the farms: those are referred to as direct jobs. 312,000 FTE are devoted to livestocks operations stricto sensu[1], out of a total of 429,000 FTE located on farms with livestock activities. The study shows that out of this total labour force, 73 % is devoted to livestock operations (excluding horses). The activity linked to the production of cereals consumed on the same unit is not included in this number; it was estimated at approximately 9,000 FTE. The labour force devoted to livestock (excluding horses) therefore represents between 41 % and 43 % of total jobs on farms. These 312,000 FTE are estimated to represent approximately 415,000 permanent workers and 168,000 seasonal workers. Family labour makes up the bulk of this labour force (84 %), with strong differences across types of livestock operations (from 93 % for dairy sheep to 63 % for eggs).
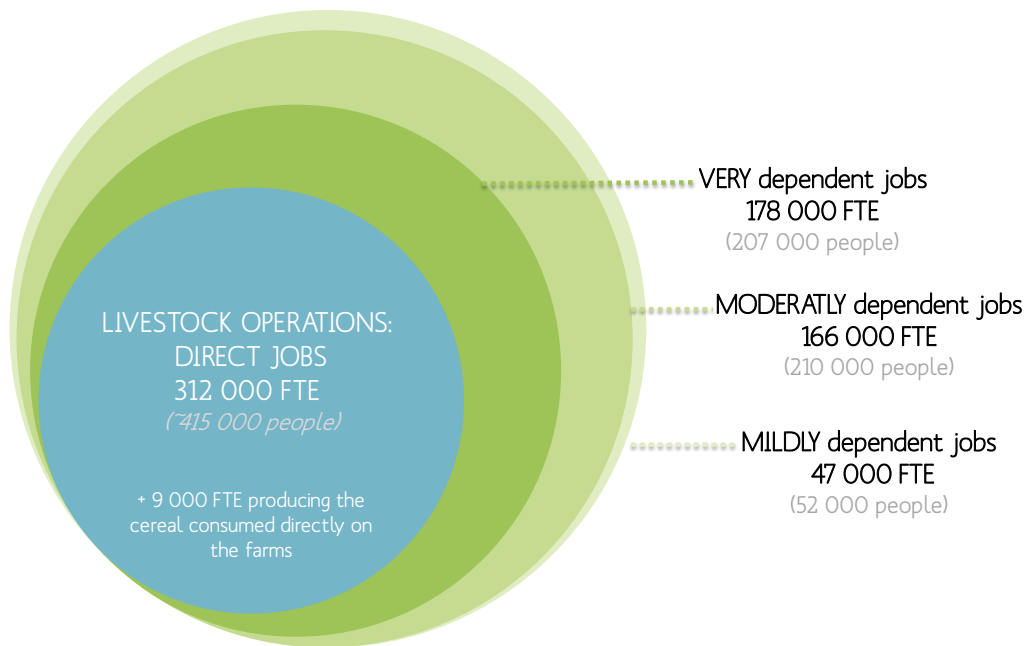

Figure 1: Direct and indirect livestock-related jobs in France

The 391,000 FTE remaining (470,000 people) are indirect jobs. Among these 391,000 FTE, 45 % are highly dependent, 43 % moderately dependent and 12 % mildly dependent on the French livestock sector. This means that for each on-farm FTE, there are 1.25 FTE in other economic sectors that depend on the presence of livestock operations.

The average uncertainty of those results is evaluated at approximately +/- 2 %, under the hypothesis of independency between each evaluation. The total number would therefore be between 383 000 and 399 000 FTE. This average uncertainty has been calculated based on the margin of error for each measurement. This percentage varies greatly by operator, with in general the best precision for the most dependent operators, representing the largest number of jobs. The average uncertainty is then calculated by using the propagation of uncertainty formula.

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[1] The method to evaluate the workforce specifically dedicated to livestock operations is based on a multiple linear regression on the data of the 2010 agricultural census. Physical allocation keys were taken into account to evaluate coefficients to distribute labour on each farm. The full description of this work conducted by Christophe Perrot (IDELE) is available in "Les emplois liés à l'élevage en France, rapport d'étude, Lang et al, 2015").

2.3. Distribution of indirect jobs in economic sectors

Those indirect jobs are distributed in various economic sectors within the livestock sphere (Figure 2).
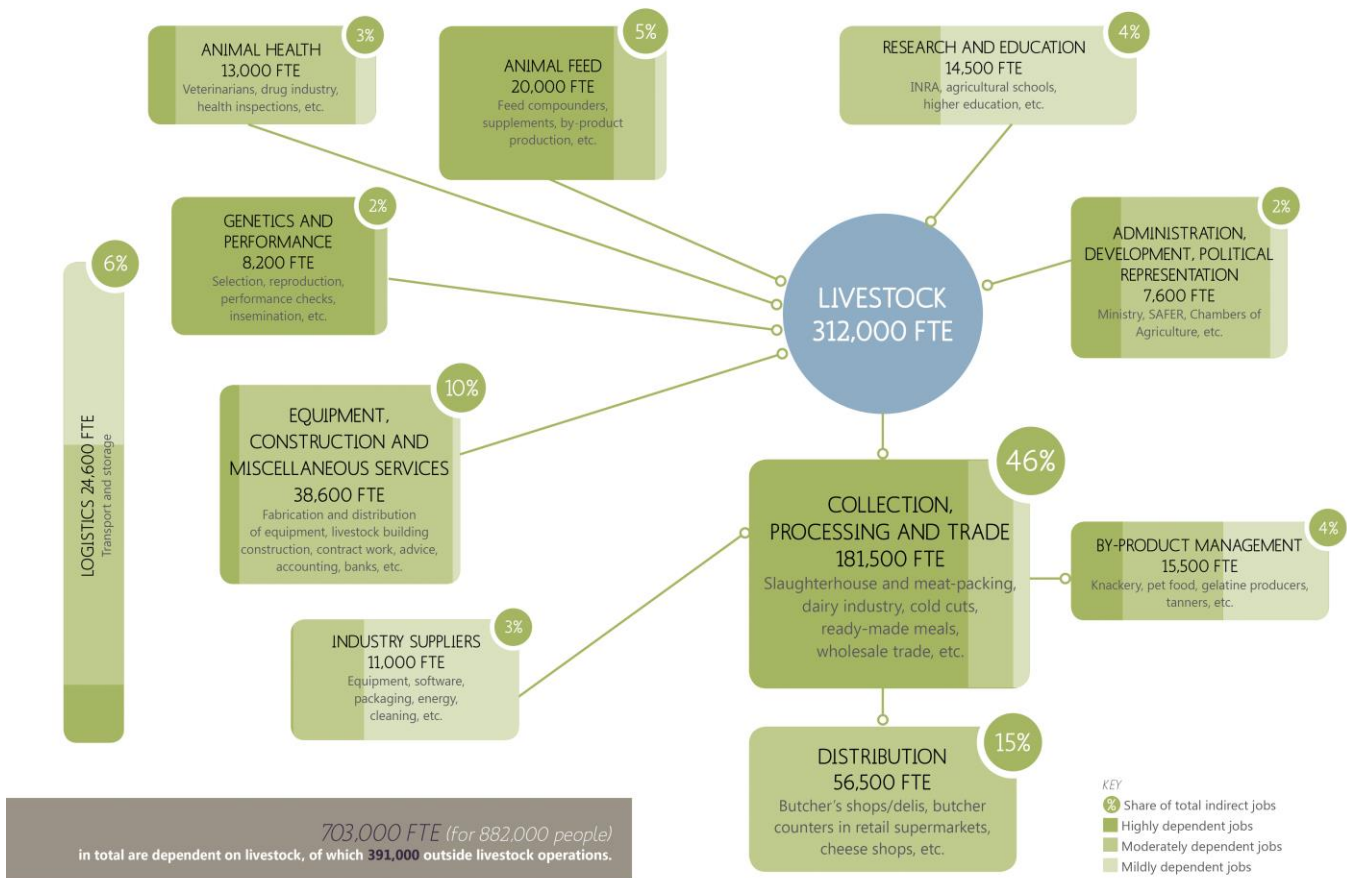

Figure 2: Distribution of direct and indirect livestock-related jobs in France

a. Upstream sectors (20 %)

20 % of this employment is located in upstream operators such as animal feed, health, genetic sectors, as well as general goods and services suppliers. Over a third of those jobs are highly dependent on French livestock operations, particularly in the genetic and feed sectors, whereas health and equipment jobs are, for the most part, less dependent. The upstream sectors dependency level is just below the average: its weighted average grade is around 28.7 out of 45 (all-sectors average is 29.5).

Having a look specifically at the geographical dependency shows us that upstream sectors are some of the sectors where the spatial dimension is the most important. The average dependency grades those sectors obtained for the territorial constraints component is around 9.5, whereas the overall average grade is 6.7. All upstream sectors are above average, with a maximum on territorial constraints for the equipment and building sector (11), followed by health operators

(9.4). Genetics (8.5) and animal feed (7) have a slightly lower grade, even though their global dependency level is significantly higher: those sectors are indeed very specialized.

b. Collection, processing and trade (53 %)

Nearly half of indirect jobs are found in the collection, processing and marketing of livestock products, and 53 % in downstream industries in the broad sense. These sectors gather the vast majority of very dependent jobs (82 %), and the average dependency is quite superior to average, reaching 32.4 (all-sectors average is 29.5). Very dependent jobs are mostly in the initial food-processing industry itself, such as slaughterhouses and meatpacking (71,900 FTE) and dairy industry (47,800 FTE).

Territorial constraints are just above average considering all downstream operators, with a 7.1 grade (reminder: all-sectors average is 6.7). However, if we take into account only initial food-processing, geographical dependency is significantly higher, rating at 8.8. Given the perishable nature of milk, dairy industry's territorial constraints are ones of the highest all sectors included, with a 11.5 grade. On the contrary, processed-food industry, such as cold cuts and ready-made meals has one of the lowest territorial grades (3.1).

Other food industries have been found not significantly dependent on French livestock operations, even though they use animal products. That is the case of biscuit factories using butter, or ice cream factories using powder milk. These products can easily be substituted with vegetable products and/or importation.

c. Distribution (15 %)

Non-specialized retail sectors are not dependent on French livestock operations: in all likelihood, a drop in the French production level would have no effect on their own activity level. Dependent distribution gather therefore only butchers, butcher counters in supermarkets and cheese shops. Those jobs are all moderately dependent, with a low territorial constraint (3.0). Their location is indeed driven by the consumers' geographical breakdown, and not to the livestock farms distribution.

d. Public and semi-public sectors (6 %)

In the public and semi-public sectors we find research, education, administration and development organisations. Given the different nature of their relationship to livestock farms, another dependency evaluation has been built for these operators. It takes into account the proportional nature of the activity to the recipient numbers and its specificity to livestock operations. Territorial constraints evaluation is however identical to the commercial sector. Those constraints are not very strong, with an average grade of 5; this matches a national or regional dependency level.

e. Logistics (6 %)

Dependent jobs in logistics sector are about 6 % of the total. Most of these jobs are road transport, both upstream and downstream of livestock farms. Territorial constraints are particularly tough to assess given the moving nature of the activity. The average grade is 4.9.

2.4 Regional evaluation: the *Grand Ouest*

Whereas all data on direct jobs are available on a very low territorial level, the number of indirect jobs was initially only available at a national scale. An additional work allowed us to get further information on indirect employment in the French *Grand Ouest*. This area, located on the north-west part of France, is formed of four regions: Brittany, *Haute Normandie, Basse Normandie* and *Pays-de-la-Loire*. It gathers only 16 % of the French population, but 21 % of farmland and, most importantly, a great part of all animal productions: 51 % of dairycows, 26 % of beef cattle, 72 % of pigs and 58 % of poultry. The regional evaluation of indirect jobs as been conducted on 45 operators out of the 135 we considered in the national study. Those operators were accountable for 85 % of all indirect jobs.

The results show that 39 % of French indirect jobs are located in the *Grand Ouest* region (152,000 FTE). Regarding on-farm jobs dedicated to livestock operations, this share is slightly lower, as a third of direct jobs are in these regions (102,000 FTE).
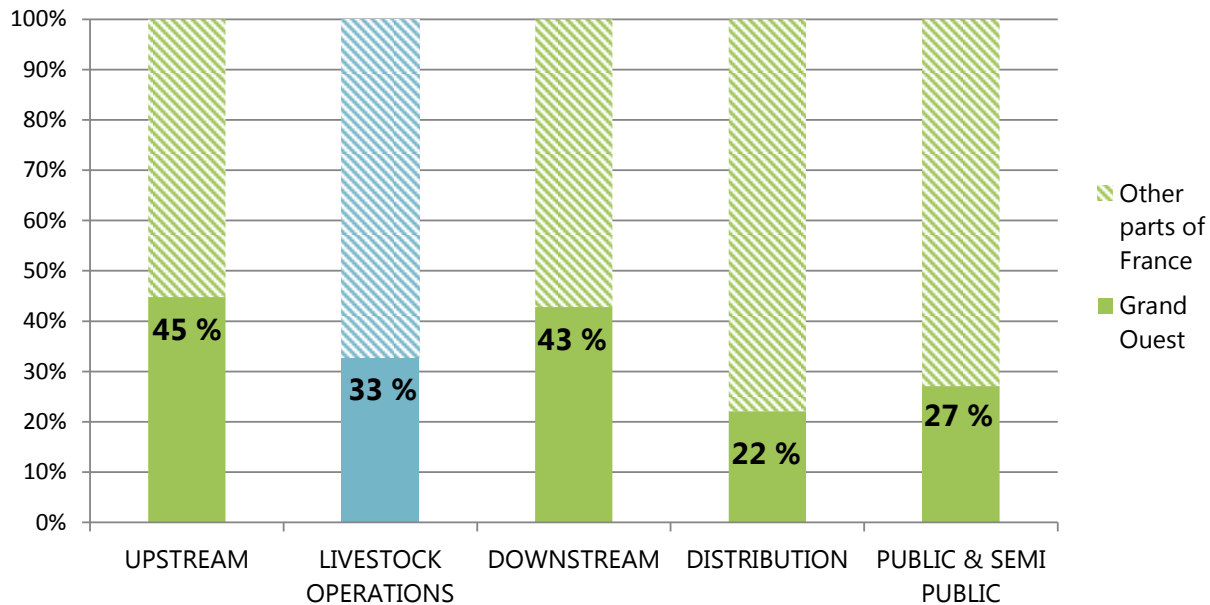

Figure 3: Share of *Grand Ouest* region in livestock-related jobs in France

The share of *Grand Ouest* is quite variable according to the sector considered (Figure 3). Upstream and downstream sectors are more present in this region by comparison to livestock operations. On the contrary, only 22 % of distribution jobs are located in the *Grand Ouest*.

These differences make sense considering the respective territorial constraints of these sectors. Distribution and public sectors have a geographic dependency under average, meaning their distribution on regional level doesn't match the livestock farms distribution. In this case, they seem to be closer to the *Grand Ouest* share of French population (16 %) than to the livestock one.

Upstream and downstream sectors had much higher territorial dependencies, with respective weighted averages of 9.5 and 7.1 grades. In regard to Table 3, those dependency levels are between region and department level. We should therefore expect a number of indirect jobs strongly correlated to direct jobs.

However, given production levels, it seems that labour productivity in the *Grand Ouest* is significantly higher than in the rest of France. As our dependency evaluation is based on the activity and not the jobs number of the direct sector, indirect employment is actually linked to productions levels. Besides, we observed on national level a strong variability in the indirect/direct jobs ratio depending on the species. Pork production, which is particularly important in the *Grand Ouest*, has the highest ratio of indirect jobs per direct jobs. It is therefore quite logical that upstream and downstream sectors have a higher share of the national employment than livestock operations.

CONCLUSION

This work provides a detailed map of livestock-related jobs, and gives a precise number of direct and indirect jobs on national level. This information can contribute to a better understanding of livestock value chain, and help quantify one of the socio-economic impacts of livestock operations in France. These indirect jobs are quantified with a clear and explicit method that takes into consideration economic and territorial aspects of dependency.

Perspectives are wide for the use of this method. As it is not specific to the agricultural sector, it could therefore be applied in other sectors. More generally speaking, many economic studies could benefit from this evaluation method.

This dependency evaluation have however been reduced here to a linear degree of dependency. An interesting development could be to consider operators not only according to the level of dependency, but to also take into consideration its nature. This way, we could have a better understanding of the kind of impact (short or long-term, global or local…) that would have an effect, and of their possible reactions.

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