CLASSIQUES GARNIER

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Résumé – Cet article analyse la transformation du secteur agricole et le passage d'une agriculture industrielle à une agriculture servicielle. Nous examinons en particulier le concept de servitization qui apparaît encore insuffisamment élaboré, et nous montrons que ce concept est beaucoup plus large qu'une simple adjonction de services à l'offre agricole traditionnelle. Nous mettons ainsi en évidence le rôle important de la relation de service et plus largement de la diffusion d'une culture du service et des services sous-jacentes à la servitization. Nous discutons ensuite les impacts de la servitization sur le développement durable en insistant plus particulièrement sur le volet social.

Mots-clés – industrialisation, servitization, agriculture, développement durable

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Abstract – This article analyses the transformation of the agricultural sector and the transition from industrial to service-based agriculture. In particular, we examine the concept of servitization in agriculture, which is still poorly investigated, and show that it is much more than the simple addition of services to the traditional agricultural offer. We thus highlight the important role of the service relationship and, more broadly, of the propagation of a service culture underlying servitization. We go on to discuss the impacts of servitization on sustainable development, with a particular emphasis on social aspects.

Keywords – industrialization, servitization, agriculture, sustainable development

FROM INDUSTRIALIZATION TO SERVITIZATION IN AGRICULTURE

Consequences for sustainable development

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INTRODUCTION

The agricultural sector has been undergoing considerable change – marked by a genuine scientific and technical rationalisation of its production methods – ever since the 1950s. The rapid intensification of agricultural production (usually referred to as the "green revolution", though it is in fact the forced industrialization of agricultural production) has been characterized by an unprecedented rise in both returns and productivity. Nevertheless, it has generated many negative externalities, and these have driven new paradigms and agricultural trajectories.

The 1950s to 1990s had been characterized by a vast movement of uniformization and standardisation of the agricultural product, but from the mid-1990s onwards, there was a real complexification of this product, as well as an increasing tertiarization and servitization of agriculture. These phenomena of tertiarization and servitization, which have been widely discussed in the literature with regard to industrial sectors (Martin Pena *et al*., 2018; Vandermerwe and Rada, 1988; Baines *et al*., 2009; Crozet and Milet, 2017; Lightfoot *et al.* 2013, Ahamet *et al*., 2013) have been somewhat neglected in the case of agriculture. This

is all the more surprising given that this sector has a strong link with sustainable development.

The purpose of this article is to discuss the changes affecting the agricultural world, particularly in France. In the first section we address the still-dominant trajectory of industrialization of the agricultural sector, highlighting the main characteristics of this industrialist and productivist vision of agriculture. Alongside over-industrialization of the sector, this productivist orientation has generated a number of negative externalities that are shocks, and have upset the previous natural balances. Section 2 is devoted to an analysis of these shocks. In Section 3, we set out the different forms of tertiarization and servitization affecting the agricultural world. In so doing we identify four trajectories (sometimes opposed, but generally overlapping), representing ongoing modifications to productive logics in agriculture. These trajectories, which are integral to servitization, are not enough to characterize these dynamics in a satisfactory manner. In Section 4, we discuss how servitization also encompasses both a new way of thinking, and a cultural transformation in terms of the agricultural world and beyond. We are particularly interested in the significant phenomenon of increasing agricultural product complexity, which is at the heart of the logic of servitization. Along with agricultural tertiarization more generally, this servitization is (likely to be) correlated with sustainable development issues. The final section is devoted to an analysis of these links and their possible underlying contradictions.

1. INTENSIVE AGRICULTURE AND THE INDUSTRIALIZATION OF AGRICULTURE

At the end of the 1950s, France witnessed an agricultural revolution that, as observed above, has paradoxically been described as "green". During this period, "traditional farming knowledge" has gradually given way to a phenomenon of rapid and massive industrialization of agriculture, i.e. to the emergence of so-called intensive agriculture, characterized by the intensive use of inputs in a bid to maximise

production. This intensive (or productivist) agriculture is based, firstly, on the use of inputs (chemical fertilizers, pesticides, herbicides, fungicides and insecticides or other growth regulators)[1] and secondly on the twin dynamics of powerful mechanisation and substitution of capital for labour. More precisely, the industrialization of agriculture (or the integration of industrial logic into the agricultural domain) was based on four main developments (Néfussi, 2007):

- Use of scientific and technical knowledge to rationalise production (especially knowledge originating from INRA and the Technical Institutes of the Chambers of Agriculture)
- Use of capital to replace or support labour. This capital/labour substitution includes not only investment in equipment or buildings, but also "circulating capital" (fertilizers, phytosanitary products, etc.)
- Regrouping and broadening of land ownership, supported by public policy
- Relevant long-term financing mechanisms provided in particular by the Crédit Agricole bank and public authorities (via the Common Agricultural Policy).

Agriculture has adopted concepts and methods widely used in the industrial world. The initial success of the productivist industrial agricultural model lies in the extension of "industrial and industrialist logic" to agricultural production. The rapid industrialization of agriculture contributed to a sharp reduction in production costs and a drastic increase in yields and productivity. In other words, there has been accelerated massification and standardisation of agricultural production, which have also been largely driven and fuelled by the needs and demands of the agro-food industry and supermarkets – themselves responsive to changes in consumer behaviour.

Between 1950 and 1990, then, agricultural productivity levels were multiplied by about 7.5, that is, far more than during the eight to nine millennia from the invention of agriculture to the World War II (Bruges Group, 1996). At a more granular level, the yield per hectare of wheat

1 In terms pesticide and fertilizer use, French agriculture ranks third and fifth worldwide, respectively.

increased steadily from just over 20 quintals in the 1950s to almost 75 quintals today (*cf.* Gallouj and Viala, 2021).

Industrialization and agricultural modernisation have certainly generated positive externalities; the application of industrial methods and processes to agriculture has undeniably helped put an end to food insecurity (especially in western countries). It has also led (to some extent) to an improvement in public health. Indeed, by contributing to the fall in the price of animal proteins, agriculture has led to better nutritional balance. At another level, it should also be noted that, thanks to mechanisation, industrial agriculture has also contributed to drastically reducing the drudgery of farm work. Nevertheless, it has also generated shocks that reach far beyond the agricultural world, in the strict sense.

2. INTENSIVE AGRICULTURE: SHOCKS AND NEGATIVE EXTERNALITIES

While intensive agriculture has had many positive effects in terms of increased production and yields, it has also resulted in multiple negative externalities. Using Charvet and Levasseur's approach to analysis through the prism of shocks (2018)[2], we consider the industrialist logic massively applied to the agricultural world to have brought about five shocks relating to: i) demography and social issues, ii) territory, iii) landscape, iv) environment and v) health.

2.1. A DEMOGRAPHIC AND SOCIAL SHOCK

Intensive agriculture has led to a significant decrease in the farming population, directly induced by greater concentration at farm level. In 2020, the number of farms in France was around 430,000 – down from around 920,000 in 1990, and more than 2.3 million in 1955. The number of people working in agriculture is less than one million today, compared with six times as many in the mid-1950s. Thus, the relative

2 The authors identify three major shocks: demographic, territorial and landscape.

share of large farms has increased considerably throughout the country, to such an extent that the average utilised agricultural area (UAA) in France is now over 60 ha compared with just over 30 ha in 1990.

2.2. A TERRITORIAL SHOCK

The trend of farm concentration has been accompanied by a high degree of specialisation. Indeed, while for a long time French farms were dominated by polyculture, they gradually evolved towards a significant territorial and regional specialisation. Charvet and Levasseur (2018) highlight three new regional agricultural specialisations:

- the Paris basin and, to a lesser extent, the Aquitaine basin – specialised in cereals and oilseeds (requiring industrial fertilizers)
- Western France (and Brittany in particular) – specialised in industrial animal production, with harmful ecological consequences (especially due to nitrate use)
- the Midi-Pyrenees area and part of the Rhone valley – specialised in wine and fruit production (requiring phytosanitary treatments)

2.3. A LANDSCAPE SHOCK

Landscape shock refers to the dramatic transformation of rural landscapes, largely linked to the two previous shocks. Charvet and Levasseur (2018, p. 59) thus evoke multiple phenomena as having resulted in this transformation, and in particular "major land consolidation operations and/or *bocage* destruction in the western France, where the *bocage* had been the expression of a centuries-old landscape- and for some, even a heritage value". The landscape gradually became uniformized, with a significant reduction in grassland and the disappearance of hedges on many plots of land, due to the needs of motorised mechanisation. The profound changes and homogenization of the landscape, together with the increasing scarcity of hedges and copses (formerly vital refuges for wildlife), contributed to higher risk of flooding and loss of biodiversity.

2.4. AN ECOLOGICAL SHOCK

Although ecological shock partially covers some earlier shocks (demographic, territorial and landscape shocks in particular), the term can also be applied more broadly. As we have seen, these first three shocks also have their consequences – such as water pollution, global warming, the drastic reduction in biodiversity and the waste (and non-renewal) of resources.

Water pollution. Intensive agriculture is considered the main cause of surface and ground water pollution. At least three sources of pollution are worthy of mention: i) livestock effluents which, when carried away by water, mineralize and are transformed into nitrates; ii) synthetic nitrogenous fertilizers intended for field fertilization (cereals, rapeseed, beet, etc.), but which are only partially absorbed by the crops and end up in groundwater; iii) nitrates from pesticides and herbicides – widely used, for example in Brittany[3].

Global warming. The issue of global warming is also regularly highlighted as a negative externality of intensive industrial agriculture. This kind of agriculture is indeed responsible for more than 20% of greenhouse gases, making it the fourth largest contributor to global warming – after transport, industry and housing. Moreover, according to some estimates (*cf.* Dufumier, 2020), agriculture's contribution could even reach 30% – making it the second largest contributor to climate warming.

Reduction in biodiversity. The spread of industrial logic and industrialist culture has led farmers to seek to limit the variety of their crops and production as much as possible, in order to reduce their production costs. At the same time, the use of motorised systems (whose optimal performance can be achieved only over large surfaces) combined with increased use of chemical inputs (herbicides, insecticides, antibiotics, vaccines, etc.) not only directly impacts plant and animal variety[4] and wildlife, but also causes lasting damages to soil.

3 Green algae pollution in Brittany is linked to the influx of nitrates directly correlated with industrial agriculture and the concentration of livestock farming in this region (Dufumier, 2020).

4 Over the last two decades, France has lost a third of its birds.

Linear logic and non-renewal of resources. Industrial agriculture is based on a linear model of the economy which follows a number of stages that can be summed up as extraction, manufacture, use and disposal. As Dufumier (2020, p. 169) puts it, "industrial agriculture is a so-called 'mining' agriculture. It exploits the land without regenerating the organic matter and mineral elements that make it fertile, just as the mining industry extracts minerals from the soil without renewing them". The linear industrial model that still prevails today is no longer viable on a finite planet (that is, a planet characterized by the finiteness of resources). Of course, the ecological shock is not, strictly speaking, the result of agricultural industrialization. At the time of the Anthropocene (*cf.* Valiorgue, 2020), it is linked to all human activities. However, it cannot be denied that productivist agriculture has played a very important part in it.

2.5. A HEALTH SHOCK

Intensive agriculture has also generated many negative externalities that directly impact human health. The elements most often discussed in the literature are, for example, the rise of obesity (even its endemic nature, in certain geographical areas), increased resistance to antibiotics, etc. More generally, the various health crises that have punctuated the end of the 20th century and the beginning of the 21st are also a reflection of agricultural and food industrialization.

Given all these shocks, the move away from the intensive, industrialist agricultural model is a necessity. The development of service-based agriculture (or more generally, the movement towards the tertiarization and servitization of agriculture and its products) is among the most original avenues mentioned in both academic and professional literature, as means of effecting this fundamental change. This service-based logic (in certain dimensions at least) is already being put to work in current agricultural practices.

3. SERVICE-BASED AGRICULTURE AND AGRICULTURAL TERTIARIZATION

To date, tertiarization and agricultural servitization can be analysed through the prism of four distinct (though possibly overlapping) trajectories that reflect varying relationships to services. In the first trajectory, agriculture provides the community with a range of (most often) non-market services (though there is a strong tendency towards their commodification). In the second trajectory, the farmer is becoming an intensive consumer of various market services – and in particular advisory services. In the third, agriculture is becoming a genuine provider of market services, mainly (but not exclusively) for the end consumer. Finally, the fourth trajectory addresses the question of tertiarized agricultural production in which the increasing complexity of the agricultural product leads – beyond the "product" – to a logic of offering "agricultural solutions".

3.1. AGRICULTURE AND (NON-MARKET) SERVICES TO THE COMMUNITY

It is not totally new to claim that agriculture provides (both market and non-market) services to the community. Guillaume Morel Cheviller (2018), for example, notes that, in the course of the 19th century, the city and the farmer were models in terms of material flows management. To farmers, urban organic waste was a major productive resource. According to Roy (2015), "farmers of the peri-urban areas of Paris were already collecting a wide variety of urban organic waste[5]", which they transported out of the city on carts, and spread over their fields (Gallouj and Viala, 2021). Today, agriculture also produces a number of joint-services, i.e. services that are both an extension of agricultural activity and beneficial to the whole community. Many of these services are provided involuntarily. As Agnès Terrieux (2014, p. 138) points out, "through its primary activity,

5 Horse manure in particular because Paris had more than 100,000 horses at the end of the 19th century; slaughterhouse effluents, brewery draff, mushroom millstones, domestic green waste, etc. (J.-M. Roy, head of the heritage unit at the Courneuve town hall in Seine Saint Denis, Oral presentation:"Let's cultivate the city" conference, 15th September 2015).

the farmer can, for example, make an attractive landscape available to all, and ensure respect for biodiversity or water quality". Néfussi and Aznar (2007, p. 538) stress the positive impact of permanent grassland in mountain areas, observing that "these meadows make it possible to preserve biodiversity and water quality and combat erosion, and in the same way, certain agricultural landscapes (*bocage*, vineyard landscapes, terraced farming landscapes, etc.) are appreciated by tourists and residents for their landscape qualities." Lastly, Blanc (1997, p. 11) notes that "one of the joint products, inseparable from agricultural production (from the farmers' point of view) is the maintenance of space". This observation makes it possible to "distinguish farmers (who maintain space for little reward) from other social groups who enjoy doing so during their leisure time, or for their own pleasure"… without paying for it.

Farmers have regularly fulfilled missions of collective interest that are comparable to the production of environmental services or services to territories (as opposed to services to people) in a logic of joint products. Yet as Terrieux (2014, p. 139) points out, municipalities – as well as other local and territorial authorities – are increasingly calling on these farmers (especially in sparsely-populated rural areas), "to maintain roadsides, clear snow or participate in landscaping development such as undergrowth maintenance" and to maintain "on their plots of land a conservatory of locally-cultivated biodiversity, most often by establishing conservatory orchards or vineyards – which they look after and whose heritage they disseminate to individuals and plant breeders alike".

The role of the farmer as a provider of environmental services to the community has often been highlighted in the context of discussions on the circular economy and the future of agriculture. The French roadmap for the circular economy as applied to agriculture (2019, p. 9)[6] recognises this sector as an important provider of environmental services – mainly through the treatment and recovery of urban effluent and other city-produced organic waste by spreading it on the land. "As a recycler of biodegradable waste from communities and economic actors, the farmer is a service provider. He is thus a key operator in the treatment and recovery, on agricultural land, of organic waste from the

6 "Volet agricole de la feuille de route pour l'économie circulaire" ["Agricultural part of the roadmap for the circular economy"], French Ministry of Agriculture and Food, February 2019.

territory. The recovered tonnage should increase in the coming years due to the recycling objectives set by the law on Energy Transition for Green Growth, particularly with regard to bio-waste".

The environmental or territorial services we are reporting on have become a strategic issue in peri-urban and rural areas, in that they give rise to a number of theoretical debates regarding their funding possibilities and modalities – since a certain number of them are, as we have seen, free joint products.

3.2. THE SERVICE-CONSUMING FARMER OR THE OUTSOURCING LOGIC APPLIED TO AGRICULTURE

The increasing tertiarization of contemporary economies has often been explained as the effect of outsourcing by the industrial sector (Rousset-Deschamps, 1984; Lichtenstein, 1993). Since the 1990s, numerous studies (Gallouj *et al.*, 2006; Niel and Okham, 2007) have shown that this outsourcing logic also heavily affects the service sector itself. Therefore, agriculture has also been contributing to the tertiarization of economies by increasingly resorting to the use of external services – regardless of their mode of governance. Indeed, farmers are increasingly using external service providers for both the management (in the strict sense) of their farms and their strictly agricultural activities.

There has thus been a remarkable increase in the services required for the smooth running of a farm as well as, more generally, an increase in the use of services such as expertise and consultancy (accounting, invoicing, advertising, fairs and exhibitions, etc.). Though no recent information is available on this point, the French national statistical office (INSEE) reported that farmers' expenditure on management and consultancy already amounted to more than 1.2 billion, even back in 2005 (Chevalier, 2007).

Indeed, farming is characterized by a growing need for information, research, advisory and support services to help and guide decision-making. Of course, these are not radically new practices, and industrial logic has itself stimulated demand for such services. As Louis Reboud (1997, p. 140) has already noted, farmers need services and advice to help them in "the choices they have to make to maximise their production and income: choice regarding the specialisation of the farm, which is increasingly mono-productive; choice of equipment and investments to

be made; choice of plant seeds and animal breeds; choice of fertilizers, herbicides, pesticides, insecticides, etc." Nevertheless, it is above all as a result of the transformations of the industrial model and the search for greater differentiation that the need for services will see renewed growth. These services also help farmers keep pace with the increasing complexity of the agricultural product, in the sense that, as stated by Orio Giarini (1986), they equip farmers to navigate greater uncertainty and complexity. As agricultural systems become more and more complex, services are needed as a means of anticipating, overcoming and reducing consubstantial vulnerability to these increasingly complex systems (see also on this point Giarini and Stahel, 1989). It is significant to note that farmers are, for example, the main clients of services offered by meteorological service centres.

Use of external services within the agricultural community is also extremely widespread in the area of human resources. Again, this is not entirely new, and the traditional practices of tenant farming and sharecropping can be considered a form of human resources outsourcing. In recent times, the development of contract work has also been part of this logic, as has the use of cross-border seasonal work, in some regions. Agricultural contract work is a form of delegated agriculture, an agreement whereby a principal who owns agricultural land asks a third party to exploit all (or part) of it and pays for the service provided. Thus, in France, many agricultural work companies have entered this niche, which is also increasingly popular among CUMAs[7] (Hébrard, 2001). The use of seasonal workers, including cross-border workers, is another facet of the agricultural sector's use of HR services (and outsourcing). OMI (now ANAEM[8]) workers are part of an outsourced labour logic similar to that of temporary agency work. This foreign workforce is highly valued in that it offers "the combined advantages of availability, docility and tolerance to working and living conditions" (Morice and Michalon, 2008, p. 12).

However, the trajectory of service use and outsourcing remains both ambiguous and ambivalent. It could even mean decreases in both the

7 Coopérative d'Utilisation de Matériel Agricole. Cooperative for the Use of Agricultural Equipment.

8 In 2005, the Office for International Migrations (OMI) became the National Agency for the Reception of Foreigners and Migrations (ANAEM).

service *component* of agriculture and the service *content* of the "agricultural product". In reality, this externalisation is complex: one sector (services) gains what the other (agriculture) loses. In the case of the increased use of services by agriculture, outsourcing runs parallel to a very strong growth in both need and demand. Moreover, this recourse to services, whether private or public, remains largely focused on the agricultural sector itself. In other words, the service providers are essentially part of the agricultural field and universe. More fundamentally, however, the fact that recourse to external services (whether public or private) considerably reinforces the very service content of the agricultural product is beyond doubt – regardless of whether these services are integrated upstream (invisible to the customer) or downstream, accompanying the agricultural product (thus visible, from the customer's point of view).

3.3. SERVICE-BASED AGRICULTURE, OR THE FARMER AS A PROVIDER OF MARKET SERVICES

Since the early 1990s, a number of studies (Reboud, 1997; Muller, 1991; Néfussi, 2004; Le Roy, 2007) have highlighted the orientation of agriculture and farmers towards a structured offer of "farm services"; in other words, the development of a service-based agriculture defined as bringing together "all the economic practices where the farmer uses the assets of the farm to develop an activity of selling 'farm' services either linked to agriculture or integrated into a local economic logic" (Muller, 1991, p. 67). The provision of agricultural services can be divided into three distinct fields: training and support, reception and accommodation, and food and nutrition. More recently, a diversified range of local and personal services has also emerged.

The services offered may correspond to an extension of the farm's activities via the mobilization of existing agricultural skills. Other trajectories mobilize craft or technical skills that are complementary to agricultural skills. Some also refer to the integration of radically new skills that go beyond the traditional field of agricultural expertise. On this basis, Muller (1991, p. 68) distinguishes a number of agricultural or farm services[9] (see Table 1).

9 The author also refers to a number of non-market services (snow-clearing, river maintenance, rural entertainment, mail distribution, etc.) which, in our view, have specific status and were discussed in section 3.1.

Tab. 1 – Typology of "farm services"
(Source: according to Muller, 1991).

Type of service	Characteristics and examples
Services corresponding to an extension of the farm's activities, using agricultural skills	Horse boarding and related services, setting up an agricultural service business, tree care and pruning, forest maintenance, second home maintenance (gardening), consultancy activity in the design and implementation of farm buildings
Services related to tourism activities in which the farmer uses the farm as a support for the provision of hospitality or recreational activities related to the farm's natural environment	In addition to the classic farm accommodation offer, many other examples exist: mountain guides, nature guides, horse-riding, provision of socio-cultural courses (silk painting, music culture, etc.), educational farms, farms offering sports services, etc.
Services related to craft or technical skills that are complementary to agricultural skills	Farm-based catering, wood craftsmanship, plumbing and maintenance work, computer science

The emergence of farm services – in other words the appearance of a structured service offer from farmers – is both reactive and proactive. Some studies (Reboud, 1997; Le Clanche, 2014; Terrieux, 2014) have thus shown that agricultural diversification towards services refers to a survival logic. It is the marginalised farmers and small farms who most often develop a service offer that appears necessary to the farm's survival and sustainability. As Le Clanche (2014, p. 99) points out, "some producers joined the resistance back in the 1970s, and have come up with 'alternative' ways of farming. Service activities were thus created on farms, often small businesses in search of additional income".

We note another highly-original trajectory – one that is much more proactive and resembles a form of militant resistance. It refers to entrepreneurial practices implemented by both new and old actors, described as neo-farmers. These people often come from horizons other than agriculture in the strict sense of the word. They are in search of new ways of life, and are part of an entrepreneurial logic. As a result, they develop all the material and immaterial resources that the farm

is likely to offer, and also dream up innovative service offers that may or may not be linked to the agricultural product.

Flament-Ortun and Macias (2018, p. 41) write of these neo-farmers: "they set up on smaller than average plots. They then move towards such promising markets as organic farming, often differentiating themselves from traditional farms by producing a diverse range of products: ancient vegetables, aromatic and medicinal plants, sheep, etc. They compensate for the small size of their farms through high value-added activities, and bypass intermediaries either by selling directly or by processing their products as much as possible. This is also sometimes complemented by activities such as agrotourism or educational sessions".

3.4. PRODUCT COMPLEXITY, SERVICE-BASED AGRICULTURE AND THE LOGIC OF "SOLUTIONS OFFERING"

As we have seen, the industrial (and also industrialist) period favoured the production of massified agricultural goods. This massification was based on a high degree of standardisation and simplification and it led to the agricultural product becoming a basic raw material for the food industry. Indeed, it was this very desire to reduce costs through the mass effect and standardisation that served to reduce both the dimensions and the scope of the agricultural product to its simple material dimension.

Since the 1990s, there has however been a movement towards greater complexity in agricultural output and products. This was determined partly by new consumer expectations – and thence through the emergence of new registers on which their needs were based: contribution to health and nutritional balance, food safety, beauty, physical and mental fitness, product freshness, authenticity, culture – and more recently cultural identity (*cf.* Néfussi and Aznar, 2007). In our view, there are several stages to this complexification of the agricultural product (see Figure 1).

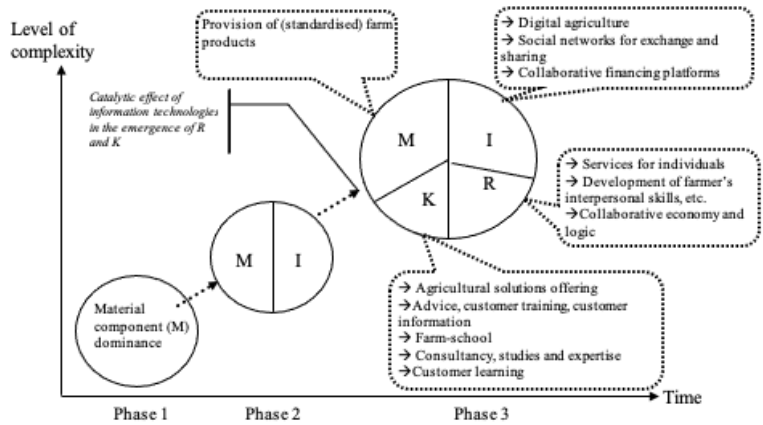

FIG. 1 – The complexification trajectory of the agricultural product.

There is a shift from an initial phase in which the agricultural product is dominated by the material dimension (or more precisely by logistics and material processing operations) to a phase marked by the integration of logistics and information processing operations. This second phase is a catalyst for a third phase – marked by the advent of the cognitive and relational dimensions.

The first stage of complexification of the agricultural product is based on a very strong increase in the product's information content. Digital agriculture reflects a convergence between agriculture and ICTs whose aim is to respond to the changes linked to the new logics of modern agriculture, themselves developed in response to changes in consumer consumption and food issues. In other words, digital agriculture, and the increase in the information content of agricultural supply and products, are aimed at offsetting the negative manifestations of agricultural industrialization. Thus, for example, farmers have implemented new risk control and management methods in the form of HACCP (Hazard Analysis Critical Control Point), various certifications, ISO standards, etc. More generally, the invasive nature of ICTs in the agricultural world is expressed at the level of the individual farmer him/herself (offer of support services), at the farm (operations optimisation) and the territories (adaptation of production to market, management of water

resources, waste treatment, etc.). Each material logistic flow demands an increasingly heavy immaterial flow of information processing. Above all, though, both the information flows and the ICTs that underpin them play a central (or even catalytic) role in the development of the other cognitive and service dimensions.

Industrial and intensive agriculture has greatly impoverished the relational dimension of agricultural activity; the relational and service-oriented content of output has been drastically reduced. This impoverishment is reflected first at the farm level, where mechanisation has dramatically reduced the need for the mutual aid and cooperation that were traditionally common currency in the agricultural world. Farmers now spend more than a third of their time on their tractors, and are able to carry out a number of tasks alone that in the past required cooperation between neighbours. Moreover, the farmer is also involved in a broader range of both upstream and downstream relations. Thus, as Le Clanche (2014, p. 98) observes: "the modern farmer has gradually become… integrated into a sector open to national and international trade. It was necessary, in order to sell this production, to call upon intermediaries – often cooperatives. As a result, farms lost control of the relationship that linked them directly to the consumer. Farming systems have become 'heteronomized' and lost their autonomy… The farm is gradually becoming 'off the land and out of the territory'."

Digital agriculture plays a significant role in strengthening links with consumers; new contacts can be made via the digital platforms that bring the players together. Farmers can thus communicate about their products, production methods, and even the preparation methods of the products in question. Digital and informational logic also makes it possible to revive the old relations of mutual aid and collaboration that existed between farmers and were destructured (or even annihilated) by the industrial model (social network for exchange and sharing between farmers, participatory financing platform, etc.).

The knowledge intellectual processing (or cognitive) dimension of the agricultural product seems, a priori, more difficult to define. It is, however, very real and denotes a considerable growth in the farmer's expertise (Labarthe, 2005; Labarthe *et al.*, 2013), acquired either through initial or on-the-job training. This expertise is often used to provide specialised consultancy services (sometimes even at

international level). At local level, this expert positioning increasingly helps the farmer understand the problems and functions of users (of the agricultural product), regardless of whether they are agri-food industry, agricultural trade, wholesalers, distributors, restaurant owners or even end consumers. He is capable of both understanding them better, and integrating them into his supply system. The farmer is thus less and less a supplier of inert, simple, raw materials, and more and more a "provider of solutions" (to the problems of the manufacturer, the intermediary and the distributor, and to the precise demands of the consumer).

The specialised literature (Néfussi, 2007; Lorino and Néfussi, 2007) provides many examples of agricultural outputs in which "product logic" is replaced by a (usually co-constructed) "solution logic". Néfussi (2007) discusses how the potato has shifted from being a simple, basic product to being a "complex service product" whose design and production takes account of both its washability and its intended "culinary use". There has been a very rapid transition from production of a banal product intended for universal use to production of a wide variety of potatoes, each with its own specific culinary use – and for the most part, this is also known and valued by consumers.

The evolutions and transformations evoked in the case of the potato are also at work in the dairy sector, where the need to respond to the technical problems of cheese production (or simply product differentiation) is central to the competitive logic, and leads to collaboration in the production of differentiated milks from the beginning of the chain. The same logic prevails for most other agricultural products and chains – especially for the so-called vegetal chains. The cereal sector produces special wheat for the different, specific uses envisaged (general food, child food, etc.). The same is true of the wine sector, with the costs of vinification being closely linked to the characteristics of the grapes, etc.

4. COMPLEXIFICATION OF THE PRODUCT, SERVITIZATION AND SERVICE-BASED AGRICULTURE

Paradoxically, despite the multiplicity of existing publications, the notion of servitization, remains a fairly vague notion. The outlines of industrial servitization remain fuzzy, but those of agricultural servitization are fuzzier still. In the literature, the meanings of servitization – whether applied to industry or agriculture – refer to different logics that largely overlap with the four concepts discussed in Section 3. In other words, for some authors, servitization simply consists of the addition of "services around the product". In this instance it is limited to meaning the multiplication of the offer of peripheral services linked (or complementary) to a given agricultural product. Servitization is also sometimes confused with a single one of its dimensions, which refers to the "consumption of services" by the agricultural sector. These services, which may be provided by the public or private sector, may be operational (routine services) or advisory (advanced services). Another conception of servitization falls within the scope of an economic logic in which the product is seen from the perspective of how it will be used, consumed, etc. – in other words, what service it will provide to the consumer – rather than as a disembodied entity. It is, then, a question of replacing the sale of a good by the sale of a service, or of an integrated solution fulfilling the usual functions of the good (or even extended functions). This perception of servitization is based on the well-known economy of functionality, economy of performance and economy of access models.

These concepts are, however, no more than fragmented and intermediate dimensions of the process of servitization. In our view, servitization is a much deeper process which goes beyond the addition of services, the provision of services or the simple integration of a logic of use… even though it does encompass all of these. Servitization is based on a real complexification of the agricultural product – but it is also based on a transformation of the practices and logics of functioning and thinking of the agricultural world as they were shaped by the model of intensive or industrial agriculture, during the period from the 1950s to the 1990s.

Indeed, within this model, agriculture has adopted the concepts, methods, tools and processes of manufacturing. It is now a matter of adopting (and sometimes adapting) concepts, logics and methods typical of the service economy and society. More fundamentally, for agriculture it is as much a question of becoming part of a service relationship as it is of developing a real culture of service and services. Indeed, as we pointed out in the previous section, where the farming world used to be a place of cooperation and mutual aid, motorised mechanisation and intensive agriculture have reduced its relational content, both upstream and downstream. Yet the logic of servitization makes it possible to bring the "service relationship" back into the heart of the agricultural world.

The development of a real culture of service(s) within the agricultural world takes the form of collective learning – of service practices, standards and values – undertaken by the market's various individual actors and by multi-agent networks. The logic of servitization is also based on the activation and mobilization of personal networks of farmers' collectives or individuals who know (or get to know) each other, and work together. These servitizations of agriculture falls within the scope of what Desmarchelier *et al.* (2020) calls "the servitization of (innovation) networks". These networks are multiple and reach beyond the strict framework of the farm. They include the five following categories:

- Networks of farmers who may belong to the same field or type of activity and who may carry out joint projects aimed at consolidating the collective they form; these networks are specialised.
- Networks of suppliers who operate according to the same logic as the previous category. In other words, they may be part of the same activity, or of complementary activities. In this context, reference should also be made to the many public-private partnerships that can be set up around a market or innovation theme.
- Networks of consumers, established in relation to their needs and the difficulties they are likely to encounter in identifying, selecting and choosing suppliers (and in their "management"). These consumer networks may constitute communities, tribes based on common interests, common practices and customs,

or common philosophies of life. The emergence of movements such as the "locavores" who value proximity in their food purchases is obviously part of this logic.

– Networks and connections (between farmers and agri-suppliers, farmers and agri-food industries, farmers and distributors, or farmers and consumers) aimed at facilitating circulation of both information and shared knowledge, and sometimes at carrying out projects of common interest.
– Extended networks involving a multitude of other actors or stakeholders who have (or could have) influence, at any level, on the promotion and dissemination of a service logic. More generally, the aim here is to develop and diffuse broader knowledge of agricultural servitization, at the level of society as a whole.

These networks highlight the importance of the interplay of cooperation, collaboration and mutual aid in an agricultural world that certainly is offering more and more services. But, above all else, it is the rediscovery of the service relationship that, as we have seen, used to be at the heart of the agricultural world prior to its "industrial revolution".

5. SERVITIZATION, SERVICE LOGIC AND SUSTAINABLE DEVELOPMENT

What are the environmental impacts of the trajectory of tertiarization and agricultural servitization, and are they systematically positive? Djellal and Gallouj (2012, 2018) have rightly pointed out that in the academic literature, the idea prevails that services would be both greener, and more sustainable, than industry. Indeed, this is material transformation that swallows up natural resources – and consequently has an unfavourable impact on the environment and sustainable development. Thus, services, because of their immateriality, would have an "ecological footprint" generally considered small compared with that of manufacturing and agriculture. However, while it is possible to admit a

certain "environmentally friendly" aspect of services compared to other sectors, the ecological harmfulness of services is undoubtedly underestimated (Fourcroy *et al.*, 2012); the most-tertiarized contemporary economies are not systematically the least-polluting. Following Djellal and Gallouj (2012), we therefore consider that, in the case of agriculture, the tertiarization and development of services and the service logic do not necessarily guarantee increased sustainability. For example, in a work devoted to the place of agriculture and short food channel farmers, Gallouj and Viala (2021) stress that short channels are neither more sustainable (nor more circular) than long food channels – in fact the opposite is true. Short channels do have a number of recognised positive effects. By reducing the distance to be covered from the farmer to the consumer, these short channels contribute to reducing levels of packaging. Short channels also offer real opportunities in terms of waste reduction; direct sales allow better use of "out-of-gauge" products, or products having aesthetic defects. The reduction of packaging is also encouraged by better anticipation of demand – thanks in particular to the subscription system. However, when it comes to transport, things are a little more complex. From a strictly environmental point of view, short channels are a good response to a concern to reduce transport costs and thus have an impact on the levels of greenhouse gas emissions linked to food. Indeed, it is estimated that a third of road transport in France concerns agricultural products and food. Intuitively, it may seem that in the case of short channels, because the distances travelled are shorter, energy consumption and greenhouse gas emissions must be lower. Yet the shorter distance between consumer and producer is not necessarily an advantage – in particular because of the difficulty of optimising logistics. According to ADEME (2017, p. 7), "large quantities transported over long distances in an optimised way can have a much lower 'greenhouse impact' per tonne transported than small quantities transported over short distances in vans that are not completely full and return empty".

Servitization in agriculture does however contribute to sustainable development. First of all, we note that the production of environmental services is a tangible contribution made by the servitization dynamic to sustainable development. Indeed, by taking charge of the industrial model's negative externalities, service-based agriculture makes a de

facto contribution to sustainable development, either reactively or proactively. We also note that by focusing on agricultural solutions (often co-produced with the client), servitization calls into question both the traditional (industrialist) agricultural economic model and its productivist constraint. This makes it possible to sustainably increase turnover without quantitatively increasing production. As Néfussi (2007, p. 314) points out, "selling agricultural solutions means creating an economic model where tonnage is no longer the only economic lever".

Agricultural servitization plays a very active role in producing innovations that are preventive and proactive (education of populations, training in standards or labels, etc.) as well as curative and reparative of damage inflicted on the environment or the socio-economic well-being of individuals (*cf.* Djellal and Gallouj, 2012).

Applied to agriculture and agricultural servitization, the service logic also, and above all, plays an important role in the social dimension of sustainable development. Indeed, while the development of a service offer linked to agricultural activity has allowed the scope of farmers' activities to be extended, it has also opened up new employment opportunities. In an article provocatively titled "Are you doing service farming because you are a woman – or because you have a farm?" Granié and Terrieux (2014, p. 144) reconsider the notion that the new service activities are essentially carried out by women. These activities are traditional domestic functions, yet as they have become market-based, they have provided women with income, emancipation and visibility as workers.

Another important aspect of the role played by servitization and service-based agriculture in the social aspect of sustainable development involves welcoming vulnerable people (at-risk children, disabled people, dependent elderly people, prisoners, etc.) to the farm and to rural areas, which are seen as therapeutic places that produce positive values such as harmony with nature (Mamdy and Terrieux, 2014). Strong links already exist between the logics of agricultural servitization and those of the social and solidarity economy. More generally, agriculture is in a position to listen to social needs, through its servitization and the service relationship this implies. As Louis Reboud (1997, p. 146) pointed out, "because it is typified by face-to-face co-production, the service relationship becomes a tool for dialogue, understanding and mutual listening, and it gives agriculture a social dimension".

CONCLUSION

The remarkable evolution seen in the agricultural sector during the 1990s might even be described as a paradigm shift – the industrialization dynamics of the foregoing decades did indeed give way to a process of servitization. In other words, following a phase of intensive productivism and manufacturing orientation, agriculture is gradually becoming (or re-becoming) relational and service-oriented. The intensive industrialization phase, which lasted from the 1950s to the 1990s, was characterized by numerous benefits in terms of increased productivity and the elimination of food crises. However, it also generated many negative effects that are extremely detrimental both to the environment and to human health. Consequently, the agricultural world is in need of new directions, including a reorientation towards increasing the service content of its output.

This increase in service content follows various logics and trajectories that often converge: the offer of (non-profit) services to communities and territories, increased use of external services (outsourcing), provision of (often innovative) market services and lastly, in the context of the increasing complexity of the product, a shift from a logic of product offering to a logic of solutions offering. All of these orientations belong to the agricultural servitization paradigm – yet servitization also encompasses an often-neglected dimension, namely that of the service relationship and the service(s) culture. Agricultural servitization (the development of a service logic and culture in the agricultural world) significantly impacts all three dimensions of sustainable development: economic, environmental and social.

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