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Official URL: http://dx.doi.org/10.1016/j.jrurstud.2019.09.003
DOI: http://dx.doi.org/10.1016/j.jrurstud.2019.09.003
EPrint URI: https://eprints.glos.ac.uk/id/eprint/7272

The economic potential of agroecology: Empirical evidence from Europe

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[abstract:] This article discusses the economic dimensions of agroecological farming systems in Europe. It firstly theoretically elaborates the reasons why, and under what conditions, agroecological farming systems have the potential to produce higher incomes than farms that follow the conventional logic. This theoretical exposition is then followed by a presentation of empirical material from a wide range of European countries that shows the extent to which this potential is being realized. The empirical data draw upon different styles of farming that can be described as 'proto-agroecological': approaches to farming that are agroecological by nature, but which may not necessarily explicitly define themselves as agroecological. The empirical material that we present shows the huge potential and radical opportunities that Europe's, often silent, 'agroecological turn' offers to farmers that could (and should) be the basis for the future transformation of European agricultural policies, since agroecology not only allows for more sustainable production of healthier food but also considerably improves farmers' incomes. It equally carries the promise of re-enlarging productive agricultural (and related) employment and increasing the total income generated by the agricultural sector, at both regional and national levels. While we recognize that agroecology is a worldwide and multidimensional phenomenon we have chosen to limit this analysis to Europe and the economic dimension. This choice is made in order to refute current discourses that represent agroecology as unproductive and unprofitable and an option that would require massive subsidies. [end of abstract]

Agroecology in Europe

Wezel et al. (2009) conceptualize agroecology as having three-prongs: embodying a scientific discipline, a social movement and a set of practices. These three aspects have different relative weights in different contexts: in France the practice is strongly emphasized; in Germany the scientific discipline, and in Brazil the social movement. There is a need to develop all three dimensions in an integrated way, especially in order to foster a transdisciplinary, systemic, approach with the potential to change current agricultural paradigms and support the much-needed socio-technical transition to more sustainable food systems. Altieri et al. (2008) argue that agroecology is the discipline that "provides the basic ecological principles for how to study, design and manage agroecosystems that are both productive and natural resource conserving, and that are also culturally sensitive, socially just and economically viable". The potential of agroecology as a driver of transition has been emphasized by de Schutter (2010), whose report to the General Assembly of the United Nations highlights the contribution of agroecology to the Right to Food, and by the French government which now views agroecology as a key pillar

[1] The authors are grateful to the anonymous reviewers for their detailed and thoughtful comments and critiques of an earlier draft of this paper .

for such a transition (Bellon and Ollivier, 2018). Yet the same authors argue that one of the challenges currently facing agroecology is "negotiating these articulations" and particularly the differing approaches to agroecology adopted by the policy and scientific communities and CSOs (*ibid.* p.20).

In theoretical terms the specificity of agroecology-as-practice has been clearly and extensively outlined (Altieri, 1990, 1995; Sevilla Guzman, 2007; Gliessman, 1997, 2007; Petersen, 2018; Rosset and Altieri, 2017; Francis et al., 2003; Holt-Gimenez, 2006; Méndez et al, 2015; Guzmán Casado & González de Molina, 2017). Agroecology is an approach to farming and food systems that is based, as much as possible, on the use of natural resources and ecological principles and on closing biological cycles at farm or local level. Labour and knowledge play a key role in this. The centrality of natural resources (produced and reproduced on the farm and/or obtained through direct, socially-regulated exchange from farmers and other actors in the food chain) implies a high degree of autonomy that translates into a pillar of economic and ecological resilience.

In reality the development and adoption of agroecological practices follows a variety of different, often unexpected and sometimes, even, contrasting trajectories (Cayre et al., 2018). These can be inspired by different motives, values and discourses, just as the particular contextual settings will have their specific imprint. The different trajectories and practices might be known under different names and the particular histories and spatial distributions of the different experiences vary considerably.

This said, there are also clear commonalities. Firstly, all agroecological practices include a reduction in the use of external inputs and a simultaneous improvement in the quality and use-efficiency of internal inputs. Secondly, all agroecological practices are dynamic: they involve on-going improvements (often supported by farmers sharing their experiences, on-farm experimentation and, sometimes, applied research). Together these many, evolving, practices constitute a process of transition that offers the promise of making agriculture more sustainable and more resilient. Thirdly, analysis of the different practices and trajectories suggest that agroecology (from here onwards AE) improves farming incomes, creates more employment and strengthens the resilience of farms and rural areas.

It is also the case, at least in Europe, that of the many practices that embody these characteristics, only very few are explicitly defined, by those involved, as being agroecological. This is due to two factors: until a few years ago, the concept of AE was hardly known in Europe (apart from small pockets, such as Andalucia in Spain and small groups of specialized scientists) and in discussions between farmers the term is barely used. Yet, at the same time large segments of European farmers, all of them facing an economic squeeze (Owen 1966; Marsden 2003), and the growing imperatives of sustainability, have actively developed new strategies to address these challenges. Reducing their dependency on the agro-industrial complex is often a central element within these strategies: farmers reduce their use of external inputs and seek to increase the use-efficiency of internally available resources. This is rarely a single-step change, more a process that extends over time and occurs through incremental improvements.

In addition to this reorganization of the resource-base there has also been, in many instances, a reshuffling of arrangements 'downstream' of farms. New markets have been developed that link producers and consumers in novel ways, which often yield better off-farm prices (Ploeg, Ye and Schneider, 2012). This often involves establishing new governance mechanisms. The rise of food policy councils (Prové et al, 2016) is one example.

These changes not only enhance the sustainability and resilience of agricultural systems, but also translate into the creation and maintenance of acceptable levels of income, which support rural development and counteract the abandonment of farms (Knickel et al., 2017; Rivera et al., 2018). This has further encouraged the adoption of many proto-agroecological practices (and associated learning processes). Lucas (2018 a and b) tellingly refers to this as "*agroécologie silencieuse*". This 'silent agroecology' is widespread throughout Europe and merits careful analysis and discussion (see also De Cock, Dessein and Krom, 2016).

The gradual and silent process of the adoption of AE explains why, in practice, there are no sharp-cut delineations between agroecological and conventional farming. There are, at best, "blurred boundaries" (Wezel et al., 2009)[2]. These are the result of the step-by-step conversion to a more agroecological agriculture. This conversion is far from unilinear and can experience setbacks as well as (sometimes unexpected) leaps forward. Together with the diversity in farmers' points of departure, this means that the empirical realities of AE are highly heterogeneous.

Agroecology as a viable economic model: a theoretical discussion

There are solid theoretical reasons to support the hypothesis that agroecological agriculture entails a techno-economic model that promises to generate incomes that are comparable to, if not superior to, those obtained from conventional agriculture. This potential resides in the combination of (1) the higher ratio between Value Added and the Gross Value of Production (VA/GVP) realized in agroecological production[3], and (2) low, volatile and decreasing off-farm prices and steadily increasing costs (a situation often summarized as 'the squeeze on agriculture'). Wherever these two features meet, agroecological farms will show income levels that surpass those of conventional and industrial farm enterprises. Consequently, AE is particularly appropriate in helping farmers face adverse and deteriorating markets – and this explains the increasing attraction of AE to farmers.

When discussing AE, conventional theories often stress that the levels of GVP (per hectare, per animal) are lower in AE than in conventional agriculture. This supposed 'yield gap' feeds the misplaced assumption that AE is not capable of rendering comparable incomes. Yet, such conventional analyses miss the strong, albeit somewhat hidden, potential of AE. Even with lower levels of GVP, its VA/GPV can be higher – even to the degree that the resulting income is also higher. In the longer run, "agroecological intensification" (Titonell, 2014) may lead to the current 'yield gap' being temporary; several authors argue that AE is capable of increasing yield levels (see for example Gonzalez de Molina and Guzman, 2017).

It must be stressed that AE is inherently much more than 'farming without chemical inputs'. Agroecological practices involve processes of production and reproduction that are radically

[2] Consequently it is impossible to delineate an 'agroecological segment' or to point to single farms that are 'completely agroecological'. AE is 'under construction'. There are, in practice, no dichotomies that separate the agroecological from the conventional or the organic. In practice there only are degrees of being more (or less) agroecological. It is the degree of AE that matters, not any assumed, essentialist 'purity'.

[3] This represents a strategic contrast with conventional agriculture within which industrialization (as the dominant developmental trend) systematically brings down the VA/GVP ratio both for individual farms (van der Ploeg, 2003 and 2018) and the agricultural sector as a whole (see Rosset and Altieri, 1997, notably Figure 2).

different from those contained in conventional agriculture. AE emphasises the centrality of living nature, the importance of developing and maintaining an autonomous resource-base, the on-going improvement of resources within the farm itself, structuring the labour process as a learning process, diversified production and establishing interacting cycles that produce synergies (for an overview see Migliorini and Wezel, 2017). Consequently, AE partly overlaps with organic agriculture, but simultaneously goes beyond it.

The economic concept that is central to both agroecological theory and practice is Value Added (VA) and, more precisely, the ratio between Value Added and the Gross Value of Production (VA/GVP)[4]. In agroecology, farmers seek to maximize the VA from a given GVP (as opposed to seeking to expand GVP). This is critical: mainstream agricultural economics and the institutions that surround agriculture (banks, ministries, etc.) consider VA to be more or less given, i.e. determined by off-farm prices and given cost-levels. From such a starting point, the logical guiding principle is to increase the total production (GVP) realized per unit of labour unit (GVP/LU). In practice this translates into ongoing scale-enlargement and/or reducing labour input. Whilst at one time (notably during the 1950s and 1960s) this may have seemed socially, politically and economically desirable, most commentators nowadays would agree that it is counter-productive in terms of maintaining an urban/rural balance or preserving the integrity (social, economic or ecological) of the countryside.

If VA/LU is understood as a *proxy* for farm income[5], it is easy to understand that the orientations towards VA/GPV and GPV/LU, as well as all intermediate positions, represent a range of ways to realize and to increase incomes. For:

(1) VA/GVP * GVP/LU = VA/LU[6]

In which VA=GVP-C
C= (variable costs + depreciation)
GVP=Gross Value of Production
LU=Labour Unit

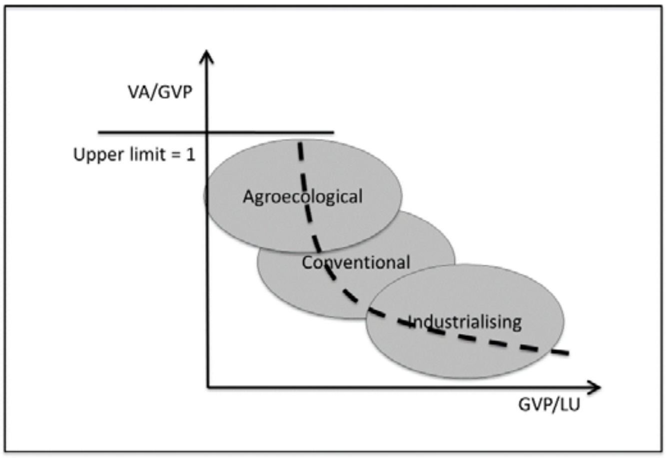
There is an inverse relation between VA/GVP and GVP/LU (see Figure 1 below). Enlarging the total production per unit of labour force GVP/LU normally requires investments in new technologies and, especially, an increase in input-levels. As a result the variable costs per object of labour[7] will rise and VA/object of labour will go down. Beyond that, the enlarged scale allows less scope for fine-tuning (as this requires too much work). On the other hand, under strategies that aim to increase VA/GVP ratios, a further expansion of the resource-base (in order to increase farm income) is difficult or even impossible[8]. "Small-scale farms and enterprises typically try to find an optimal equilibrium of basic resources: labour, buildings, machinery, cropland and pasture have to be in balance with the livestock population. Farmers in Tyrol often refer to this as 'keeping the farm running smoothly'. Growth processes tend to disturb this

[4] This reflects the concept of 'labour economy' as developed by Chayanov (van der Ploeg 2013).
[5] We understand income here as VA - Bank interest - Rent paid for the land - Workers' wages – Taxes + State subsidies (see Cochet, 2015). Inclusion of taxes and subsidies is especially important in Europe, where public subsidies can be a significant part of farmers' incomes and strong states can levy high taxes.
[6] This equation echoes the basic algorithm that underlies the comparative analysis of world agriculture done by Hayami and Ruttan (1985). The key difference here is that we include cost-levels.
[7] 'Objects of labour' are resources that can produce new values. For example, animals render milk, meat, calves and manure. A hectare of arable land renders grain, potatoes, and so on.
[8] No need to say that here family-size, the organization of rural communities, the presence of machine-sharing arrangements, or more generally: demography, culture and institutions all play a decisive role here.

delicate proportionality while recalibration becomes complex” (Schermer 2017:58; see also Butler 2006 and Duffy 2009 on the non-linearity of the relationship between benefits and growth).

These ratios differ between agroecological, conventional and industrial farming systems. Conventional systems have adopted considerable parts of the modernization script: new varieties, new breeds, mechanization, the increased use of chemical inputs and greater specialization. Industrial farming is based on the same rationale but with an even higher level of disconnection with local natural resources. Examples include the factory farming of pigs and poultry where almost all the inputs are imported into the production unit or hydroponic vegetable and fruit production in glasshouses, or very large-scale arable farms necessitating huge investments in machinery and enormous amounts of commercial inputs, that operate in (and create) low biodiversity and homogeneous landscapes. The trajectory that aims at ongoing and spurred raises in GVP/LU is increasingly path-dependent and, at least in Europe, highly dependent on subsidies.

F**igure 1: The interrelations between VA/GVP and GVP/LU (for different organizational models)**[9]



While the value added per unit of labour force (VA/LU) is a *proxy* for farm income, the two are not identical. The difference resides in payments for factors of production that are sourced from outside the farm itself: payments to wage workers (non-family labour), interest payments on loans and rent for rented land. The difference between agroecological and industrial and conventional farms is that these payments are far lower in the former (since scale is not the main carrier of the economic size of the former type of farm, there is less need for expansion and, consequently, less need for credit, rented land and wage-workers). By contrast conventional and industrial agriculture need to continuously expand (a *fuite en avant* as the French say) and to take on new debts in order to do so. This debt-driven growth decreases the

[9] Mathematically, if VA/LU is constant, the curve in the figure is convex since it follows a function of the form f(x) = 1/x. GVP is the numerator of the X-axis but the denominator of the Y-axis (the slope being the constant VA/LU ratio). However, since depreciations in AE are minor (with the time horizon following an object’s technical, rather than economic, life span) and industrial agriculture profits from discounts and premium prices related to the larger volumes of production, the curve will, in real life, have a less convex form.

proportion of value added that is available at the end of the day as farm income and leads to the emergence of ‘diseconomies of scale’.

Enhancing VA/GVP

The *capacity* of AE to realize levels of VA/GVP that are substantially higher than those of conventional, and especially of industrialized, agriculture resides in five strategic differences that are located in the heart of the productive process.

A *first* strategic difference between AE and industrial agriculture can be found in the balance between the use of internal and external resources. In agroecology the available resources are rebuilt and recombined in order to allow the resource base *as a whole* to function with as few external inputs as possible. AE is built, as much as possible, on locally available resources and optimises their contribution to maintaining ecosystem services (Wezel et al., 2014; Wezel and Silva, 2017). Most of the resources are (re-)produced within the farm or, in some cases, obtained through socially regulated (and non-commoditized) exchange – and therefore do not appear as monetary costs[10]. Consequently, when all other conditions are equal, the VA/GVP ratio is higher in agroecological farming as fewer resources are mobilized through the markets. This also implies that agroecological farms are less susceptible to market price increases for non-factor inputs and factors of production.

Secondly, AE farms are not as specialized as most conventional and, especially, industrial farms. Rather, they are based on different, interlinked crops and animal breeding activities. The return to new forms of mixed farming can be observed all over Europe, in landscapes that for decades have been experiencing ongoing specialisation towards either livestock or arable farming. Mixed farming creates synergistic loops that strengthen resilience and help to build economies of scope rather than economies of scale (Teece, 1980; Milone and Ventura, 2000; Ashkenazy *et al*., 2018; De Roest *et al*., 2018), thus contributing to further cost decreases and subsequent increases in VA/GVP (Panzar and Willig, 1981). Equation (2) expresses how the costs of producing two products (q1 and q2) together are lower than producing them individually[11] – especially if they are linked by synergistic loops. “As cases of indivisible investments and inputs are common [...], joint production of a number of products allows for better utilization of both inputs and outputs” (Scherer, 1975; see also Saccomandi, 1998):

$$(2) \qquad C(q1,q2) < C(q1,0) + C(0,q2) \text{ if } q1>0 \text{ and } q2>0$$

Equation (2) has special relevance to AE, as it seeks to optimize the interrelations between crops, animals and the local ecosystem. It focuses on enhancing *interactions* among ‘growth factors’, such as soil, location, climate, varieties, breeds and local knowledge (instead of involving *simple additions*). Practices such as intercropping, agroforestry and mixed grazing typically involve searching for positive interactions between different species and life forms. This produces synergies which not only manifest in further increases in resource-use-efficiency levels but also often reappear in product characteristics (such as typical products from specific *terroirs*).

[10] A very common example that can be found all across temperate Europe is the return to grazing and grass (“*le retour à l’herbe*”) which provide the cheapest and most balanced fodder for dairy and beef cattle.

[11] The emblematic case is the tractor used in both animal production and arable crop production. Equally emblematic is the combination of maize and beans in one field: beans providing nitrogen and maize the stalks for beans to climb.

A *third* strategic difference is that AE focuses on, and increases, the use-efficiency of internal resources and tries, as much as possible, to enhance the quality of internally available resources, which further helps to enlarge the VA/GVP ratio. The search for improvements applies to soils (Sonneveld, 2004), animals (Reijs, 2007), plants (through e.g. new approaches in the production, circulation and use of seeds (Migliorini, *et al*., 2016 and 2018; Rossi *et al*., forthcoming)), instruments, buildings and machines (Dumont et al., 2013; Baumont et al., 2014; Bonaudo et al., 2014). The synergy resulting from the interaction of improved resources, slows down the entropy increase through better energy retention within agroecosystems and helps to reduce energy consumption. Resource-use efficiency refers to the total production realized with a given set of resources. An often used proxy for this is the O/I ratio (output/input), which can be calculated for individual inputs and/or for all inputs or resources together. AE farms have more opportunities to increase their overall resource-use efficiency as a far wider range of growth factors is available *within* the farm or through local inter-farm cooperation (Lucas, Gasselin and Ploeg, 2018). This increases the possibilities to adjust these factors and to fine-tune the whole. The higher efficiency of AE production further comes to the fore when EROIs (Energy Returns on Investments) are calculated (Guzman and Gonzales de Molina, 2017).

Fourthly, AE implies a return to the centrality of labour in farming. Being able to substitute external for internal resources (the first strategic difference), to run a 'multi-product farm' (the second difference) and search for and realize synergies (the third difference), requires a very particular type of know-how and way of working. Both the quantity and the quality of labour help, through fine-tuning, experimentation and learning processes, to increase the technical efficiency (Timmer, 1970) of the production process. Thus the GVP achieved with a given amount of resources is steadily increased. For a long time this effect has gone unnoticed (because the biophysical production per object of labour often is lower), but with more attention being placed on sustainability, the use of fossil fuels and CO2 emissions this is now increasingly recognized as a strategic feature. Of course, conventional and industrial agriculture can also increase their technical efficiency, which is often held up as one of the strengths of these types of farming. The basic difference, though, is that these increases in technical efficiency are, usually *bought*: acquired on the market and thus only make a small contribution (if any at all) to increasing the VA/GVP ratio. Improvements (a higher GVP) in such systems are accompanied by increased costs and lead to a stagnation, or even a deterioration, in the VA/GVP ratios. The centrality of labour also helps to increase and consolidate the resilience and flexibility of the farm.

Finally there is yet another feature that is very influential in everyday live practices. As argued before, AE is also a movement that is creating new alliances among farmers and between consumers and producers (Loconto *et al*., 2018; Stassart *et al*. 2018) that result in new markets. In many instances this results in improved off-farm prices for agroecological products (see also Sanders et al., 2016; Stevenson and Pirog, 2008).

The impacts of the price squeeze and volatility

As equation (1) shows, farm incomes depend on how (increases in) VA/GVP and GVP/LU *relate to each other*. In turn, this depends on contextual elements such as markets, agricultural policies, consumer preferences, social movements and more besides.

For several decades scale-increases and technology-driven intensification allowed conventional and industrial farms to realize better incomes than agroecological and traditional peasant farms.

The crucial pre-conditions for this resided in the protection of markets (offering long-term security about price levels), the availability of cheap credit, spatial reorganizations, cumulative technological developments, an absence of effective environmental policies and a lack of awareness among the general public about issues such as food quality, animal welfare and environmental degradation. Strong and regular technical support by salesmen, paid for by agro-industries, also played a crucial role in the spread of industrial agricultural techniques.

Most of these contextual elements have changed. Europe's agricultural markets have been deregulated (with the subsequent emergence of price volatility), there has been a general economic and financial crisis, a rise in the cost of energy, fossil fuel-based inputs and animal feed and growing recognition of the need to reduce CO_2 emissions, mitigate against climate change and animal welfare issues. These changes have placed great downward pressures on farm incomes. Theoretically, the effects of these changes (that negatively affect off-farm prices, raise external input prices and introduce price volatility) condense into a downward shift of the VA/LU ratio. However, since AE has lower costs (C) and a higher VA/GVP the probability (p) of negative cash-flows and/or chronic losses is lower in AE than in conventional and, especially, industrial agriculture. This is summarized in Equation (3):

(3) If $C(ia)>C(ae)$ and output prices decrease, then
$p(VAia<0) > p(VAae<0)$

in which C=(variable costs + depreciation)
ia=industrial agriculture
ae=agroecological agriculture
VA=Value Added.
p=probability

In the following section we flesh out these theoretical explanations and their interrelations by drawing on empirical research from eleven European countries that identifies the economic benefits of agroecology at national, regional and farm levels. This research draws on the different datasets that are now available. Some of these have been elaborated by farm accountancy agencies, others by farmer networks (but always in cooperation with scientists) and yet others by universities (some of which is ongoing and not yet published). All datasets have been used in and for scientific publications (references will be given throughout the following text). Most data and associated outcomes have also been actively discussed by involved farmers who, as always, are eager to know whether they are on the right track (or not). All this implies, we believe, that these datasets are both accurate and reliable. Although there is unevenness in the scope, size and reach of the different datasets, we believe that together they provide a firm basis for an initial assessment and discussion of the economic performance of agroecology in Europe.

There are small differences in how concepts such as value added, income, etc., are defined in different countries (and sometimes even regions). Yet in this paper we will make *intra*-country comparisons so this does not present a methodological problem.

The economic performance of agroecology: initial empirical data from Europe

It is intriguing that most of the emerging literature on the economic performance of AE in

Europe focuses on animal production (and notably dairy farming). This probably reflects, at least partly, the central role that the integration of animal and arable production has played in the agrarian history of Europe. Whilst modernization policies promoted specialization (thus separating arable and animal production and undermining the importance of grazing), AE has a strong focus on re-establishing the centrality of grazing (together with improving the use of manure, a return to dual-purpose cattle, etc.), thus revitalizing the virtues of an almost forgotten past. The focus on animal production is reflected in the following examples, although we also pay attention to arable production and 'Mediterranean crops'.

Netherlands: The style of 'farming economically'

In the Netherlands there is a rich academic tradition of analyzing, and understanding, the heterogeneity of farming styles. A farming style is a coherent pattern that brings the organization and development of the farm in line with the strategic repertoire of the actors involved (for a synthesis, see Ploeg, 2003). It has been shown that different styles entail different, and mutually contrasting, models for generating an income and securing the long-term continuity of the farm. Here we focus on the style of farming economically (as country people often refer to it) which is a typical proto-agroecological way of farming.

In 1992 a nationwide survey (covering all agricultural sectors) showed that 21% of Dutch farmers at that time identified themselves as growth-oriented (which is mostly reflected, in the size of the farm and the speed of expansion), 7% aimed at on-going increases in labour productivity (resulting in higher levels of mechanization), 24% focused on fine-tuning (on-going intensification (based basically on the quantity and quality of farm labour) and nearly half (47%) looked to cost reduction (or 'farming economically') as their main farm-development strategy (Misset, 1992, ch. 3:2). Later surveys showed similar results (Ploeg *et al.,* 1994; Ettema *et al.,* 1995).

Table 1 compares one farm ('Hoeksma's farm') managed in a typically 'economical way' (there is ample documentation on this farm in Ploeg, 2003, pp 180-189) with average data from 80 farms that are comparable in terms of size and technological level. The data refer to 1998. At that time the word 'agroecology' was not known in the Netherlands – but agroecological practices abounded *avant-la-lettre*. Hoeksma's farm is, in this respect, a clear example. Due to the strategy of farming economically, his costs associated with external input use were far lower, whilst the use-efficiency of internal resources was far higher. This is reflected in many details and, above all, in the combination of the details into a coherent and well-elaborated pattern. Higher grassland production obtained with less fertilizer use, lower milk yield but with better fat and protein contents (therefore yielding a higher milk price), lower costs per 100 kg milk, but higher total revenues per 100 kg milk – all these features were realized by making better use of the farm's internal resources (grassland, manure, cows). This improved performance was realized through *a higher labour input*: 2.51 full time labour units as opposed to 1.60 in conventional farms. That is nearly one person extra, which, if multiplied across the entire Dutch dairy sector, would generate a significant increase in rural employment. However, this did not result in a lower income: the labour income (or surplus) per 100 kg milk on Hoeksma's farm' was more than twice that than in the reference farms (11.12 Euro/100 kg as opposed to 5.23) and the labour income per unit of labour force was also higher: +21%.[12]

[12] Dominguez Garcia (2007) has documented the style of farming economically in Spain and Kinsella *et al*. (2002) have done the same for Ireland, both coming to similar conclusions.

Table 1: Key characteristics of Hoeksma's farm compared to reference farms

	Hoeksma's farm	Reference farms
Size (ha)	58	60
Milk production per hectare (kg)	10,613	11,004
Number of milking cows	89	92
Milk yield (kg/cow)	6,449	7,256
Fat content (%)	4.53	4.44
Protein content (%)	3.61	3.45
Veterinary costs (€/cow)	38	67
Grassland production (kVEM/ha)	8,453	7,224
Fertilizer use (kg N/ha)	217	300
Net N losses (kg/ha)	221	327
Costs of custom work (€/100 kg)	0.19	1.53
Full time labour units (FLU)	2.51	1.60
Milk production/FLU	227,000	421,000
Milk price/100 kg milk	32.18	29.37
Sold meat and animals/100 kg milk	3.89	3.06
Additional revenues/100 kg milk	3.34	1.99
Total revenues/100 kg milk	39.41	34.42
Labour income/100 kg milk	11.12	5.23

Source: Ploeg, 2000:500

Similar differences were subsequently found in far larger populations (ALFA 2005, 2006, 2007 and 2017). A systematic, multi-year, and controlled, experiment at the National Centre for Research in Dairy Farming showed similar results: A proto-agroecological 'low cost' farm realized the same income as a 'high-tech' farm – but with half the volume of production (Kamp and Haan, 2004, Evers et al., 2007)[13]. More recent data from the Netherlands (Dirksen et al, 2013 and Oostindie et al., 2103, both based on large sets of farm accountancy data) show, firstly, that these differences (between 'farming economically' and conventional farming) have become even greater and, secondly, that the proto-agroecological style of farming fared far better economically throughout the milk price crisis of 2008/2009 than the conventional and industrialized segments. Similar findings emerge from Denmark, where the dairy sector has followed a similar, possibly even more exaggerated, trajectory of intensification as the Netherlands.

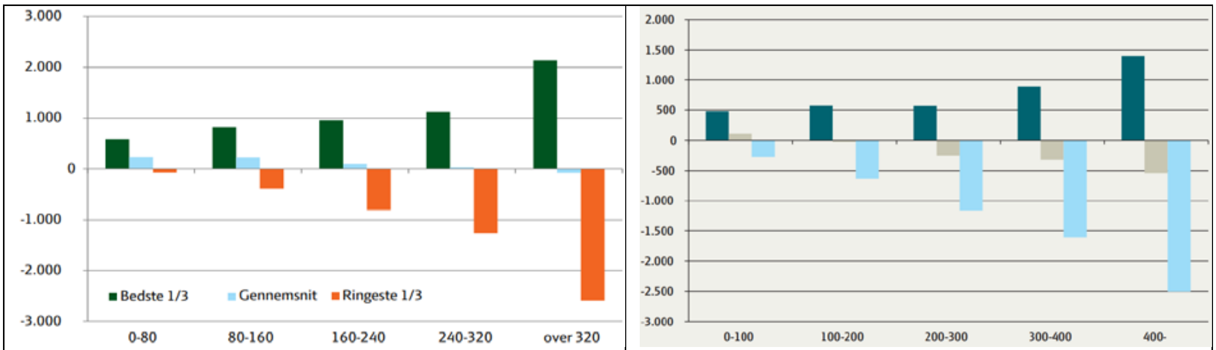
Denmark: The fragility of industrial agriculture

Danish agriculture is the most 'structurally developed' in Europe, that is to say it is the most capital intensive and technologically advanced. Ironically, this is also true of its (large) organic sector. The high level of industrialization has been driven by two factors: a strong belief in the competitive advantages of large-scale, specialized and highly intensive agriculture and a steady increase in the prices of farmland, which makes investment in farm land lucrative and reinvestment in production facilities possible. Until the financial crises in 2007, the financial sector was very keen to lend money for farm enlargements. In 2007 the price bubble of farmland collapsed, creating a heavily indebted sector. It is estimated that some 30% of fulltime farms are technical insolvent, with low revenues, and unable to service their debts.

[13] If the findings of this specific research programme are projected to the country as a whole it shows that the total output of the Dutch dairy sector in the late 1990s (10 billion kg. of milk) could have been supplied by anything between 12,500 to 25,000 farms. That is hugely relevant in that it implies that shifting from industrial forms of production towards more agroecological farming would greatly increase rural employment and total farm incomes.

Danish farm accountancy data shows the vulnerability of large-scale dairy farmers, with the majority of those at the top end of the scale running at a loss (see Figure 2). What is notable is how much the 'balancing point' has shifted between these two surveys. In 2008 around half the farmers with between 240 and 320 cows were operating at a profit (and the others at a loss) with the majority of smaller farms being more profitable and the majority of larger farms running at a loss. By 2016 the 'balance point' was among farms with between 100 and 200 cows, with the majority of larger farms running a negative balance sheet. This shift in the 'balance point' seems to suggest that enlarging the GVP/LU term is becoming a less viable way of improving farm incomes. The farmers with a negative operating profit are only able to stay in business because of (expected) increases in the prices of farmland. In short, they are *speculative enterprises*, shored up by the anticipation of capital gains. One day, surely, this house of cards will collapse. This illustrates a) the extent to which scaling-up increases farms' vulnerability and b) that smaller-scale farming, which is more reliant on self-supplied fodder and family labour, offers farmers a more viable and sustainable financial future (see also Hamerlinck *et al*., 2014; Bijttebier *et al*., 2018)[14].

Figure 2: Operating profits/losses for fulltime Danish dairy farmers, by size (2008 and 2016)



2008 Green best 1/3, blue mean, orange lowest 1/3

2016 dark blue best 1/3, grey mean, and light blue lowest 1/3

Source: Videncenter for Landbrug 2012 and SEGES 2017.
Figures in 1000 DKr., sample sizes 2012 n= 1,959 and 2016 n=1,516

Danish agriculture is now experiencing a growing countermovement to the ongoing industrialisation of agriculture. This movement has strong links with organic farming, though it is not restricted to this sub-sector. One key aspect of the emerging initiatives is to link changes in farming practices to changes in market relations (Lamine and Noe 2017). Within the dairy sector a growing number of farms are applying agroecological principles, such as avoiding the use of antibiotics, switching to Jersey cows (which yield less, but higher value, milk) and a return to a diet primarily based on grazing and hay. These farms produce high value specialities for local markets and/or develop partnerships with supermarket chains.

France: Grassland-based dairy farming

In France, the development and fine-tuning of grassland-based farming represents an important agroecological trajectory that aims to strongly reduce the use of bought feed and fodder

[14] Note also that the categorization of farms (i.e. the number of cows deemed to constitute small, medium or large scale farms) increased quite dramatically (by around 20%) in the eight years between the two surveys, an indication of the ongoing scale increases in Danish dairy farming.

(especially concentrates) for dairy cattle. It does so by improving the quality of grasslands and (mostly) by re-introducing grazing or increasing its importance (see Peeters and Wezel, 2017). The fine-tuning of agronomic cycles is central to all of this: the quality of manure is improved, which results in a more robust soil biology which, in turn, brings better grassland yields. By carefully choosing and coordinating the right moments for mowing and grazing, good yields of well-balanced cattle feed (which include a high proportion of forage legumes) are produced, reducing the need for supplements, improving the health of the cattle and the quality of the manure (notably by increasing the C/N ratios through a shift from slurry to farmyard manure). The improved fodder (grazed and cut), produced on farm, allows for the replacement of locally cropped green maize and imported soybean. In this way, the use of concentrates, herbicides and chemical fertilizers is being progressively reduced. By contrast, in conventional and industrial agriculture, scale-enlargement and technology-driven intensification continue to increase their use of external inputs, but without increasing farm incomes (Veysset *et al*., 2015; Inosys, 2017).

The Network for Sustainable Agriculture, RAD (*Réseau Agriculture Durable*) is one of the many networks that is (re-) developing grassland-based dairy farming. It was created by farmers in the West of France, some of them members of the *Confederation Paysanne* (the Peasant Confederation) and it is now part of the *Réseau Civam*. "From the end of the 1980s onwards, farmers noted that the use of external inputs and the need for large capital investments contributed more and more to a reduction of their incomes; they equally became worried about the environmental impact of the excessive use of chemical fertilizers and pesticides" (Garambois and Devienne, 2012: 62). Thus, "driven by the wish to increase the autonomy and sustainability of their farms, they radically modified their way of farming by improving their grasslands [...] and putting grazing centre stage" (*ibid*: 57).

The RAD produces annual overviews of the economic results of grassland-based dairy farms and compares these with those of conventional farms. These overviews show that the "overall results per worker and, even more, per hectare [that] are far better for the farms belonging to the RAD network: they create more value added and this translates to improved labour income [....]. The results demonstrate that grassland-based farms are more viable, easier to transfer to the next generation and create significantly more employment in the area" (RAD, 2015: 2). This conclusion was later confirmed in a much larger scale study by Devienne et al. (2016). Table 2 summarizes some of RAD's empirical findings. The data are based on 107 grassland-based farms. The conventional farms are part of the European RICA database. In terms of acreage, etc., the two sets of farms are similar.

Table 2: Comparison of grassland-based and conventional farms in Bretagne, France

	Conventional farms	Grassland-based farms	Difference
GVP/worker	118,281 €	86,837 €	- 27%
VA/GVP	33%	51%	+ 54%
VA/worker	38,884 €	44,179 €	+ 14%
Family income/family worker	15,797 €	27,271 €	+ 73%

(Source: RAD, 2015: 3-5) 'Worker' includes both family members and wage workers. VA is defined as GVP minus the costs of acquired inputs and annual depreciation. Family income is VA plus state subsidies minus bank interest, rent, wages paid and taxes.

The table shows that the total production (GVP) per worker is higher in conventional farms than in the grassland-based ones. This is due to a somewhat higher labour-input in the grassland-based farms. However, the table also shows that the income per family worker is significantly higher (+73%) in the grassland-based farms. This is due to grassland-based farms' capacity to obtain a far higher value added from a given volume of production (VA/GVP). In consequence, the VA/worker is higher and, after the deduction of other costs (related to management and the remuneration of factors of production apart from family labour), the resulting income per family worker is significantly higher (RAD, 2015: 18). Based on a sample of 354 conventional and 170 agroecological farms, *Réseau CIVAM* (2016) published similar findings for 2015 and concluded that "grassland based systems demonstrate more economic efficiency: For every 100 Euros produced, the [non-organic] agroecological farms realize, on average, a value added that is 16 Euros higher than the one of conventional farms [44 Euros vs. 28 Euros]". The certified *organic* farms (also using a grassland-based production system) exceed this level, realizing a VA of 58 Euros per 100 Euro (Réseau CIVAM, 2016: 6). Of course, such results are only reached after a period of change and re-adaptation. It is also the case that not all farms can easily be adapted in this way (due to path-dependency and structural constraints), but once dairy farmers develop a well-tuned grassland-based management strategy in their farms, they realise better incomes. Dieulot and Pupin (2016) note that grassland-based farms are also more resilient to price volatility.

Experiences like these are increasingly becoming the object of scientific scrutiny. One recent study shows that grassland-based farms receive only half the amount of subsidies per hectare than conventional ones. However, they achieve family labour incomes that are considerably higher (Garambois and Devienne, 2012:67). The study also shows that the grassland-based farms are able to maintain this difference: "there is a positive evolution and this allows the grassland-based farms to maintain their income without having to enlarge the farm" (*ibid*:69). In a more recent study, covering large parts of France, Devienne *et al*. conclude that "these autonomous and more economic systems are more able to face price volatility and the risks related to global warming" (2016: 97). They conclude that conventional dairy systems realize a VA/GVP ratio of 25%, grassland-based dairy systems 50% and organic grassland-based dairy systems a ratio of 75%. The report reaffirms that "these enterprises are easier to transfer to the next generation" (*ibid*). Surveys of the arable sector also show that low input arable systems generate better economic results than high input systems (Devienne *et al.*, 2017; Lechenet *et al.* 2017; Jacquet *et al.*, 2011,)

Wallonia: the return to grazing, reduced tillage and new market gardening projects

Important changes towards more sustainable and resilient agricultural systems are occurring in Belgium, mainly in the French-speaking south (Wallonia). There are three main trends at work here. First there is, like in the Netherlands and France, a search for forage autonomy, which allows for a decrease in livestock feeding costs. Second comes the development of reduced tillage techniques in arable crops. Third, Wallonia witnesses a the rapid development of short and local marketing chains for processed and unprocessed food.

Since 2015, *FUGEA*, the Walloon farmers' union that promotes peasant agriculture, together with two regional parks, has been organising annual on-farm 'salons' and winter forums on fodder autonomy for farmers to share knowledge and experiences (see AFAF, 2016). The organic farming organisation *Nature et Progrès* has been studying and showcasing pioneering farms, highlighting their achievements over time and in comparison with conventional farms. These farms typically use less energy to produce 1000 litres of milk, are less dependent on subsidies (as a proportion of their total VA) and have more buffering capacity against market volatility, largely due to their lower capital depreciation costs and interest payments (La Spina, 2016). The very existence of these farms and their openness to share their knowledge and experiences has, especially since the milk price crisis of 2008-2009, encouraged other farms to follow suit, although not always without having doubts and experiencing hiccups. Interviews with network members reveal that pursuing such a strategy can involve a steep learning curve and can raise cognitive challenges (or 'psychological lock-ins') (Flament & Visser, 2017). Yet the success stories of the most advanced pioneer farms illustrate how an initial desire to 'stop getting robbed by the upstream and downstream industries' can lead farmers to embark on a journey of discovery of ways to develop the latent synergies available within their farms.

Reduced tillage techniques in conventional farming are being actively promoted by *GREENOTEC*, an NGO promoting conservation agriculture that recommends ceasing any soil disturbance but which accepts the use of soluble fertilizers and pesticides, an approach that can be considered as a first step towards agroecological systems. It also promotes the systematic use of cover crops through intercropping and more use of organic manure. Many adopters of conservation agriculture are trying to reduce their use of commercial inputs, particularly herbicides and seeking to reintroduce livestock into their systems. Their experiences show that conservation agriculture is restoring carbon levels in soils, improving soil fertility and structure and increasing soil life.

GREENOTEC (2011) studied 27 farms, classified into four categories, ranging from occasional to full non-inversion tillage systems (no ploughing). Those that had more fully adopted the no-till technique were saving 60 €/ha on machinery costs (investment and running costs) and their workload had decreased by an average of 75 minutes/ha. While there were some differences by crop type, the evidence showed that crop yields under the till and no-till systems were broadly similar.

Germany: Differences in scale and style

The post war division (and subsequent reunification) of Germany inadvertently created an open-air laboratory that highlights the economic differences between farms of different spatial scales. The country contains many small and relatively diversified family farms in the north western and southern parts and very large-scale highly specialized agro-business farms in the former GDR. The former can be considered to be 'conventional' and the latter as 'industrial'.

Mecklenburg-Western Pomerania state is located in the extreme north-east of the country. It has the largest farms in Germany (287 ha on average, against a national average of 60 ha) and labour input per ha is the lowest of Germany (1.3 LU/100 ha compared to a national average of 3.1). Klüter (2016) used 2015 data to compare farms in Mecklenburg-Western Pomerania with those from the west. He found that VA per ha in Mecklenburg-Western Pomerania was 613 € per ha, compared to the German average of 898 € per ha, and up to 4,000 € per ha in the north-western states. Industrial farms in Mecklenburg-Western Pomerania only achieve a net value added of 183 € per ha, compared to 557 €/ha on full-time family farms in the west of the country. These family farms are less specialised, often combining crops and livestock and having a more diverse range of crops.

Table 3 summarizes some German data comparing agroecological and conventional farms, derived from multi-year studies realized by Jürgens, Poppinga and Sperling (2016). It shows that proto-agroecological dairy farms (with low levels of concentrate use and improved grasslands) achieve higher income levels than both conventional and organic farms. The detailed data suggest that (just as is the case in Austria, below, and in France) the *combination* of agro-ecological approaches and the development and institutionalization of new, alternative markets brings synergistic benefits (Eilers et al., 2017).

Table 3: Comparison of different dairy farming systems in Germany

Germany

	Farms with low concentrate levels (n=52)	Conventio-nal farms (FADN)	Organic farms
Income/dairy cow	1064 €	663 €	932€
Income/100 kg milk	21 €	9 €	16 €
Income/unit of labourforce	24.500 €	21.381 €	21.964 €

Sources: Jürgen, Poppinga and Sperling 2015, 2016; Fink Keszler and Jürgen, 2018; see also Eiler, Reyher en Müller-Lindenlauf, 2017

(Source: Jürgens, Poppinga, Sperling 2016, see also Eilers et al, 2017)

Switzerland: Increasing employment

Conventional agriculture in Switzerland embodies some basic agroecological principles as a result of a set of mandatory 'green farming practices' (USP, 2016). For example, a minimum of 7% of each farm's utilized agricultural area must be set aside to protect biodiversity and the use of fertilizers and pesticides is strictly regulated and restricted (OPD, 2013). Organic farmers have been at the forefront of further developing agroecological practices and principles that include a total prohibition on the use of synthetic pesticides and fertilizers, maintaining soil fertility through composting or with manure produced on-site and keeping herd sizes that are proportionate to the amount of land needed to meet their feeding requirements. This reduces the use of finite resources and greatly reduces agriculture's impacts on the environment (BioSuisse, 2018).

Data from the Swiss Farm Accountancy Data Network (collected by Agroscope, the Swiss Confederation's Centre of Excellence for Agricultural Research) provides the basis for comparing the economic performance of different farming systems (Hoop et al. 2016). A sample of 69 organic (out of a total of 1163) and 850 conventional (out of a total of 14226) (both selected on the basis of stratified random sampling) was used to calculate the average performances of farms in the Swiss plain region in 2015-2016.

Table 4: Comparison of conventional and organic farms in the plains of Switzerland based on the Gross Value of Production (GVP) and the Value Added (VA). Values in € (conversion: 1 CHF = 0.89 €)

	Economic comparison	CONV	ORGANIC	Difference
GROSS	GVP	293'360	327'362	11.6%
	VA	155'850	196'961	26.4%
	VA / GVP	53.1%	60.2%	13.3%
NET (- wage costs)	VA	110'370	119'318	8.1%
	VA / GVP	37.6%	36.4%	-3.1%
	Subsidies	55'940	69'794	24.8%
	Subsidies/VA	35.9%	35.4%	-1.3%
	Final income per AWU of family worker	50'910	53'025	4.2%

Table 4 shows that organic farms achieve a higher gross value added (VA), a higher GVP and a higher VA/GVP than conventional ones, although when we look at the net VA and VA/GVP the differences between the two types of farms diminishes. The VA per workforce unit is almost identical for both systems, however organic farms are more labour-intensive and have more employees, so the amount dedicated to salaries is higher than on conventional farms, meaning that they perform marginally worse than conventional farms in terms of net VA/GVP. Overall, organic farms in Switzerland perform better economically than conventional ones on nearly all counts and employ more people, thereby contributing more to sustaining the rural economy. This is due to a combination of higher resource-use efficiency and better market prices.

Gazzarin et al. (2018) undertook a study comparing the economic performance of farms that largely rely on grassland and those that use high levels of concentrates. They found similar relations in the Swiss dairy farming sector to those described earlier for the Netherlands, Denmark and France. Farms with a high levels of concentrate use (1160 kg/cow/year) had a labour income (*Arbeitsverwertung*) of 20 Swiss Francs per hour, those with low-level of concentrate use (430 kg/cow/year) one of 21 Swiss Francs per hour and grassland-based farms (using just 90 kg/cow/year of concentrates) realized a labour income of 29 Swiss Francs per hour. The report concluded that "higher milk yields and higher production volumes do not lead to better economic results" (2018:155). On the contrary: "with the extensive use of fresh grass, a very good economic efficiency can be achieved" (ibid.).

Italy: Rediscovering historical roots

The production of Parmesan cheese was, in the past, an example *avant la lettre* of AE. Farms producing milk to make Parmesan cheese were self-provisioning in terms of feed, fodder, manure, young animals, traction power, labour force and knowledge. Cooperation with other farmers materialized in small cooperative cheese-making factories. All this resulted in autonomous farming systems producing *for*, but not dependent *on* the market. The modernization of farming, which started in the early 1960s, brought Holstein Frisian cattle to the area that replaced local breeds, such as the *Rossa Reggiana*, and started to change this basic pattern – in a seemingly irreversible way that ultimately created strong market dependency for inputs, which brought about a series of economic crises. These crises triggered a group of farmers to return to the *Rossa Reggiana*. Although having a relatively low milk yield, the breed was revaluated, in the new context, as a resilient animal, with considerable longevity, strong calves, able to nourish itself on locally available feed and fodder: an animal that avoided the need to engage in all kinds of dependency relations (with breeding stations, providers of concentrates, veterinary doctors, technical assistants, etc.). Thus the *Rossa Reggiana* can now be seen as a symbol of agroecological production. The cheese produced from the milk of these red cows is highly valued in the market (and, due to short chains, a larger part of this stays with the farmers). Even if the cost of production is higher than on farms using the Holstein breed, the VA per 100 kg of milk from these red cows is nearly twice as high from high-yielding ones. Table 5 summarizes some of the most important comparative data. It is, once again, a convincing example of *earning more while producing less* (see Milone 2009 for similar cases).

Table 5: Comparative economic performance of farms that supply milk from *Rossa Reggiana* and Frisian Holstein for producing Parmesan cheese

	Farms with Rossa Reggiana	Reference farms (with Holstein Frisian)
Farm acreage (ha)	39	58

Number of milking cows	60	86
Milk yield/milking cow (kg)	5,729	7,468
Milk production/ha (kg)	8,740	11,091
Fat content (%)	3,65	3,57
Protein content (%)	3,40	3,25
Family labour (FTE)*	2.0	3.0
Workers (FTE)	0.2	0.5
Milk price (€/100 kg)	78.00	53.51
Meat revenue (€/100 kg)	3.52	3.35
Subsidies (€/100 kg)	3.23	2.91
GVP/100 kg (€)	84.75	59.77
Total production cost (€/100 kg)	54.96	41.58
VA/ 100 kg (€)	29.79	18.19
Income/person (€/hour)	16.49	14.26

- FTE = full time equivalent

Source: derived from Menghi et al., 2015

Ventura (1995) made a detailed comparison between the economic performance of proto-agroecological and industrial meat producing systems. The former are largely based on locally available resources (and/or resources reproduced in the farms themselves) and the latter are highly dependent on the use of external resources. As with the Parmesan dairy cattle, there is a degree of breed and regional specificity. *Chianina* cattle are mostly bred in a closed cycle in which calves are born, reared, fattened and reproduced on the same farm. In addition the animals are nearly exclusively fed with feed and fodder produced in the farm itself. The labour process is highly artisanal as the treatment of the animals cannot be standardized (Meulen, 2000). The animals are mainly sold through short circuits to local butchers and restaurants. The industrial style, represented by 'feed-lots', is very different. Young calves are mainly bought in from France and fed with bought concentrates and maize silage. The animals are kept in corrals and their treatment is highly standardized and the meat sold to major retailers.

The study found that the levels of net income per labour unit were broadly similar in the two contrasting styles, even though the number of animals per labour unit was far higher in the 'open cycle' feed lot system (Ventura, 1995:227, Table 1). This was because the *Chianina* system was able to fetch a far higher price for each kilo of meat than the industrialized system[15].

There were also important differences in the two systems' use of fossil fuels: "The energy efficiency of small-scale, artisan farms, developed around the 'closed cycle', is higher than that of industrial farms [...] in both absolute and relative terms" (*ibid*, 229). Beyond that the artisanal system "uses less non-renewable energy" (*ibid*, 230). In a scenario-study (grounded on empirical data), Meulen (2000:225) concluded that "if all the beef which is now being imported into Umbria were produced in the region, there could be important macro-economic gains". Regional net value, employment levels, income levels of farmers and the stability of the later would all increase significantly and substantially (*ibid* 231). Recent data on energy use in

[15] Dries and Portela (1995) found similar relations in Tras-os-Montes, (Portugal) whilst Oostindie et al. (2016) made a cross-country comparison of pig fattening that showed that increases in local food provisioning "go along with a higher farm-level added value per kg carcass and a much better remuneration of farm labour and capital and more rural employment per kg of pork" (2016:8, especially table 2). These differences are closely intertwined with a different way of organizing processing: "The same gradient from lower to higher value added can be noticed in the processing of ham" (*ibid*).

different kinds of AE farms can be found in Migliorini *et al*. (2012 and 2014).

Elsewhere in Italy groups of cereal growers are experimenting with new breeds and varieties and reorganising their cropping systems in an attempt to protect themselves from the volatility of global commodity markets (Rossi and Bocci, 2018). One strategy, adopted by organic farmers is to find ways to overcome the lack of suitable germplasm. Through participatory plant breeding programmes, that started with using heritage cereal varieties, they have developed varieties that are better suited to both organic and low input farming and diverse local climates (see Rossi *et al*., forthcoming). The emphasis is very much on promoting agrobiodiversity and moving away from dependence on the major seed supply companies. This has had positive knock-on effects along the supply chain.

Poland: A dualistic agricultural sector

In Poland, the MAESTRO research programme, which ran between 2014 and 2016 and covered 3551 farmers, shows statistically significant and substantial relations between the share of feed and fodder produced within the farm and farmers' incomes. The higher the degree of self-provisioning, the higher the income (see Table 6). Attention paid to the quality of produce and to avoiding contamination also contributed to enhancing farm incomes. This highlights an underlying dualism in Poland's agrarian structure (also encountered in other European countries) that is not so much related to differences in farm size, but more to *the style of farming*. On one hand there is a segment of industrial farms (which seek rapid expansion, are highly specialized and highly dependent on technology) and the other hand there is peasant or proto-agroecological agriculture that mainly uses locally available resources, produced and reproduced within the farm or nearby. Living nature is an important part of these resources and can be found in the fields, the fertility of the soil and in the seeds, plants, crops and animals, as well as the art of knowing how to use, combine and develop them. The key to the success of this style of farming lies in the quantity and, especially the quality, of farm labour. Autonomy (the freedom to make decisions about resource use and how to combine resources) is decisive here, especially when combined with an aversion to overexploitation that devastates natural resources for a quick profit.

This duality explains the adverse relations discussed above. Autonomy (as exemplified by a high degree of self-provisioning) and taking care (of the land, the animals and product quality) sustain relatively good income levels, whilst industrial farms have to buy far more inputs (at high prices) and, due to their scale, have less time to pay attention to product quality, animal welfare, and the like. They are 'oversized' and, under current market conditions, this implies lower levels of remuneration.

Table 6: The relationship between the proportion of plant production used in animal production and farmers` incomes, Poland (2014 – 2016, n=3551)[16].

Percentage of plant production used	Incomes (1000 PLN)

[16] The data shown partly depend on farm-size. The research shows that proto-agroecological practices, i.c. the percentage of plant production used for animal production at the farm, only seem to be economically profitable on larger farms (with a threshold of around 20 ha).

in animal production at the farm level	2014	2015	2016
0	16.9	17.4	17.8
1-50	23.5	24.1	24.0
51-99	25.4	25.5	27.3
100	39.6	39.6	41.9

Source: Data from research conducted in 2017 within the framework of the MAESTRO research project: ”Think Locally, Act Globally: Polish Farmers in the Era of Sustainability and Resilience” supervised by Krzysztof Gorlach of Jagiellonian University.

Ireland: Effective support for low-input grassland management

The evidence presented so far is mainly based on the performance of relatively small numbers of farms (often linked through networks that aim to develop and share knowledge) whose owners are motivated by an explicit desire to move away from the constant pressure towards scale enlargement and technology-driven intensification. They are going "*à contre courant*", to quote Devienne et al. (2017:9). In this respect the Irish situation is different in as far as there is, nowadays, a massive engagement in 'low cost grass fed production' that has become a pillar for economically efficient dairy and beef farming. The importance of this practice is recognized within Ireland's national vision for agriculture, which aims to increase the value of primary production by 65% and to create 23,000 additional jobs in the agri-food sector by 2025 (DAFM, 2015). This has seen a shift from conventional high external input production systems for milk and beef to more balanced and sustainable systems, based on efficient grassland management which is being supported by the growing role and importance of farmer discussion groups, established to create and share farming knowledge. As a consequence of these groups, improved soil and grassland management, underpinned by practices such as soil nutrient planning, grass measuring and grass-clover sward maintenance, have moved from being peripheral to becoming core concerns of Irish farmers and the advisory services that support them.

The effects of a more efficient and reduced use of purchased farm inputs on farm incomes were already highlighted in the 1990s. Research by Kinsella *et al*. (1999) showed substantial positive impacts on farm net margins from better grass management which applied grass budgeting and reduction in use of nitrogen fertilizers.

For the past 10 years, *Teagasc*, the state agency for agricultural research, advisory and training services, has worked with the industry and farmers to establish *Monitor Farms* for dairy and beef enterprises. Monitor Farms demonstrate best practice in a number of areas, including grassland management and work to an agreed, detailed, five-year, physical and financial farm development plan, recording their actual cash flow on a monthly basis. In 2018 over 100 beef and dairy Monitor Farms, located throughout the country, provided evidence of the strong links between improved grassland management, reducing the costs of feed and fertilizer and improved margins. The financial benefits derived from lower feed and fertilizer input costs, combined with improved grassland management on beef farms are summarized in Table 7, which show that participating farms have almost doubled their gross margin (similar to gross VA) per hectare in just three years.

.

Table 7: Selected results from beef Monitor Farms in Ireland (2013-15)

Year	Output (kg/ha)	Feed cost (€/ha)	Fertilizer cost (€/ha)	Gross margin (€/ha)
2013	676	358	245	597
2014	757	296	210	837
2015	835	296	226	1,029

Source: Dillon, 2016

A similar story emerges from the results of the dairy Monitor Farms which show increasing efficiency in feed and fertilizer usage, with a similar, albeit slightly lower, increase in financial returns to farmers over four years (see Table 8). Dillon et al. (2005) showed a strong negative relationship between the grazed-grass proportion in the diet of dairy cows and total production costs.

Table 8: Selected results from dairy Monitor Farms in Ireland (2014-17)

Year	Milk Yield (litre/cow)	Feed cost (c/litre)	Fertilizer cost (c/litre)	Net profit (€/ha)
2014	5006	3.31	2.84	1,475
2015*	5581	2.87	3.14	1,343
2016*	5766	2.93	2.63	1,334
2017	5816	3.18	2.47	2,612

Source: Teagasc, 2018 (*2015 and 2016 were characterized by relatively low milk prices which affected net profits).

The strong influence of discussion groups on the performance and profitability of dairy and beef farms in Ireland has been highlighted by Bogue (2013 and 2014), Hennessy and Heanue (2012) and Moran (2015) who all have shown that, over time, membership of a farmer discussion group has substantial positive effects on farmers' grassland management and ultimately their net profit margins. The farmer discussion groups, almost 1,200 in 2017, engaging 20,000 farmers, have provided a good arena for considering, debating and adapting the experiences of the Monitor Farms.

Ireland's path to lower input and more knowledge-driven systems of farming is expanding. The key challenge it faces is to bring about a cultural shift in the way farmers perceive 'good farming' (Krom, 2017; Dessein and Nevens, 2007; Knickel et al., 2018).

United Kingdom: Learning networks and cattle-breeding

As in other European countries, innovative farmers and farmer networks in the UK are developing a range of agroecological approaches, often with a number of intentions, including improving soil quality, reducing their use of inputs and/or maintaining/increasing the profitability of small-scale farms. *Innovative Farmers* is an example of a relatively recent action-research network of farmers, agronomists and scientists which aims to develop new approaches to growing good food, reduce waste and pollution and boost profit margins. The network uses 'field labs' to bring farmers and researchers together to experiment with practical solutions for both conventional and organic farms. Topics covered include managing weeds without herbicides; finding alternatives to *glyphosate* for terminating cover crops (in ways that are beneficial to farm profitability, soil structure and the environment); cultural alternatives for controlling black grass and crop varieties that are suitable for low-input systems. *The Pasture-Fed Livestock Association,* the *Agroecology Network*, the *Permaculture Association*, the *Centre for Alternative Technologies* (of Harper Adams University) are other examples of such networks.

These different initiatives are resulting in a range of hybridities: different farming systems are adopting agroecological principles and practices while still using some conventional practices, perhaps using chemical inputs in a reduced or more resource efficient way (e.g. conservation agriculture) and thus are creating a kind of 'middle ground' (Morris and Winter, 1999; Levidow *et al*., 2014). However the shift towards more agroecological farming systems generally involves a change in emphasis from following an agronomical approach (focused on crop yields at the plot scale) to a more holistic approach (Lampkin et al., 2015).

Table 9 summarizes data on cattle-breeding from the UK. The data relates to farms belonging to the *Pasture-Fed Livestock Association*. They show, as John Meadley, Chairman of this association writes in the preface of the study that "making a living from beef and sheep farming is never easy. However, those that make the most of pasture can be profitable" (PFLA, 2016:1). By moving farming in an agroecological direction farmers can make a difference, both to their balance sheet and their sustainability.

Table 9: Comparative data on livestock breeding in the UK

United Kingdom	Pure grazing	conventiona l
Sheep (GVA/ewe)	72,74 Pound	66,12 Pound
Suckler cows (GVA/cow)	343,77 Pound	280,58 to 349,31 Pound*
Beef cattle (GVA/cow)	632 Pound (to 1.128**)	197 Pound (tot 366 Pound ***)

* Varies between lowland, upland and Severely Disadvantaged Areas
** direct selling
*** varies with age and weight at delivery

Source: Pasture for life, The Pasture-Fed Livestock Association, 2016

Spain: Mediterranean crops

Spain's conventional agriculture is largely split into two sectors: a highly intensive and industrialized segment that makes very high use of irrigation water and other external inputs and rain-fed agriculture in inland areas, which is focused on cost reduction. Many farmers in this latter segment have turned to organic production in search of adequate incomes and the number of agroecological practitioners within this (growing) organic sector is expanding. Currently, organic agriculture and livestock accounts for more than 2 million hectares, almost 9% of Spain's total agricultural land (MAPAMA, 2017; Willer and Lernaud, 2018). Fifty two percent of this area is used for livestock production and the remainder is cultivated, split roughly equally between arable and permanent crops. Organic farming has helped to strongly decrease the use of external inputs and contributes to maintaining the quality of Spain's inland agroecosystems (González de Molina et al., forthcoming)

Organic agriculture is a viable economic alternative for many farmers and ranchers. Domestic demand for organic food has continued to grow, even during the recent period of economic crisis (Willer & Lernaud, 2017). According to one study of organic farming accounts, conducted in 2007 in Andalusia (Soler et al., 2009), the gross added value of organic farms is

35% higher than it would be if the same farms were conventional. Alonso et al. (2008, 157-160) conducted a comparative study of the socio-economic performance of 82 organic and 82 conventional farms producing typical Mediterranean crops: cereals (wheat, barley, rice, oats), legumes (pea, vetch, beans), vegetables (asparagus, lettuce, melon, celery, cauliflower, potato, broccoli, onion, bean, tomato, cherry tomato, pepper), citrus fruits (orange, mandarin), fruit trees (apple tree, pear, plum, grape, peach, apricot, banana fig, avocado, mango), and permanent crops (olive grove, almond tree, hazel, carob, vine). The study shows that, on average, organic farms have lower yields, but benefit from higher prices, higher revenues and lower expenses, giving them better economic returns on balance. The higher prices obtained by organic farmers are partly related to the organic premium and partly to producers receiving a larger share of those end-prices, through shorter distribution channels. Another study (Raigón et al., 2000) compared four crops (broccoli, lettuce, potato and oranges) in organic and conventional management in Valencia (in the east of Spain), a typical Mediterranean vegetable growing zone and showed that, in all cases, the yields of organic production are lower, but that other costs (except labour costs) are also lower.

Agroecological and organic agriculture make a strong contribution to maintaining farming in ‘marginal’ agricultural areas. Many parts of Spain, such as the Pedroches Valley, the Sierra de Huelva, the Sierra de Segura and the North of the Province of Granada have a very high ecological and landscape value, which is maintained by farmers who are highly dependent on subsidies and whose crops (such as nuts, low-yielding olive groves, and rain-fed cereals) are not economically viable when conventionally grown (Guzmán Casado & Alonso Mielgo, 2009). In such areas, AE makes a significant contribution to avoiding land abandonment and rural depopulation.

Portugal: the Mediterranean uplands

Portugal’s Mediterranean Uplands are highly vulnerable to climate change, due to extreme temperatures and prolonged droughts. Maintaining the economic and ecological viability farming in these ecosystems is challenging, especially in the face of highly competitive markets. Many, such as wine growers in the Douro region, are turning to agroecological farming practices, including no and minimum tillage, together with more sophisticated biodiversity-enhancing practices, such as maintaining or re-introducing schist walls and bushes and woods that enhance the ecosystem services that ensure their vineyards’ long-term sustainability. Vine growers are acquiring the knowledge and skills to adopt new farming practices that can help them to prevent soil erosion, control pests and diseases (through enhancing functional biodiversity) and improve water retention. There is increasing awareness of the need to reduce, or eliminate the use of proprietary herbicides associated with no and minimum tillage. The classification of the area as a UNESCO World Heritage Landscape and the growth of wine-tourism, have created further incentives and pressures for farmers to adapt their farming practices. In this mountainous (and high-cost) wine-growing region this can best be done by drawing on traditional agroecological practices and marrying them with science-based knowledge to develop a biodiversity-based agriculture.

In 2015 a little more than 8000 hectares of permanent crops were managed on a no tillage basis under the soil conservation measure of the 2020 Portuguese Rural Development Programme (one quarter of the area under this conservation measure in Portugal in 2015). Vineyards occupy more than 50% of the region’s agricultural land surface (a total of 108,979 ha) and almost 100% in some areas. There is some indication that agroecological practices are gaining acceptance, although mostly among medium and large commercial farms, managed by people with a higher educational level. The pioneers are mostly a few large farm estates, owned by private companies, which have, for more than ten years, been at the forefront of introducing biodiversity-based farming practices through EU funded collaborative research and demonstration projects involving the local university and a local vine-growers association.

In recent years more vine growers have become interested in these practices but the major obstacle to more widespread uptake is the extra labour needed for the (re)-introduction and maintenance of an ecological infrastructure of walls, bushes and living hedgerows. No-tillage is only more costly and resource-demanding in vineyards on very steeply sloping land. On new or recently converted vineyards, where higher levels of mechanisation are possible, the costs of no-tillage farming are lower. Trindade and Fonseca (2015), found conventional vine growers use around 25% more energy than no-tillage systems with spontaneous cover (1.14 MJoules/kg vs 0.89 MJoules/kg).

Austria: Constructing stable economic frameworks

Agroecological farms need a relatively stable economic framework in order to optimize their internal resource flows and to balance and stabilize the delicate configuration of labour, capital and natural resources (e.g. land and animals). Agroecological farmers experience economic pressure (albeit less so than conventional ones) to increase their output in order to maintain income levels. That is why AE, as a social movement, often has a strong focus on constructing new, distinctively different markets (LVC 2017). However the scope for developing these alternative marketing channels (such as direct marketing, community supported agriculture, farmers' markets) is sometimes limited by the availability of committed consumers and/or the lack of adequate regulatory frameworks (Prové et al, forthcoming). Medium-scale value-based food chains (VBFCs), which bring together like-minded partners along the supply chain, are one mechanism that can create the conditions for scaling up agroecological production (Stevenson and Pirog, 2008; Stevenson et al., 2011; Pirog and Bregendahl, 2012). When talking about VBFCs it is important to emphasize the plural aspect of 'values'. Unlike conventional value chains, which are largely, if not completely, focused on economic value, VBFCs are grounded on collectively shared non-economic values. These may include the small-scale and agroecological production systems, the keeping of autochthonous breeds, the use of hay instead of silage and (in the case of mountain farming) the benefits of alpine pastures which have a unique mix of herbs and grasses (Steinlechner and Schermer 2010). These values are reflected in specific product qualities and are embedded in the relationships between partners along the supply chain: for example, fairness in price negotiations and profit distribution (see also Dessein, Crivits and Block, 2017).

In the Alpine province of Tyrol the *Bioalpin Cooperative* provides an interesting example of such an chain. Bioalpin emerged in the early 2000s as a regional platform to bundle together the products of small-scale organic farmers. The cooperative offers a full range of organic mountain products under its own brand (*Bio vom Berg*, meaning 'organic from the mountain') selling a large proportion (60%) of their turnover through the large regional supermarket chain *MPreis*, which runs 260 stores in Tyrol and adjacent provinces. Although a conventional supermarket chain, MPreis seeks to distinguish itself from its competitors by focusing on regional products. Over the years MPreis and Bioalpin have entered into an almost symbiotic relationship with MPreis giving preference to Bio vom Berg products over other organic brands. While MPreis offers approximately 1000 organic products, under various brands, they profile Bio vom Berg and only sell other organic brands if Bioalpin is unable to provide them. In return Mpreis is the only supermarket chain where Bio vom Berg products are available (Furtschegger and Schermer 2015).

Bioalpin has grown substantially since it was established and this has allowed it to preserve and develop small-scale regional production and processing structures. Their product range has increased to approximately 130 products, with milk and dairy products as the backbone, but also including fruits and vegetables, eggs, cereals, fresh and processed meat, honey and herbs. The gross sales of the cooperative developed from 672,000 € in the first year of operation (2003) to 9.6 million € in 2017. The cooperative consists of eleven small dairies (mostly local cooperatives), processors (such as an organic butcher), producer groups (e.g. for eggs) and a number of individual farmers. Around six hundred small-scale farms (including the members of the dairy cooperatives) are affiliated to Bioalpin. In relation to the gross sales figures shown above, the financial benefits for each single farm may, at first glance, seem only marginal. However, many of the member farms operate on a part-time basis with off-farm employment and a substantial share of their farm income comes from public payments for the provision of public goods, such as payments for farming remote or difficult land (often with a high conservation value) and participation in agri-environmental programmes. Many of the farms are also involved in complementary direct marketing activities. Without the cooperative, most of the member farms would not have access a large retail chain. In addition, the existence of Bioalpin helps strengthen the position of artisanal processing facilities (such as the small local cheese making dairy cooperatives), which might otherwise be very precarious. Thus, the contribution of Bioalpin is not only of financial benefit to the individual farms, but also the maintenance of a web of local processing and marketing structures that make regional food production viable (Furtschegger and Schermer 2015).

The cooperative coordinates the supply chain on both the horizontal and the vertical levels. The horizontal coordination involves aggregating sufficient volumes and the collective purchase of packaging. This also allows the members to specialize in complementary ways: each dairy specializes in a limited variety of products, and their many different cheeses are assembled under the collective label. This gives each dairy the opportunity to professionalize their operations and to develop specialized skills and knowledge. This co-specialization reduces competition between the dairies and allows the creation of a collective identity and feeling part of the federated cooperative.

Vertical coordination involves price negotiations and planning volumes, the product range and product innovation together with the retailer. Stevenson et al. (2011) postulate that VBFCs are not characterised by price setting and taking, but consist of partners who negotiate prices at 'eye-level'. Ownership of the Bioalpin brand allows the coop to negotiate prices with MPreis, based on cost calculations, agreeing on a fair sharing of the revenues.

Bioalpin primarily grows through extending its network, a strategy Schermer (2017) terms 'multiplicative growth', which stands in stark contrast to the conventional 'additive' form. Multiplicative growth requires several preconditions but also raises some challenges. One benefit is that the long-term relationships reduce transaction costs, due to higher levels of trust but, at the same time, the multiplication of actors involved increases coordination costs (Talamini and Ferreira, 2010). The aim of the cooperative is not to maximize its own profit, but to improve conditions for all its members. Thus, a primary goal is to balance the increased coordination costs by reducing the transaction costs. The constant extension of the network provides the base for a growth in turnover, which in turn facilitates the professionalization of the central hub (Bioalpin itself) and its services. The members are, at least to some extent, relieved from the pressure to 'get big or get out'. This allows the individual farms to concentrate on their internal flows of resources and better management. The focus on network growth also increases product differentiation, which adds to the diversification of farming systems. The agroecological aspects of quality often rely on the revalorization of traditional varieties and production methods, which further preserves or enhances agro-biodiversity. The traditional production methods may even preserve otherwise abandoned elements of cultural landscapes, enhancing their aesthetic value, a feature of special interest in Tyrol, whose economy is highly reliant on tourism (Schermer 2017).

Discussion

In this paper we have elaborated the thesis that the VA/GVP ratio is strategic in distinguishing (proto-) agroecological approaches to farming from conventional and industrial approaches. This thesis is confirmed, we think, through our analysis of (often newly available) datasets that compare different ways of farming. In all our examples (proto-)agroecological practices generate VA/GVP ratios that exceed those from comparable conventional and industrial practices. Although this higher VA/GVP ratio is mostly achieved through increases in labour input, the (proto-) agroecological farms have income levels per person that are equal to or higher than conventional or industrial farms.

At the same time this finding points to the Achilles heel of agroecological farming. It can only continue to generate higher incomes if appropriate labour-saving devices are available to contain increases in labour demand. This, in turn assumes the existence of well-functioning technological support structures that are able to generate the socio-technical innovations required.

Theoretically, the capacity to generate relatively high levels of VA/GVP depends on the possibility to reground agriculture on ecological principles and cycles. In a way, this is confirmed by the data presented and discussed here. Agroecology fares well, in terms of VA/GVP, when it comes to farming practices that combine grassland (and/or arable farming) with animal production. This combination of (different) crops and animals allows for the construction of productive ecological cycles. On the other hand, this same finding points – again - to a yet underdeveloped aspect of agroecology: its potential seems to be rather small in specialized crops (that are difficult to integrate into poly-culture schemes). The data on Mediterranean crops in Spain, no tillage crops in Belgium and vine growing in Portugal seem to confirm this.

A third observation that also relates to the VA/GVP ratio, regards the difference between proto-agroecological and 'fully-fledged' agroecological practices. Regardless of the many possible differences, both types purposefully focus on reducing their use of external inputs (thus enlarging VA/GVP) and mostly effectively succeed, as the data show, in doing so. The burning question, though, is whether *further advances* along the agroecological trajectory will continue to render additional increases in VA/GVP. If not, AE might easily loose its momentum.

Finally, there is the possibility of agroecological agriculture resulting in overproduction which would exert negative pressure on the VA/GVP ratio and create entry barriers for new AE farmers .

These critical observations have a common denominator. They all point to the need to further contextualize the economics of agroecology. That is, equations (1), (2) and (3) need to be specified further so as to include time, space, governance issues and the dynamics of the interactions between man and nature. Farm incomes depend on how (changes in) VA/GVP and

GVP/LU relate to each other. As argued before, such changes and their interaction depend on contextual elements such as markets, agricultural policies, consumer preferences, social movements, the potential of nature, the availability of technological support structures and much more besides.

We consider that the equations we use in this paper satisfactorily explain many of the *differences between* various ways of farming. However, to get a firm grip on *the further development* of income levels, and on the *disparities within* agroecological agriculture, theory needs to be further elaborated.

Conclusions

There is currently a paucity of published data on the economic performances of agroecology within Europe. We hope that this analysis goes some way to filling that gap and will complement D'Annolfo *et al.*'s (2017) recently published review of the social and economic performance of AE, which analysed 17 case studies from the world and provided some initial evidence of the positive economic impacts of AE.

In the first part of this paper we set out some theoretical grounds for assuming that AE may well be capable of realising better economic returns than conventional and industrial agriculture. The second half of the paper provides a set of empirical examples that show, notwithstanding the limitations and doubts that we recognise, that agroecological farming *currently* generates farm incomes that exceed those from conventional and industrial farms (see Table 10 for an overview). In addition to this benefit, agroecological farms also provide more employment per hectare (thus supporting regional economies), use less fossil fuel and make positive contributions towards the maintenance of scenic landscapes and biodiversity.

Table 10: Examples of the economic benefits of agroecology

Case	**Criteria**	**AE compared to average**
Netherlands, 'farming economically'	Labour income/100 kg. of milk	+ 110%
Netherlands, Centre for Research in Dairy Farming (PR)	Employment generated at volume of production of 800,000 kg. of milk	+ 100%
France, grassland-based farming	Family income/family worker	+ 73%
Germany, low concentrate feeding	Income per dairy cow	+ 60%
Switzerland, organic farming	Employment/farm	+ 27%
Italy, *Rossa reggiana*	Income per hour	+ 15%
Poland, dairy farming	Income according to level of self-provisioning for feed and fodder (0 compared to 51-99)	+ 53%
Ireland, beef and milk	Gross margins per hectare	increases in the order of 75-80% in a 3-4 year period
UK, sheep farming	Gross value added/ewe	+ 10%
Spain, Mediterranean crops	Gross Value Added	+ 35%
Belgium, no tillage crops	Decrease in workload Decrease in machine costs	- 75 min/ha - 60 Euro/ha

Belgium, grass-based farming	Decrease in dependency on subsidies	Subsidies down from more than 60 to only 20% of VA
Portugal, vine growing	Fossil energy consumption/ha	- 30%

Source: Synthesis of data presented in this article.

We consider these results to be both impressive and convincing. The more so, since there is enormous potential to further strengthen the economies of agroecological farms through the construction of closely knit webs for local processing and marketing, as shown in the case of Bioalpin in Austria (as well as, to a lesser extent, the Italian dairy and cattle sectors). Such webs can further improve farm incomes and employment opportunities, thus contributing to the scaling up of AE practices and creating strong links between rural production and urban consumers.

Taken together these results shows that AE is far from being a 'second-best' type of agriculture with a limited potential for providing adequate incomes to those who work in it. By contrast, this paper shows that AE generates levels and stability in incomes and employment that are all, under current circumstances, superior to those generated by conventional and industrial farming.

It is important to stress that the many AE practices discussed in the paper are the outcome of social struggles, each of which involve many actors and can take place at multiple levels (fields, farms, networks, markets, etc.). We see a promising potential for these manifold practices to become increasingly interlinked and mutually supportive. New social movements and well-articulated policies will need to play a role here. The example of Ireland is a case in point. It shows the potential for appropriate agricultural policies, that centre on applied research and co-ordinating flows of communication, in facilitating and supporting agroecological farming. This could readily be replicated elsewhere and would allow for a substantial transition from conventional and industrial to agroecological farming. As the article shows there are already many proto-agroecological practices within Europe that are capable of functioning as spring boards and inspirations for the further unfolding of AE in Europe.

One final point that emerges from this comparative analysis is that AE depends overwhelmingly less on subsidies than conventional and industrialised agriculture. This is largely due to the way in which in the EU's agricultural subsidy system is structured (with the lion's share of the budget going to the largest 20% of farms) but also reflects AE's inherent higher income generating potential (without which agroecological farms would not be able to survive under the current subsidy regime). Shifting part of the CAP budget towards agroecology would greatly strengthen the already significant contribution that these farms make in providing quality food, employment, public goods and environmental services. This money could also be used to waive the debts of thousands of highly indebted farms on condition that they embark on a transition process towards becoming more agroecological. Both these shifts in funding would accelerate the much needed transition towards a more sustainable and resilient agriculture and signal a switch away from the current and wholly unsatisfactory situation of EU taxpayers' money being used to top-up the incomes of large and unsustainable farms.

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