**Appendix A. Short description of current and alternative farming systems. All changes and impacts are expectations from the stakeholder participants in the workshops1.**

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| **Short name** | **Category** | **Description** |
| **BG-Arable** | Current | The North-East of Bulgaria is known as “the granary of the country”. The climate and natural conditions in the region favour agricultural production and agriculture is a key economic sector. The agricultural land is approx. 80% of the territory in the region and represents over 1/3 of the total arable land in the country. The soils are among the most fertile, suitable for growing of cereals, sunflower, industrial crops, fruits and vegetables. In terms of production the region’s share is between 45% to 60% per crop (mainly wheat, barley, maize and sunflower). It produces 1/3 of the total national Gross Value Added in agriculture. Last decades, the developments in the region encompass processes of specialisation and concentration and rapid and large increase in size of farms bringing into existence the large-scale mechanized intensive farms. They dominate land cultivation and specialize mainly in grain production. Hence, the monoculture dualistic production structure has established in the region. As result it endangers maintenance and preservation of natural resources (soil fertility the most) as well as the viability of the other farm types (livestock farms, farms with perennials, vegetable growers, beekeepers, arable farms with smaller size). The price volatility both for inputs and outputs and the subsidies’ level are major drivers of change into the current prevailing arable farming system, altogether with contradictory trends in climate, legislation and demography in rural areas. |
| Innovation and technology | Technology | Innovations at a general level were perceived as a solution for any of the current and future challenges of the existing system and they are part of any of the possible future systems. This alternatives system encompasses various dimensions of change/adaptation/transformation in the technology, e.g. new production technologies, new varieties, less damaging inputs, technical modernization, and labour-substituting technologies. The adoption of new technologies should lead to cost reduction, preservation of soil quality, sustainable production levels, reduced negative consequences from the lack of skilled labour and improved farm income and viability. Important preconditions for the success of this system are: the success to adapt innovations to the local conditions and natural capital, available financial resources for investments, the need of adjustments in the farms and access to the relevant advisory services and support. Last but not least, the technological innovations and trends would influence and attract more young people in the business and they are an important part of the smooth succession process. |
| Processing and increasing added value | Product valorization | The main products of the current farming system are grains and oilseeds for the export markets and they are traded (mostly) internationally at wholesale prices. Usually, for a single farmer it is difficult to comply with international market requirements and the role of international trade companies increased a lot. Thus, farmers are price-takers and they have few opportunities to manage their revenues. The proposed alternative system is an opportunity to increase value added through processing of output into food products for the end consumer as well as for biofuel production. Different challenges should be taken into consideration for the transition, e.g. consumers’ preferences, financial issues, competition, requirements, and legislation in food industry. A very important part of the success of this alternative are targeted efforts (including policy) for strengthening the image of Bulgarian products among consumers in the country. For sure it would improve market performance and it would have wider positive effects on the local economy in terms of upstream and downstream economic linkages and transactions. The successful achievement of this alternative may be complemented by the collaboration and diversification activities (e.g. sharing processing facilities, new crops). |
| Collaboration | Collaboration | As has been mentioned already, collaboration as identified alternative system could successfully be part of the other alternatives. Collaboration (in terms of cooperation in production/marketing) is an opportunity for achieving lower production costs, to increase revenues by accessing a different market or achieving higher price of output, utilising the economies of scale, etc. Cooperation implies positive changes into both better coupling with local conditions and natural capital, since farmers can better plan the structure and territorial allocation of production. The capacity of cooperating farmers to overcome different disturbances together is higher, either regarding weather conditions and/or market realisation. Collaboration is important also in terms of facilitating the learning process, better access to advisory services, and increasing exchange of experiences. This requires better partnerships and networking either with actors inside and outside the system with a special attention to reinforce interlinkages with research institutions and universities.  An important point should be mentioned: there is pessimism about the prospect for collaboration due to different historical developments and societal perceptions and experience from the past. |
| Crop diversification | Crop diversification | The next alternative for the future farming system is production diversification, since at the moment it is poorly diversified both regarding on- and off-farm activities. Diversification could be in different dimensions: increased variety of cultivated crops (varieties that are more suitable for a drier climate) and/or territorial diversity of plots (in conformity with the local conditions and the state of natural capital), changes to a mixed farming system (crops and animal breeding), and introduction of processing facilities, as all directions would preserve farms from risk of income instability. But inevitably diversification activities require farmers to be ready and open for changes, especially innovations, and to invest. The new crops/varieties/activities would require new machines (differences in tilling practices required by the crops), suitably equipped stables, and new knowledge about the production, processing and marketing. The access to finance is recognised as a possible issue for successful achievement of the changes towards a diversified farming system. It should be mentioned, as above, this alternative state overlaps with the others (especially innovations) which suggests a complementarity in the future vision for farming system development in the region. |
| **NL-Arable** | Current | The Veenkoloniën is a rural region in the North-East of the Netherlands. More than 60% of its area of almost 80,000 hectares are dedicated to agriculture. The soils are mainly peat soils mixed with sand, which makes them very suitable for growing starch potato. More than half of the agricultural land is dominated by farms that cultivate starch potatoes, typically in a rotation of 1:2 to 1:3 with other crops, which are mainly sugar beet and winter wheat. With the current typical crop rotation, profit per hectare is low compared to other regions with arable farming. For the cultivation and processing of starch potatoes, farmers are organized in a cooperative (AVEBE). This provides certainty of income, but also co-dependency between farmers and the cooperative. Arable farms are often medium-sized farms run by a family. Apart from arable farms, there are also dairy farms, intensive livestock farms and horticulture. The number of farms has gone down over the years, and remaining farms have increased in size (economic output and area), and different farmers have diversified by including new crops in their rotation (onion, carrot, flower bulbs), by becoming mixed farms (currently about 10% of agricultural land) and by developing activities outside agriculture. Over time, also the intensity of land use has increased, i.e. more output per hectare. |
| Precision agriculture | Technology | A system based on precision agriculture will have less production risks, leading to a higher and more steady supply of starch potatoes in the region. For instance, by early detection of mycotoxins by drones. Drones can also be helpful in assessing damage, thus improving insurance of crops and thus improving incomes in less favourable years. Profitability and soil quality will improve through reduced application of crop protection products. Application of light robots can reduce soil compaction. As precision agriculture is expected to be “conventional” in the next generation, it will also contribute to the other proposed alternative systems. |
| Collaboration & water | Collaboration | This system is focused on collaboration between actors within the farming system. Arable and livestock farmers collaborate to exchange land and improve circularity. In addition, there is collaboration with regard to alternative water management. Central in the alternative water management is the idea of taking the 5-10% of lowest laying fields with low productivity out of production and improving water levels in the remaining areas. The improved water levels will result in higher yields per hectare and at least compensate for the loss in area. This leads to higher profitability, as collaboration will reduce the need for investment, e.g. through sharing costly equipment. Improved water tables will increase soil quality, provided that also machines in the future will exert less pressure on the soil. The share of land that is taken out of production will be dedicated to nature and water retention, thus increasing water availability, but also making a better connection between production and local and natural resources. Social self-organization is a result as well as a precondition for this system. The extension of social networks will lead to better exchange of information and more joint ventures in terms of investments, thus improving the infrastructure for innovation. |
| Alternative crops | Diversification | In the current situation, a lot of bulk products are produced. There are opportunities to increase value of products, for instance by filling niches in the provision of animal and protein suitable for human consumption. These niches require also alternative processing facilities. The area for livestock farming will decrease, thus guaranteeing that the current level of starch potato production can be maintained. Through increased value of products, profitability will increase. The soil quality will change, either positive or negative, because of a different fertilizer need of the alternative crops. A possible lower regional water supply will stimulate farmers to increase the water use efficiency, and to increase local water retention. |
| Nature-inclusive | Organic / nature friendly | This system can have different levels, from small adaptations at field level to changing the crop rotation and increased collaboration between farms. Soil quality will increase out of necessity. Increased collaboration between arable and livestock farmers improves circularity, where manure is seen as a valuable product and rest products are processed. Downside is that this system is more labor intensive. The interaction between nature and agriculture is also increased, with an important role for the soil. Production of starch potato is expected to increase moderately: on the one hand there are increased risks for contamination of fields with nematodes, on the other hand, increased soil fertility will lead to increased yields. With subsidies for nature-inclusive agriculture, it is expected that profitability will increase moderately.  While the proposed systems have different foci, stakeholders expect that a future system combines strategies from all proposed systems. |
| **UK-Arable** | Current | Large-scale arable farming prevails in the East of England region due to fertile soils and mild climate which results in high production of arable and horticultural crops. These elements make the East of England the region with the most impact on the country’s agricultural value, as it is responsible for one third of the country’s cereal production. Wheat and barley are the main cereals cultivated in the region. Other non-cereal crops are also grown, such as potatoes, mustard and squash. As a combined effect of population concentration in cities (and thus a desertion of the countryside) and of the local large flat open area, the farms are large-scale family or corporate farms. In the last ten years the size of farms grew considerably as the number of farming businesses decreased by more than 40% while the farmland surface area remained the same. Three main farm types have been identified:  1. Large cereal farms with an increasing frequency of additional specialisation of sheep and cattle production for the provision of manure. These farms have high labour requirements at the end of the growing season for harvest and land preparation for the next season.  2. Large general cropping farms, which are usually specialised in root crops. These farms have also high labour necessities at the end of the growing season. In addition, these farms have a need for more labour during the rest of growing season than the large cereal farms.  3. Smaller horticultural farms, which, despite their smaller surface compared to the abovementioned farm types, have a high economic output. These family or corporate farms are highly specialised, even within their own sector. |
| Likely system | Business as usual | Given the political and environmental situation in terms of Brexit, the likely future system was considered to be one that is only changed slightly, “tweaked” from the current system. Such a scenario would incorporate ‘public money for public goods’ which has been under discussion over the last few years, and would focus on the use of existing agri-environmental stewardship features such as hedgerows and wildflower margins. It would therefore miss the opportunity to be a broader, more holistic landscape scale change.  In terms of payments for this, it was thought that a ‘volatility payment’ should be put in place, in order to cushion farmers against weather and global trade uncertainties. The current Basic Payment System (BPS) was thought to be susceptible to change and being decreased by government despite current reassurances that this would not happen. There were also concerns that money set aside for tackling climate change through carbon neutrality plans may in reality be part of the same budget as the public money for public goods agricultural system, therefore putting much greater strain on this spending with less for farmers. An example was given for this  regarding the UK’s peat strategy. |
| Desirable system | Organic / nature friendly | A desirable future farming system was summed up to be a regenerative one. This was defined as arable systems incorporating livestock into rotations in order to add manure (organic matter) back to the soil to increase its health. This would also entail greater across-farm cooperation and collaboration, with livestock moving across 3 or 4 arable farms. It was also thought that within this system, subsidies should not prop up production, but that farming should be a viable business within itself, as well as having positive environmental impacts. As is the current trajectory for farming post Brexit, ‘Public Money for Public Goods’ was thought to be a part of this desirable system. Food prices were considered to be kept affordable in order to be accessible to all, however welfare standards would be kept high. |
| **DE - Arable & Mixed** | Current | The Altmark is located in the German Federal State of Saxony-Anhalt and captures important features of the large-scale agricultural structures of Eastern German agriculture. The region has a relatively high proportion of grassland in agricultural land, at nearly 27 %. The soil quality is rather poor, and the arable farming yield levels are relatively low. The majority of the land is cultivated by farms with more than 200 ha. Farm types are heterogeneous, but mixed and arable farms are most prevalent. In terms of numbers of farms, individual full and part-time farms as well as partnership farms dominate the Altmark. Despite most of the farms being family farms, they are often ten times the size of family farms found in Western Germany and rely on hired labour. Although farms categorised as legal persons (mainly limited companies and producer cooperatives) only account for ~10 % of the farms, they farm 45 % of the agricultural land. The family and cooperative farms have a high share of loan capital and rented land, and therefore a relatively low capital base. The main commodities produced are cereals, oil seeds, potatoes, and sugar beets as well as meat and milk, which are marketed as standard via wholesalers, large dairies, and slaughterhouses. Livestock production is dominated by large stocks. Fattening pigs are mainly kept in herds of more than a thousand animals and dairy cows in herds of 100 to more than 500. Around 40 % of the dairy cows and 53 % of the specialised dairy farms in Saxony-Anhalt are located in the Altmark, although the region contains only 23 % of the agricultural land of Saxony-Anhalt (in 2007) (StaLa-Statistisches Landesamt Sachsen-Anhalt 2008, 2014), emphasising the relative importance of livestock production. |
| Better societal appreciation | Attractive countryside | This system state of a better societal appreciation has a strong positive effect on the availability of qualified workers and farm successors. Since farming is more attractive because of its better societal recognition and gain of respect, more people look for employment at a farm and move to the rural sites in the Altmark. Subsequently, villages become more dynamic and livelier which also trigger many improvements in the regional infrastructure. The motivation of farmers and employees are higher which increases the profitability of farms and also improves their ability of response diversity. |
| Organic farming | Organic / nature friendly | This system has a slight positive effect on soil quality from an increased organic matter and more living organisms in the soil. This improved organic matter could then also bring a slightly positive effect for the availability of water in the region. The cereal and biogas production level are reduced. On the one hand, organic farming rather applies fewer intensive varieties since many of them are more resistant to plant diseases and need fewer pesticides. On the other hand, they are more optimized to more moderate nutrient levels. Another aspect that contributes to the lower production level is the need of longer crop rotations. Since organic farming needs to intercrop with leguminous plants, it is not possible to cultivate cereals or corn every year. In order to accommodate these lower production volumes, however, this alternative system has the corresponding value chains to bring the products to consumers in the conurbations outside the Altmark and receive higher prices. |
| **RO-Mixed** | Current | The case study in Romania consists of small-size, mixed family farms in the Nord-Est region of the country. The last Farm Structural Survey (2016) shows that 73% of the Romanian farms are mixed (have both utilized agricultural area and livestock). The agricultural area of the Nord-Est region totals 2.12 million ha and includes 65% arable land, 32.6% grassland, 1.5% vineyards and 0.9% orchards. The main crops are maize, wheat, sunflower and vegetables; important quantities of fruits and wine are also produced in the region. Livestock is composed mainly of cattle and sheep, pigs and poultry. In the last two decades, bee farming developed as well. The case study concerns small, mixed, family farms (under 20 ha, with field crops and livestock), which represent 99% of the total number of farms in the region. They operate 54% of the utilized agricultural area (UAA) and own 89% of livestock units in the region. Agritourism also developed in the region, based on local traditions, rich historical and cultural heritage and wonderful landscapes. The rural population is heavily dependent on agriculture in economic terms (93% of farms use more than half of the production for on-farm consumption). It is characterized by an accelerated ageing process and low levels of education. There is a lack of workforce in the region, due to migration to urban areas or abroad. In terms of the embedding in the value chain, the main problem is the lack of cooperation among small farmers, which results in lack of sales organization and poor development of local chains. It also results in poor bargaining power with more concentrated upstream input providers and downstream actors in the value chain (processors and retailers). |
| Commercial specialization of family mixed farms | Specialization | This alternative system is considered to be the most likely one, because it comes as a natural development of the small farm system with a certain commercial vocation. The passage to this alternative system is expected to come through expanding the farmland (by renting or buying), by increasing the number of animals, and through technological and managerial improvements. Land is used in correct technological rotation of crops, including perennial fodder crops such as alfalfa, annual good quality grass mixtures and cereals. Most of the fodder crops are used as feed for animals (cattle, sheep, goats). Production is expected to increase, due to better technology, as well as income from sales of cereals (exceeding the need for feed consumption) and of other high-quality fresh products (vegetables, fruits). Income from animal husbandry comes from selling milk to local processing units or live animals to slaughterhouses. Current NRDP offers funds through several measures included in Pillar II for developing the farm, such as building new facilities for animals and buying high-quality animals. This alternative system is characterized by some circularity; manure is used in the farm, so are other residues. There is a higher need for permanent and seasonal workers, since this system is more labour-intensive in the animal husbandry activity. Availability of labour is an important boundary condition, and a possible solution would be hiring foreign workers (from Asia mostly). The system contributes positively to the heterogeneity of the farming system, due to the multiple possible combinations in which it can come; innovation has also a major contribution to the numerous possibilities. It certainly supports rural life and contributes to improving it. Legislation can favour the system, through support instruments provided for installation of young / new farmers, and ease of access to various form of support. Subsidies are essential for farm profitability. |
| Cooperation / multifunctionality | Collaboration | In this alternative system, farms are still small and mixed, but they are integrated in true and functional cooperatives. The cooperatives play an essential role in a better insertion of the member farmers in the value chains. The farmers become horizontally and vertically integrated. Multifunctionality refers to the fact that through the cooperative, complementary activities may occur, such as milk collection and primary processing, cereals, fruit and vegetable collection, conditioning and sales to large retailers (supermarkets), as well as agro-tourism development. Subsidies are essential for the small member farmers, but supplementary support for the cooperative may be accessed. Agricultural production is expected to increase moderately, since the farmers are still small, but the cooperation allows for technology improvements resulting in moderate productivity increases.  Spatial heterogeneity is slightly decreasing, but small farms are consolidating. Legislation is still not favoring small farmers. This system is supporting rural life, by retaining small farmers in the rural area and offering them better opportunities to obtain moderate profit in the small mixed farms. Through the cooperative, the farmers are better connected with actors outside the farming system, such as consultants, input suppliers and wholesalers or retailers, but from a better bargaining position. There are some specific boundary conditions linked to the legislative gaps for the small farmers, as well as the need for financial and insurance instruments tailored to their specific needs. |
| Alternative crops / livestock | Diversification | This system is likely to emerge less than the previous ones, but has certain development perspectives because it provides niche products, which are sold at good prices, and allows development of farms in areas generally improper for other crops or livestock (high hills, semi-forest and mountain areas, etc.). Sales of products increase significantly through specialized outlets. Animal products are processed in special slaughterhouses with specific veterinary regulations (e.g. products from deer meat and wild pigs). Farms growing alternative crops have also good developing perspectives (e.g. sea buckthorn, berries, asparagus), they are very profitable, their products are in high demand either fresh, or with minimum processing (which is generally done on the farm premises, such as conditioning, packaging, freezing). Outlets include restaurants, cosmetic producers and export markets. This system is best contributing to biodiversity, since the alternative animal species are growing basically in extensive systems, close to the natural conditions. This is less valid for alternative crop products, for which more intensive growing technologies have been developed. There are some major boundary conditions, such as the availability of subsidies for alternative crops and animals. There are also some specific and tight regulations for some species; an example is that wild pigs cannot be raised in farms, only half-breeds, and the meat products have special rules for processing, since they are generally assimilated with game products, and need supplementary food safety rules. |
| Organic agriculture | Organic / nature friendly | This alternative system is considered to be a good development direction. Romania has good conditions to extend this alternative system in the short and medium term; there are many areas where, until now, extensive farming was practiced, with low chemical inputs, thus creating good premises for conversion to organic farming. There is an increasing demand for organic and healthy food (in urban areas mostly, where consumers have higher income and afford more expensive products). Organic production is expected to increase as such; sales are expected to increase, since in the last few years, all supermarkets opened special selling areas devoted to organic products. Subsidies are essential for this alternative system. It contributes to maintaining natural biodiversity; it also supports moderately rural life by creating more agricultural employment.  Present legislation needs improvement; it currently provides poor support for this system and is considered to be more hindering than stimulating for organic farming; it is also disadvantaging Romanian organic farmers as compared to their peers in EU especially in terms of certification rules. Connection with actors outside the farming system needs improvement, in terms of development of organic storage facilities and processing plants, which for the moment are quite underdeveloped, forcing most of organic producers to sell or export unprocessed products. The major boundary conditions are those mentioned above: (need for) adequate legislation; availability of processing facilities; the cost of certification process, which currently is very expensive and is roughly costing as much as the current subsidy, leaving the organic farmer to support high production costs. The (much needed) presence of associations is another boundary condition in this alternative system. |
| **ES-Sheep** | Current | The extensive sheep farming system is located in the Huesca province, Northeast Spain. Huesca covers about 15,000 km2 and two main regions can be distinguished: 1) The Pyrenees and pre-Pyrenees in the North, covering about 6,000 km2, where agricultural activities are confined to extensive livestock; and 2) the southern part of the province, characterised by the plains of the Ebro depression (about 9,000 km2), where extensive farming (sheep, goat and cattle), intensive farming (pigs and broiler) and crop farming (rainfed and irrigated) are present. In Huesca, the number of (ovine and caprine) decreased from 2,902 (1995) to 1,018 (2019) and the number of sheep from 923,399 (2005) to 521,501 (2019). The size of farms has shown an upward trend in the last years. The current size of a herd is between 200 - 1,000 sheep. These trends are a result of the convergence of a range of economic, institutional, social and environmental challenges the farming system is facing. The extensive sheep farming system is highly dependent on EU and national subsidies, and hence, vulnerable to changing agricultural policy goals and increasing bureaucracy and control requirements. Regarding the social challenges, the case study area suffered a vast population decline over the last century that comes along with a lack of skilled labour, social services and infrastructures. The low attractiveness of the farming system and the agricultural specialization result in the lack of new entrants. Finally, the extensive sheep farming system is increasingly limited in the access to pastures. In addition to the provision of private goods, such as to ensure sufficient farm incomes and deliver high-quality food at affordable prices the extensive farming system also provides public goods. Grazing helps to maintain and preserve the natural resources contributing to keep soil quality and biodiversity by maintaining landscape heterogeneity. Extensive livestock activity is also important to prevent forest fires by keeping the area clean from dry biomass (weeds and scrubs), which act as fuel in Mediterranean areas. Grazing activities also provide recreational areas demanded by society and keep the rural areas attractive. As a result of the challenges, levels of functions in the farming system are generally perceived to be low. |
| Semi-intensive | Intensification | The production of meat is improved with an intensification of the production (more labours per year) and the stabling of the livestock. The improvement of production is based on the use of technology and the standards for lamb quality are achieved with a diet based on high quality fodders. The greater production trusts in the national demand, but especially in the openness to international markets, in which the lamb meat prices obey to volatility of markets. As a consequence of the stabling, the grazing of pastures decreases and the feeding with fodders increases. Grazing is maintained but in a lesser extent and almost exclusively in stubble fields. Therefore, sub-products are necessary as a source of cheap food supply. This system is more likely to be performed in the flat areas of the region. In these areas, pasturelands are less abundant, whereas irrigated lands are more present. The alternative crops (fruits and cereal crops) guarantee the provision of sub-products facing the scarcity of pastures. In these areas, the diversification activities as well as the sub-products supply are easier than in the mid-mountain areas.  The economic viability of the farm will increase as a result of the improved farm management and animal handling. For instance, an improved prolificacy of two-three labours per year, opposite to one labour per year in the extensive system, will decrease the feeding cost by ewe. Increased margins will lead to increasing number of farms (quality of life) and number of heads in the region (food provision). However, the size of the herds by farms could be smaller than the existing ones. Increasing the herd size to increase gross margin would not be needed anymore, because the source of increased gross margin is the improved farm management and the herd prolificacy. As this system considers stabling and the increased consumption of feed, the feeding costs will be affected largely by unstable markets of commodities. In turn, market volatility will also affect largely on lamb meat prices. Due to the livestock stabling, breeds adapted to it will be predominant, whereas the maintenance of local breeds adapted to environmental conditions will not be necessary (Rasa aragonesa breed). |
| Hi-tech extensive | Technology | The main characteristic is the coupling with local and natural resources. The system has two main functions: the production of safe and high quality food and the conservation of natural resources and animal welfare. The quality of lamb meat is achieved rearing GPI lambs (Ternasco de Aragón), which belong to the local breed (Rasa aragonesa breed), adapted to the environmental conditions. The technology is mainly oriented to the shepherding and the management of the pasturelands. The sheep herd mainly grazes extensively on the natural grass pastures available throughout the region for most of the year. It is more likely that this system takes place in the mid-mountain areas than in the flat areas, where the presence of pastures is scarce. Feeding costs would be lower, as the pastures constitute the main diet resource. Those feeding costs would increase in the event of environmental and natural hazards (droughts) resulting in lower quality and quantity of the pastures, and the occasional use of fodders. The gross margin will increase because of the increase of the administration aids (related to the environmental service the sector is providing). The lower prolificacy of sheep (one labour per year) leads to the necessity of increasing the size of the herd in order to maintain the gross margins. There will also be an increase in the number of farms in the region, on the condition that the access to the lands increases (and consequently the access to administration aids). |
| **FR-Beef** | Current | The Bourbonnais region coincides more or less with the department of Allier, located in the Massif Central, central part of France. The farming system is an extensive, grassland-based beef production system, with about 483000 ha of land dedicated to agricultural activities. The linkage between the livestock farming activity and the landscape is very solid. The landscape is dominated by grasslands with a reticulate of hedges forming the so-called bocage. Agriculture is a dominant activity in the region, constituting 5.1% of the overall workforce of the region and it is mainly composed by the beef sector (42%), followed by the crop sector (16%) and small ruminant production (12%). The region traditionally sells the weanlings to Italian butchers. Usually, females are finished in the region, while some crop farms finish also the males. |
| Only-for-export production | Specialization | In this alternative system the internal French market is not addressed with the exception of a small fraction of farms focused on a very niche internal market of high-quality French-finished beef. The specialization of export (mostly to Italy) constitutes a more stable output as the demand from the Italian market is even increasing as the Italian value chain cannot satisfy the domestic demand with its number of suckling cows. The difficulty to address the consumer expectations of the internal French market are avoided. At the same time, the farmers of the Bourbonnais do their best to address the social concerns about environment and animal welfare. Farms have smaller herds (to reduce methane emissions) and, as a consequence, fewer farms are able to survive economically. The production is lowered, however the international demand keeps the price still competitive. The raising of weanlings is almost completely done on grass in order to promote a good local image of the animal welfare. This scenario makes it possible to still valorize the grassland resource of the Bourbonnais even in face of the decrease in the consumption of high quality local meat in the French market. |
| Production only for the French market | Product valorization | The COVID-19 raised the awareness in many countries about the primary importance of feed self-sufficiency. In addition to that, the reputation of the farmer in the society increased along with the feeling of gratitude for farmers for guaranteeing food production during the crisis. Production for the internal market will be more and more encouraged and, on the contrary, the export (especially the transportation of live cattle) and imports will be discouraged. The internal production are more and more controlled so to have a higher quality and the environmental awareness will push policy-makers to protect the landscape and animal welfare. Consumers are willing to pay higher prices for French beef. The growth of cattle is slower and grass-based. |
| Development of tourism | Attractive countryside | Tourism is more and more developed in the region. Farm activities will not only be based on cattle breeding but also on agro-tourisms and other activities related to the external society such as education. People are more and more attracted to the Bourbonnais, which will become a region of excellence for the food produced but also a place to visit for the beauty of its landscape. Farmers have multiple sources of income, coming from their different activities and the number of people working on the farm increases. Interactions with other forms of tourism will embed the farming activity in a more economically dynamic context (e.g., trekking and cycling tracks, historical sites, gastronomic holidays). |
| **SE-Poultry** | Current | Historically, poultry farms in Sweden have been developing in the plain districts in the southern and the central part of the country. The region is recognised for its agricultural activity. While it occupies one third of the country’s area, 85% of the utilised agricultural area, and 75% of the agricultural holdings registered in Sweden are situated in this region, employing 80% of the regular labour engaged in agriculture. Although the landscape and the soil quality are heterogeneous, the region is highly recognised for its fertile plain districts, with dominating cereal production (45%). Private person/family farms are most common, owning about 90% of the total agricultural land, respectively.  The commercial poultry sector in Sweden is dominated by egg and broilers production for the domestic market; 95% and 68% of the total consumption is from the domestic production. Despite the large and increasing demand for domestic poultry products in Sweden, the sector facing challenges related to: i) fast changes in the consumers preferences (animal welfare, food quality), ii) strict environmental/animal welfare regulations; both I) & ii) leading to requirements for technology change (adoption of free-range poultry systems, adoption of organic poultry production) and pressure on profitability; iii) different standards for domestic and imported products, making the domestic production less competitive especially for the export market; iv) vulnerability to acute animal health issues (pathogens) (Sweden is among the countries with the lowest level of antibiotics use per slaughtered kg of meat (ca. 12 mg per slaughtered kg of meat, compared to an EU average of 152 mg per slaughtered kg of meat). |
| Large farms | Intensification | The increase in size refers to both: i) increasing the size of the buildings i.e. increased egg production; ii) functional diversity, with an accent on self-sufficiency level for fodder production, i.e. increase of land. Farms have to grow in order to improve the productivity. Both egg and broiler farms operate under constant pressure for the need of technological change. Moreover, broiler farms have a constant pressure of low prices for imported products. Therefore investments in technology and increase in size are necessary for the profitability of the farms. Large farms applying modern technologies for production and monitoring will contribute to high product quality (animal health, and welfare). Large farms can easily diversify in order to be more self-sufficient for fodder, or diversify the income sources, such as from bio-energy production, forest, etc. Functional diversity is recognised by the stakeholders as a risk management strategy for unpredicted shocks, commonly communicated as *“stå på flera ben*” (“stand on several legs”, translated). Boundary conditions for this alternative system are strongly related with the profitability of the farm, i.e., access to qualified labor, access to land, ground water and capital, and a functioning and efficient bureaucracy. |
| Robots | Technology | Robots are already used in the production system, and the use of artificial intelligence is expected to increase in the future. Robots are seen as inevitable change, for securing better productivity (e.g., labor) and efficiency, but also for minimizing the possibility for contamination and speeding diseases, and thus having high quality products. Robots are expected to be more extensively used in i) processing (determining the sex of an eggembryo, packing, transporting lines, slaughtering, sorting carcasses), but also in ii) farm management activities (transporting lines, feeding, ventilation, etc.). However, the contact between the farmer and the animals has to exist. Stakeholders strongly believe that a successful farmer has to have *“djuroga”* (“animal eye”, translated), i.e., ability to pay attention and detect when things are not as they should before the real problem comes/escalates. It was argued that robots lack that kind of human intuition.  Boundary conditions for this alternative system are mainly related to profitability, the size, and the infrastructure for innovation. Both egg and broiler sectors are ready to increase in size and advance in new technology/robots if there is a market for their products. The need for advanced technology in the sector stimulates innovative solutions, but the gap between the innovators and the final users must to decrease. |
| Self-sufficiency fodder | Diversification | This alternative system ensures more stable economic performance of the farms due to the lower risks originating from the volatile prices of the fodder. Self-sufficiency in fodder increases the response and functional diversity of the farms and the need for applying new technologies, i.e. support innovation infrastructure. Functional diversity is ensured with the multiple production lines (poultry products, cereals/crops to be used for fodder production) on the farms. Boundaries identified for the expansion of this system refer to the: i) farm location - egg and broiler farms are located in productive regions competing for land with other farms, thus farm expansion with a purpose for own fodder production is not always possible; ii) needs of specific technology and but also investments in buildings knowledge (especially for production of concentrates); iii) access to capital. |
| **PL-Horticulture** | Current | The Polish case study is located in Central-East part of Poland (in two NUTS2 regions: PL92 - Mazowieckie and PL81 - Lubelskie) and it is dominated by five key farm types. This CS area is the most renowned for its horticultural farming system. It is determined by the region’s diversified landscape, high land fragmentation and historical traditions. Typically, these are family farms with an average area between 5-10 ha. Key challenges include extreme weather conditions, fluctuation of prices of agricultural products, lack of seasonal workers, bureaucracy and variability of regulations. Development limitations are caused, among other, by government limitations on agricultural land turnover, lack of farm successors, low intensity of horizontal and vertical cooperation. The average size of horticulture farms slowly grows in the past years, as well as the intensity of cooperation. The market infrastructure and the distribution channels have improved significantly. |
| Horticulture farming | Specialization | The case study area is suitable for further development of horticulture as the agricultural land is highly fragmented and the terrain is hilly in some parts of the region. Thus, large-scale production of many other crops is limited, either physically, or economically. Due to this, such alternative system could improve the situation with a lack of utilised agricultural area. Further specialization in horticulture farming could be a catalyst to the creation of producer groups able to unite efforts to maintain contracting with processors, supermarket chains, large-scale customers. It is also perceived as the way to minimize existing risks: weather (e.g. by building storage and cold-storage facilities), financial (e.g. receive better loan offers and financing options), market (e.g. insure price fluctuations, supply shortages). It could increase the farmers’ competitiveness due to distinct labelling of product origin. Focus on quality is determined as a key competitive advantage of Polish fruits and vegetables. Product variety is important, as introduction of such diversity would help minimizing various risks (e.g. withstanding plant diseases). |
| Shelter farming  (farming under cover) | Technology | Key aim of this system is to focus on risk mitigation, as currently farmers are increasingly facing extreme weather events, which put pressure on the horticultural production (especially soft fruits). This approach would also provide technical means for smart (advanced and complex) farming techniques, which would increase the production efficiency. Utilised agricultural area is expected to stay the same, thus allowing to increase yield under the current land availability limitations. Key obstacles to its introduction are financial (availability of investments), as well as construction legislation (building code) in Poland, as obtainment of necessary building permits is perceived as lengthy in terms of time and overly bureaucratic. |
| Local organic farming | Organic / nature friendly | Increased shift to organic farming is perceived as a positive transformation, supporting positive impact upon the human health and the environment. Shortening the supply chains has a potential to lower the prices and along with increased eco-awareness could lead to transformation of the entire farming system. Currently there are already farms in the area focused on organic production, yet the scale is still relatively low. Utilised agricultural area is not expected to change, despite the fact that organic production is overall more land-intensive compared to conventional farming. This would be expected due to structural replacement of farming approaches within the current UAA boundaries. Overall prices for agricultural products are expected to increase, as the traditionally-produced crops would be replaced by the organic products. There is also a regional differentiation, as locally these organic products would be available at lower prices than for products that have been transported. Assuming the demand for organic products would be at the level of conventionally-produced crops, the income would either stay at the same level or increase. Labour costs are not expected to change. |
| **IT-Hazelnut** | Current | The farming system (FS) in Viterbo province, in central Italy, is highly specialized in hazelnut farming. The revenues generated by hazelnut cultivation represent a major economic resource in the province since barely any other farming activity provides comparable profitability. Hence, this perennial crop provides satisfactory levels of income to farmers. In contrast, there is a growing concern about the potential negative impact on the environment due to its single-crop specialization and because of the limited number of organic hazelnut farms. The local hazelnut market is unstable and strongly exposed to Turkish production, the main competitor. The presence of cooperatives (often organized as producer’s organizations - POs) is crucial in terms of both economic and social influences on/from farms: they represent the main form of socio-economic organization inside the FS, but they are also essential in connecting producers to confectionary industries and downstream markets. While the FS is socially self-organized and supporting rural life, the FS has been characterized as not fully coupled with local and natural capital especially because water quality and quality are expected to deteriorate because of the growing pressure of intensive farming on natural resources. Finally, policies have played, so far, a minor role in the development of the FS that has been driven mostly by the favourable market conditions. |
| Technological innovation | Technology | The “technical innovation” alternative system includes changing processes or products towards the improvement of technical innovation infrastructures. The hazelnut system in Viterbo is highly mechanized: it has widely introduced technological innovations since the sixties. Although it is not a backward system, technological innovation is still a driving strategy to FS improvement.  High-performance levels of the indicators “Gross Saleable Production” and “Gross Margin” are expected because the adoption of technological innovation can increase the efficiency of technical means, reduce costs and increase production value. In this sense, young people would find it more interesting to participate actively in the production. An innovative system in technology is more organized thanks to structural centralization. A greater link between natural and local capital could allow the diversification of roles and skills. As the demand for technological infrastructure increases, average costs may decrease. This has a positive impact on the overall quality of life. Policies support do not adapt to needs promptly; therefore, they are unable to drive innovation to promote change due to slow bureaucratic procedures. Also, enhancing the training and the cooperation among stakeholders (including farmers, industries, advises, NGOs and government) are the main strategies to be enforced in this alternative system. Farmers are left with an incomplete amount of information negatively affecting their bargaining power. |
| Product valorization | Product valorization | The valorization of typical agri-food products is a complex process involving a plurality of actors, who have specific interests and therefore potentially pursue different and sometimes conflicting individual objectives and strategies. Product valorization could be pursued in two (not alternative) ways. On the one hand, undertaking a geographical indication that could overcome the problems currently faced by the PDO “Nocciola Romana”. On the other hand, the potential role of developing locally processed and differentiated products to be directly sold to retailers need to be mentioned. In this alternative system, the performance of the indicators generally improve (Gross Saleable Production and Gross Margin) due to the increase in the competitiveness of the local production and better placement of the products in the market. This may be a more attractive for young people. The impact to valuing the local product is considered indifferent on the organic surface. The valorization of the product might help to close the supply chain and to open up new market channels as well as direct links with the local and natural capital supporting rural life from a regional and employment point of view. This alternative system can be a driving force to improve the infrastructures: however, concerted planning among all stakeholders of the system represent the main strategy to adopt involving farmers, industry and government to increase the product value. Boundary conditions, in this sense, are represented by high-value brands of the area: the protection of the intrinsic and extrinsic quality of local production is not enough today. Also, a market alternative through the closure of the supply chains is needed. |
| Sustained demand (high and stable prices) | Attractive countryside | Increasing demand would generate, ceteris paribus, a price increase with positive repercussions on the profitability of the cultivation and consequently on farmers' income. This alternative system may have positive effects on keeping young people in the system but, on the contrary, could reduce the interest in organic and eco-friendly farming practices. Such an alternative system should improve system organization, the infrastructure for innovation and support rural life. These have positive consequences for the resilience of the system because it increases robustness and adaptability capacities. On the contrary, it reduces its link with the natural and local capital because the production intensification and specialization could have negative consequences on the environmental function.  The removal of trade restrictions is a boundary condition to make the alternative state of the system happen and the promotion of product placement in markets where demand is growing such as China, as a strategy to reach this result. |
| Eco-friendly agriculture | Organic / nature friendly | Considering the increasing awareness natural resources conservation an eco-friendly alternative state of the system appears desirable. The performance indicators “Gross Saleable Production” and “Gross margin” may decline at the beginning because possible negative consequences of organic farming on yield and product quality. But, if eco-friendly practices are properly communicated to consumers, it might be possible to observe an increase in product prices. This could offset the impact from lower yields. The system organization, as well as the organic area under hazelnut cultivations, should increase with this alternative state.  A necessary condition for the realization of this alternative system is a cultural change within stakeholders. The contribution provided by the research, which interacts with the POs suggesting good practices given this transition, is important as well as the economic support to all actors of the system.  Strategies to implement this alternative state require public support targeted to key operators of the system. Moreover, it is needed to encourage the introduction of third parties of collective actors in charge of control and technical support. In detail, the introduction of consortia (e.g. managed by POs) capable of providing consultancy and control for public administration are desirable. |

1 The farming systems in the case studies were first described in Bijttebier et al. (2018). Alternative systems are described in Accatino et al. (2020). The book by Meuwissen et al. (2022) synthesizes the diversity and pathways in all case studies.