foodwatch international

External costs in agriculture

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Since 1962, the Common Agricultural Policy (CAP) has regulated financial support for European farmers. The CAP has been reformed many times over the years. Today, agricultural holdings in all EU Member States are supported by a two-pillar structure and benefit above all from direct payments. Every year, farmers receive these basic premiums per hectare of land. There are also support programs for young farmers or the implementation of certain environmental protection measures.

The CAP system is on the verge of reform. The coming support period 2021-2027 is currently being debated at European and national level.

Critics of the CAP question, among other things, the unrestricted area-based direct payments, from which large farms benefit the most. In addition, in the current system subsidies for environmental measures are deemed at best ineffective, and if truly compared to the extent of the negative environmental impacts of agriculture, we can even say they are absurd.

One factor that is insufficiently considered in the current discussion are the **external costs of agriculture**. Although the environmental impact on climate, soil, groundwater and biodiversity is scientifically proven and to a certain extent measurable in monetary terms, this aspect hardly plays a role in the discourse on the design of the CAP. Agricultural policy is not used to internalize the polluter pays principle.

This paper aims to provide an overview of the current legal framework, the ongoing political debates and the theoretical basis for external effects. A literature review summarizes the current state of research on external costs in agriculture and their quantification. This makes it clear that the EU's agricultural policy must be reoriented.

CAP measures and objectives

Currently, the CAP amounts to about a third of the total EU budget: 58.8 billion euros in 2018 (European Commission, 2018a). **Every year, EU farmers receive subsidies averaging 267 euros per hectare of agricultural land** (European Commission, 2018b).

In Germany, about 6.2 billion euros per year are available for agricultural subsidies (BMEL, 2014). In the EU budget year 2017, 310,000 German farms received subsidies – with 125 farmers each receiving more than one million euros (BMEL, 2018).

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The average subsidy per hectare of agricultural land is 267 euros.

These subsidies are politically justified by several arguments. Firstly, to guarantee consumers throughout Europe a stable and safe food supply. Secondly, to deal with the uncertainty in agricultural production. The main aim of CAP subsidies is therefore to provide farmers with an adequate standard of living. Since farmers provide public goods (e.g. a well-kept landscape) and this is not being rewarded by the market, they are to be compensated through the subsidies (European Commission, 2018b).

At the same time, the EU is committed to using the funds to promote the sustainable use of natural resources, preserve rural regions and landscapes and support rural development.

The two-pillar structure

The EU's agricultural policy is based on two so-called pillars. In the first pillar of the CAP, about 70 percent of the subsidies flow as direct payments to farmers. These are not linked to the production volume, but are paid out as a lump sum per hectare of land.

In addition, there are direct payments for environmental services. This 30-percent share is aimed at rewarding specific environmental services such as grassland conservation, crop diversification or the so-called land use in the environmental interest (BMEL, 2014). The latter comprises the preservation of ecological priority areas such as fallow land or buffer strips on parts of arable land. Farmers who provide such "greening" services are entitled to the funds. Young farmers and small to medium-sized farms also receive additional money.

The second pillar of the CAP is the promotion of rural development and environmental measures. Here money flows into village development projects, the compensation of “sustainable practices” or the promotion of organic farming.

External analyses of current EU agricultural policy

The EU's agricultural policy is currently being discussed anew, as the funding period is to be extended from 2021. In the upcoming seven years, a total 365 billion euros will be available. It remains to be seen to what extent the CAP will be realigned.

Meanwhile, there is considerable dissatisfaction among stakeholders with the current structure (see info box on page 4). Scientists, non-governmental organizations and experts have examined and denounced the weaknesses of the system.

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The organizations **BirdLife Europe, the European Environment Bureau (EEB) and the German Nature and Biodiversity Conservation Union (NABU)** carried out a fitness check on the CAP in 2017 using a meta-analysis of 450 publications. In doing so they complied with the European Commission's Fitness Check method. The CAP has been tested for its effectiveness, efficiency, internal and external coherence, relevance, added value and contribution to sustainable development objectives. The authors find, among other things, poor results in efficiency and internal coherence. For example, the distribution of payments is highly inefficient, the distribution of budgets is unfounded and effective implementation is weakened by sometimes contradictory instruments. In addition, direct payments create a dependency on subsidies. In the area of the environment, investments are made in ineffective measures. On the whole, the environmental objectives are not pursued adequately. The authors conclude that EU agricultural policy in its current form should not be entitled to billions in taxpayers' money. Instead, they demand that

the United Nations Sustainable Development Goals (SDGs) be the core objectives of the forthcoming CAP. "Structures and measures of the CAP that do not clearly contribute to sustainability objectives should be abolished" (BirdLife Europe, European Environment Bureau (EEB) & NABU, 2017).

According to the expert statements of the **German Advisory Council on the Environment (SRU) and the Scientific Advisory Board on Forest Policy (WBU)**, there are also serious doubts as to whether the CAP's direct greening payments have benefited the environment (SRU & WBU, 2017). Pe'er et al (2016) find that most farmers engaged no significant costs in order to meet the greening requirements. Therefore, there are simply windfall effects in this area of direct payments instead of controlling the market in an ecologically effective and cost-efficient way. Moreover, there is a lack of effective enforcement of regulatory law and clearly defined support conditions (SRU & WBU, 2017).

There are serious doubts as to whether the CAP's direct greening payments have had an environmental benefit.

The **Scientific Advisory Board on Agricultural Policy, Food and Consumer Health Protection** (WBAE, 2018) at the Federal Ministry of Food and Agriculture (BMEL) criticize the excessive complexity of the CAP, in some cases excessive centralization, the dangers of distortions of competition, ineffective greening and the poor coordination of the two pillars in the CAP. The budget for the second pillar is also deemed as too small.

From a legal perspective, the Member States could do more for environmental protection and sustainable rural development due to a national leeway. After all, up to 15 percent of direct payments from the first pillar can be reallocated by the Member States to the second pillar. In Germany, only 4.5 percent is currently being redirected. In a scenario in which 15 percent is redeployed, the budget for rural development in Germany would be over 500 million euros larger. A bill of the Federal Council (Bundesrat) to increase the reallocation to six percent has not yet been supported by the Federal Government (German Bundestag, 2017).

Member States could do more for the environment and sustainable rural development through a national margin for decisions.

The EU is well aware of the need for action in view of the public and scientific criticism - especially in the area of climate protection. According to the Paris Agreement 2015, the agricultural sector needs to contribute to a reduction in greenhouse gas emissions. Three EU research initiatives have now announced a joint call for EU research projects to reduce greenhouse gases from animal husbandry (ERA-Net, 2018).

The WBAE (2018) fears, however, that EU subsidies will continue to be distributed primarily on an area-by-area basis from 2020 and that only minor changes in the design of the system can be expected (BMEL, 2018c). The Scientific Advisory Board is of the opinion that a reform of agricultural policy is necessary and must lead to a CAP geared to the common good in order to meet future challenges, increase acceptance and create better framework conditions. The WBAE (2018) lists the following measures, among others, as building blocks of a system oriented towards the common good:

- First, a new objective should be developed on the basis of the environmental, climate and animal welfare challenges.
- In addition, the development of adequate control and financing systems for the provision of services and duties of general interest are considered necessary.
- The funding should be geared to the social function of agriculture, agricultural and food policy should be coordinated and the architecture of the CAP should be restructured.

- The administrative burden should be cut down and direct payments reduced.
- There should be more measures rewarding agricultural services of general interest.

Meanwhile, representatives of organic farming call for a redistribution of EU funds to farms that make efforts in the areas of environmental protection, permaculture and species protection. In a position paper, the **German Federation of the Organic Food Industry** (BÖLW) calls for a redistribution of EU funds to the second pillar in order to end the subsidization of landowners. "Harmful practices must no longer be subsidized. If farms damage groundwater, do not keep animals in a species-appropriate manner or manage them in a climate-damaging manner, they may not receive any tax money (...)" (BÖLW, 2018). Specifically, it calls for at least 70 percent of CAP funds to be paid out to farmers who provide concrete environmental, climate and animal welfare services. In addition, the environmental budget should increase significantly and all subsidies should be earmarked from the first euro onwards.

Other Member States are also critical of the consequences of the CAP. The **French Court of Auditors** has analyzed the consequences of EU subsidies between 2008 and 2015 and comes to the conclusion that the design of the CAP leads to an unfair distribution of funds and further negative effects. The direct payments distributed in France, amounting to around 7.8 billion euros a year, reach small and diversified French farmers only to a very limited extent. The authority lists a statistic according

EU consultation: Low level of satisfaction with the CAP

In 2017, the EU held a public stakeholder consultation to gather views on the CAP (European Commission - DG AGRI, 2017). The collected data include the answers from 58,000 respondents. Of these, about 48 percent state that they are uninvolved citizens. Almost 37 of the respondents stated that they work in agriculture. About 16 percent were organizations. The survey revealed trends and gave an insight to the full range of political views.

88 percent of the respondents agreed that farmers must be guaranteed an adequate standard of living. Both farmers and other citizens feel that support for rural development and climate change measures in agriculture and rural areas is one of the most important CAP tools in the face of current challenges.

As far as these challenges are concerned, for the farmers surveyed, this is primarily about enabling farmers to achieve an adequate standard of living. Other citizens more frequently mention the impact on the environment and natural resources as well as climate change. The most frequently cited environmental challenge is the protection of biodiversity. A total 66 percent of respondents consider direct income support for farmers to be the best means for this purpose.

Satisfaction with the current CAP is not particularly high: less than ten per cent find that the CAP "largely addresses" the current challenges, while around 57 per cent find that this is "only partially" the case. When respondents are asked to assess whether the CAP addresses the environmental challenges, 46 percent say "only partially", 24 percent "not at all". Only six percent find that they are "quite well" or even "largely" up to these challenges. The rest is undecided.

When asked what they criticize about the CAP, respondents were commonly missing a stronger focus on sustainability and support for small farms and organic farming.

Too much bureaucracy and complexity of the CAP and too much influence of industry and lobbying were also frequently pointed at.

to which the proportion of farmers who receive state social benefits to top up their low income quadrupled between 2000 and 2016 in France. The large farms, which have a much greater negative impact on natural resources and biodiversity through the cultivation of monocultures, receive the most money. The direct payments would therefore support those farmers who were already profitable.

The French Court of Auditors also points out that the CAP can have negative effects on the environment. There is a correlation between EU subsidies and the increase in the use of pesticides and fertilizers in the cultivation of the main crops. In the Authority's view, the effects of existing 'greening' measures are very limited because of low requirements.

The French Court of Auditors concludes that EU agricultural policy should be corrected to avoid increasing inequality within the agricultural sector and to reduce undesirable effects on the environment (Cour des Comptes, 2019).

Consequences of subsidization for foreign trade

Approximately 17 percent of global trade in the agricultural and food sector currently involves the EU as an importer or exporter. Reforms in agricultural policy are therefore expected to influence both trading partners and third parties (Matthews, 2018).

Since 2010, the trade balance of EU agriculture has shown a surplus (European Commission, 2018c). This means that more "refined", i.e. more expensive, products are exported than are imported into the EU. The most important export products are currently wine and other alcoholic beverages, infant formulas, cereals, milk powder, chocolate and pork (European Commission, 2018c).

The main imports are tropical fruits, nuts, spices, coffee, tea, soybeans and palm oil. Estimates assume that about 60 percent of the agricultural land used by the EU agricultural and food industry is imported virtually - i.e. outside Europe, primarily in Brazil, Russia and China (Lugschitz, Bruckner & Giljum, 2011). This means that, in addition to using their own land resources, the EU exploits arable land outside the EU.

If one takes into account the virtually exported agricultural areas (about 37 million hectares) associated with EU agricultural exports, this results in a net land import of 338 million hectares. Measured against the total EU land requirement (640 million hectares), this means a net import area share of 53 percent (Lugschitz, Bruckner & Giljum, 2011).

Another study concludes that about 31 percent of the area used to meet EU food needs is situated outside the EU (Steen-Olsen, Weinzettel & Cranston et al., 2012).

A further feature of EU trade is the fact that exports of animal products exceed the value of imports, while the opposite is true for exports of plant products: imported goods are of significantly more value than exported goods (European Commission, 2018d).

The CAP plays a not negligible role in the trade structure described above. Subsidies are also paid for the production of agricultural goods made for export, thus enabling lower export prices. Public support for investment in new and larger farms also allows for increased output and lower prices. Negative effects on the competitiveness of producers in developing and emerging countries have therefore long been criticized by non-governmental organizations - see Germanwatch (2018) and the demands with regard to EU agricultural policy of a German joint platform consisting of associations engaged in the areas of environmental protection, nature conservation, agriculture, development policy, consumer protection and animal welfare (Plattform von

Verbänden aus Umwelt- und Naturschutz, Landwirtschaft, Entwicklungspolitik, Verbraucherschutz und Tierschutz, 2018).

Keep it up? The debate so far on the CAP

The current discussion and criticism of the content of the CAP revolve primarily around a redistribution of funds, the reduction of bureaucracy and a more effective use of "greening" instruments. There is no general questioning of subsidies. The effects on international markets, especially in developing countries, are hardly taken into account.

The negative effects of agricultural production on the environment and the cost of avoiding or compensating for them are not specifically included in the debate so far, although they cause enormous costs and can and should play an important role for the orientation and target setting of the future CAP.

In the following, we therefore discuss what externalities are, where they occur in agriculture and how they can be quantified and expressed in monetary terms. A special focus will be placed on water, climate and biodiversity.

What are the external effects and why are they important?

Most economic activities impact the environment, either through the use of natural resources or through environmental pressures. External effects are the effects of these activities on the welfare of third parties. These effects on the environment are also called externalities because they are side effects of economic activities and no party compensates for them. There exist both positive and negative externalities.

External effects are the impact of economic activities on the welfare of third parties.

A **positive external effect** is occurring when a third party benefits from an economic action but does not compensate the actor responsible for it. This situation can mean that the good is not sufficiently made available and the social optimum is not achieved. The producer has no incentive to make the good (sufficiently) available because it is not compensated for the full value of the good. In the case of positive external effects, intervention by the state can ensure that private incentives to make the good available increase - for example through subsidies.

Negative external effects in turn are the costs to a third party of an economic action that is not compensated by the producer/polluter. Negative externalities can become less attractive to the polluter due to taxation. The higher costs of economic activity increase the incentive for the polluter to include externalities in his production function and to "internalize" the inefficiencies.

Economically, all costs and benefits of an entrepreneurial decision must be included in an efficient market. In economic terms, uncompensated positive and negative externalities identify a market failure. The equilibrium in a competitive market is not pareto-optimal under these conditions.

Economically, uncompensated external effects mean market failure.

This means that market participants could be better off without others being worse off. Pareto-optimality is ensured when the price of a good is equal to the marginal social cost. Uncompensated costs or benefits of an economic activity thus justify a policy intervention consistent with political incentives.

In environmental law, the “polluter pays” principle plays a central role. It states that the polluter should bear the environmental costs. These can include costs for

avoidance, elimination or compensation. EU environmental policy has been based on this approach since 1987 under the Single European Act (SEA).

The Treaty of Lisbon of 2007 states: "Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay." (Art. 191 para. 2 TFEU ex Article 174 TEC). In Germany, for example, the polluter pays principle justifies the wastewater levy.

External effects in agriculture

Farmers use natural resources such as water, soil and air and change the landscape. This results in numerous external effects.

Some of them are positive external effects: maintaining a varied landscape, contributing to the preservation of biodiversity and promoting food security, regional development and health (Hirschfeld, 2011). However, there is no strategy or comprehensive empirical data analysis on the question of how valuable these positive externalities are. The positive impact is hardly quantifiable.

On the other hand, the cultivation of arable land, the use of fertilizers and pesticides and animal husbandry also have negative external effects on the quality of soil, water, air and climate, as well as on species diversity and human health. The main causes of the external costs are the farms of high-intensity conventional agriculture (colloquially often referred to as "industrial agriculture"), especially in the field of animal husbandry (Hirschfeld, 2011).

As a rule, the polluters do not compensate for the negative effects in agriculture; instead, third parties incur costs. For example, consumers have to pay more for drinking water or taxpayers have to pay for the treatment of water bodies and measures to conserve biodiversity. The costs of climate change are also borne by third parties, especially future generations. Only the internalization of external costs by the polluter would create an efficient market. With regard to agriculture, this is legally anchored in Germany: "Intervening parties shall primarily avoid any significant adverse effects on nature and landscape. Unavoidable significant adverse effects are to be offset via compensation measures (Ausgleichsmaßnahmen) or substitution measures (Ersatzmaßnahmen) or, where such offset is not possible, via monetary substitution (§ 13 Federal Nature Conservation Act - BNatSchG). Legal requirements are also issued at EU level. Various so-called directives apply. It is therefore important for research and politics to understand exactly where external costs incur and by whom.

Hirschfeld (2011) argues that resources are used economically inefficiently, and environmental quality is impaired if external costs are not internalized in agriculture. If farmers had to compensate for (i.e. internalize) the environmental damage they cause (i.e. their external costs), their production costs would increase. "This would provide a financial incentive to avoid e.g. groundwater degradation that does not exist in the current situation."

Compared to negative externalities in other areas (e.g. airport noise), these externalities in agriculture have so far mostly been neglected or difficult to identify (Zukunftsstiftung Landwirtschaft, 2001). In addition, they often occur with a time lag and are sometimes not clearly attributable to an economic activity or an emitter. The interests of some affected groups are sometimes not represented (e.g. future generations). They also lead to suboptimal economic and political

Externalities in agriculture have so far mostly been neglected or are difficult to identify.

solutions (Pretty et al., 2000). However, there are approaches to quantifying them – but one has to take note that these measures can vary widely. The clearest possible demarcation between the systems is necessary.

In general, the evaluation of the external costs of agriculture is a very complicated procedure in environmental economics. A common example is tilling the soil. On the one hand, it is a good practice for climate (carbon storage is higher and fuel consumption is lower than by ploughing) and soil biodiversity is not disturbed. On the other hand, it can cause an increase in herbicide use compared to ploughing. An estimate of the effects can be better approximated in some categories than in others. The monetarization of external costs is, however, helpful insofar as it makes it possible to make external costs more tangible and, for example, to compare them to the selling prices of the end products or the subsidies paid (Hirschfeld, 2011).

Monetization makes it possible to make external costs more tangible.

Two central approaches to quantifying external costs are the avoidance cost approach and the damage cost approach (Hirschfeld, 2011). The latter calculates the sum that is necessary to compensate for impairments caused by externalities. This includes, for example, the costs of re-establish a forest damaged by acid rain. The avoidance cost approach in turn measures what it costs to avert or avoid externalities. The costs of treating water or building sewage treatment plants are examples.

How high are the external costs in agriculture?

A recent study by the University of Augsburg examines the external costs of German agriculture on the basis of nitrogen, greenhouse gases and energy consumption (Gaugler & Michalke, 2018). The paper "How much is the dish - was kosten uns Lebensmittel wirklich?" estimates the external effects in these areas and assigns a price to each unit of these externalities. Then the "true" prices of agricultural products are estimated. The authors calculate a significant price difference between true and current prices. According to the study, the differences between producer price and true price are particularly high for conventionally produced animal products. **A price premium of 196 percent would be necessary to compensate for the external costs of production.** In second place come conventionally produced milk products with a surcharge of 96 percent. The authors explain the high difference by the external effects on the environment and climate caused by the energy-intensive cultivation of animal feed, the operation of stables and ventilation systems, and animal metabolism.

Conventionally produced cow's milk would have to cost about 30 percent more if energy consumption and climate emissions were included in the price.

The rearing and volumes in the production of animal products such as meat and sausages differ greatly from those in the dairy sector. According to the study, conventionally produced, unprocessed cow milk would therefore only have to cost about 30 percent more if the external costs of energy consumption, greenhouse gases and nitrogen fertilizers were priced in proportionately. What is notable here is that organically produced cow milk would only have to cost about ten percent more to internalize the external costs. The difference comes from the fact that no mineral nitrogen fertilizers are used in the cultivation of animal feed and that less energy-intensive animal food is produced.

In the case of plant products, the calculated externalities are significantly lower. **According to the authors, the surcharges required for plant-based organic foods are the lowest and are only around six percent.**

Gaugler & Michalke (2018) assume that the actual price differences are still considerably larger, as their analysis is reduced to three channels. However, a more comprehensive analysis of the environmental impacts of German agriculture was not

carried out due to difficult data access in other areas. For example, the consequences of pesticide use have not yet been sufficiently and conclusively researched, so that the costs for nature and health cannot yet be priced in. The author of the study, Dr. Tobias Gaugler, concludes: "At present, neither agriculture nor consumers are responsible for many negative climate, environmental and health consequences resulting from the production of food. The associated price and market distortion is - economically speaking - a form of market failure that needs to be countered with economic policy measures. On the basis of our results and the UN's 'polluter pays principle', products from conventional livestock farming in particular would have to cost significantly more than it is currently the case in Germany".

A study by Pretty et al. (2000) examines the external environmental and health costs of British agriculture. The research group uses seven cost categories to measure the total environmental and health costs of agriculture in the UK. They calculate avoidance and damage costs in the areas of water, air, soil, biodiversity, nitrate and health as well as administrative and supervisory costs in the areas of environmental protection and health. Positive externalities are not included. The authors' database consists of 17 data sets compiled from various British and European sources. The authors calculate that the negative externalities taken into account in 1996 were about GBP2343 million. Put differently, external costs were GBP208 per hectare of agricultural land. If the significant costs of the BSE epidemic in the period under study are excluded from this sum, negative externalities of around GBP154 per hectare of arable land remain.

Pretty et al (2000) assume that they still significantly underestimate the value of the actual externalities of British agriculture. After all, they do not measure, for example, the costs that allow a return to the original state of biodiversity, but estimate the costs necessary to conserve part of the variety in species. In addition, they only consider externalities that they have been able to quantify. However, they see their results as a basis for politicians to classify the extent of externalities of agriculture and to compare different categories.

A study from the United States replicates the study by Pretty et al. (2000) with US data. Tegtmeier & Duffy (2004) estimate the external costs in the US for natural resources (water, soil and air quality), biodiversity and health at USD5.7 to USD16.9 billion per year. The authors base this calculation on 168.8 million hectares of arable land. Per hectare of arable land, this results in an amount of external costs of USD29.44 to USD95.68. This is significantly lower than the value of Pretty et al. (2000). The authors explain this with the fact that they do not include any costs due to the BSE epidemic and disregard costs to public institutions in the supervision of environmental protection and health in connection with agriculture. They focus only on certain direct costs. This research group also stresses the need for further research on the externalities of agriculture (Tegtmeier & Duffy, 2004).

Effects on water

Overall, a quarter of all water use in Europe occurs in agriculture (EEA, 2018). Farmers influence both quantity and quality of water. The European Environment Agency (EEA) explains that subsidies have sometimes set false incentives: farmers were not encouraged to use water efficiently. In addition, they would not pay the true price of water, which includes environmental and resource costs. The CAP subsidies had led to farmers being indirectly encouraged to grow crops with high water consumption while at the same time using inefficient techniques. The EEA (2018) also cites examples that have shown that irrigation efficiency can be significantly increased through a sensible water price structure and the reduction of adverse agricultural subsidies.

The OECD publication "Water Quality and Agriculture: Meeting the Policy Challenge" (2012) predicts that the pressure on water systems will continue to increase and that climate change may make it more difficult to achieve water quality goals. Just like the EEA, the OECD underlines that external costs in agriculture occur and that there are too few incentives for farmers to internalize the external production effects (here water pollution) on the community, unless farmers themselves are motivated to do so.

Negative external effects arise due to farmers' indirect water use.

The project "Wasserflüsse in Deutschland" commissioned by the BMBF (2014) shows that the direct water use of agriculture in Germany is very low, as farmers in only a few regions irrigate their arable land intensively. However, indirect water use, where negative external effects are identified, is problematic: fertilizing agricultural land pollutes seepage and groundwater with nutrients (BMBF, 2014). In the case of nitrate, for example, the limit value for German drinking water is 50 mg/l. However, in many German counties the limit value is exceeded by indirect water use. In some cases, so much water is required for dilution that it is regionally scarce - this therefore requires expensive treatment or long-distance water pipelines to other regions (BMBF, 2014). The external costs in terms of water quantity and water quality are in some cases even more dramatic in other EU countries: In Spain, for example, intensive irrigation is used and external costs are incurred due to a lowering of the groundwater level and increasing salinization due to subsequent seawater flow (BMBF, 2014).

Pesticides, nutrients, soil deposits and microorganisms from agricultural production pollute both groundwater and surface water. As a result, water companies and sewage treatment plants incur real water costs. Based on European drinking water standards, the water is examined and purified so that limit values for nutrients, pesticides and nitrates are adhered to and pathogens are removed. In this water treatment process, for example, the water is purified of too high a proportion of nitrate. The costs of water treatment are ultimately borne by the consumers through increased drinking water costs.

Nitrate enters the water cycle through agricultural fertilization. It can be converted into nitrite in the human body, which inhibits oxygen transport in the blood and is suspected of being carcinogenic. In addition, with a higher nitrate content in water, algae grow more frequently, which in turn replace other plants.

In a study by the German Federal Environment Agency (UBA, 2017), the authors calculate the external costs of eutrophication in agriculture incurred by drinking water customers. Specifically, it concerns the nitrate content and the problem that the limit value of 50 mg/l nitrate in newly formed groundwater is not met in about 18 percent of the measuring points in Germany. At measuring points in catchment areas with heavy agricultural use, even 28 percent do not conform with the limit value. According to UBA, there are various methods for nitrate and pesticide (PPP) removal, such as biological denitrification, the CARIX method, electrodialysis and reverse osmosis (for nitrate removal) or activated carbon adsorption and oxidation with ozone (for PPP removal). Not every process is suitable everywhere. UBA has calculated the costs for four German model regions in order to achieve nitrate target values of less than 50 mg/l. The analysis is based on data from the IWW Water Centre as well as information from plant constructors, engineering offices and academic literature. **For the four model waterworks, the total treatment costs (operating and investment costs) are between 0.55 and 0.76 €/m³ drinking water. Under these boundary**

The total costs of nitrate pollution are most likely still considerably underestimated.

conditions, the water bill of a family of four[2] would increase by 32 to 45 percent or up to 134 euros per year in areas where there is no alternative. This only includes the costs for the drinking water purification, however does not involve the expenses needed for the preservation of the natural condition of lakes and rivers. For UBA, this means that the total external costs of nitrate pollution they calculate are most likely to be considerably underestimated.

According to the UBA study, it is clear that the costs of water treatment increase with increasing pollution and constant target concentration. Nitrate removal is significantly more expensive than cleaning water from pesticides. Although there are already various measures taken by water suppliers to ensure drinking water quality, these are not sufficient. Many municipalities are upgrading and investing public money in the construction of sewage treatment plants and its technology.

The conclusion is that there is a need for a consistent agricultural policy that addresses the problem of external water costs, for example through consumption-based wastewater charges and a ban on eutrophication. Based on the above-mentioned UBA study, this would mean regionally different charges for farms to compensate for treatment costs of about 0.55 to 76 €/m³ of drinking water and to achieve nitrate targets.

Effects on climate and air quality

The agricultural sector contributes to atmospheric pollution and climate change through the emissions of four gases. Methane (CH_4), nitrous oxide (N_2O), ammonia (NH_3) and carbon dioxide (CO_2) are particularly strongly associated with agricultural production processes. While methane is primarily generated by livestock farming, nitrogen oxide is released through fertilizers. Ammonia is mainly released into the air as a pollutant from intensive animal husbandry and favors acidification and eutrophication in soils and waters. The most important greenhouse gases CO_2, CH_4 and N_2O lead to atmospheric warming (CO_2, CH_4, N_20) and contribute to climate change. Nitrous oxide also destroys the ozone layer.

In a Methodological Convention, the German Federal Environment Agency, UBA, publishes cost rates for measuring the external costs of greenhouse gas emissions to the climate. With regard to CO_2 emissions, data is available that can be used to estimate the external costs per ton of CO_2 emitted for the climate.

The UBA updated the cost rates in November 2018 and currently recommends 180 euros per ton of CO_2 (UBA, 2018). Previously, the UBA had recommended 80 euros per ton of CO_2 emissions, but had stated that this was an average value for short-term climate costs and that medium to long-term costs would differ considerably to up to 390 euros per ton of CO_2 (UBA, 2012).

The CO_2 emissions of EU agriculture - at a price of 180 euros per ton of CO_2 - result in external costs of around 77 billion euros per year.

Considering that EU agriculture produced about 426 million tons of CO_2 equivalents in 2015 (Eurostat, 2017), a price of 180 euros per ton of CO_2 results in an amount of 77 billion euros. Even at a price of 80 euros, 34 billion euros in external costs are estimated. Only very few polluters internalize their externalities through compensation payments.

2 There are significant regional price differences for tap water in Germany. In addition to the different costs for the treatment of water, other factors also play a role, such as the maintenance intensity of the pipeline networks.

Effects on Biodiversity

According to the German Advisory Council on the Environment and the Scientific Advisory Board on Forest Policy, unsustainable agriculture, rising settlement densities, increasing traffic volumes and pollutant inputs contribute to an unacceptable decline in species and habitats (SRU & WBU, 2017). They denounce the state of biodiversity in Europe as worrying. The Advisory Council presents EU data sources showing that more than 60 percent of protected animal and plant species and 70 percent of habitats exist in an "unfavorable conservation status". The use of pesticides and fertilizers and the intensification of agriculture as well as the abandonment of extensive farm work are among the reasons. (SRU & WBU, 2017).

In order to measure the external costs of a decline in biodiversity, it is necessary to know the value of goods and "services" and understand what happens when they decline or cease to exist. It is difficult to give monetary value to goods that are not traded on markets. Environmental economists have thus developed methods that ask questions about the preferences of a population through qualitative surveys. There is also the approach of measuring people's willingness to pay - or the payments that are necessary for something to be accepted.

Hirschfeld et al. (2018) conducted a so-called choice experiment in a nationwide representative survey in 2013. This makes it possible to induce the willingness to pay for individual components of the ecosystem by conducting structured interviews with the respondents. Choice experiments make it possible to estimate aggregated willingness to pay and thus assess landscape and land-use changes. In the interviews of a choice experiment, socio-economic characteristics are also surveyed by means of questionnaires. In their study, Hirschfeld et al. (2018) question the willingness to pay on the topics of forest, agricultural landscape and landscape in general. **The results of the survey show that an increase in biodiversity, measured by a bird indicator on agricultural land, is desirable and that the respondents are willing to pay a positive sum.** In addition, the interviewees are willing to pay positively for an increase in the proportion of forest and for a higher proportion of grassland on agricultural land. Furthermore, 90 percent of the respondents stated that the proportion of forest in a landscape was ‘very important’ or ‘important’ to them, 83 percent found this to be the case for biodiversity in forests. In summary, the study points to considerable willingness to pay for more forest and biodiversity. Aggregated, the authors also find the wish that society as a whole should invest more in agri-environmental and climate protection measures.

Meyerhoff et al. (2012) also refers to the willingness to pay for biodiversity. They estimate an aggregated willingness to pay of 2.22 billion euros per year for a package of measures relating to forests in Germany. Pretty et al (2000) analyze the costs of the Biodiversity Action Plan (BAPs), which was designed to restore part of the UK's biodiversity. This brings them closer to the true costs of habitat and wildlife loss. They estimate the cost of restoring biodiversity lost as a direct consequence of agriculture at GBP24.6 million in the UK alone in 1996.

Other external effects of agriculture

Soil is the basis for agriculture, but can be the victim of negative externalities in the event of excessive stress. Soil erosion occurs when soils are overstrained by human hand. For example, the cultivation of winter cereals and too short fallow periods can lead to soil erosion. Overgrazing and deforestation also increase the risk of soil erosion. This leads to problems both for farmers themselves and for the environment.

Farmers suffer when the fertile topsoil is lost, and persistent soil erosion can lead to soil degradation, which can ultimately result in the soil no longer being usable for agriculture. The environment suffers from the fact that the eroded soil is increasingly blown away through the effects of wind and can thus pollute water and roads. In addition, the risk of flooding increases.

Human health is affected by pesticides used in conventional agriculture. There are also risks from epidemics, food contamination and antibiotic resistance from agricultural practices. The causality between agriculture and these risks is clear. However, the extent of these effects is difficult to assess. The chronic effects of pesticides are also little known.

Both human and **animal health** can suffer from avoidable diseases that arise in animal husbandry if additional efforts are spared in the prevention of farms. It repeatedly comes to light that farmers were unwilling to invest effort and cost to reduce animal suffering and improve the quality of animal products. The external costs of this practice can hardly be estimated economically, but it is clear that it has negative effects on animal welfare and consumers, which are not compensated.

The well-kept and varied landscape that can be created by agriculture is seen as the primary **positive external effect of agriculture**. For example, the promotion of alpine farmers in the mountain regions of Europe is particularly emphasized because they maintain the rural economy and have a positive impact on tourism.

These services, which are not rewarded by the market, are to be compensated by EU funds and enable alpine farmers to maintain their farms despite comparatively low productivity. However, it has not been scientifically investigated whether and to what extent positive external effects occur in the majority of farms. In addition, it is unclear whether these effects would be lower at all if CAP subsidies were reduced.

Reorientation of EU agricultural policy

So far, externalities have not played a significant role in the agricultural policy discussions surrounding the reorientation of the CAP. A reason why they are not mentioned anywhere, may also be due to uncertainty about their dimensions. Only the positive effects of agriculture are cited as one reason for the EU's intervention. In the political discourse, the funds for environmental services are also highlighted, although they represent only a fraction of the budget. It is unclear to what extent the CAP provides incentives in the area of environmental protection and crop differentiation. Most critics regard the "greening" instruments of the 1st pillar as ineffective.

Negative externalities currently play no role in the design of subsidies and in the political debate. As the scientific studies and analysis presented by experts show, these are enormous:

- Both groundwater and surface water are polluted by pesticides, nutrients, soil deposits and microorganisms from agricultural production. As a result, water incurs real costs for water companies and sewage treatment plants - and up to 45 percent additional costs for drinking water customers.
- The CO_2 emissions of EU agriculture alone - at a price of 180 euros per ton of CO_2 - result in external costs of around 77 billion euros per year.
- British and American studies estimate the negative external costs for water, soil and air quality at around £154 per hectare of arable land or USD29.44 to USD95.68 dollars. The research groups point out that, due to the difficult data situation, these calculations contain only a fraction of the true externalities.

- According to a study by the University of Augsburg, conventional milk would have to cost at least 30 percent more. Plant-based products generate significantly lower external costs.
- The extent of the effects on biodiversity, soil quality and human health are clearly visible and cause real costs, e.g. through action plans to restore biodiversity.

Neither agriculture nor consumers are currently held responsible for most of these negative climate, environmental and health impacts arising from food production.

Hirschfeld (2011) underlines that farmers' production costs would rise accordingly if they had to eliminate or compensate for the environmental damage they cause. However, this would provide an effective incentive to protect future generations and avoid costs.

It is therefore up to the EU to take into account the external costs of farms in its future agricultural policy. This can only work through an end to flat-rate direct payments and through a targeted internalization of the individual negative externalities, e.g. through consumption-based wastewater charges, a CO_2 tax and binding framework conditions for species protection.

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