POLICY REPORT

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A policy mix aimed at reducing impacts of agricultural production and consumption – Synthesis of potential impacts

This policy brief presents the findings from ex-ante impact assessments of the land policy mix aimed at reducing negative impacts of agricultural production and consumption.

The land policy mix is one out of three policy mixes developed in the DYNAMIX project. Each policy mix was developed based on an understanding of relevant drivers for unsustainable resource use and informed by an ex-post analysis of cases for successful or failing policy support for achieving decoupling. In contrast to the other two policy mixes (which focus on consumption in general and on the use of metals and other materials), the land policy mix aims at reducing the overall resource use of agriculture by targeting both the production and the consumption side. A number of instruments in the mix are targeted at farmers, motivating them to apply sustainable production methods. Other instruments aim to incentivize consumers to change their behaviour with regard to diets and food waste.

Following an executive summary, this brief first presents the rationale of the policy mix (section 1) and then describes its objectives and the instrument mix (section 2). In a next step, the brief highlights both potential key environmental impacts (section 3.1) as well as potential side effects (economic and social impacts, issues of legal feasibility and public acceptability – section 3.2) that may reduce the policy mix' potential environmental effectiveness. Based on these key findings the policy brief then provides suggestions for revising the policy mix, which could mitigate such side effects and hence foster the mix' potential environmental effectiveness (section 4).

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EXECUTIVE SUMMARY

The environmental impact related to the EU's consumption and production of agricultural products continues to grow, both within and beyond the EU. Through increasing net imports of agricultural products, the EU is contributing to the rising global demand for agricultural land. At the same time, this shifts the environmental (and social) burden of EU consumption to other countries. Among the main drivers for the EU's demand for arable land are the high consumption of meat and dairy products as well as a high level of food wastage in the EU.

Within EU territory, semi-natural farmland – which is rich in biodiversity – is declining due to economic pressure on farmers. Simultaneously, farming is intensified in many areas, increasingly involving the use of fertilisers, plant protection products and heavy machinery. On the whole, current agricultural production practices are detrimental for biodiversity, soils and water resources.

The DYNAMIX land policy mix aims at progressing towards a more sustainable use of land both at the European and at the global level. Therefore it targets both the consumption and the production side of the agricultural sector. The policy mix consists of eight instruments. Five instruments on the production side aim to enhance biodiversity, soil quality and water quality. In addition, they aim to improve human health and contribute to climate change mitigation.

- Revision of the Common Agricultural Policy (CAP)
- Measures limiting nitrogen emissions
- Regulation for Land Use, Land Use Change and Forestry (LULUCF)
- Improved pesticide management
- Promotion of Payment for Ecosystem Services (PES) programmes

The three instruments on the consumption side aim to change dietary habits – particularly to reduce meat consumption – and to reduce food waste.

- Value added tax (VAT) on meat products
- Targeted information campaigns on changing diets and on food waste
- Development of food redistribution programmes

The instruments were assessed qualitatively and, where possible, quantitatively (with up to three different models) for their environmental, social, and economic impact, their legal feasibility and public acceptance. Results of these ex-ante assessments are summarised in the following table.

Policy instrument	Impacts		Public acceptance	Legal feasibility
	Environ-mental	Socio-economic		
Revision of the CAP				
Measures limiting nitrogen emissions				
Regulation for Land Use, Land Use Change and Forestry (LULUCF)				
Improved pesticide management				
Promotion of Payment for Ecosystem Services (PES) programmes				
VAT on meat products				
Targeted information campaigns on changing diets & food waste				
Development of food redistribution programmes				

Legend		*likely positive*		*likely rather negative*		*likely neutral*
		Likely rather positive		*likely negative*		*uncertain*

Overall, the land policy mix can be considered to have positive environmental effects. It is likely to contribute to the following DYNAMIX key environmental targets for the EU for 2050:

- Limiting annual per capita greenhouse gas (GHG) emissions to 2 tons of CO_2 equivalent.
- Reducing consumption of arable land to reach zero net demand of non-EU arable land.
- Reducing nutrient surpluses to levels achievable by the best available techniques.
- Managing freshwater use so that no region experiences water stress.

Although the actual contributions to each target are not quantifiable, the policy mix can be expected to be particularly beneficial for limiting GHG emissions and for reducing nutrient surpluses. The impact on the consumption of arable land is the most uncertain, as there is a risk that crop yields decrease due to more sustainable production practices, which in turn could lead to an increased demand for land in the EU and beyond.

Regarding its socio-economic impact, a positive side effect of the land policy mix is an overall favourable impact on human health. This is mainly due to a reduction of harmful pollution as well as healthier diets. However, potential negative socio-economic impacts and issues of public acceptance might prevent this policy mix from being implemented or might reduce its effectiveness. In particular, the policy mix is expected to result in rising prices for food, which might increase social inequalities. Furthermore, while for the majority of the instruments public approval is likely, the VAT on meat products faces problems with

regard to public acceptance and legal feasibility. On the whole, it can be stated that the land policy mix is relevant sectorally, but much less at the aggregated economic level. Therefore a rather low impact on GDP and employment can be expected.

The policy mix was designed to be consistent, i.e. minimising conflicts and maximising positive interactions between instruments. For instance, the decline in meat consumption due to the VAT on meat products will be intensified through the accompanying information campaign. The mix of price signals and awareness-raising policy measures in the land policy mix appears likely to prove an efficient approach.

Despite a consistent design of the policy mix, the assessment results indicate that:

a) A number of negative side effects will have to be addressed through additional policies; and
b) some of the instruments will likely face significant challenges as regards public acceptance and legal feasibility.

The political feasibility of the land policy mix could be fostered by adjusting the potentially contentious policy instruments so that potential negative side effects are minimised. For example, in order to mitigate the aggravation of income inequalities caused by the VAT on meat products, a VAT decrease on cereals, vegetables or fruits could be introduced. Furthermore, advisory services could be offered to help farmers avoid potential losses associated with limitations of sustainable farming methods.

The ex-ante assessments undertaken in the DYNAMIX project could only partly be based on harmonised assumptions and parameters. Therefore, the results of the qualitative and quantitative assessments differ – in some cases significantly. In particular, the quantitative assessment of the information campaign was based on very optimistic assumptions about its effectiveness. Furthermore, the assessments undertaken were not able to assess actual cumulative effects of the instrument combination in the policy mix beyond individual effects. This remains a methodological challenge requiring more research.

The concept of policy mixing is promising because it

- Requires identifying most important drivers to be tackled to achieve certain objectives;
- Allows bundling together instruments in a way that contributes to achieving set targets while minimising or mitigating unintended negative side-effects, thus strengthening acceptability and political feasibility of the policy mix.

However, the concept of policy mixes might clash with political practices and experience. Resulting from political needs, such as existing alliances, election-based tactics or lacking time or knowledge long-term strategic policy mixing poses a formidable challenge.

1 Rationale behind the policy mix

Agricultural activities exert pressures on resources such as land, water and biodiversity

Severe negative environmental impacts are associated with farming and with the consumption of agricultural products in the EU. Agricultural activities exert pressures on resources such as land, water and biodiversity. In addition, agriculture is a major emitter of green house gases (GHG).

The land policy mix was designed to tackle these problems. More specifically, it aims at reducing land use pressures, freshwater use and nutrient surplus through improvements in food production, changes in diet and reductions in food waste. The policy mix addresses two different dimensions: the global land use related to EU consumption and the environmental effects caused by agricultural production within the EU.

1.1. Pressure on global land resources caused by EU consumption

By increasingly importing agricultural products, the EU contributes to the rising global demand for agricultural land and shifts the environmental burden of EU consumption to other countries

Land is a finite resource. At the global level, the use of land for agriculture is currently rising. Next to a growing world population, the main drivers for this development are changing diets – especially increasing consumption of meat[1,2] – as well as food waste and the increasing consumption of first generation biofuels[3,4]. The EU is contributing to the rising global demand for agricultural land, as the net imports of agricultural products from countries outside the EU have increased over the past decades. This has not only added to pressures on land use in other countries, but has also shifted the environmental (and social) burden of EU consumption[5]. An illustrative example is EU feed imports – mainly soybeans and maize – to sustain intensive livestock systems (see textbox on the left[6]). Expressed in numbers, the EU-27 used about 0.31 hectares (ha) per capita of cropland at the global level in 2007– one third more than the cropland that is globally available in per capita terms.[7]

> It is estimated that EU soy imports account for 12 million hectares of soybean cultivation outside Europe, nearly all in Brazil and Argentina. EU consumption therefore contributes to pressures driving conversion of semi-natural habitats high in biodiversity (e.g. Cerrado in Brazil, Chaco in Argentina) into soy plantations. At the same time, soybean cultivation causes indirect deforestation through the displacement of livestock farming into forest areas.[6]

The EU's consumption of meat and dairy products corresponds to two and three times the world average respectively

One relevant factor in this development is the shift in diets towards more animal products. The European per-capita consumption of animal food products increased by 50% between 1961 and 2007. Today, the consumption of meat and dairy products in Europe corresponds to two and three times the world average respectively.[8] Regarding protein supply, meat production has a much higher land consumption compared to protein from plant sources (compare Table 1). In fact, one third of the worldwide available cropland is used for the production of feed.[9] Chickens require about 2-3 kilogrammes (kg) of feed to produce 1 kg of meat, whereas cattle can require up to 16 kg of feed to produce 1 kg of beef[10]. Excessive meat consumption is also associated with health risks. For European citizens, the average per-capita intake of saturated fatty acids associated with animal products is about 40% higher than levels recommended by the World Health Organisation (WHO). Such dietary conditions pose an increased risk of cardiovascular diseases.

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Table 1: Land use requirements of food, calculated for German consumption considering international land requirements due to global trade of agricultural products

Food product	Land requirement (m^2/Megajoule)
Beef	2.09
Pork	0.79
Milk (from cow)	0.72
Eggs	0.60
Poultry	0.54
Vegetables (open land)	0.34
Bread	0.19
Apples	0.16
Grain / cereals	0.12
Potatoes	0.11

Source: Bringezu and Schütz 2009[11] (p. 139), cited and corrected in SRU 2012[12] (p.106).

A significant proportion of the food produced for consumption ends up as food waste. In the EU27, around 90 million tonnes of food waste are generated annually (agricultural food waste and fish discards not included), corresponding to approximately 179 kg per person per year.[13]

1.2. Environmental degradation within EU territory caused by agricultural production practices

Two major trends of EU agriculture are the intensification of farming and abandonment of semi-natural farmland

In contrast to the global development, the area of agriculturally used land in the EU is declining. Two major trends are driving this process: the intensification of agriculture – particularly in areas with productive soils - and the abandonment of farmland.[14] Both these trends are detrimental for biodiversity.

Intensification and specialisation of agriculture has had the positive effect of increasing yields. Yet, intensive production methods such as the frequent use of chemical fertilisers, plant protection products and heavy machinery often **reduce ecosystem quality** and create conditions which are **hostile to wildlife and natural vegetation**.[15] Agricultural practices with negative impacts on biodiversity have become widespread over much of the EU over the last 30-50 years, especially in the north-west. Consequently this has resulted in widespread and significant population declines of various species.

At the same time, extensive traditional farming systems in marginal agricultural areas are being abandoned, as they are no longer economically viable. As extensive traditional farming systems present an important habitat for a range of species and are often characterised by very high biodiversity values, their abandonment and subsequent degradation forms a central threat to biodiversity in the EU.[16]

In the next decades, a greater intensification of more productive agricultural land and further abandonment of marginal land is expected. This will especially affect some of the newer Member States, which currently hold a high proportion of high-quality semi-natural habitats.[17]

Furthermore, current agricultural practices present a major **threat to water quality** in Europe and to fulfilling the targets of the Water Framework Directive (WFD). In fact, agriculture is the main cause of diffuse pollution of European water bodies. Run-off from agricultural fields results in pollution of water by excess nitrogen compounds, phosphates and pesticide residues. These originate, for example, from excessive fertiliser use and plant protection

products, from high livestock stocking rates, as well as poor soil management and cultivation techniques. This pollution affects freshwater ecosystems, marine and transitional waters as well as groundwater stores (for example through nitrate leaching).[3]

Figure 1 illustrates the extent of pollution associated with agriculture across the EU.

Agriculture is the main source of diffuse pollution of the EU's water bodies

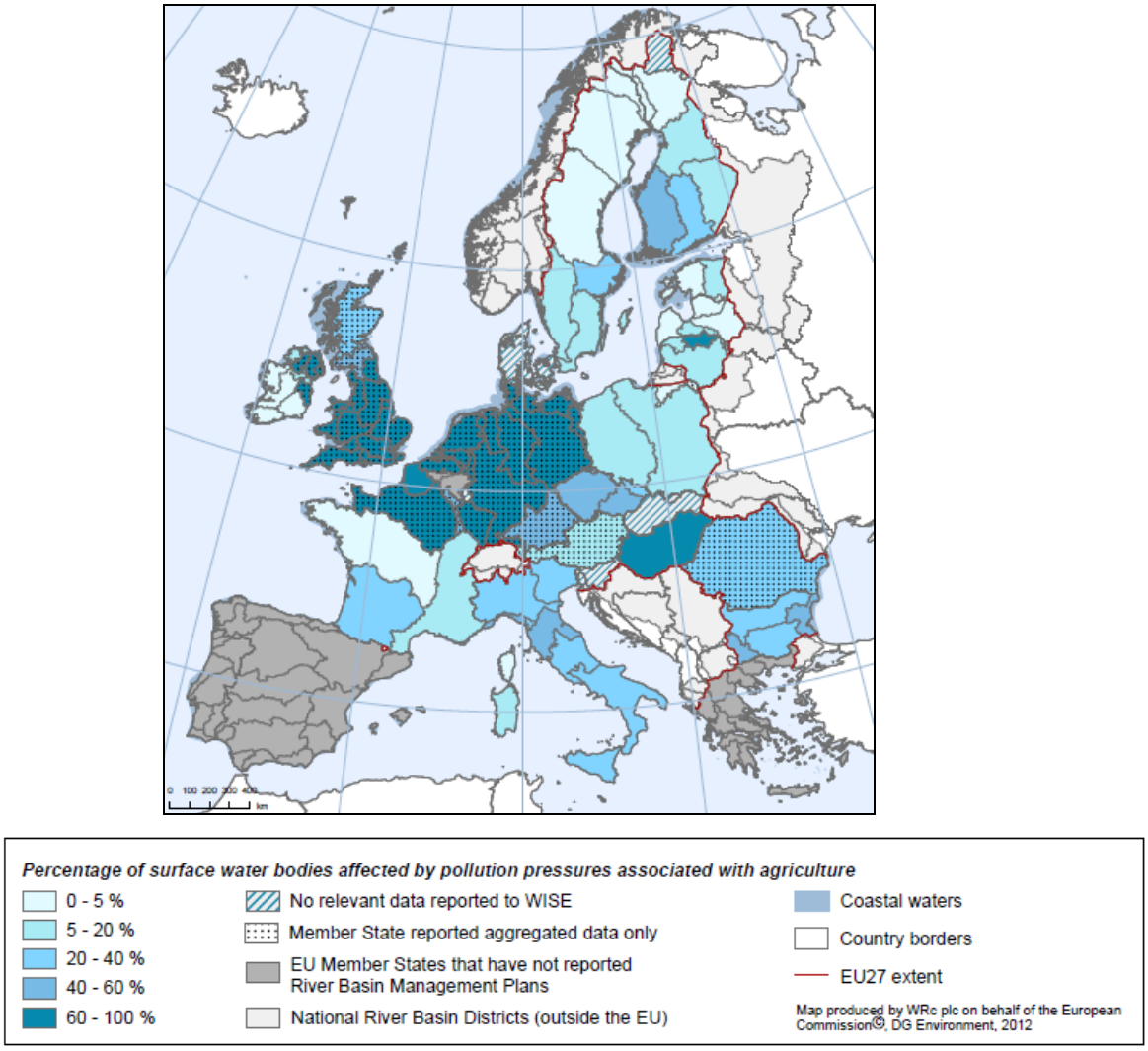

Figure 1: Map of surface water bodies affected by pollution pressures associated with agriculture. Source: European Commission[18] (version 29 October 2012)

In addition to affecting water quality, EU agriculture consumes considerable amounts of water for crop irrigation and livestock production. 24% of total water abstraction in Europe is ascribed to agriculture.[19] In some parts of southern Europe, agriculture accounts for more than 80% of water abstraction and typically this occurs mainly in the summer when water is least available.[20] The **risk of over-exploitation of finite water resources** is likely to be exacerbated in the future, particularly in southern Europe, as climate change leads to more intensive periods of drought.

Agricultural practices cause pressures on soils, such as soil compaction, erosion and decline in organic matter

Pressures on soils caused by agricultural practices include soil compaction through the use of heavy machinery, erosion by water (it is estimated that 1.3 million km² are affected in the EU27) and a decline in organic matter (45% of soils in Europe have low or very low organic matter).[21] Although it is in the

farmer's interest to manage soil resources in an environmentally sustainable way, this interest appears to be often overridden by the short-term economic incentive to maximise productivity.

To put it briefly, current agricultural production practices within the EU are on the whole detrimental for biodiversity, soils and water resources.

The most important policy for EU agriculture is the Common Agricultural Policy (CAP), which provides direct subsidies to farmers and also subsidises a range of agricultural activities that involve farmers. The CAP includes different instruments that promote eco-friendly farming, such as cross compliance or the 'greening component', under which farms have to comply with basic levels of environmental management to secure subsidies. However, numerous exemptions exist for the greening component, and its potential impact on farming practices appears to be limited in its current form.

2 Structure and design of the land policy mix

The land policy mix focuses on the consumption as well as the production side of the agricultural sector

Focusing both on the consumption and the production side of the agricultural sector, the land policy mix was designed to contribute to achieving the following vision for DYNAMIX as a whole:

> ***By 2050 all European citizens meet their basic needs and enjoy high levels of quality of life and well-being. At the same time, significant shifts in production and consumption patterns mean that impacts associated with the average consumption of a European citizen have gone down significantly and Europe's overall footprint is within the earth's carrying capacity. Both because of increased level of awareness and the incentive structures in place (i.e., prices), consumers demand low environmental, health and social impact products. In a range of key consumption categories (e.g. food), habits have changed. Infrastructures and land planning have been adapted in a way so as to make sustainable living, moving and consuming the obvious choice for all social groups.***

Through this vision, the overarching policy mix is intended to contribute to the DYNAMIX key environmental targets for the EU for 2050:[22]

I. Reducing consumption of virgin metals by 80%, compared to 2010 levels and measured as raw material consumption (RMC).
II. Limiting annual per capita greenhouse gas (GHG) emissions to 2 tons of CO_2 equivalent.
III. Reducing consumption of arable land to reach zero net demand of non-EU arable land.
IV. Reducing nitrogen and phosphorus surpluses in the EU to levels that can be achieved by the best available techniques.
V. Managing freshwater use so that no region experiences water stress.

The land policy mix has a double objective: Decreasing the EU's land footprint at the global level and reducing the environmental impacts related to agricultural production within the EU

In this context, the land policy mix aims to progress towards a more sustainable use of land both at the European and at the global level, while meeting the nutritional needs of the EU and global populations.

The policy mix has a **double objective**. On the one hand, it aims to **decrease the land footprint** at the global level related to European consumption of agricultural products. On the other hand, it aims to **reduce the environmental**

impacts related to agricultural production within the EU. Therefore, the land policy mix targets both the consumption and the production side of the agricultural sector.

The consumption side of the policy mix focuses on meat consumption and food waste

As regards **consumption**, the policy mix's objective is to reduce the global agricultural land use due to EU consumption by addressing two key drivers:

1) Consumption habits, in particular the overconsumption of meat, dairy products and eggs, which have a much higher land consumption per calorie than any other kind of food
2) Food waste

The production side of the policy mix aims to minimise the impact of agriculture on biodiversity, water quality and quantity as well as soil quality

As regards **production**, the policy mix aims to decrease the environmental impacts of agricultural activities in the EU and globally, which can be influenced by the EU and Member State policies. In particular, it focuses on three key categories of environmental impacts:

1) Biodiversity loss
2) Deteriorating water quality and overconsumption of water for irrigation
3) Reduced carbon storage in soil

The policy mix was designed under the assumption that EU agricultural production will remain stable or continue to increase slightly to 2050. The following criteria have been used to guide the selection of instruments:

(i) Potential for systemic impact of the mix;

(ii) Addressing both supply-side and demand-side drivers through the mix;

(iii) Policies may deliver important benefits in terms of improving quality of life;

(iv) Policy intervention is necessary, because markets won't bring about the necessary changes;

(v) Feedback on proposed instruments and additional instrument ideas from stakeholders throughout various DYNAMIX project events.

The land policy mix encompasses market-based, regulatory and information-based instruments as well as voluntary measures

The land policy mix comprises eight instruments, encompassing market-based, regulatory, information-based and voluntary measures (see table 3 below). It covers different regional dimensions, ranging from EU level to the regional and local level, and it targets different drivers of environmental degradation, such as excessive fertiliser use or intensive livestock farming. In the following table, the individual instruments are presented.

Table 2: Overview of instruments of the land policy mix

	Measure category	Name of instrument	Main targets of instrument	Mechanism and specifications
Production	**Regulatory instruments**	(1) Revision of the Common Agricultural Policy (CAP)	Enhance biodiversity, soil quality and water quality	This measure aims for a stronger and more effective environmental and climate dimension for EU land management in the CAP. Through the revision of the CAP, stronger incentives are provided to increase the eco-efficiency of farming and to reduce the environmental impact of agriculture without hampering production. Focal points are the support of semi-natural ecosystems, traditional and eco-friendly farming practices, as well as the promotion of efficient use of land, soil and water. The measure focuses on a stronger enforcement of the existing greening payment conditions as well as the cross-compliance obligations during the current implementation period. Environmental requirements can then be strengthened during the upcoming negotiation process for the period after 2020.
		(2) Measures limiting nitrogen emissions	Enhance biodiversity Improve human health	The instrument aims to establish revised emissions levels in the National Emissions Ceilings Directive (NECD) to reduce eutrophication of water bodies. At the same time, it aims to implement additional measures for better management of the nitrogen cycle on farmland. Such measures include, for example, higher fertiliser use efficiency, improved crop and manure management that reduce emissions, low-protein animal feeding, and improved manure storage.
		(3) Regulation for Land Use, Land Use Change and Forestry (LULUCF)	Climate change mitigation Enhance soil quality	This measure consists of developing a Regulation for Land Use, Land Use Change and Forestry (LULUCF) which sets targets for carbon emissions and removals related to forest management, cropland management, grazing land management and re-vegetation, ensuring that this incorporates the protection of farmed semi-natural habitats. Hence, the measure will prompt Member States to create incentives – such as funding or offsetting mechanisms – for carbon sequestration in regard to land use (e.g. preventing the conversion of grassland to cropland).
		(4) Improved pesticide management	Enhance biodiversity	This measure aims to strengthen the pesticide reduction targets in national pesticide action plans under the Sustainable Use of Pesticides Directive. At the same time, it strives to improve pesticide-licensing regimes to encourage full implementation of integrated pest management. Finally, the measure aims to ensure that Farm Advisory Services provide all farmers with advice on integrated pest management; and improve the incentives for uptake of integrated pest management, including through links to the policy on a stronger environmental dimension to the CAP.

	Measure category	Name of instrument	Main targets of instrument	Mechanism and specifications
	Voluntary instrument	(5) Promotion of Payment for Ecosystem Services (PES) programmes	Enhance biodiversity and water quality	Through encouraging the establishment of new PES programmes financed by private companies, the measure aims to increase the sustainability of agricultural practices. Sectors with potential for making such payments include the water sector (to encourage farms to avoid practices which lead to diffuse water pollution); energy undertakings or other businesses with an interest in offsetting carbon emissions; and tourism businesses that rely on high levels of landscape value and biodiversity. Public authorities will play a key role in the increased use of this kind of measure by offering 1) fiscal incentives and 2) support, including mediation, control activities and also, when appropriate, guarantees to ensure long-term planning (e.g. guaranteeing the payment even in case the company goes bankrupt or cannot afford to pay).
Consumption	**Market-based instrument**	(6) Value Added Tax (VAT) on meat products	Reducing meat consumption	This policy instrument aims to change dietary habits by reducing meat consumption through the application of Value Added Tax (VAT) on meat products. This would raise the price of meat products in most Member States, as they currently apply a reduced VAT rate on meat products,[23] and thus influence consumer purchasing decisions. There could be possible exemptions for certain types of meat products that promote environmental protection and health (e.g. organic meat products, meat being donated to charities and food donation programmes). The measure would follow the already established rules on VAT – it applies more or less to all goods and services that are bought and sold for use or consumption in the Community; therefore goods which are sold for export are normally not subject to VAT. Conversely, imports are taxed (to ensure competitiveness and a level playing field).
	Information policy	(7) Targeted information campaigns on changing diets and on food waste	Changing dietary habits Reduce food waste	This measure is an awareness campaign that aims to encourage and achieve a reduction in food waste and a change in diets. The campaign should be initiated by national governments or the EU and be carried out in close cooperation with retailers and key actors in the eating out and catering sector. The measure would provide information on the serious issue of food wastage to increase respect for food and promote healthy and more environmentally friendly/ less resource intensive diets (focus on reducing meat consumption). Advice and guidance could also be provided to consumers on how they could more efficiently consume food by providing information and tips on shopping, shelf life, storage, preparation, recovery and disposal options.
	Voluntary instrument	(8) Development of food redistribution programmes	Reduce food waste	This policy instrument aims to reduce the generation of food waste through the development of food redistribution programmes. An additional benefit of the measure is that food donation provides a crucial support for the most deprived groups in society. Deployed at Member State level, the measure would be targeted at the retail (including food restaurateurs) and food supply chain sector, and would target the retail/use and disposal phase of food products. It encourages households, retailers and other relevant food stakeholders to donate eligible food products to food distribution programmes.

3 Potential of the policy mix to reduce pressure on global land and to enhance the environment

3.1. Potential environmental impacts

Positive environmental effects through reduction in fertiliser and pesticide use, protection of habitats as well as reduction in food waste and in meat consumption

Overall, the policy mix can be considered having positive **environmental effects,**[24] as in combination the eight policy instruments will:

- Reduce the overall fertiliser input and promote an efficient application of fertilisers;
- Decrease pesticide use;
- Promote the protection and creation of habitats;
- Reduce food waste; and
- Promote a change in diets away from meat and dairy products.

Benchmarked against achieving the DYNAMIX environmental key targets,[22] with great likelihood the policy mix will contribute to four of the five targets.

Target: Limiting emissions to 2 tonnes CO_2-equivalent per capita per year by 2050.

According to findings for several instruments of the land policy mix, the mix very likely significantly contributes towards achieving the DYNAMIX target on climate, assuming full effectiveness of its component measures.

The policy mix has a great likelihood to contribute to reduction of GHG emissions through reducing meat and milk consumption, food waste as well as fertiliser use

Considerable cuts in GHG emissions can be achieved through the reduction of meat and milk consumption. The reason for this is that various GHG emissions are related to livestock production. These include methane (CH_4) emissions caused by the digestive process of ruminants, nitrous oxide (N_2O) stemming from manure,[8] as well as CO_2 emissions related to food processing, transport and the production of mineral fertilisers needed to grow feed crops. In addition, further indirect CO_2 emissions are caused by the conversion of forests into cropland for feed production. However, there are risks that the impact of reduced consumption in the EU would, in part, be accompanied by a lowering of global prices, leading to increased consumption elsewhere, reducing its overall effectiveness in tackling environmental issues.

For the VAT on meat products, different economic models were used (ICES, MEMO II and MEWA) to simulate an average one-off increase of the consumption tax on meat products by 13% in 2020 and its impact on the EU as a whole.[25] The simulations showed similar results: The VAT on meat is moderately successful in reducing meat consumption, while domestic meat consumption is decreased to a lesser extent. The latter can be explained by slight increases in meat exports due to a decrease in meat prices in the world market following the EU demand contraction. Figure 2 shows the results of the MEWA model, i.e. a 10% fall in the consumption of meat and an approximate 7% fall in the domestic meat production, both for the short- and long-term[26]. In fact, the MEWA simulations produced overall the most optimistic results in comparison with the other models. It assumes that the EU share in demand on the international meat markets is too small to significantly influence prices on the global level. Thus, meat exports do not rise substantially. Next, it assumes that European meat producers are forced cut meat prices, as they will face a noticeable drop in domestic demand and are confronted with excessive production capacities. The lower prices will result in the substitution of foreign meat by domestic products.

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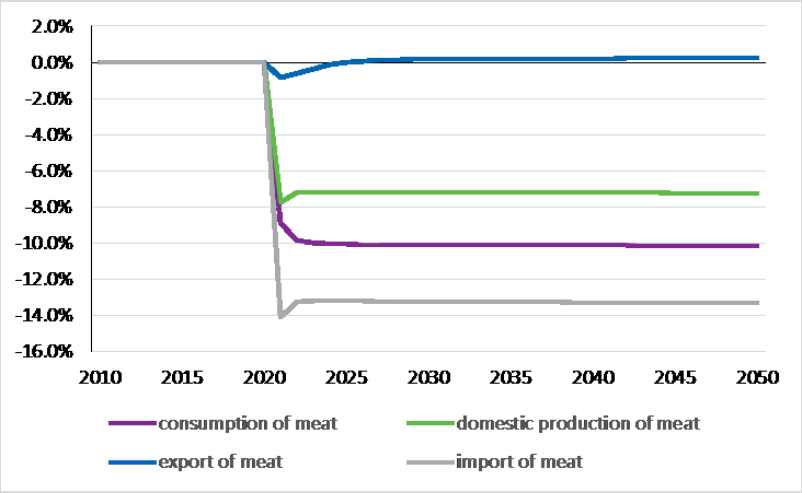
Figure 2. VAT on meat products: Change in sectoral variables in comparison to the baseline



Source: MEWA model simulations[Error! Bookmark not defined.]

The VAT on meat products could result in a 10% fall in the consumption of meat and an approximate 7% fall in the domestic meat production

Next, it can be expected that a targeted information campaign can result in considerable emission savings. Albeit information campaigns are in general expected to only have small effects on people's behaviour[27], even such small effects can have a significant impact due to the large direct and indirect GHG emissions associated with both meat and dairy consumption and food waste.

The food redistribution programme might decrease GHG emissions in two ways. Firstly, through reducing food production, and secondly through preventing food waste from going to landfill.[28] In fact, each tonne of food waste prevented results in 4.2 tonnes of CO_2-equivalent emissions avoided compared to landfilling.[29]

The revision of the CAP could reduce GHG emissions through the decrease of fertiliser use and more energy-efficient farming

Further emission reductions can be expected from the production-side instruments. Bigano et al. (2015) estimate that a 10% reduction of GHG from agriculture can be achieved through the revision of the CAP, more specifically through the decrease in fertiliser use and more energy-efficient farming.[30] Other instruments will also contribute to more efficient fertiliser use (e.g. measures limiting nitrogen emissions) and thus strengthen this effect. The LULUCF regulation should assist achieving the DYNAMIX target through carbon sequestration (e.g. protection of grassland, afforestation, restoration of degraded soils).

In sum, the expected emission reductions described above constitute an important contribution towards the DYNAMIX target of reducing the GHG emissions to 2 tonnes of CO_2-equivalents per year. However, the DYNAMIX target requires that the GHG emissions be reduced by 80% compared to current emissions (and this target in turn appears insufficient to meet the objectives now set out by the Paris Agreement). Thus, either further reductions would need to be achieved from the agriculture sector, or other sectors would need to reduce their emissions by more than 80%.

It must be noted that there is a risk that the policy instruments cause decreases in productivity, e.g. due to restricted fertiliser use. This could mean that – in case no reduction in consumption takes place – emission cuts are compensated by increased production and associated GHG emissions outside the EU.

Target: Reducing the consumption of arable land in order to reach zero net demand of non-EU arable land

The land policy mix has potential to contribute to achieving the target. Particularly, the consumption side instruments are expected to have positive effects on land use.

Food redistribution programmes have the potential to reduce land consumption, provided that they reduce overall food production

For instance, food redistribution programmes could considerably reduce land use, as long as the avoided food waste leads to a reduction in the production of food.[31, 28] For the information campaign, a positive, albeit small impact on land use is expected due to the reduction of land needed for livestock farming (as pastureland, and in terms of the land needed to grow feed crops) as well as a reduction of land associated with food waste.[28] A higher potential impact was assessed by a modelling exercise. Assuming that the instrument was very effective for changing diets, results indicate that the information campaign has the potential to reduce land use by more than 30%.[31] This is depicted in Figure 3 below. In scenario 1, the proportion of animal-based protein was reduced to 35% and 25% for 2030 and 2050 respectively, as outlined in the policy targets. It can be seen in the figure above that in scenario 0 an increase in land occupation will occur, which can be explained by assumed population increases. In contrast, a reduction in the consumption of animal products (scenario 1) will minimise the pressure on land resources. This can be explained by the fact that plant protein production has a lower land footprint compared to animal-based protein. Table 3 shows the reduction in land occupation in absolute numbers. However, this result is based on a very optimistic assumption about behavioural response of populations targeted by such a measure.

Figure 3: Simulated effect on land use without policy (scenario 0) and with information campaign (scenario 1). Land occupation normalised to the base year of 2010 (Million ha per year).

If the information campaign was very effective in changing diets, it could decrease land use by more than 30% - but this is based on very optimistic assumptions

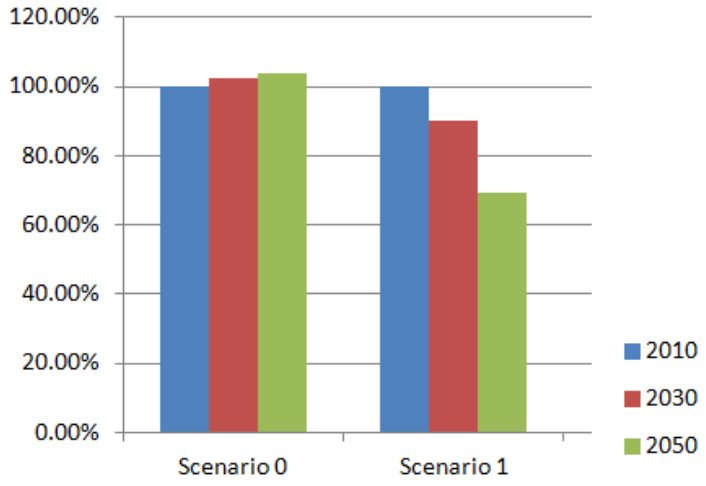


Table 3: Land occupation for Scenarios 0 and 1 (Million ha per year)

Scenario	2010	2030	2050
0) Without policy (continuation of current consumption patterns)	310	320	325
1) Information campaign (optimistic assumption on effectiveness)	310	280	220

For the production side instruments, there is a risk of crop yield decline, which in turn could lead to an increased demand for land

In contrast, for the production side instruments, a potential for minor countervailing negative effects has been identified. There is a risk that crop yields decrease – due to e.g. reduced fertiliser use or less effective pest control – could lead to an increased demand for land in the EU and beyond. Small positive impacts can be achieved by creating additional disincentives to the conversion of land to other uses (through the LULUCF regulation) and by improved soil quality, as well as reduced levels of acidification due to the revision of the Nitrates Directive.[28]

It has been estimated that a 30% reduction in land use is sufficient to keep the net demand of non-EU agricultural land below zero.[31] This illustrates the potential for reducing pressure on land from this policy. It has to be noted, though, that the modelled changes in diets depict a radical reduction in the excess intake of protein. Moreover, a critical question in regard to achieving the land use target is how the land becoming available will then be used.

Target: Enhancing biodiversity though the reduction of nitrogen and phosphorus surpluses in the EU to levels that can be achieved by the best available techniques

Although no exact level of contribution to this target can be given, the policy mix very likely contributes to this target. One important factor is the reduction of pesticide use.

Improved pesticide management is expected to have beneficial effects on freshwater ecosystems and various species

The decrease in pesticide application is expected to mitigate the negative impact on:

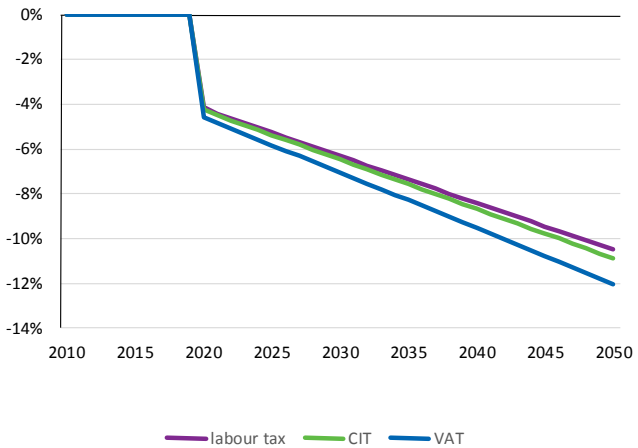
- Wild plant diversity, carabids, bees and bird species in Europe,[32]
- Freshwater ecosystems.[33]

In order to have this beneficial effect, it is essential that the reduction in pesticide use goes beyond the mere compliance with current environmental standards. In addition, the reduction of pesticide applications is expected to have a beneficial effect on soil functionality through the reduction of pesticide residues in soil (but only if reduction of pesticide does not lead to increased tillage).

According to the MEWA model simulation,**Error! Bookmark not defined.** a drop in pesticide use of about 10-12% can be achieved through gradual introduction of a 50% pesticide tax (see Figure 4). The range of the results reflects three scenarios differentiated by the use of pesticide tax revenue (reduction of labour taxation, reduction of corporate income tax (CIT), reduction of VAT). In contrast, a simulation with the ICES model resulted in a much more limited impact of the tax on the use of chemical products in agriculture: Merely a drop in pesticide use of 0.1% in 2030 and 0.05% in 2050 were computed. The reason for the difference between the two models is that ICES features a much smaller substitutability of chemicals with other inputs in agriculture.

Figure 4. Change in the use of pesticides in different scenarios

A 50% pesticide tax could reduce pesticide applications by about 10%



Source: MEWA model simulations

Further factors that enhance biodiversity are the intended protection of sensitive habitats and the promotion of more environmentally friendly farming practices (achieved through the revision of the CAP, promotion of PES programmes).[28]

Target: No region in the world should experience water stress

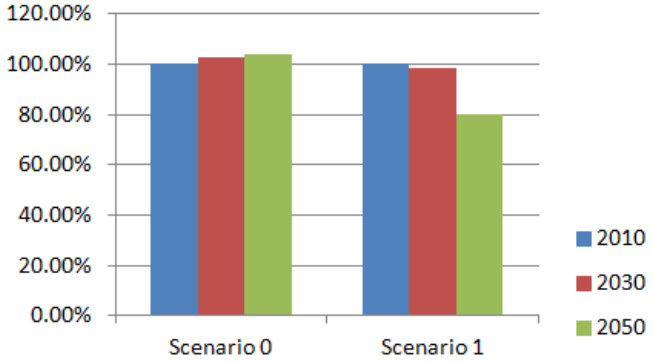
Each single instrument in the land policy mix impacts positively on water quality

The land policy mix is expected to have a positive effect on freshwater resources, as each single instrument of the mix impacts positively on water quality and/or quantity. Therefore it will likely contribute to the target.

For instance, information campaigns will affect water use if they are very effective at changing diets and reducing food waste.[31] More specifically, radically reducing the excess intake of protein until the year 2050 can reduce water use by 20% compared to the current level, even though the European population is expected to grow (see Figure 5 below).

Figure 5: Freshwater Consumption without policy (scenario 0) and with information campaign (scenario 1); normalised to 2010 Values.

A shift in diets involving a reduced consumption of meat and milk products could reduce water demand for irrigating feed crops



This 20% reduction in water use in food production is likely to contribute to achieving the DYNAMIX target that no region should experience water stress. However, since the applied model does not distinguish between different regions, it is not possible to conclude on whether the 20% reduction in the overall food production is sufficient to eliminate regional water stress, or even if it is an important step towards that target.

Apart from reducing the freshwater need for agricultural production, the policy mix enhances water quality. The revision of the CAP, the promotion of PES programmes and the measures limiting nitrogen emissions will result in a reduced use of inorganic fertiliser and a more targeted use of fertilisers in general. In combination with the reduced pesticide use, this can be expected to lead to a significant reduction in negative impacts of the agriculture industry on water quality, and therefore on water availability. This may, in turn, depending on local circumstances, reduce the pressure generated by water abstraction demands on sensitive habitats.

A further DYNAMIX target is to achieve an 80% reduction in consumption of virgin metals by 2050 through increasing dematerialisation and fostering a circular economy. The mix is not likely to contribute to this target. A small reduction in the extraction of raw materials can be expected to be achieved through it. In particular, an improved efficiency of inorganic fertiliser use is expected (through the revision of the CAP, measures limiting nitrogen emissions and through the information campaign). This would reduce the consumption of phosphorus and potassium, as well as the raw materials associated to the production and transport of mineral fertilisers.

3.2. Potential side effects of the policy mix

As has been shown above, significant environmental benefits could potentially result from the land policy mix. However, it should be noted that this is based on model outcomes which depend on optimistic assumptions about the effectiveness of measures. Moreover, some (potentially negative) side effects of the policy instruments might prevent this policy mix from being implemented or might reduce its effectiveness. This would mean that the above potential environmental effects might not occur or be different. In this context, economic, social and legal impacts as well as public acceptability of the mix must be considered.

Socio-economic impacts

Through a reduction of pollution and healthier diets, the land policy mix has an overall positive impact on human health

One positive side effect of the policy mix is its overall favourable impact on human health.[34] This is mainly due to a reduction of harmful pollution as well as the healthier diets.

Looking at the land policy mix from an economic perspective,[35] an important point is that the mix is likely to increase prices of agricultural outputs. This could encourage the desired shift in diets as well as the avoidance of food waste – and to that extent appears at first glance to be coherent with the aims of the policy mix.

Price increases could pose health risks for certain groups of society and endanger social equity

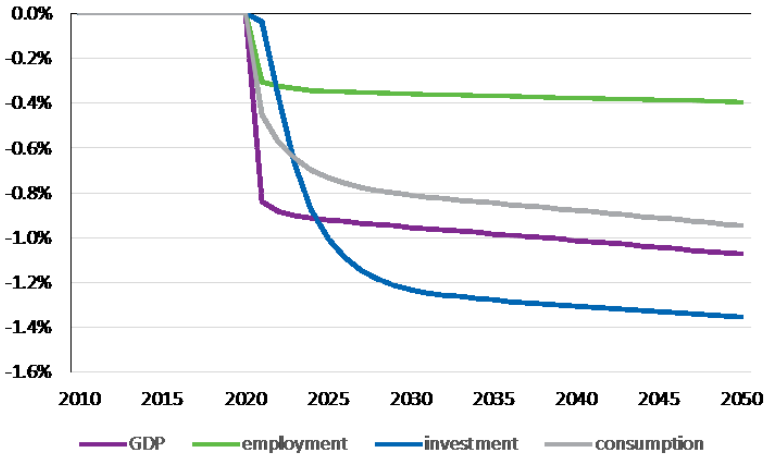
However, the increase in prices also has negative side effects. Most importantly, it poses different health risks, and a risk to social equity. As the poorest households spend the highest share of their income on food, they will be most affected by price increases caused by the policy mix. This could also increase the risk of malnutrition for certain groups of society, in particular through inadequate consumption of key micronutrients by children. Apart from the general price increases associated to the policy mix, the VAT on meat products in particular will disproportionately affect low-income households. Here, the food redistribution programmes have the potential to offset this effect, at least in part. Next, since there are no policies targeted on seafood and fish, the consumption of these will presumably increase. Considering the global problem of overfishing, this could be seen as a rather critical side effect.

Regarding employment, the effects for most of the production policies are uncertain.[34] For three policies (revision of the CAP, measures limiting nitrogen as well as the improved management of pesticides) a likely neutral or rather negative impact on the labour market was assessed, dependent on specific provisions and adaptability of farmers to the new requirements. In contrast, the promotion of PES is expected to have positive labour market effects in rural areas, as new employment opportunities may be unlocked.

On the consumption side, a rather negative impact on the labour market is expected from the VAT on meat products: The shift in consumption expenditure will require a reallocation of labour across the economy, which is likely to decrease employment in the short-term. A simulation exercise scrutinised the macroeconomic effect of the VAT on meat products on employment, as well as on GDP, investments and overall consumption.**Error! Bookmark not defined.** The results indicate that the impact would be very low (see Figure 6) and arguably on an acceptable level.

Figure 6. VAT on meat products: Change in macroeconomic variables in comparison to the baseline

The VAT on meat products could have a negative impact on GDP and employment – on a very low and arguably acceptable level



Source: MEWA model simulations

Public acceptability

Public acceptability differs across the instruments contained in the policy mix.[36] While most instruments can be expected to receive support by the public, food redistribution programmes have the potential to evoke some resistance and the VAT on meat products is likely to be strongly opposed.

Public support is expected for the production side instruments as well as the information campaign and food redistribution programmes

Regarding the production side, it has been assessed as unlikely that the production policies in the mix would be publically contended. Overall, the EU population is highly supportive of the objective of CAP and the objectives of these policies. It is likely that the details of the policies will be contested between the agricultural sector and the relevant public authorities, but it seems unlikely that this would be discussed widely or within public discourse. This finding, however, contrasts with experience of previous attempts to introduce an effective environmental component to the CAP, and should be treated with caution.

Regarding the consumption side, it is unlikely that policies focusing on information campaigns relating to food waste or efforts to strengthen food donation and reduce waste will encounter significant opposition. In fact, the public has frequently come out in support of food waste redistribution efforts and against efforts to cut funding to these programmes such as in France with the Fund for European Aid to the Most Deprived. However, should the proposed measures threaten to increase living costs or significantly reduce the consumer's right to shop freely and throw unwanted food away, it is possible that a coalition of interest could form to lobby against the measures. Therefore the measure needs to be designed with care to ensure the maximum positive impact.

The VAT on meat products is likely to provoke public resistance

Finally, removing VAT exemptions on meat products would likely generate considerable public discourse and resistance among many, often rooted in cultural relationships with meat. The meat sector would be likely to mount concerted lobbying efforts to highlight among the public the drawbacks of the policy. These would include fairness concerns, border issues and competitiveness issues. Therefore, the measure needs to be mitigated and implemented with the investment of political capital (see pointers for revision).

Legal assessment

As regards legal feasibility, some of the instruments contained in the overarching policy mix could be in potential conflict with WTO law or the EU Treaty.[37] The most problematic instrument appears to be the VAT on meat products.

The legal feasibility of the VAT on meat products might pose a challenge

a) At EU level, any harmonisation of legislation concerning turnover taxes, excise duties and other forms of indirect taxation would be subject to Article 113 of the Treaty on the Functioning of the European Union (TFEU) and would require unanimity by the Council. For the VAT on meat products, this is unlikely to be achieved, due to the expected resistance of some Member States. Furthermore, it would need to be "necessary to ensure the establishment and the functioning of the internal market and to avoid distortion of competition" (Article 113 TFEU), which is doubtful and still needs to be discussed. Recourse to Article 115 TFEU (approximation of laws) is not permitted. The instrument's feasibility is thus doubtful. Regarding WTO law, the national-treatment principle does not seem to be infringed as domestic products as well as imports are taxed without making any difference. However, exported meat is not subject to the tax. The intended exemption therefore needs to be justified.
b) Regarding the measures aimed at limiting nitrogen emissions, the compatibility of a fertiliser tax with the General Agreement on Tariffs and Trade (GATT) is questionable.
c) Similarly, the compatibility with the GATT is questionable for taxation elements within the measures for improved pesticide management, such as a volume tax on active ingredients in pesticides placed on the market.
d) Regarding food redistribution programmes, it is important to note that the imposition of VAT on food donation in some Member States is a difficult area. Terminology in legal texts varies, such that the value of food may be considered low or zero at time of donation, VAT may be 'abandoned', or 'exempted'. This issue is both controversial and lacks clarity.

3.3. Coherence of the policy mix and the role of sequencing

Overall, the mix of price signals and awareness-raising policy measures in the land policy mix appears likely to prove an efficient approach and to contribute to the overall efficiency and effectiveness of the proposed set of policies.

Combining production side and consumption side instruments appears to be a sensible approach, as it enables to tackle a wide range of environmental problems caused by EU agriculture

It has been assessed that the consumption policies are potentially the most beneficial in regard to achieving the DYNAMIX decoupling targets although, as noted, this is dependent on optimistic assumptions about their effectiveness. Nonetheless, the approach of combining production side and consumption side measures is sensible, as the agricultural production in the EU is to a considerable degree responsible for pollution and environmental degradation. Focusing on consumption alone would miss significant opportunities to reduce those impacts.

The information campaign and the revision of the CAP are the two instruments in the mix that are expected to yield the highest benefits at relatively low implementation costs (including high public acceptability). However, these policies alone are not sufficient to bring about the intended benefits of the policy mix. While improving information for consumers is a necessary precondition in order to change diets and avoid food waste, the measure needs to be coupled with more incisive policies to have considerable effects. Similarly, a revision of the CAP has the potential to make effective use of existing public expenditure levers and prepare the agricultural market for upcoming changes. It paves the

way for other policies targeted to bring about the intended changes, e.g. measures limiting nitrogen emissions, pesticides directive.[30]

Cumulative effects

Furthermore, the combination of certain instruments can be expected to enhance the desired impact of the policy mix. For instance, the decline in meat consumption due to the VAT on meat products will be intensified through the accompanying information campaign. In particular, through those measures, different drivers of high meat consumption are addressed, as depicted in Figure 7: The VAT on meat products targets the relatively low prices for meat (considering its external costs), while the information campaign addresses the lack of knowledge regarding environmental and health effects of excessive animal protein intake. Likewise, as the information campaign also addresses the issue of food waste, it increases the effectiveness of the food redistribution programmes.

Combining the VAT on meat products with an information campaign increases the effectiveness through addressing both price mechanisms and lack of knowledge/ awareness

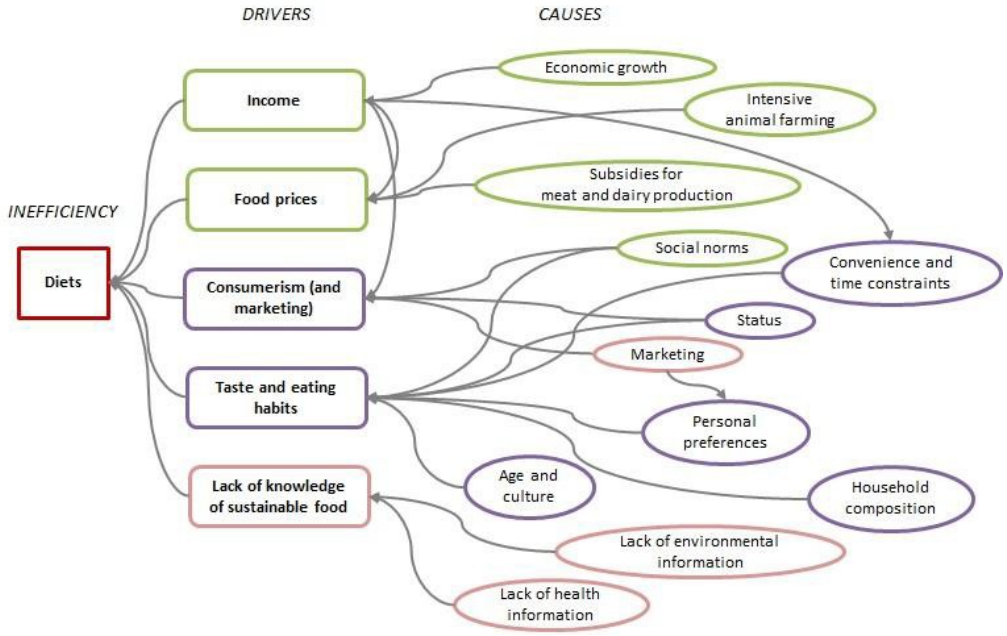


Figure 7: Drivers for high consumption of meat and dairy products; adapted from Tan et al. (2013)[38].

On the production side, similar cumulative effects can be expected, as various instruments pursue the same targets. For example, more sustainable farming methods such as a more efficient use of fertilisers are promoted through several instruments in the mix: the revision of the CAP, PES programmes, measures limiting nitrogen emissions.

Sequencing

Implementing the revision of the CAP and the information campaign first will raise awareness and acceptance of farmers and consumers, and thus facilitate the implementation of the other instruments in the mix

Careful sequencing is key to the successful implementation of the policy mix[35.] We recommend to first implement both the revision of the CAP and the information campaign on diets and food waste. Those instruments will smooth out the working of the whole policy mix, by creating favourable pre-conditions for the implementation of the other policies yet to come. For example, the revision of the CAP will increase farmers' awareness of the need to improve environmental outcomes, as well as to respond to the food production incentives provided by the market. Likewise, information on environmental and health effects of high

meat consumption could increase consumers' acceptance of higher prices for meat products. Therefore, these actions should start as soon as possible. Moreover, they need to stay in force over the long-term to create policy stability and maintain their function to create enabling framework conditions. With regard to the CAP, policy-makers will need to show consistency of purpose in ensuring a more effective impact on environmental outcomes than has been achieved by previous reforms.

4 Pointers for revision

Despite the overall largely consistent and coherent design of the policy mix, the available assessment results indicate that:

c) A number of negative side effects will have to be addressed through additional policies; and
d) Some of the instruments will likely face significant challenges as regards public acceptability and legal feasibility.

Hence, in the following section we will provide some pointers for revising the policy instruments in order to improve their political feasibility.

Improving the effectiveness and political feasibility of the policy mix

Regarding the socio-economic side effects, we recommend introducing the following complementary policies to the land policy mix:[34]

Political feasibility of instruments that potentially reduce crop yields could be improved through offering advisory services to farmers

a) Policies to counteract income inequalities should be considered. For example, a VAT decrease on crops or higher social protection for vulnerable groups of the society could be introduced. Monetary support for food banks, which is part of the policy mix, is already a component to reduce inequality, yet alone not sufficient.
b) Measures to help farmers avoid potential losses associated with limitations of sustainable farming methods (e.g. reduced productivity related to decreased fertiliser and pesticide application), particularly through advisory services, and the use of peer-to-peer knowledge networks.
c) Policies to address the risk of an aggravation of the overfishing problem (e.g. information policies).

Concerning public acceptability, both VAT on meat products and the policies targeting food waste need to be implemented carefully. More specifically, for food waste policies, caution is required for the stronger initiatives concerning dietary behaviour, as well as reforms to supply chains in order to prevent loss of support. The proposed measures need to both avoid excessive cost on retailers and be gradual in how they change the consumer experience. Key to this will be to ensure that the sources of food waste from the production and retails sectors do not impact on sales to higher-value consumers.

Public acceptance for the VAT on meat products can be increased e.g. through consulting stakeholders or focusing the tax on certain types of products

In order to increase public acceptability for the VAT on meat products, we recommend to:

a) Ensure a full and effective process of consultation with relevant stakeholders;
b) Focus the measure on luxury products;
c) Explore a 5-year transitional exemptions for certain meat products; and
d) Implement the measure across all EU Member States at the same time and using the same tax level – thereby mitigating border import issues.

Finally, from a legal analysis point of view, we recommend to try to use the measures that generate revenues (e.g. VAT on meat products) to co-finance the other measures to form a consistent policy mix. For example, tax revenues could be used to finance the information awareness campaigns on food waste reduction and changes in diet. Alternatively, revenues could be used to finance compensatory measures proposed above.

Improving the DYNAMIX research for the land policy mix

To provide convincing assessment results, various instruments of the land policy mix require specification

For a number of instruments of the land policy mix, it is essential for the success of the policies to make their specifications more precise. In particular, this is the case for Measures limiting nitrogen emissions, the revision of the CAP, the promotion of ecosystem services and the policies on pesticide use. Without the quantification of some key parameters, it cannot be assessed whether the measures will be reducing social welfare or improving it.[30] Moreover, modelling or more in-depth analysis of key environmental effects of certain policy instruments is needed. For example, a more detailed assessment of the impact of reduced pesticide use on water quality and biodiversity would make the policy mix more convincing.

Further research efforts should include the development of an indicator showing the EU's net land use impact (that is, the land use impact of EU agricultural consumption minus the land use impact of EU agricultural production). This would improve the measurability of the proposed instruments and the policy mix as a whole in regard to the impact on land use, which is the central target of the land policy mix.

5 Outlook and caveats

Policy mixing requires the identification of relevant drivers and thinking about smart instrument combinations

The concept of policy mixing is promising because it requires identifying most important drivers and mechanisms to be tackled to achieve certain objectives. At the same time, the acceptability and political feasibility of the policy mix can be strengthened by bundling together primary instruments, which mainly serve to achieve a set objective, with supportive instruments, which minimize or mitigate unintended negative side-effects of primary measures.[39]

However, designing, implementing and evaluating policy mixes is much more difficult than individual instruments loosely bundled. The concept of policy mixes might clash with political practices and experience, where policy formulation often entails so-called policy layering, i.e. stacking new instruments or objectives on-top of existing ones without any overarching design.[40] Resulting from political needs, such as existing alliances, election-based tactics or lacking time or knowledge, policy layering increases the risk of unplanned mixes with contradicting objectives and measures and hence trade-offs in effectiveness.

Differences in assumptions and model mechanisms impact on ex-ante assessments

The ex-ante assessments undertaken in the context of the DYNAMIX project could only partly be based on harmonised assumptions and parameters. Therefore, the results of the qualitative and the quantitative assessments differ – in some cases significantly. It cannot be stressed enough that the assumptions going in the assessments define the outcome to a great degree.

And finally, the assessments undertaken were not able to assess actual cumulative effects of the instrument combination in the policy mix beyond individual effects. This remains a methodological challenge requiring more research. Likewise, not all relevant environmental impacts can be calculated by the quantitative models. In particular, effects on biodiversity and on water quality

were not included in the quantitative assessments, leaving them underrepresented in comparison to the other key targets.

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DYNAMIX Deliverable D8.2.4 Policy field Roadmap – The overarching policy mix

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DYNAMIX PROJECT PARNTERS

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