CLIMATE CHANGE AND THE PRIMARY SECTOR: PHYSICAL EFFECTS AND THE ECONOMIC APPROACH WITH PARTICULAR REGARDS TO TURKEY

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Connecting People to Nature – in the city and on the land, from poles to the equator

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1. Economic approach

Markets are a powerful mechanism of coordination: resources are allocated toward those productions of goods and services that are preferred by consumers. Consumers signal their preferences by buying quantities of goods and services as functions of the prices. Assuming:

- private goods
- competitive markets
- rational choices from individuals

the markets deliver Pareto Optimal allocations on the production possibility frontier.

But the more we study the real world, the more we see that the very important things in our lives are not private goods. Markets do not provide a solution for many fundamental social situation. Because either there are no markets at all, or the assumptions are wrong. There are no markets for clean air, no markets for polluted water, no markets for exchanging climate effects.

The environment is a **public good**, it has different characteristics from private goods:

- non excludable supply, there is no easy way to prevent somebody from using it
- non rivality of benefits, the consumption by one person does not diminish the consumption by others
- non rejectable (when a public bad, like pollution), the collective supply cannot be rejected by people

2. The environment as a public good (bad): two (strange) example

Climate changes regards our environment, they can consist of increasing average temperature and abnormal heat waves and of increased air pollution.

Is there a link between air pollution (a public bad) measured by concentration of particular matter up to 10 micro meter and public health? A paper by Fattore et al. shows not only that there is a strong link but also an ingenuous way of find it out. When people suffer from asthma they often use Salbutamol to ease their respiration.

They analyzed the content of Salbutamol in waste water of the city of Milan and found a strong correlation of its residues with periods in which air pollution was higher.

Estimates show that in the US the value of pollination by bees is around $ 16 billion. Crops like almonds, apple, blueberries and peaches are bee pollinated by more than 50%. Honey production is worth about $ 160 mln per year. Colony collapse disorder is a major reason for bee population decline and environmental stresses induced also by climate change is a possible cause of CCD.

3.1 Mithology of sustainable economic development

The main point of the economic approach to natural resources is that they are infinite: the impact of human beings over the environment is felt and understood since few years, the earth was considered as a hostile playground where economic activities could only provide a better life to all without really change the landscape.

Even the great economist Keynes dismissed worries about the future by saying that “in the long run we will all be dead”. He was wrong, today we understand that in that same “long run” our nephews will be alive, trying to solve the mess we left them.

In fact, the first economist to recognize that economic scarcity is caused by physical reality was Nicolas Georgescu Roegen. By considering the Entropy law he stated that the Earth’s capacity to sustain human populations is bound to decrease.

The second principle of thermodynamics says that a closed system evolves toward a maximum level of entropy. This state correspond to the maximum statistical disorder or randomness where no biological activity is possible.

This approach was later termed *entropy pessimism*. It is criticized for the main reason that the Earth is not a closed system, since it receives much energy from the sun: it is thus argued that it will be possible to use the external energy to counter the increase of entropy.

3.2 Mithology of sustainable economic development

This is a long standing fundamental idea of neoclassical economics: the fact that technology will allow us to find the right answers to problems that seem unsolvable today. Capital and know-how substitute natural resources thanks to technological innovations.

For example, it seems true that the development of an economy based on hydrogen instead of fossil fuel will solve many of today's pollution problems, but:

•we hear about it since 50 years and our civilization still moves thanks to oil

•and the batteries of our phones do not last more than 10 hours!

Maybe this is due to the mere fact that oil is still at less than 50$ per barrel! By the way, the market price of fuel for private consumption does not reflect the entire cost of using it. Bad externalities like pollution are not priced as they should.

The sustainability criterion states that, at least, future generations should be left no worse off than current generations.

Efficient allocations methods do not automatically satisfy the sustainability criterion.

3.3 Mithology of sustainable economic development

Entropy pessimism is closer today to one of the two camps of the community of scholars that deal with the economy and the environment: *Ecological economics*. The second approach is called *Environmental economics*.

Between these two groups, that share many methodological approaches, differences arise mainly from the value judgments that are brought into the analysis. Environmental economics, consistently based on neoclassical economics, emphasizes the maximization of human welfare and the use of economic incentives to modify destructive human behavior.

Ecological economics uses a larger set of tools also from other sciences and prefers a regulatory approach to modify human behavior.

I personally believe that the best criterion is pragmatism: what works better in understanding and forecasting is to be used, depending on the situation.

3.4.1 Mithology of sustainable economic development

Having said that, I argue that the entire set of policies developed in last 20 years to deal with environmental problems caused by economic activities is wrong. The very concept of sustainability as it is heralded today is a oax. Basically, we are curing a cancer with aspirins, and it does not look like we really have some better treatment.

This is not the moment to fully prove this point and I will offer only some hints:

1) the standard neoclassical model assumes that human needs have no upper bound: agents always prefer to consume more

2) its results are based on the assumption that goods are private, while we deal here with public goods. There are no proper markets for them. The entire idea of decentralizing decisions does not apply.

The *positive* approach of neoclassical economics takes the real world as a given set of objects, agents and relations. It is merely a description of the way resources are allocated.

In order to deal with public goods and natural resources a *normative* analysis is needed, to find out what *should be* the best allocation. Even if a good deal of normative analysis was developed, many economist believe that the only proper economic analysis is positive analysis.

3.4.2 Mithology of sustainable economic development

3) decision making processes based on profit maximization and efficiency are inherently short sighted.

This is a particular important point. Bipedal primates are on this earth since about 7 mln years. The genus homo is 2,8 mln years old and Homo Sapiens appears to having migrated from Africa 0,2 mln years ago. During all these years we incorporated certain behavior that are hard wired into our brain and that are the main tools of our survival in a hostile environment. For example, if we hear a big noise we duck, if we feel a danger we run away. We developed a system of trust indexes that allow us to relate to each other and to trade.

These behavior are hard wired into our brains. On the contrary, nothing prepared us to the situation in which we are today: our very existence is the main cause of an environmental disaster that can imply our own destruction as a species. We have a very short time to adapt and to find a solution.

4) the whole system of capitalistic production is forced to ensure positive returns to capital investment, leading to the mythology of measuring "*development*" not even by absolute levels of GDP per person but by its annual increase.

3.4.3 Mithology of sustainable economic development

5) Data show that inequality is increasing in all major countries. The rate of return to wealth is constantly larger than the economic growth rate (***r>g***).

With inequality increasing the number of agents dealing with or influencing strategic decisions concerning the environment diminishes, while their stronger incentive is given by return on investment in the short period. The welfare of future generations is not a parameter of this mechanism. The world's eight richest persons have the same wealth (net worth, the difference of assets minus liabilities, this is not income) of 3,6 billion people.

6) consumerism lead to the production of goods whose working life is designed to be short: so that its demand is renewed over time.

As a consequence, more than 8 mln ton of plastic are dumped in the oceans every year. We are convinced that producing more is simply the best thing to do and even under this assumption we are unable to have economic system that produces full employment, because the search for profit implies the highest efficiency associated to large capital investments that save labor inputs

3.4.4 Mithology of sustainable economic development

7) the demand for non renewable resources from the future generations are only considered into our models of optimal allocation by assuming:

- that it is constant over time (because we do not dare to compare utility functions)
- that there is a discount rate. It dramatically reduces the present value of future benefits

Notwithstanding all these aspects, it is also true that the modern approach to the Utility functions as ordinal ranking of all possible combinations of goods and services can accommodate the introduction of particular goods: inter generational equity, the availability of natural resources in the future, the conservation of the environment. This also clarifies that the main problem is given by individual preferences, which are a function of the general level of education, culture and sensibility. This is to say, that if the majority of people cared more about the environment, the social utility function would reflect the change and optimal allocations methods would automatically produce more sustainable and fair outcomes.

Assume the utility of the average citizen changes from A to B:

$$U_A(\text{car, food, house, vacations}\ldots.)$$

$$U_B(\text{food, house, vacations, education, conservation of the environment, public transportation, free time}\ldots)$$

Then it is clear that optimal allocation of resources over time will be quite different

4.1 LULUCF

Land**U**se,**L**and**U**se**C**hange and **F**orestry is the greenhouse gas inventory sector that covers emissions and removals of GHG resulting from direct human induced land use, land use change and forestry activities

This sector is accounted for separately under the United Nations Framework on Climate Change, for at least two reasons:

- it is the only sector that measures both carbon releases and carbon removals
- the carbon removals are temporary: they cannot simply be added to data from other sectors

In fact, in the case of trees, a living tree absorbs CO_2, but CO_2 is released when the tree dies.

LULUCF as a whole in EU removes more CO_2 than it releases in the atmosphere: it is a carbon sink. Actually, it has the potential to remove much more of what it removes today.

However, this is a hidden danger: member states can mistakenly assume that CO_2 removals can cancel out the emissions of other sectors. But the removals from LULUCF are temporary, while emissions stay in the atmosphere for thousands of years.

If it was allowed to offset the emissions with removals from LULUCF, the emissions target could be reduced by 10%, leading -for example- to 1.35 mln ton more CO_2 in the atmosphere per year

The European target is to reduce the amount of 1990 by 40% in 2030.

4.2 LULUCF

European emissions of CO_2 equivalent in million tonnes

	1990	1995	2000	2005	2010	2014	Share in EU-28*
EU-28	**5 735.1**	**5 399.3**	**5 283.8**	**5 347.0**	**4 914.4**	**4 419.2**	**100.00%**
Belgium	149.2	156.9	153.9	148.4	137.5	117.9	2.67%
Bulgaria	104.8	74.4	58.5	63.2	60.3	55.4	1.25%
Czech Republic	199.8	158.7	151.5	149.7	141.1	126.8	2.87%
Denmark	72.4	80.4	73.4	69.3	66.0	53.9	1.22%
Germany	1 258.2	1 133.4	1 060.3	1 012.8	963.6	969.1	21.93%
Estonia	40.1	20.0	17.1	18.4	20.0	21.2	0.48%
Ireland	57.2	61.0	71.2	72.9	64.6	60.6	1.37%
Greece	107.3	113.4	130.2	138.4	120.8	104.3	2.36%
Spain	291.6	333.0	395.3	450.5	373.6	342.7	7.75%
France	556.8	557.7	568.8	570.6	530.7	475.4	10.76%
Croatia	35.2	24.6	27.1	31.3	29.2	24.8	0.56%
Italy	526.1	539.2	562.6	588.1	517.9	428.0	9.69%
Cyprus	6.4	7.9	9.2	10.2	10.4	9.2	0.21%
Latvia	26.4	12.9	10.5	11.6	12.6	11.6	0.26%
Lithuania	47.5	21.7	18.8	22.4	20.2	19.2	0.44%
Luxembourg	13.3	10.7	10.7	14.4	13.5	12.0	0.27%
Hungary	94.6	76.2	74.2	76.7	66.2	57.7	1.31%
Malta	2.2	2.8	3.0	3.2	3.4	3.3	0.08%
Netherlands	226.8	239.8	230.2	225.5	224.1	198.0	4.48%
Austria	79.7	81.2	82.1	94.8	87.0	78.3	1.77%
Poland	473.5	446.0	393.0	397.9	407.7	382.0	8.64%
Portugal	62.1	73.0	86.0	90.5	73.1	67.6	1.53%
Romania	252.7	183.4	140.9	147.0	117.5	110.4	2.50%
Slovenia	18.7	18.8	19.2	20.6	19.7	16.7	0.38%
Slovakia	74.8	54.8	50.0	51.6	46.7	40.8	0.92%
Finland	72.4	72.8	71.1	70.9	77.6	61.1	1.38%
Sweden	73.3	75.5	70.8	68.9	67.1	56.7	1.28%
United Kingdom	812.2	769.0	744.0	727.3	642.1	556.7	12.60%

*Share in EU-28 total in year 2014

Emissions of CO_2 from Turkey were 475,1 mln ton in 2015

How much volume does 1 ton of CO_2 occupy (at 27°C and 1 atm)?559 cubic meters. The average emissions of 5.000

5 Agriculture influencing climate changes

The National Inventory of Turkish emissions of CO_2 from agriculture tells us that they were 57,4 mln ton of CO_2 equivalent in 2015. Considering that LULUCF absorbed 64 mln ton of CO_2, the balance is positive: there is more fixation than emission.

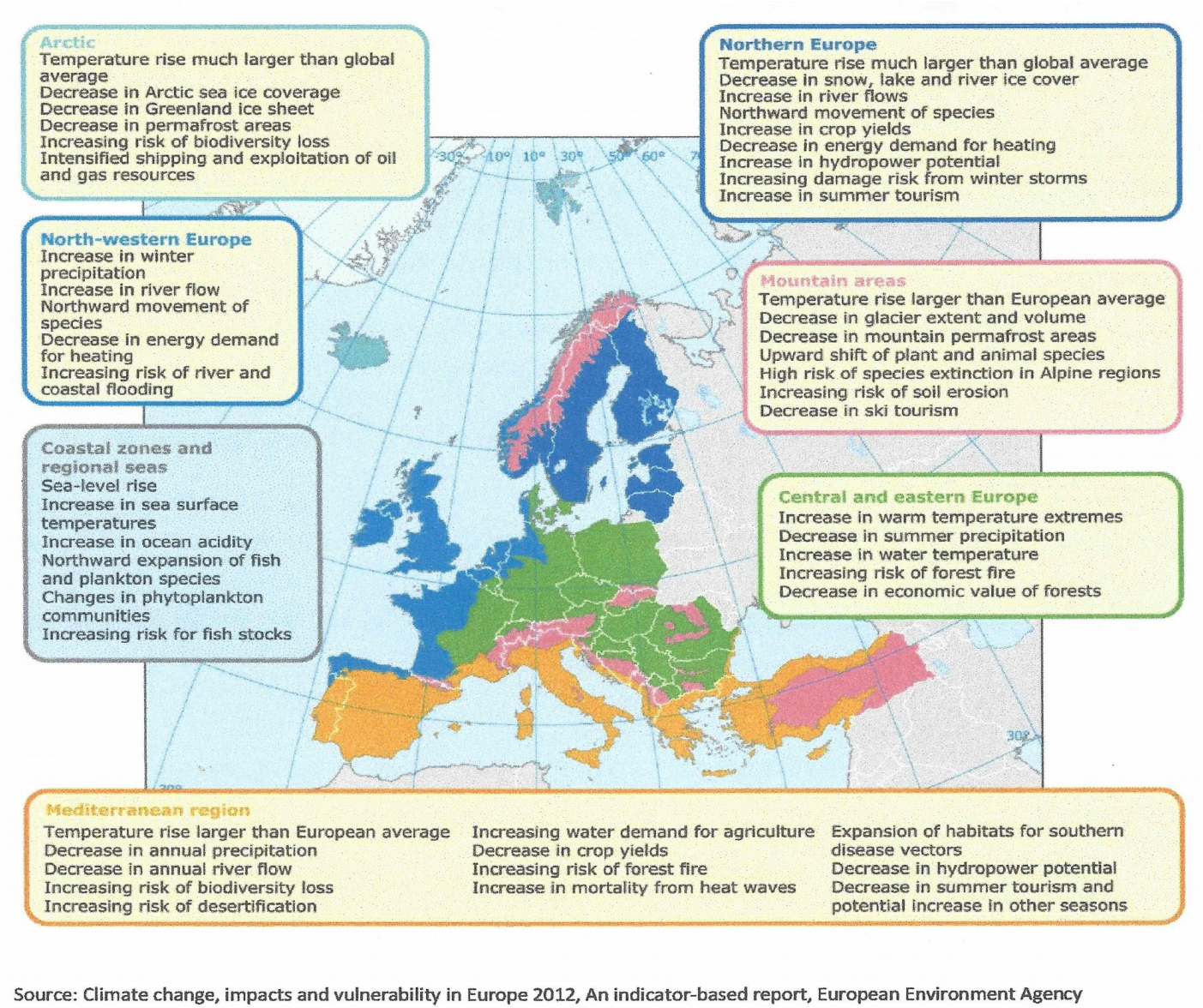
Total emissions from Turkey were 475,1 mln ton (excluding LULUCF), so that the share of emissions from the agricultural sector is 12%.

At the European level, the average share of agricultural emissions was 10,3% in 2015.

How does farming influence climate change? By producing two powerful greenhouse gases:

- Methane (CH_4) from livestock digestion processes and animal manure
- Nitrous oxide (N_2O) from organic and mineral nitrogen fertilizers
- using fossil fuel, energy and inputs that emit CO_2 during their production
- By temporarily removing CO_2 in vegetable growth

6. Agriculture influenced by climate changes



Source: Climate change, impacts and vulnerability in Europe 2012, An indicator-based report, European Environment Agency

6.1 Agriculture influenced by climate changes

The European Environmental Agency lists three major effects:

- changing in rainfall
- rising temperatures
- increasing variability and seasonality, with heatwaves, droughts, storm and floods

Forecasts based on geographical considerations allow us to define two large areas in Turkey: the continental Anatolian plateau and the south east (which share the same features of other European mountain areas) and the Mediterranean region, comprehending the mountains facing the black sea.

More likely effects:

A) Mountain areas (Anatolian plateau and south east):

- more than average European increase of temperature
- increasing risk of soil erosion

6.2 Agriculture influenced by climate changes

B) Mediterranean region:

more than European average increase of temperature

increasing risk of biodiversity loss

increasing risk of desertification

increasing of water demand for agriculture

increasing risk of forest fires

increase in mortality from heat waves

expansion habitats for southern disease vectors

decrease in annual rainfall and river flow

decrease in hydro power potential

decrease in summer tourism and potential increase in other seasons

decrease in crop yields

Mitigation, definition: measures of agricultural practices that reduce GHG emissions

Farmers behavior and their adoption of mitigation measures depends on economic incentives and on the values upon which they base their individual choices.

Adaptation, definition: measures of agricultural practices that reduce damages due to climate change.

In all this cases, a huge effort in research and development and extension of new technologies is needed.

7. The environment and the Common Agricultural Policy (CAP)

The EU finances the CAP through the European Agricultural Guarantee Fund and the European Agricultural Fund for Rural Development, with an annual budget of around € 59 billion. This money is used to ensure that 22 million farmers (and 44 million jobs in food processing and food retail depending on agriculture) enjoy a **decent standard of living** and at the same time respect requirements for **animal health and welfare** and for **environmental protection**.

The CAP integrates a number of instruments to improve the environmental performances of agriculture. Sustainable management of natural resources and climate change action represent one of the main objectives of the CAP.

Cross-compliance is a mechanism that links direct payments to compliance by farmers with basic standards concerning the environment, food safety, animal and plant health and animal welfare, as well as the requirement of maintaining land in good agricultural and environmental condition.

The ***Green Direct Payment***, introduced in 2015, is granted if the following compulsory practices are implemented: crop diversification, ecological focus areas and permanent grassland

the ***Rural Development Policy*** states that at least 30% of the budget of each rural development program must be reserved for voluntary measures that:

- Restore, preserve and enhance ecosystems dependent on agriculture and forestry
- Promote resource efficiency and support the shift toward a low carbon and climate resilient economy in the primary sector

Cross-compliance is based on the ***polluter pays principle*****:** all its requirements represent and additional cost for the farmer. If the farmers does not satisfies them, he receives no aid and can be fined.

7.1 Adapatation strategies of the CAP

Adaptive measures are both technological innovations at the **farm level** and **sectoral policies**.

Adjusting the timing of farm operations, such as planting or sowing dates and treatments;

Technical solutions, such as protecting orchards from frost damage or improving ventilation and cooling systems in animal shelters; adjust the intensity of input use

Choosing crops and varieties better adapted to the expected length of the growing season and water availability, and more resistant to new conditions of temperature and humidity;

Adapting crops with the help of existing genetic diversity and new possibilities offered by biotechnology;

Improving the effectiveness of pest and disease control through for instance, better monitoring, diversified crop rotations, or integrated pest management methods;

Using water more efficiently by reducing water losses, improving irrigation practices, and recycling or storing water;

Improving soil management by increasing water retention to conserve soil moisture, and landscape management, such as maintaining landscape features providing shelter to livestock;

Introducing more heat-tolerant livestock breeds and adapting diet patterns of animals under heat stress conditions.

Migration, that is ,leaving the sector or moving the place of operations

Identification of vulnerable areas and sectors and assessment of needs and opportunities for changing crops and varieties in response to climate trends;

Crop and farm income insurance

Support to agricultural research and to experimental production aiming at crop selection and development of varieties best suited to new conditions;

Building adaptive capacity by awareness raising and provision of salient information and advice on farm management.

8. Conclusions

The main message of this presentation are the following:

the current economic model does not seem to be compatible with the concept of sustainability, the so called green economy is at best, insufficient.

a farmer nowadays needs more than to be just a good agronomist and a good manager. Training of trainers and extension activities must be fundamental points of a modern agricultural policy.

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Thank you