89

EARTH'S CHALLENGE

ecology and justice in the xxi century

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"Our planet offers all that man needs,
but not all that man covets" (Gandhi)

Following the cycle of booklets that *Cristianisme i Justícia* has been dedicating to the challenges of the year 2000, it seems necessary that we speak of ecology, considering that it is one of the open themes that we, men and women, who will be ushering in the third millennium will have to count with.

For the last twenty-five years the ecological movement has been warning us against the peril of industrial civilisation reaching the point of ecological destruction. What was at first considered a radical ideology and perhaps unreal, is today perceived as a voice that cannot go unheeded. Actually in Europe, some left wing parties present today environment-friendliness as one of the important features of their political proposals.

The United Nations Organisation in one of its recent "summit" meetings, has broached this topic, and has insistently asked the developed countries to elaborate guidelines for acceptable production and consumption procedures". This is a challenge for the whole of humanity of today and tomorrow. A challenge that can make us all a little bit wiser, a little bit more solidarity-minded, a little bit more human.

In this booklet we have set ourselves two objectives: firstly, to make a short but a sufficiently comprehensible review of the main environmental problems facing us today. We would be reviewing here the different symptoms this problem presents. Secondly, we will try to mention some of the ways that are currently being carried out to solve the problem. We are especially interested in the relations that exist between ecology and economy, and between ecology and poverty. This can help us to reflect on our personal and collective decisions since, inserted as we are in a "globalised" world, we need necessarily to take into consideration a great variety of factors, one of which is ecology.

1. PROBLEMS OF THE ENVIRONMENT

"Aspiring to be superhuman, we are on the point of destroying humanity. Capable of flying, man risks his life in space; aspires to determine the sex of his children, and to cure them of prenatal illnesses; sterile women opt to be mothers, and the fertile choose otherwise; we meddle with winter's cold and summer's heat; we demand different types of food at any time of the year, irrespective of regular harvest seasons and natural cycles; we approach the speed of light and invent arms that endanger our continuity and that of the world. But, despite all that, we have abolished neither fear nor hunger nor death, we do not know peace, we oppress the cities we have built to save ourselves, and we do not feel any happier than we were before" (Antonio Gala)[i].

We will presently enumerate a few facts, which are regarded as "symptoms" of the ecological degradation of our planet. Our treatment of the subject does not propose to be exhaustive. Certain topics, such as the scarcity of non-renewable resources, have been left out for want of space.

As in every enumeration of problems, the reader may get the impression that he is being confronted with some sort of alarmist exhibition of an apocalyptic nature. This is decidedly not our intention. What we have set out to do is localise the problems, try to measure and understand them so as to face up to them in as adequate a fashion as possible.

1.1. EARTH

Desertisation

The process of desertisation consists in the loss of fertile soil on account of atmospheric factors (rain and wind). Green land vegetation depends for its life on the humidity of the soil, which is captured by its roots. Erosion eliminates this fertile soil and makes it impossible for vegetable life to exist, and as a result, animal life suffers too. This process of impoverishment of eco-systems is frequently produced by farm activity.

The greatest risk of desertisation is to be seen in "arid", "steppe" and "sub-desert" zones. In these regions, the conditions of life for vegetation are very precarious, because of the lack of fertile soil. Actually climates between deserts and steppes differ by no more than 100-150 mm of annual rainfall. If the average rainfall were to increase by only 200 mm a year, all the deserts of the planet would cease to exist.

Desertisation is a natural phenomenon, which has always taken place. There are, for example, testimonies of human life in the north of what is currently the desert of Sahara that date back 5,000 years. The North African desert became uninhabitable only 3,000 years ago. Well, it is also clear that human action can also bring about the desertisation of lands especially those that are close to a desert-type of climate. The exaggerated use of underground natural water deposits by over-exploitation is one of the clearest dangers: it brings about the salinisation of land making it impossible for vegetable life.

The "Programme of the United Nations for the Environment" in its Agenda 21 (1992) considers that one-quarter of the surface of the land on the planet is under the threat of desertisation, which means to say that the means of subsistence of some 900 million people are at stake.

We can form an idea of the magnitude of the problem by examining the figures of the following table which shows the extension of lands in arid zones of the planet that are being desertised by human action[ii].

Degree of desertisation	All over the world (km^2)
Slight	24.520.000
Moderate	13.770.000
Severe	73.000
Very severe	47.063.000

"Very severe" desertisation is what is commonly known as "desert". We are talking here of a situation of impoverishment of the earth that is considered irreversible: land, which has reached a point where it is practically useless for man or animals. These have relatively little extension and are concentrated in some areas. So, the desertisation of our planet can still be reverted for the major part, if the necessary measures are applied.

Diminution of bio-diversity

The variety of forms of life on the earth planet is enormous. Up to now biologists have described approximately 1,400,000 species of live organisms. The most numerous group is that of insects with 750,000 known species. The number of mammals known is around 4,000. This notwithstanding, scientists think that we know only a relatively small part of living beings. Naturally, we do not know how many species are unknown to us, but these estimates make the number range between 5 and 30 million[iii].

This variety does remain stable, but keeps on changing in a way that while some new species appear, we have some others that move out of existence. This is brought about in a natural way. There have been times when species have disappeared on a massive scale, including "families" of species: we know of at least five periods of big "extinctions" that took place some millions of years ago. With the elapsing of the Permic period (some 250 million years ago) more than 95% of species are calculated to have disappeared.

However, it seems that the action of man accelerates the rate of disappearance of some species. Estimates (always approximate and open to discussion) would have us believe that in the last decades, one species of mammals is extinguished every two years, whereas three centuries ago a species would disappear every five years. The process of current global deforestation supposes the disappearance of some 5,000 live species every year, whereas a million years ago, when *homo sapiens* entered onto the scene, it is calculated that the rate of extinction was some 10,000 times less.

The conservation of bio-diversity is a postulate of conservationists. As a matter of fact, man seems to depend on a very small number of species. Three quarters of the food consumed by the human race come from just seven species: wheat, rice, corn, potato, barley, sweet potato and tapioca.

This notwithstanding there is increasing talk of the utility of bio-diversity for man. Bio-diversity, from a certain perspective, is a big live warehouse of genetic information, which humanity can make use of. Actually, a great number of medicines that are currently used obtain their active basic ingredients from vegetable and animal species. Man is still far from knowing the potential utility of the life that surrounds him.

The demographic problem

It is well known that the population of our planet has undergone an unprecedented growth during the century, which is now drawing to a close. In the year 1999, world population is expected to reach a historic maximum of 6,000 million inhabitants.

To get an idea of this evolution, let us give some figures, which characterise the growth of world population:

	1950-55	1960-70	1985-90	1990-95
Index of average annual growth (%)	1.78	2.04	1.72	1.48
Annual growth (millions of inhabitants)	47.0	71.9	87	81

Source: *O.N.U. Population Division 1997.*

It is obvious and no one needs reminding that world population growth is enormous. During the twentieth century, each year the population has not only been more numerous but the increase each year has been bigger (in the year 1950 it was 47 million and in 1985, 87 million). Despite this, in later studies it has been observed that this increase has started a "freezing" process: in recent years the index of annual growth has diminished from 2.04 to 1.48. Population increases but not so swiftly, the *speed* of growth is diminishing.

What will the evolution in the future be? It is clear that humanity will keep on increasing in the next decades. But it is still a question mark how its evolution will turn

out in the long term. In the year 1998 the forecasts that have been elaborated by the United Nations for the XXI century present three possible "settings": a "high variant", according to which world population could exceed 10,000 million inhabitants towards the middle of the century, and will keep on increasing; a "middle variant", according to which by the year 2050 population would approach 9,000 million inhabitants; however, this would occur with a very low growth and a tendency towards stabilisation of world population; finally, the "low variant", which foresees a population of some 7,300 million inhabitants for the year 2050, with the beginning of a process of reduction of world population which would be more pronounced in the future.

If we consider the middle variant, and if we regard it with a little bit of historical perspective, we could conclude that we are passing through a stage of very strong transition as far as population on our planet is concerned. If at the beginning of the XIX century the population of the planet was 1,000 million inhabitants, towards the half of the XXI century we could expect a stabilisation of population around 9,000 million. During these 250 years, the world population will have made a "leap" as a result of the industrial, scientific and technological revolution.

This is the situation we are living and it entails some problematic consequences. The lack of food and habitable land which is already being felt in certain parts of the planet. The needs of a rapidly growing humanity in turn grow rapidly. And the higher the level of development attained by this population, so much higher would be the demand.

We are confronted here with a characteristic that dramatically aggravates the problem: the heterogeneity of the situation depending upon which zone of the planet it occurs in. A child born today in Gambia has a life expectancy of 46 years, while in Spain a child is born with a life expectancy of almost 80 years. While in the First World, child mortality is less than 1%, in South America it often exceeds 3% and in Africa it is 10%.

All this has led to world growth being considered as one of the factors of ecological risk. This was the approach of the United Nations when it convoked the Conference on Population and Development in Cairo (1994), following the Summit of Rio (1992). We shall speak about this in the second part of this booklet.

The big urban concentrations

One of the phenomena that has developed in a more decisive way in the last century has been the urban concentration of the population. Whereas at the beginning of the XIX century only 5% of the world population lived in cities, today it is already 45%, and in the next 15 years, it will probably reach 55%. This is especially serious in developing countries, where the growth of big cities is incapable of being accompanied by the corresponding urban action and services.

The city represents an eco-system very different from natural ones. In a city, the population of "consumers" is disproportionately higher than that of "producers": it is for this reason that the city needs to import from outside a great quantity of "energy" in the form of water, food or energy (chemical, electrical....). And one must not forget that

today 19% of the world population live in big cities (more than 750,000 inhabitants)... and a good part in underdeveloped countries, in which problems generated by ecological imbalance are less controlled.

From the viewpoint of ecology, cities produce different effects on their surroundings. Firstly, one must mention that cities are responsible for residues that produce contamination of land and water. But, above all, roads of communication have an especially destructive effect: the fragmentation of natural habitats by a railway track or a motorway causes the flight or extinction of many animal species. The concentration of population in big cities strongly affects the environment on account of the excessive demand that is required for farmland cultivation as well as natural spaces for leisure activities.

Summing up, we are talking here of a hyper-growing process of cities, in detriment of agrarian life. To invert this tendency, it is necessary to give incentives to life in smaller town centres, and this can only be done by channelling investments in strategies for development of small or rural populations.

The concentration of population in a small limited territory as happens in cities involves in addition a concentration of basic requirements (water, energy, food, housing) and also a concentration of the production of residues. Atmospheric contamination is an especially universal feature of cities on account of the accumulation of residues generated by automobiles, industries, central heating, etc. Let us remember by way of an example that is both close and significant, the instances of traffic restriction in Paris in the autumn of 1997 on account of the excessive contamination prevalent at that time.

The principal "ingredients" of urban air contamination are residues of combustion that are by-products of petrol: carbon dioxide (CO_2), carbon monoxide (CO), tars, hydro-carbides, lead, oxides of sulphur and nitrogen, and particles of carbon and ash. Factories emit all types of dangerous substances.

	Population in 1995 (milions)	Population in 2015 (milions)
Mexico	16.562	19.180
San Paolo	16.533	20.320
Bombay	15.138	26.218
Shanghai	13.584	17.969
Buenos Aires	11.802	13.853
Seoul	11.609	12.980
Lagos	10.287	24.640
Karachi	9.733	19.377
Dacca	8.545	19.486
Metropolitan Manila	9.286	14.657
Cairo	9.690	14.418
Jakarta	8.621	13.923
Istanbul	7.911	12.328

Source: 1998 PNUD Report.

Atmospheric contamination can have different forms and characteristics. The two most important are *acid smog* and *oxidiser smog* (or *photosmog).*

Acid smog is produced in cold and humid high-pressure situations (London is a typical case in point). Due to air stability caused by the high-pressure situation, humid air contains a high concentration of oxides (especially of sulphur and nitrogen), and behaves like an acid medium. This has a very strong corrosive effect on metals and on buildings in general. Acidity does not have by itself a bad effect on human health; however, when combined with the effect of sprays and ash, can produce serious illnesses.

As far as *photosmog* is concerned, it is characterised by the presence of certain key substances: ozone, nitrogen monoxide and dioxide, and aromatic and rising hydrocarbides. It is produced in situations of atmospheric stability but in places that have low humidity combined with high temperatures (as Athens or Los Angeles). Solar energy acts on these substances present in the air, decomposing the oxides and setting free highly reactive atoms of oxygen. This provokes reactions that end up producing diverse products (ozone, peroxiacilnitrates and aldehides) highly irritant to live animal and vegetable tissues.

Administration of water and land in developed countries

Development involves a spectacular increase of water consumption (household appliances, watering gardens/fields, hygiene...) Consumption of drinking water in rich countries has increased 500 times in the last century. This increase cannot be sustained by dry climate countries such as Spain. It is becoming increasingly important to improve the administration of drinking water.

On the other hand, modern techniques for land-and-animal farming which are characterised by intensivity and the separation of agriculture from stock-breeding, offer three main problems:

a) erosion of fertile land
b) excessive use of artificial fertilisers (nitrates, phosphates, potassium)
c) phytosanitary products (herbicides, fungicides, insecticides and plague-killers in general.

Alternative "biological" methods are currently being tried. The use of natural fertilisers (manure, purine and hay) meet with the difficulty of the separation of cattle and land farming. On the other hand, time is lacking to develop guaranteed methods for substituting artificial plague-killers by "natural" methods (hormones).

Finally, developed countries are characterised by the enormous quantitative importance that is given to transport activities. The transport sector has undergone an unprecedented growth during the last decades. And very especially road transport with the popularisation of private cars. Precisely road transport is the most contaminating. Compared with the railway, road transport contaminates between 9 and 14 times more for every unit transported and kilometre covered.

The problem, as in so many other environmental questions, is that the costs for contamination, for less energetic efficiency, and for occupation of natural space (what we could call "ecological cost") are not reflected in the price of consumption. In this way, the enormous advantages of transport by railway are not reflected in the market.

As far as occupation of natural spaces are concerned, one must point out that in developed countries, communication channels and their areas of support (paths and roads, railways, airports, ports, channels) occupy half the surface that human activity makes use of.

The disappearance of woods

A fourth part of land surface is occupied by woods. But, according to the report of *World Resources Institute* 1998, every year 0.3% of this surface is lost. The rate of deforestation goes so far as to exceed 3% in some countries like Lebanon, the Philippines, Costa Rica, and El Salvador.

In developed countries, industrial combustion for obtaining energy produces naturally gas emissions. These are mainly water vapour and carbon dioxide (CO_2). But other oxides (of the dioxide type) such as sulphur, nitrogen or phosphorous. A characteristic of these oxides is that, in contact with the water of the atmosphere, they produce acids: mainly sulphuric and sulphurous acids (from sulphur oxides), and nitric and nitrous acids (from nitrogen oxides). This is the origin of acid rain: rain with a high degree of acidity, which is produced frequently in industrialised zones.

"Normal" rain is already slightly acidic (pH 5.64)[iv]. But when the above-mentioned oxides are found in the air, the acidity can increase a lot. It seems that these rains are the cause of serious illnesses that many woods suffer in North America. Similarly, it is considered that one-half of the woods in Central Europe (Germany, Poland, Hungary) have already disappeared on account of this ecological aggression.

Acid rain does not have a direct effect on living beings, but it does so through their physical medium. Acid rains increase the acidity of the soil and waters of the interior such as rivers, ponds and lakes, rendering them uninhabitable for the species that live there. This acidification of soil and waters is notorious in some places and less so in others. On the other hand, it must be said that for soils that are very alkaline, acid rain can be a factor that improves fertility.

In fact, not always have accusations of the supposed effect of acid rain been well founded. In many cases of diseased woods, it has been verified that the rain in question was not abnormally acidic[v]. On the other hand, the correlation in some cases appears quite evident between the strong acidity of rains and fogs as a result of contamination and the negative effects on vegetation.

Whatever be the case, it is clear that industries produce a large quantity of contaminating emissions. Every year, a quantity of some hundred million tons of

sulphur dioxide is thrown into the atmosphere. This is a constant menace to the biosphere.

Finally, it is necessary to mention acid rains of natural origin. In certain tropical forest regions (such as the Ivory Coast, the Congo, the Amazons and Australia) rains have been found to have an average pH that is less than normal, around 5 points and with lower "tips" that reach as low as pH 3. This acidity proceeds from the intense bacterial activity of the soil: the degradation of organic matter carried out by bacteria produces sulphidric acid (H_2S), and oxides of sulphur and nitrogen. It is this source that is responsible for two-thirds of the acidity of tropical rain. The other third, surprisingly enough, proceeds from emissions of the vegetation itself that grows there: many of these tropical plants liberate substances (light hydro-carbides) that get oxidised when they come in contact with strong moisture and form organic acids (formic, acetic).

This casts doubt on whether the effect of atmospheric oxides is the only one that causes the disappearance of woods in developed countries. If tropical woods tolerate well acid rain, why has this to be so prejudicial for central European woods? For this reason it is necessary to look for other factors that can act on these forest masses. Studies carried out in Germany point out to chlorate solvents being the most important agent causing damage to woods. Scientists are also beginning to talk of the influence exercised by ozone and other factors and this influence will have to be discovered in the future.

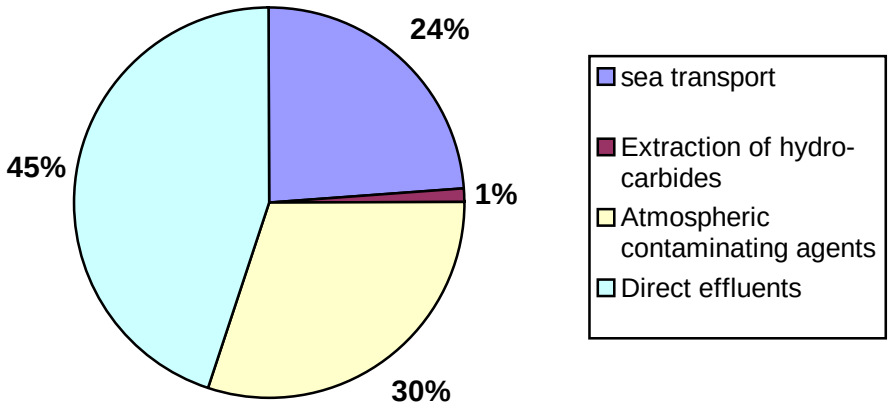
Another factor of vital importance is forest fires. Naturally not all forest fires are caused by human action but it is evident that human activity provokes a growing number of these fires. Fire is the woods' worst enemy because it strips the soil of the natural protection provided by the vegetation that grows in it. Trees and bushes prevent rains and winds from taking away the fertile layer of the soil. And so more than a direct destruction of current life, the gravity of forest fires lies more in the destruction of the conditions of terrestrial life, leaving the land to the mercy of erosion.

This is a very real problem in our country. In the decade of the eighties, Spain was the third country of the OCDE most affected by forest fires. An average of 230,000 hectares has been burnt down annually. Between 1990 and 1995, 1,214,054 hectares have been burnt, of which 46% were covered with trees[vi].

1.2 SEA

Contamination of seas

It is a well-known fact that the contamination of seas constitutes a real problem. This contamination owes its origin to the industrial activity of man, in the proportions indicated in the chart:



As we can see, one of the principal problems of marine ecology is the direct or indirect discharge (through rivers) of industrial wastes. The case of mercury (and of cadmium) is especially grave[vii], and for this reason a lot of legislation has been enacted to reduce drastically the emission of these substances into the seas. On the other hand, the effects of the intense "fertilisation" of the seas, due to the presence of agricultural fertilisers and organic animal and human remains, can seriously upset marine ecological balance. The increase of fertilising substances in seawaters produces the phenomenon of "eutrophisation" of seas, which consists in the massive growth of some species, as for example jellyfish and certain types of seaweed. The exaggerated growth of these species constitutes a serious imbalance. For example, "tides of seaweed" occurring in recent years on the Blue Coast, the northern Adriatic and the Danish coast, does not permit the passage of light and oxygenation of the lower waters, and thus brings about the deterioration of underwater fauna life.

A similar effect is caused by the emissions of hydro-carbides given out by oil tankers, either accidentally or by cleaning operations (illegal but not prosecuted) of tanker holds in open sea. Petrol contamination has multiple consequences. It prevents the passage of light and of oxygen reaching lower waters. It annihilates sea plankton. Besides, bigger animals ingest it mixed with their food. In this way, petrol has a toxic effect on practically all marine fauna and flora. Even sea birds are affected, since their source of food is found in superficial and coastal areas that are the most affected.

Finally, there is the contamination caused by the loss of fishing tools: fishing nets and strings sinking to the bottom act as deadly traps for marine fauna. It is thought that this causes the death each year of a million sea birds and more that a hundred thousand big animals (whales, sea lions...).

Finally, fishing on a world scale runs the great risk of causing a big collapse by extinction of species used for food. FAO has asked for fishing catches not to exceed annually 100 million tons, a figure that was exceeded by 20% in the year 1990. International norms have tried to control this danger, but all the same we are moving towards the limit of a process of progressive extinction.

Sweet waters

It is really not necessary to mention the importance the presence of sweet water has for making vegetable and animal life possible on the continent. In fact, the rainfall (more than 500 mm annually) that the earth receives on an average, is sufficient for life. But the distribution of these rains is terribly unequal: one needs only to look at the differences within the Iberian Peninsula! And we have to remember that sweet water on the continent comes from rains. Because in the ultimate analysis, subterranean waters too, come from there. For this reason, utilising subterranean waters in areas of little rainfall cannot be considered a normal long-term resort.

We run into two ecological problems with sweet water: scarcity and contamination. Regarding the latter, it is evident how grave contamination of water can be because of industrial and domestic effluents as also on account of filtration of agricultural fertilisers (especially nitrogenates).

With respect to water scarcity, it is necessary to point out the spectacular growth of water consumption, which has multiplied itself by four in the last half-century. This has got a lot to do with population growth on the planet but even more with industrialisation. So, for example, whereas in North America more than 2,000 cubic metres are consumed annually per inhabitant, in Guinea-Bissau annual consumption per inhabitant is 20 cubic metres, a hundred times less.

It is not only a question of scarcity, but also of equality and justice. One must remember that, according to the data of the PNUD report 1998, 43% of the population of less-developed and 29% of developing countries do not have access to drinking water: this means to say, 1,500 million people. One should not be surprised then that this is one of the principal factors for the low life expectancy in these regions.

Finally, on account of population growth and desirable development perspectives, human consumption of water will increase over the next decades. It is necessary, therefore, to find new ways of getting and regulating, saving and re-cycling water to meet these needs.

1.3 AIR

Greenhouse effect and climatic change

Probably we have had the opportunity of seeing how a greenhouse works. Within its glass or plastic walls, the temperature is a few degrees higher than that of the outside air.

The physical principle that greenhouses work on is very simple. What occurs is: their walls (glass or plastic) allow *only a part of the radiations* that reach them to pass through. To be more specific, they permit radiations of relatively short-length waves (more energetic) such as light waves to pass through. On the other hand, they prevent the passing through of other radiations of longer wavelengths such as infrared rays. These latter are heat rays, invisible to the human eye. If we put our hand in front of a

heater that has been turned on, we will note a warmth that reaches us directly from the apparatus: it is the effect of the infra-red radiation that it emits.

A greenhouse is none other than a closed space with glass walls. The rays of light coming from the sun enter the closed space. As light is also a form of energy, it heats up the interior of the greenhouse: the soil, the plants, and the objects that are in it. On getting heated up, these objects in turn radiate energy; but instead of radiating it in the form of light rays, they do so in the form of infrared ones. These rays cannot pass through the walls of the greenhouse, and so they remain inside, warming another time the surroundings. The greenhouse, therefore, functions like a sort of heat-trap, a place where more energy enters than leaves. For this reason, its temperature is higher than that of the surrounding air.

Well, our whole planet is like an immense greenhouse. The transparent "wall" of this greenhouse is the atmosphere. The atmosphere functions in a fashion very much the same as the glass of a greenhouse: this is why we speak of the "greenhouse effect".

Solar energy that our planet receives reaches us in the form of radiations: 48% infrared, 43% visible and 9% ultra-violet. This energy is partly reflected off by the atmosphere, and of the remaining energy one part is absorbed by the gases of the atmosphere and the other part reaches the earth's surface. At the same time, the surface of the planet emits radiation one part of which escapes to outer space, while another part is absorbed by the atmosphere or reflected again to the terrestrial surface

These fluxes of energy are stable: they form a "dynamic balance" in which the total energy received by the planet from space (from the sun, especially) is equal to the total energy emitted by the planet (between that reflected to the atmosphere and that which from the surface of the earth passes through the atmosphere).

This greenhouse effect is produced by certain gases, present in the atmosphere, capable of absorbing radiation and transforming it into heat. These gases form a sort of "thermal cushion" which permits our planet to have a temperature superior to that of the space which surrounds it. We are talking here of a natural and necessary phenomenon which has permitted the existence of a very diversified life on our planet earth. Without it, in the midst of the cold of interplanetary space, the average temperature of the planet would be some –18º instead of the 15º that we currently enjoy. The main gases that cause this greenhouse effect are:

a) "natural": water vapour, carbon dioxide (CO_2) methane (CH_4), oxides of nitrogen (Nox) and ozone (O_3).
b) "artificial": chlorine – fluorine – carbonates (CFC).

The importance of the contribution of each one of these gases to the increase of temperature on the planet, is reflected in the following table:

Gas[viii]	Current concentration	Contribution to average temperature increase (%)	Contribution to average temperature increase (º)
Water vapour	0-4%	62.4	20.6
CO_2	366 ppm (0.0355%)	21.8	7.2

Tropospheric O_3	0.03 ppm	7.27	2.4
N_2O	0.3 ppm	4.24	1.4
CH_4	1.7 ppm	2.42	0.8
Others	Approx. 2 ppm	1.82	0.6

Up to here, as one can see, there is no problem. The problem arises when the concentration of gases of the greenhouse effect increases in the atmosphere on account of human activity as from the Industrial Revolution. The increase of carbon dioxide (CO_2) in the atmosphere is of special significance.

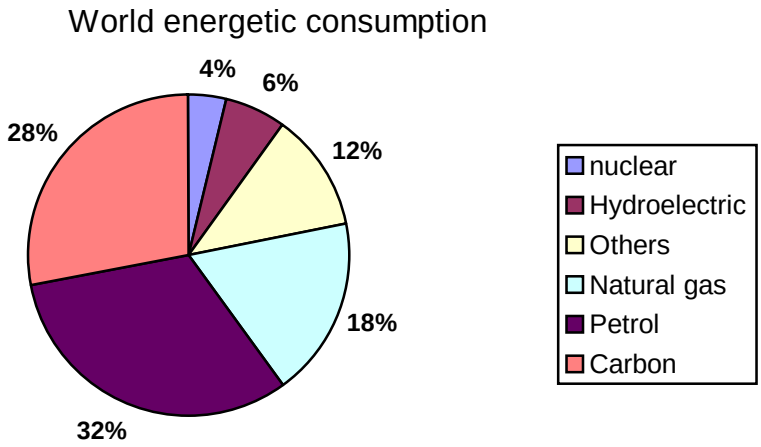
This gas, as is well known, is let off in the majority of combustion processes. And the human race, in the last 100 years, has increased in spectacular fashion the quantity of burnt fuel. Let us think of the difference that can exist between our modern life (central heating, thermal power centres, automobiles, trains, planes, and ships with diesel engines...) and that of not too many years ago (with one fireplace per family).

The global consumption of energy can reach the following figures:

- year 1900: $5.8 \cdot 10^{12}$ Kwh.,
- year 1995: $103 \cdot 10^{12}$ Kwh. (an increase of more than 17 times)[ix]

With the aggravating circumstance that the population has "only" trebled in this period of time, and with another aggravating circumstance that 70% of this energetic consumption is produced in developed countries (which is just 20% of the population of the planet).

Up to the Industrial Revolution, energy was obtained from renewable sources: from the sun and from its derivatives (animal metabolical energy, eolic, hydraulic), and on a small scale from the combustion of renewable fuels (timber and peat). Today, with a much greater expenditure of energy, 78% of the energy comes from fossil fuels.



Currently, it is believed that the quantity of CO_2 emitted on account of world energetic production is some 24,000 million tons (which represents less that 1% of atmospheric CO_2, which, as we have seen, has relatively low concentrations among the atmospheric gases). That is to say, the *quantity* of CO_2 produced by human activity is relatively small.

What we must look into is up to what point the increase of these concentrations *on account of human activity* will have an influence in the increase of temperature and the corresponding change in climate. Two of the main gases of the greenhouse effect are carbon dioxide (CO_2) and methane (CH_4). They are important because man plays a significant role in the abundant production of these two carbon gases (the concentration of CO_2 increased by 25% in the last century).

Carbon "circulates" in our planet following a wide and complex cycle, ranging from the atmosphere, the rocks and sea, passing through the "bio-mass" (living matter).

This "carbon cycle" has its own self-control mechanisms. It seems evident that human action increases the concentration of atmospheric carbon (CO_2 and CH_4). This, in principle, constitutes a change in the carbon cycle. But what effect will this have in the long term? If the temperature of the planet were to rise as a result of increased concentration of CO_2 and CH_4, it seems that this too will increase the natural production of these same gases (the maritime emission of CO_2 and CH_4 to the humid ecosystems). However, this too could be offset by the increase of marine phyto-plankton and of green plants in general, which absorb CO_2. What would be the final balance? The answer is quite difficult really.

And it is even more difficult to know how it will affect the climate. Because in this we have another very important element playing its role: water.

We have said that water vapour is one of the main factors responsible for the greenhouse effect. The presence, however, of water vapour in the atmosphere has a double contradictory effect: on the one hand it is a powerful greenhouse-effect gas, with a great capacity for accumulating heat; on the other hand, it is one of the elements responsible for reflecting solar radiation. If on account of an increase in the temperature of the planet, the concentration of water vapour were to increase, this would probably entail a diminution of the absorption of solar energy on the planet and an increase in the capacity of retention of this heat. Which of the two tendencies would predominate? It is not easy to respond to this either.

Our knowledge of the climatic situation of the planet leaves several questions unanswered. However, the major part of the studies regarding climate that have been carried out with mathematical models of simulation, coincide with the diagnosis of an inevitable climatic change resulting in a global temperature increase on the planet. The IPCC (International Panel on Climatic Change) a scientific group commissioned by the United Nations to investigate this question, submitted their report at the Conference on Climatic Change in Kyoto (December 1997), and drew the conclusion that the climate of the planet was indeed changing, and that one of the most probable factors of this change was human action.

According to predictions of this type, the temperature of the planet will increase between 1 and 3.5ºC in the next century. This would imply a rising of sea levels between 15 and 95 cm. As a consequence, the "climatic zones" would be displaced from 150 to 550 km towards the poles in the temperate zones. Countries like Canada, Chile or Argentina would benefit from a warmer climate; but, for example, the agricultural plains of the USA would face problems of dryness. On the other hand, coastal regions and small islands would have the sea entering their homes. Finally, it would seem that a climatic change would favour extreme natural phenomena, often of a catastrophic nature.

Whatever be the case, it is considered that the emissions of greenhouse-effect gases should be reduced by at least 50% with respect to the 1990 levels. Protocol in Kyoto proposed a global reduction of 5.2% with respect to the same level in developed countries. If this were to come into effect, it would be a step forward, if we take into account that if nothing is done, it is estimated that by the year 2010 the level will have risen by 20 to 30%.

The ozone layer

All of us have heard of the "hole in the ozone layer". But very often, the man-in-the-street does not know exactly what it involves. It is convenient, therefore, to begin speaking of the ozone cycle in the atmosphere and its relation to the radiations, which come to us from space.

Stratospheric ozone (from areas higher than the atmosphere) proceeds from the oxygen which was produced by vegetable life of the planet (3,500 million years ago) and which has gone on spreading towards the higher layers of the atmosphere. Ozone is formed following the following cycle of chemical reactions:
O_2 + UV rays (100 – 200 nm) → 2 O (very unstable)
3 O → O_3
2 O_3 + UV rays (200-310 nm) → 3 O_2

Oxygen molecules (O_2), break up under the action of ultraviolet rays, giving way to free oxygen atoms (O). These atoms unite, forming ozone molecules (O_3). In turn these ozone molecules, under the impact of ultraviolet rays, get decomposed to form again molecules of oxygen. It must be remembered that the radiation, which our planet receives, proceeding from the sun, can be divided into different types of rays. In descending order of energy, they would be:

Type of ray	Wave length
Cosmic rays	
Gamma rays	
X-rays	
"Hard" ultraviolet rays (UV-C)	130-280 nm[x]
"Medium" Ultraviolet rays (UV-B)	280-320 nm
"Soft" Ultraviolet rays (UV-A)	320-380 nm
Visible light rays	400-800 nm
Infrared rays	800... nm

Of these rays, the first three (the most energetic, and consequently, the most "destructive") are quickly absorbed by the atmosphere. UV-C rays do not pass through the layer of ozone: it would require the destruction of more than 90% of ozone for one part of these rays to reach the earth. On the other hand, UV-B rays depend very much on the quantity of ozone that exists in the air to be able to reach or no the surface of the earth. The remaining types of radiation reach the earth without any difficulty. This is because strong radiations (100-300 nm) get "consumed" in the "ozone cycle" which we have just seen.

Having said this, we can calibrate the importance of stratospheric ozone: it protects us from UV rays of high and medium energy. If ozone in the higher layers of the atmosphere were to disappear, we would be stripped of our protection against these rays. This would have an incidence in different areas. For example, an increase could be foreseen of skin[xi] and cataract cancers as also malfunctioning in the immunity system of the human body. In the same way, large quantities of vegetable species would register a reduced growth due to the effect of UV-B rays. These rays are also harmful to plankton, which is the nutritional base of sea life. There would also be repercussions with regard to atmospheric contamination: there would be an increase in the concentration of some reactive substances in the air (acids, hydrogen peroxide and ozone[xii]). UV rays, finally, bring about the degradation of some materials, such as wood, plastic coverings and rubbers.

The Antarctic hole in the ozone layer was detected for the first time in the year 1982 by the Japanese scientist Shigeru Chubachi at the Japanese base of Syowa. Studies on the Antarctic ozone layer began with the installation of the first measuring apparatus on the British base in the Antarctic (1957), followed by another apparatus situated on the same South Pole (1961), and still another of the Japanese base (1967). In addition, satellite *Nimbus-7* has been collecting data since 1978.

The "ozone hole" is a periodical diminution of the concentration of ozone over the Antarctic. In the months of October and November (the Antarctic spring), the values of this concentration suffer a diminution of around 20%. This transitory diminution is repeated every year.

Among the factors that seem to cause this effect, there are three that stand out:

a) The dynamics of the circulation of winds in the Antarctic, which explain why this phenomenon is produced precisely in the Antarctic and only in spring. This does not exclude the possibility that a reduction in the quantity of oxygen is also produced in other places.
b) The irregularity of solar activity. The sun goes through some sort of "cycles" in the course of which, its activity oscillates, rising and descending in cyclical fashion. The main cycle lasts 11 years. When solar activity is strong, ozone concentration increases, whereas when solar activity is low, ozone concentration decreases. And so, every eleven years, there are five or six of "fat cows" and five or six of "lean ones" where ozone is concerned.
c) Finally, the action of some gases, among which the CFC's stand out. We are talking here of gases produced by human industry and which reach the high layers of the atmosphere. Although they do not reach in large quantities, the

long life of these contaminating gases and their destructive action on ozone, make their effect felt as we see in the following table[xiii]:

Gas	Formula	Average life in the atmosphere (years approximately)	Destructive capacity compared	Rate of annual increase (%)
CFC11	$CFCl_3$	70	1	4
CFC12	CF_2Cl_2	135	1	4
CFC113	$C_2F_3Cl_3$	90	0.8	10
Tetrachloride C	CCl_4	60	1.06	1.5
Methylchloroform	CH_3CCl_3	8	0.1	4
Derivatives of Hydro-carbides 1301	CF_3Br	105	11.4	15
Derivatives of Hydro-carbides 1211	CF_2BrCl	20	2.7	12

In successive international treaties (Treaty of Vienna, 1985; Protocol of Montreal, 1987) efforts have been made to eliminate the production of CFC's before the year 2000 and, without a fixed date, the production too of derivatives of hydro-carbides and other gases dangerous to the ozone layer.

The destructive effect of these gases is caused by their supposed disintegration, which sets free atoms of chlorine. This element is what affects the cycle of ozone. We are, nonetheless, talking here of very stable molecules, that break up only under conditions of extreme pressure and temperature and under the intense effect of ultraviolet rays: conditions that are only obtained in the highest layers of the atmosphere. And so, in the Antarctic the quantities of chlorine measured there are 100 to 1000 times greater than those measured in other places.

On the other hand, it must be said that the phenomenon of the destruction of stratospheric ozone is not limited to the Antarctic region alone, although it is in this place where it is most evident. In fact, there are significant diminutions during the months of spring-summer in the middle latitudes of both hemispheres. So, it would seem we have to carry on the battle against atmospheric contaminants.

1.4 CONCLUSION

None of these analyses gives evidence that a "global ecological crisis" is being produced. But they do speak of an accumulation of signs. And where life is concerned, man is not ruled by mathematical exactitudes but by "moral estimates".

Imagine the parents of a child who offers not the certainty but some symptoms that could suggest a mortal illness. Would they remain calm waiting for an absolute certainty? Could it be that when they finally have this certainty, it would be too late to act?

We have to remain alert and begin to look right away for ways of solution.

2. WAYS OF SOLUTION

"The fact that we look now towards ecology does not denote anything more than a certain dissatisfaction, not a decided will to change our lifestyles; not – as it should be – a substantial change in the creation and utilisation of energy, a change in agriculture, commerce and in the policy of aid for development (not even a change of direction that this aid should take). It is for this reason that I often wonder if ecology is not just a pretext for distracting restless heads, young people who are ignorant of the real policies involved, reminding one of a panel that is placed to hide something that will blow up the house and only benefits those who have put it there" /Antonio Gala)[xiv]

To confront the problem that we have just described, there has been a whole collective effort, which has tried to find ways out. Let us see some of the key questions of this effort that can help us in our reflection.

2.1. From nonviable development to sustainable development

In the year 1987, a "World Commission for Environment and Development" published a document entitled "Our Common Future", commonly known as the "Brundtland Report". In this document the need to work in the direction of a "sustainable development" has been put forward. From that time onwards this expression has become part of the topics shared in circles involved in international co-operation. In fact, the proposal for "sustainable development", as its very name suggests, is an attempt to face in an integrated way a twofold challenge to humanity: on the one hand, the state of poverty in which the great majority of the population of our planet lives in; and on the other hand, the challenges posed by the environmental problems that we have spoken about in the preceding paragraphs.

We live in a world that is deeply marked by the existence of massive poverty. The alarming figures of successive reports of the PNUD leave no room for doubt. Basic humanitarian feeling calls for the need to work to eliminate this situation. In fact, after the Second World War, a new stage in our history was entered upon, in which the economic distance between the countries of the north and the south was understood as a summons for "development". The richer countries, it was thought, should help the poorer countries to raise their living standards: the objective was a certain equality. That way, poverty in the world was understood as a situation of lack of "development", as a sort of "historical lagging behind" of some countries in their way towards the attainment of economic prosperity, represented paradigmatically by Western Europe and the USA.

So, the fight against poverty was converted into a fight for "development" of the countries in which poverty was prevalent on a large scale. The idea then was to "make the economies of poorer countries grow", while helping them to increase *quantitatively* their capacity of production and consumption.

Well, in the eighties it became quite evident that economic development of the whole of humanity, according to the models of European and North American industrialisation *is just not viable.* Studies on ecology, levels of contamination and the rate of extraction of non-renewable natural resources, show us that it is not possible for the human race to live at the same rate of consumption as Europeans of today, considering that its numbers in the coming century will surpass 9,000 million inhabitants.

If we imagine 6,000 million inhabitants, as we are now, producing (and consuming) in the quantities and manner as we do in the "developed" world, we can say without excessive fear of making a mistake that in a question of a few years, the economic system would collapse for want of natural resources. Besides, contamination levels would shoot up in too dramatic a way. We would leave a heavily mortgaged world to future generations. Or, looking at it in another way, if we wish our grandchildren to find resources on the planet by which they could continue with a similar lifestyle to ours, then it would seem that a good part of humanity will have to carry on living in poverty similar to that prevalent in current times. In the last analysis, we are desiring three things that are incompatible: a lifestyle similar to that of rich countries; this extended to the whole of humanity; and this situation should be maintained, in principle, indefinitely from generation to generation.

Perhaps some might think that this is an exaggeration, typical of "calamity-predicting prophets". Well, we have not to allow ourselves to be carried away by the lack of confidence in humanity's capacity of reaction, which will lead them on to going on finding solutions to all these problems. However, it is necessary to make some serious reflections. When talk is heard of an "ecological collapse", or a situation that endangers human life on the planet, perhaps we imagine a sort of "nuclear disaster" as if our planet had to explode, or as if we were suddenly reduced to an inhospitable desert in the way some science-fiction films have shown us. This, surely, is not realistic. We should rather think that if our world were to reach an extreme point in respect to the conditions of human life, this would not manifest itself as a sort of "global catastrophe" but rather as the death, in the first place, of the more feeble segments of our own human society. *It is the fate of the more feeble that would indicate to us if we are or not in an extreme situation.*

Looking at it in this way, it would not sound so strange when we talk of an ecological collapse or of humanity reaching the limits of its viability. At least if we view the situation of millions of men and women of our world.

In any case, what we are faced with now is *the necessity of looking for new models of production and consumption, which would be viable for everybody, now and in the future.* This would be, in principle, the proposal of the Brundtland Report, which defines sustainable development as "development, which satisfies the needs of the present generation without compromising the capacity of future generations to satisfy

their needs". So, what is being put at stake is, as it is termed, "intergenerational solidarity".

International institutions have accepted this proposal, at least in their official discourse. In the documents approved in the last World Conferences summoned by the United Nations, demands have repeatedly been made for progress along the lines of sustainable development[xv]

2.2. Internalising ecological costs

This is about fighting against an economy that does not take into account important ecological factors such as the using up completely of certain natural resources, or the contamination of air and water. These factors, which are considered "external" to badly understood business economy, are termed "externalities" Natural resources and environment do not form part of the economy, according to classic economic theories. Seen from another point of view, this is equivalent to accepting the supposition (although not openly admitted) that natural resources and the environment are unlimited. As far as the economy is concerned, it is said, the environment can receive contamination without going bad; and the extraction of resources does not entail a loss of "natural capital" but a "production" of wealth[xvi].

For example, let us suppose we have a factory of chemical products installed in a European country. And let us suppose, in the worst of cases, that the legislation for the environment is very permissive, so much so that it does not control contaminating emissions (smoke let out into the air, water heated up and contaminated with chemical products thrown into the river). This factory produces, for example, paint dissolvents, and can sell these at "p" price in the above-mentioned production conditions.

In this case, neither the water of the river nor the air contaminated by the effluents of the factory has affected the price of the product. They are factors "external" to the economic process *because they have no value in terms of money*.

Well, let us imagine now that the government of the country passes legislation which charges an "environmental tax", with a value proportional to the quantity of contaminating material emitted. Automatically production costs will increase by a certain amount. Production of the dissolvent will now be price "p+p1". The action of letting out contaminants in the river before did not entail any production cost; now, however, it does carry a monetary cost on production. Thus, pollution, which before was considered external, is now "internalised" in the economy of the production process.

If the government acts in a coherent way and allots the money got from this tax for the depuration of water and air, then, in addition to having internalised the environmental cost, it will have obtained a clean production, which does not destroy the environment.

This is the case with "eco-taxes", which have been tried out with success. In Sweden, between 1980 and 1995, the government with a tax policy was able to reduce

substantially the emissions of sulphur oxide (that cause acid rain) and eliminate totally petrol with lead. Denmark, Norway and Germany are other cases in point. Paradigmatic too is the case of Malaysia, where a law in 1974 made it obligatory for factories to pay a quota for effluents cast into public waters. The result was a spectacular diminution in contaminating effluents (from 222 to 5 tons daily between 1978 and 1984) proceeding from the production of palm oil, despite the fact that production of this item tripled in that period[xvii].

But returning to our example, we can still go one step further. If the government were to prohibit in a categorical way all types of contaminating spills, the factory of dissolvents would have to install filters, water treatment plants and a process of contaminant elimination. All this would imply a cost that would have its repercussion on the final price of the product. We would then have a price "p+p2". With this we would be able to maintain a clean environment.

Perhaps some would say that this increase "p2" is a price that is possibly too high, that the "luxury" of conserving in tact the environment is turning out excessively expensive. One would evidently have to debate this point: to see if this is really a "luxury" or we are reaching a point when this is becoming a real necessity. But, it is necessary to say that when we do not take into consideration this prohibition requiring factories not to contaminate, we are putting *a price* to production that is *irresponsibly low*. Because "saving us the expense" of maintaining the environment clean, is not saving but an act of irresponsibility. In fact, the production of dissolvents has a *real* environmental *cost*. In the first case of our example, it is not really that the cost of production (and the price) is lower but simply that part of the real cost of production is not considered a cost as such since it has been "externalised". In the first case, it is sold at a price "p", which is lower than the real production cost. And we are deceiving ourselves here. We are hiding our head under our wing so as not to see reality.

The way of acting, then, of many companies is very irresponsible when, faced with the obligation of incorporating environmental costs to that of production react by moving their factories to countries of the south. In doing so, they create unemployment in their country of origin, and ecological destruction in the country that receives the contaminating factory. All this is done to maximise private economic profits.

2.3. Sustainable development?

The previous example is valid for the case of evitable contamination by technical means. But it is much more difficult to apply it to other cases as happens with natural non-renewable resources, or the loss of bio-diversity. We can avoid contamination of rivers; we only need to construct water treatment plants. But we cannot run our automobiles and thermal power stations without reducing our petrol reserves. There are, therefore, some natural goods for which we must place a reasonable price.

With respect to non-renewable resources, a reasonable principle could be that of "technological renovation", which would consist in saying that the tax of diminution of

a natural non-renewable resource should be inferior or equal to the "tax of technological renovation" which would permit us to do without this natural resource in the future. So, as one can see, it is very difficult to carry this out in practice in a very precise way. Because this "tax of technological renovation " is not something which can be measured a priori. Here decisions of a political nature would have to be made, which in turn would require previous work of a cultural nature. In any case, the principle of "technological renovation" could be used as a point of orientation for reflections and evaluations revolving around this topic.

As for problems of "irreversible changes" in nature, as is the loss of bio-diversity, desertisation or climatic change, we must say that our ignorance is still very great. We do not have the scientific capacity, which could permit us to foretell what the world will be after these changes. However, I think that two principles are valid: firstly, one must have confidence in the possibilities of our planet and of humanity to find satisfactory solutions; and secondly, that we must avoid useless or less useful destructions.

Finally, it is necessary to say that there are those who are of the opinion that the problem is more global and profound than all this, up to the point that we should consider that the very expression "sustainable economic growth" is self-contradictory. Indefinite economic growth, it is said, is a dangerous illusion. Reality is finite, and one should not dream of an infinite growth. *Reality with the resources it has does not offer so much as this. Besides, indefinite growth guarantees neither growth in humanitarianism nor in happiness.*

According to this, the capitalist economic system works precisely on the supposition (unreal) of this indefinite growth. We keep on producing more wealth and in this way we maintain the economy alive. This is reflected in the search of ever widening markets for products produced by industrialised countries and in the creation of "new necessities" (everything becoming necessary what before was convenient, and convenient what before was superfluous). The productive system should be like a locomotive that has to run always in fast gear, constantly increasing its speed.

It is necessary to re-think our whole system of production and consumption, not merely as a "technical correction" to eliminate certain undesirable effects but in a radical way. It is a question of changing the assumptions of our economy. In this direction we are offered as an alternative paradigm the way of life of some rural societies which are truly sustainable models of production and consumption... but which are totally alien to the idea of "economic growth".

This is the point most debated upon within the ideological world of ecologisms: between the "radicals" and "reformists". The future alone will tell us what will have to be done. However, it is up to us, meanwhile, not to remain idle.

2.4. The attempt to pass the "ecological invoice" on to the poor or two fallacies that must be avoided

At the international meetings that have taken place in the last few years, an effort has been made to negotiate common actions to face up to environmental

problems. Among the points that were placed on the table of discussions, two need special mention as they deal with North-South relations. They deal with the correlation between ecology and population, and ecology and poverty. These correlations are used sometimes to pass the "ecological invoice" on to the countries of the South. It is said that overpopulation and poverty are the causes of environmental deterioration. One tries to make the responsibility for ecological problems fall on the countries with a higher index of poverty or a higher index of demographic growth. It is important that we examine, even if briefly, these two aspects of the ecological question.

a) Ecology and over-population

In this first case, it is affirmed that one of the causes of environmental degradation is over-population. "Demographic pressure" exerted over the environment is a cause of ecological problems. A population that increases in a big way involves an over-exploitation of the environment in which we live.

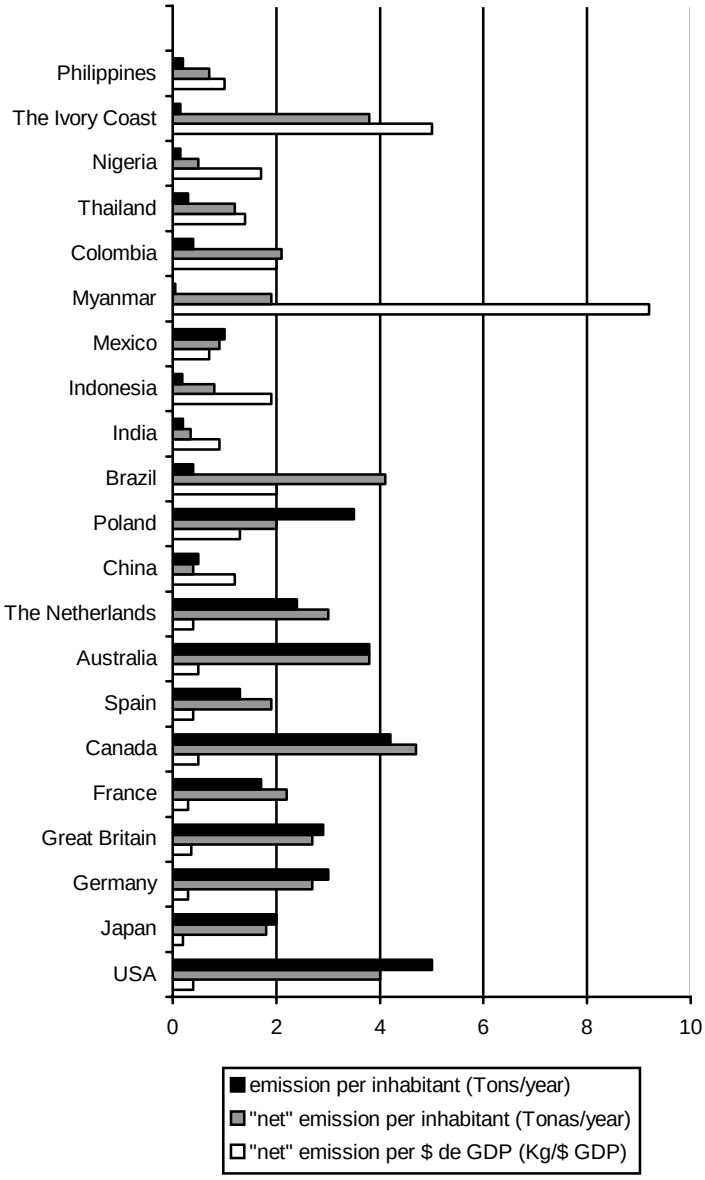
This is true in certain places, as some areas in Africa with a climate very close to desertisation, and which see how their scanty vegetation is destroyed by cattle and firewood collection. It is also true that in some other points of the planet: in Guatemala, for instance, in many virgin lands vast forests have been cut down to give way to agriculture.

But all this is often no more than just an appearance. The question, if we want to examine it coldly, is: Is there an objective correlation between "over-population" and "destruction of the environment"?

To reply to this question, one must first define what is understood by "over-population". If by "over-population" we understand the fact that a country exceeds its capacity to feed its own population, we would come to the absurd conclusion that Holland is depopulated (with a density of 1,044 inhabitants per square mile) while Sudan (with 27 inhabitants per square mile, 38 times less!) is over-populated. In point of fact, it is the lack of adequate technology, which produces "over-population". In Sudan no destruction of the environment would occur from the collection of firewood, if its population were to dispose of, for example, a supply of fuel which today it has no access to. Let us not forget that for the poor, it is more necessary to satisfy their hunger of today than to save the environment of tomorrow. No one can rightly demand that they act differently.

The facts, on the other hand, indicate that there is no correlation between overpopulation and environmental problems. The example of Guatemala, that we have just cited, is understood differently if we consider that 2% of the owners possess two-thirds of cultivatable land. It is logical then that the other farmers need to look out for new lands. But is this a problem of overpopulation? Or rather of distribution?

Another example. Paraguay, one of the countries with the lowest population density of America, is one which has the highest rate of deforestation. Similarly, Argentina and Uruguay, also with low-density population, have problems of land salinisation and erosion. In the same way, the destruction of the Amazon forest in



Brazil stems not so much from population increase as from an attempt to avoid a necessary agrarian reform while pushing forward the colonisation of the forest.

One cannot say, therefore, that population growth is the cause of environmental degradation. One must rather talk of a collusion of technological, social, political and economic factors.

b) Ecology and poverty

The second question, related to the previous one, would be the correlation that has been established between poverty and ecological destruction. This was quite evident in the discussions on reduction of greenhouse-effect gases. It is clear, in this case, that if the emissions of carbon dioxide (CO2) per inhabitant were to be measured, industrialised countries are those that contaminate most. Canada and the USA exceed 4 tons per year per inhabitant; Germany, The United Kingdom, the Netherlands, Australia and Poland exceed 2 tons. The countries of the south are well below 1 ton of carbon dioxide per inhabitant per year. This is what is reflected in the table.

Well, in a report written by World Resources Institute and which was used at the Conference of Rio, the emission of carbon in the atmosphere was made equivalent to deforestation. Losing area covered by woods, it was said, was equivalent to losing the capacity to absorb CO2, and, thus, was equivalent to contaminating. At the conference they calculated a value termed “clean carbon emissions” which was the result of adding the quantity of carbon thrown into the atmosphere plus the deforested area (in its equivalent value of absorption of atmospheric carbon). The result is that Brazil (which emits much less than a ton of carbon per year per inhabitant, but on the other hand, has a high rate of deforestation) appears as equally or more contaminating than the USA! “Do you see – they said – how the poor, in point of fact, contaminate in the same or a greater degree than the rich?

But there is still another argument, which one must show is not true. The same report measures these "clean carbon emissions" per "dollar of GDP". That is to say, the quantity of "contamination" is measured which is created to produce one dollar of wealth in each country. In this way, it turns out that poor countries are much more contaminating than rich ones. It is as if one were to say: "rich countries contaminate more than poor ones, but that is because they produce much more wealth than poor countries. Considering the quantity of wealth produced, it turns out that rich countries really contaminate less. Poor countries, on the other hand, contaminate less but they hardly produce anything. So, in fact, to produce whatever they do, they are contaminating more than rich countries". To sum up, wealth is produced in rich countries in a much "cleaner" and "ecological" way than in countries of the south.

But this is also misleading[xviii]. Because in these calculations, what is done is simply dividing "total clean emissions" of carbon of a country by its GDP (that is to say, the quantity of wealth produced in that country). In this way, they are equating *any type of wealth* produced. Obviously in rich countries much more wealth is produced than in poor countries. But in rich countries much superfluous wealth is produced, while in poor countries what is produced is almost exclusively what is strictly necessary for survival (or living a life of very simple quality!). Should one evaluate with the same yardstick the production of goods of prime necessity with production of luxury goods? Considering it covers a much greater human need, should a dollar of rice in Thailand not have a much greater value than a dollar of perfume in Paris?

Summarising, if we wish to examine things with certain equity, we cannot escape from the fact that it is we, the rich countries, that contaminate more. And further, we contaminate in good measure simply to produce a type of wealth that is scandalously superfluous, if we look at how the majority of human beings live. This is said not with the intention of creating a bad conscience that serves no useful purpose, but in order to show in which direction it is necessary to direct our steps ... and this direction is certainly not that of making the more feeble countries pay the price of the ecological degradation that is being committed!

2.5. The challenge of the earth...a call to responsibility

We have cast a quick glance on what we might call an "ecological challenge" for the year 2000. The panorama is interesting. The human race is making an approach for the first time, in a global way, to the need of taking care of nature. In this way, we will respond to that first cry that the Scriptures placed on the lips of God, before the first man who had just come out of His hands. God took him and left him in a garden, which he should cultivate and look after (Gen. 2,15). Perhaps never before as today have we the opportunity so clearly before us to listen to that first commandment: a commandment which as all other things in the Bible, is sound advice from a loving Father.

We will see then in the near future, how we will keep finding a way of life through the challenges of history. We will see how we will learn to organise collectively a way of working without having to pillage, of consuming without having to plunder. Doing so, we will probably discover ways of living in a more human fashion. The "ecological crisis", then, is an occasion to advance. It is also an occasion to show solidarity, because it is a problem of everybody: nature knows no political, racial or religious frontiers. It is a challenge that the earth throws out to us. Will we know how to receive the challenge and turn it into an opportunity?

For this to be made possible, it is necessary to make an appeal for responsibility. Modernity has to learn to switch over from its "worship of man" to a more modest vision of man as a steward or administrator of a land that is not his. He is not the absolute lord, only a guardian of the land. This is what the challenge is really about.

This "change of paradigm" implies the acceptance of the human being not as the only instance (and for a believer, not even the *last* instance, as is shown in the text of Gn 2). He is, rather, nature's "Big Brother" and as such, responsible for taking care of her and called to being in communion with her. With "our sister, mother Earth", as St Francis of Assisi would say.

Will we, human beings, know how to measure up responsibly to this challenge? Or will we prefer to look the other way and ignore the whole lot of warning symptoms, exclaiming in the words attributed to one of the great tyrants of history: "after me, the deluge!"?

NOTES

[i] Taken from *Pobreza, desarrollo y medio ambiente,* col. Intermón 1, Deriva, Barcelona 1992; pl. 15

[ii] Taken from DREGNE, H.e., *Desertification of arid lands, a Physics of desertification,* F. El-Baz and M.H.A. Hassan, Dordrecht, The Netherlands: Martinus, Nijhoff 1986.

[iii] Cf. WILSON, E.O. (ed.) *The current state of biological diversity, a Biodiversity,* National Academy Press, Washington DC 1988, 3-18.

[iv] The symbol pH measures the acidity of an aqueous solution. Maximal acidity is pH 0 while pH 7 is that of a "neutral" liquid like distilled water. A pH greater than 7 up to a maximum of 14, corresponds to an "antiacid" liquid or alkali.

[v] This is what happened to the woods of Maestrat (Teruel), that were supposedly damaged on account of the contamination proceeding from the thermal power station of Andorra (Teruel). Later, it was verified that the rain that this wood received was not only not abnormally acidic but was even alkaline. A similar situation was had in some areas of Germany, where after some serious studies, acid rain as the cause for the pathology of those damaged woods was discarded as not valid.

[vi] Cf. J.M. DELGADO PÉREZ, *La erosión del suelo en España: efectos de los incendios forestales,*in Documentación Social, 102, Madrid Jan.-March 1996, 83-96.

[vii] Between 1952 and 1970 at least 400 persons died in Minamata (Japan) and some thousands were affected with serious cerebral sequels, on account of mercury being absorbed by marine fauna in the region. The mercury came from a nearby chemical factory.

[viii] From TAPIA-TOHARIA, *Medio Ambiente, ¿alerta verde?,* Acento Editorial, Madrid 1995, pl.61.

[ix] Kwh is a unit used to measure energy. To get some sort of an idea of how much a Kwh is, imagine a not very powerful electric radiator. It would be the energy consumed by this apparatus working one hour.

[x] Nm (nanometre is one thousand-millionth of a metre).

[xi] "A 10% sustained reduction of ozone would produce a 26% increase in non-melanin skin cancer", which would mean 300,000 cases a year in the whole world. TOLBA et al., *The world environment 1972-1992.* Chapman and Hall, NewYork 1992.

[xii] Ozone which is so useful when it is present in the high layers of the atmosphere (stratosphere), is very contaminating when present in the low layers (troposphere) .

[xiii] Data taken from TAPIA-TOHARIA, *Medio ambiente, ¿alerta verde?,* Acento Editorial, Madrid 1995, pl.82; and from TOLBA et al., *The world environment 1972-1992*,Chapman and Hall, New York 1992.

[xiv] Taken from *Pobreza, desarrollo y medio ambiente* ,col. Intermón I, Deriva, Barcelona 1992; pl.1516.

[xv] *Declaración y programa de acción de la Cumbre Mundial sobre Desarrollo Social*, Copenhagen, 1995, n.26,b; *Conferencia Internacional sobrePoblación y Desarrollo*, Cairo, 1994, Chap.II, Principle 6: Chap.III, 3.28.b and 3.29.d.

[xvi] One can find a focus on economy which takes this question very much into consideration in J.M. NAREDO, *La economía en evolución,* Madrid 1996 (2ª).

[xvii] Cf. PNUD, *Informe sobre el desenvolupament humà 1998*, pl.95.

[xviii] Aside, one must say that in the report of the WRI, the GDP of various countries are compared. The GDPs were converted according to the current rate of exchange, which tended to increase comparitively the GNP of rich countries. If the same conversion was done keeping in mind the "parity of acquisitive power" (that is to say, comparing the "cost of living" in different countries, and not simply the rate of exchange of the different currencies), the differences would be lessened in favour of the countries of the south. For all this discussion, please see the article of Bob SUTCLIFFE in AA.DD., *Pobreza, desarrollo y medio ambiente,* col. Intermón1, Deriva, Barcelona 1992.

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