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***Ethical considerations in
protecting the environment
from the effects of
ionizing radiation***

A report for discussion



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FOREWORD

In recent years awareness of the vulnerability of the environment has increased and the need to protect it against the effects of industrial pollutants has been recognized. This trend is reflected in new and developing international policies for environmental protection. In the context of protection of the environment against ionizing radiation, the existing international approach is based on providing for the protection of humans. The current recommendations of the International Commission on Radiological Protection (ICRP) include the statement that *“the standard of environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk...”*. In the light of the new focus of concern for the environment, this statement is being critically reviewed in several international fora.

The IAEA has, over many years, sponsored studies of the effects of ionizing radiation on species other than humans. Most recently it published a discussion report as IAEA-TECDOC-1091 (1999) in which the need for developing a system for protecting the environment against the effects of ionizing radiation was elaborated and in which various related technical and philosophical issues for resolution were discussed.

The current report explores the ethical principles that could underlie a system of environmental protection. It is intended as one step in the development of a framework for the protection of the environment from the effects of ionizing radiation, and is being published in order to promote awareness of the current developments in this field as well as to encourage discussion amongst those involved.

This report was developed with the assistance of consultants and formed the basis for discussions at a Specialists Meeting in Vienna in November 2001. Ms. C. Robinson of the Division of Radiation and Waste Safety was the responsible officer at the IAEA. Comments and reflections on the contents of this report should be directed to Ms. Robinson.

EDITORIAL NOTE

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1. INTRODUCTION

1.1. BACKGROUND

At present, there are no generally agreed policies and criteria for protecting the environment explicitly from the effects of ionizing radiation. In many countries, assessments based on the protection of humans are currently used to determine whether the environment is also protected on the basis of the following statement from the 1990 Recommendations of the International Commission on Radiological Protection (ICRP) [1]:

“The Commission believes that the standard of environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk...”

Questions have been raised concerning the universal applicability of the above statement, and there is evidence that protection measures based on man alone may not be adequate for all components of the environment, nor for all possible space or time scales.

A number of international and national policy commitments have been made that demonstrate the increasing pressure to develop specific criteria for environmental protection. Environmental risk assessment methods, and the underlying research, are undergoing rapid development in many countries and a number of international organizations, including the International Atomic Energy Agency (IAEA), have established related programmes of work. The IAEA is working towards the development of an international approach to the protection of the environment from the effects of ionizing radiation, in co-operation with its Member States and other international organizations.

The issues to be considered in developing a more unified approach to the protection for the environment were identified in IAEA-TECDOC-1091 [2]. The current report aims to develop some of these issues in order to make more concrete proposals. In particular, the focus has been the clarification of the ethical basis of environmental protection in general, and the identification of the underlying common principles that relate to protection of the environment from ionizing radiation and, given an understanding of the way in which ionizing radiation interacts with matter, possible approaches for identifying components of a protection framework. It therefore provides a summary of progress, and some preliminary conclusions, in order to stimulate further debate.

1.2. SCOPE

The purpose of this study was to identify the implications for environmental protection, with respect to ionizing radiation, of different world views on the way in which the environment, and the impact of man's actions on it, are seen and assessed. In doing so, it has been recognized that there is a very wide range of religious beliefs, legal statutes, and cultural views and attitudes that may be reflected in different approaches to the subject of environmental protection. As an international body with over 130 Member States drawn from all parts of the globe, the role of the IAEA in the development of a framework of protection must therefore take account of these different cultural factors.

Some basic principles have already been laid down, and agreed to by Member States, as in the Rio Declaration on Environment and Development of 1992; but these do not, in themselves,

provide a complete framework. This report therefore discusses the plurality of different existing ethical approaches and interfaces them with the scientific and legal background in order to derive a firmer basis for policy decision making with respect to radiation and the environment.

'Environment' is defined within the framework of national laws and international legal instruments, and may be considered to include man, biota, abiota, physical surroundings, and their interactions. It is therefore necessary to discuss whether the framework for protection should apply to the abiotic components of the environment, the biotic components or to both components.

Finally, in preparing this report, it is recognized that many of these discussions are not unique to environmental protection. Consideration of the way in which different countries have regard for, and take steps to protect the wellbeing of, fauna and flora is also the subject of current ethical debate on such subjects as: animal welfare in an agricultural context; animal testing (for medicine/cosmetics); genetically modified organisms; cloning; the use of animal tissues for transplants; international wildlife trade; and conservation of habitats and migratory species.

1.3. STRUCTURE OF THE REPORT

Following this introduction, Section 2 very briefly introduces the scientific background to the way in which ionizing radiation may affect living elements of the environment. Section 3 explores the different motivations and ethics underlying environmental protection, while Section 4 presents aspects of the most relevant international legal instruments. In Section 5, areas of agreement and common principles of protection, implicit in these instruments, are identified and discussed. The application of these principles to assessments of environmental impact is discussed in Section 6, and the further work necessary to put them into effect is briefly considered in Section 7.

2. SCIENTIFIC BACKGROUND TO ENVIRONMENTAL PROTECTION

The interactions between individual members of different species in the environment are complex, chaotic, and necessarily competitive. Any living organism is constantly under stress from other organisms and from abiotic agents. The relative numbers of individuals and species fluctuate in time and, over long periods of time, vary as a result of evolutionary changes. Human development increasingly perturbs these interactions.

The scale and speed of this impact of human development on the natural world has been a cause of widespread concern, and the subject of considerable scientific study. Environmental science has played a large part in determining the nature, extent, and prioritisation of the measures that have been taken to protect the natural environment from further destruction. This basic science, and its translation into managerial action, continues to evolve.

2.1. THE EFFECTS OF IONIZING RADIATION ON BIOTA

Natural radiation is a physical stressor to life that has been present since life began, the general levels varying considerably through time. Living organisms have therefore evolved

through a period of varying radiation dose rates. It is uncertain whether the impact of radiation in general has been a significant factor in driving the evolutionary development of processes in living organisms, but it is possible that the ability to repair damage caused by radiation may have been a factor. It is also uncertain whether fluctuations in the magnitude of exposure to natural radiation at the current environmental levels are sufficient, in general, for there to be a resulting effect on the ability of biota to live their normal lives. Given the multitude of uncontrollable variables in any environmental habitat and the complexity of species' interactions, it might be argued that the influence of radiation in the environment at current levels could not, in any case, be observed.

It is known that detrimental effects on biota can be observed when radiation doses are considerably above those occurring naturally. Indeed, much of the current basic knowledge about the molecular and cellular mechanisms of radiation damage has come from studies with both animals and plants. Some detrimental effects (termed **deterministic** effects) are manifest in individuals when the radiation dose absorbed by the organism exceeds some threshold — cell killing and resultant tissue damage, for example. Other detrimental effects (termed **stochastic** effects) are manifest by an increase in the frequency of their occurrence, in a population, with increasing dose. Examples of such effects are the development of cancer in some animals, or mutation in the genome. A consequence of both of these types of effects is that the lifetime of some organisms will be shortened, reproductive ability may be reduced, and the genome may be adversely affected. Were sufficient numbers of organisms in a given species to be affected in these ways, changes in populations could be manifest, and any given ecosystem perturbed.

Although there have been extensive surveys of radiation levels and concentrations of radionuclides in various parts of the world (as reported by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) for example [3]), a coherent picture of magnitudes and variabilities of lifetime radiation doses to a wide variety of biota in the wild has not emerged, nor have the dose models necessary to make such studies been sufficiently developed. Some organisms are clearly subjected to natural radiation doses many times greater than those experienced by humans but, also clearly, there is a great variability in their response. In addition, much of the information gleaned on the effects of radiation on biota has been obtained under laboratory conditions in which the other stressors on the organisms being observed will have differed from those in their native habitats.

There is therefore much uncertainty about the actual radiation doses experienced by natural biota throughout their lifetimes. There is also no coherent model for predicting the likelihood of deterministic and stochastic effects that can be applied in a generic way for individual members of species, for populations, or whole ecosystems. The current situation is that assessments of the significance for health, competitive capabilities, and reproductive success of biota resulting from anthropogenic additions to their radiation exposure have to rely on extensive compendia of empirical data on the relationships between deterministic or stochastic effects and radiation doses.

2.2. EFFECTS OF RADIATION ON ABIOTA

The environment also encompasses the non-living (or abiotic) components. All living things are dependent upon their abiotic surroundings, and thus the concept of environmental protection also has to include this component of it. Abiotic issues often relate to the risk of damage in a physical or chemical sense. Thus habitats are often protected with respect to the

removal or addition of materials (water, soil, waste) or the addition of chemicals that change their nature (acidity, nutrient content) primarily because of the consequent effects for biota. But abiotic issues also arise when there is no clear evidence of actual harm to the biotic community but the presence (or absence) of abiotic materials is unacceptable; litter is an obvious example. Indeed, even the mere presence of a chemical in the environment, at trace levels, may cause offence — as in areas held ‘sacred’, or regarded as ‘wilderness’ areas. Thus although radiation may, at very high levels, be shown to have a physical effect on their immediate physical surroundings, it is the presence of any radionuclides — irrespective of any evidence of ‘harm’ to biotic or abiotic materials — that is the issue. And, as with the effects of radiation on living things, it is an issue that needs to be addressed by reference to the cultural context in which it arises.

3. CULTURAL ASPECTS

3.1. CULTURE, WORLD VIEWS AND ETHICS

Culture affects how scientific findings are interpreted and how ideas are developed. The cultural framework itself is structured through religious traditions — or the lack of them — ideologies, politics, scientific understanding, education and world views. Different views of nature held by different cultures therefore affect their understanding of biological processes, including interpretations of radiation effects upon them, and their moral and ethical significance. Science, in turn, affects the way in which nature is viewed, and the rapid developments in the fields of biology and genetics are particularly dynamic factors today.

The preceding paragraph introduces a number of concepts that require at least some rough definitions. **Culture** could be conceived as a general term for world views and customs which distinguishes human communities and sets them apart from others. A **World view** consists of an individual’s basic values, general ideas about human beings, nature and the universe, entwined with a basic mood such as optimism or pessimism. **Religions** are world views where the idea of a god or gods affects the values, ideas and moods of its adherents — and their way of life. Within the concept of ‘religions’ one also has to accommodate other ‘beliefs’ with respect to the existence or not of a god or gods — the atheists, the agnostics, the humanists and so on. **Morality** can be described as the values and norms that affect actions and attitudes of men and women. **Ethics** is the scholarly reflection upon these values and norms, either in the form of sociological description of their dissemination and change, or in the form of a prescriptive account about what values and norms should be followed — and why.

3.2. CULTURAL PLURALISM

Human awareness, experience, and understanding of the natural world have resulted in a wide variety of views concerning living things and the place of humans in the wider scheme of nature. These differences are expressed in the way humans use, exploit, protect, respect and value other living things. These schemes and ways of life are incorporated into religions, philosophical world views, and ethical beliefs, and are often encoded in national and international laws.

The plurality of cultures is a human characteristic. These differences are greatly valued and traditional practices are recognised in international conventions, in so far as they contribute to a sustainable management of the environment. There is also a clear link between cultures and

traditions, including those of indigenous peoples, and contemporary concerns for the environment. A variety of beliefs can also occur within cultures. It has been observed for example, that women often have a more environmentally friendly view of nature than men and many feminists draw parallels between male dominance and ecological destruction [4].

These concerns display a diversity that would need to be taken into account by international agencies promoting protection of the environment. The variety of beliefs is also an important part of the explanation for the variety of environmental policies. The search for consensus in these areas must be conducted in a way that acknowledges, respects and protects this diversity.

3.3. THE ETHICS OF RIGHTS, WELFARE AND JUSTICE

Another reflection of cultural diversity is linked to the variety in ethical beliefs. Philosophers have derived a number of concepts to describe some of the basic differences between moralities, including the expression of basic environmental concerns. These concepts can also arise from more general world views, and have been encoded in international law (e.g. human rights). Within moral philosophy, the two main theories are the ethics of ends (utilitarianism) and the ethics of duty (deontology). The proponent of classical utilitarianism argues that an action is morally correct if it contributes to the general happiness of human beings to a larger extent than any other action. Utilitarianism is focused upon maximising the net production of welfare and happiness, and on ends rather than the means by which those ends are attained. Thus, it is often difficult to make room for human autonomy and dignity in the utilitarian context. Respect for human dignity does not necessarily result in maximising happiness — self-determination might even be viewed as a burden.

Proponents of most forms of deontological ethics regard human rights and human autonomy as more important than utilitarian concerns. The protection of human rights is regarded as a moral obligation, even if greater happiness would be realised if these rights were neglected. Respect for human autonomy is seen as being of central importance for (although not the only justification of) principles of **informed consent**. The requirement to obtain informed consent has been developed particularly in the context of medical ethics [5], but it has been found to have important application in other areas, such as the involvement of the public in the decision making process about disposal of nuclear waste [6]. Informed consent implies certain requirements about the information about complicated technological issues presented to the general public; about the participation of those immediately concerned to have a special say in the decision process; and about a clear time-table for the decision process. These requirements are of obvious relevance in other areas where political decisions involving the effects of radiation are concerned.

Many ethicists have also made the argument that utilitarianism needs to be complemented with some principles of justice. Utilitarianism aims for the maximum net production of welfare, thus there are difficulties in acknowledging the importance of a just distribution of happiness over a population (e.g., pleasure and pain). Justice has been formulated in different ways, but two principles are important in the present context. First, there is the principle of **distributive justice**, arguing for a just distribution of benefits and burdens [7]. Second, there is the principle of **retributive justice**, which implies an obligation to compensate other humans for harm caused.

These two ethical outlooks are generally considered to refer only to human beings, their dignity, rights and welfare, but they also have relevance for the treatment and protection of

biota. Utilitarians might argue that welfare is not only of importance for humans but also for other sentient life forms because of their capability to feel pleasure or pain [8]; a deontologist might contend that non-human animals also have a right to life and development [9]. Different consequences of the principles of justice will follow, depending on whether humans, individual animals, species or ecosystems are regarded as bearers of **moral standing**¹.

In practice, protection standards may have a combination of ethical bases. For example, the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources [10] includes both individual dose limits for humans (based on a deontological ethic) together with a recommendation “*to keep all exposures to ionizing radiation as low as reasonably achievable, economic and social factors being taken into account*”, which has a more utilitarian basis.

3.4. THEORIES OF ENVIRONMENTAL ETHICS

Environmental ethics has developed largely from existing human-based theories and concern with the philosophical question of moral standing. What has moral standing in the world and why? Although environmental ethics is a relatively young field within philosophy, a number of distinct views on this question have emerged. Indeed, there are those who would argue that just because such a question can be formulated, it does not necessarily follow that a meaningful or sensible answer to it can ever be forthcoming. Nevertheless, the vast majority of contemporary environmental philosophers would likely acknowledge that the most fundamental source of divergence is the tension between the following two concepts: **anthropocentrism** and **non-anthropocentrism**.

Proponents of **anthropocentrism** (termed here ‘anthropocentrists’) regard human beings, their life and experiences as the only or main thing of moral standing. Environmental protection is important only in so far as it affects humans [11, 12]. Anthropocentrists acknowledge the long term effects of human intervention in nature, but are not concerned — or not similarly concerned — about the consequences for other life forms (animals, plants, landscapes, etc.) as such. Advocates of **non-anthropocentrism** reject the assertion that moral value can be derived and justified only in terms of human interests, and offer a variety of alternative ethical outlooks that largely reflect the ways different philosophers attempt to define the precise nature of value and moral standing.

For the purpose of the present discussion it may be helpful to note another conceptual distinction within non-anthropocentric environmental ethics: that between **biocentrism** and **ecocentrism** [13].

Biocentrism (literally ‘life-centered’) has been broadly defined as an ethical outlook in which it is asserted that moral standing can be derived from a particular biological characteristic of individual members of a species. Specific biocentric outlooks may result in different views on the characteristic that forms the basis of a morally-relevant value, or obligations arising from recognition of that value. Some proponents of biocentrism would argue that animals have moral standing by virtue of being able to experience pleasure and pain (sentience) [8], or due to self consciousness [9], while others would argue from the premise of the inherent worth or ‘a good of their own’ of all living things [14, 15]. A necessary consequence of all biocentric

¹ Moral Standing means that the being or thing enters into ethical evaluation in its own right, independently of its usefulness as a means to other ends.

outlooks is a recognition that individual life forms other than humans can have value in themselves, and should be respected for what they are — not only because they affect the situation of humans. Since biocentrism is focussed on individuals rather than the diversity of species, these various outlooks have also been described as an ‘individualistic’ environmental ethic [13, 16, 17].

Proponents of **Ecocentrism** (termed here ‘ecocentrists’) reject the assumption that morally-relevant value can be derived only from some biological attribute of individual organisms. Ecocentrists affirm that diversity of species, ecosystems, rivers, mountains and landscapes can have value in themselves, even if they do not affect the welfare of humans or other individual members of non-human species [13, 18, 19]. All ecocentrists attach particular value to the diversity, dynamics and interactions within a healthy ecosystem, but differ in their views on the cause of and solutions to modern environmental problems. Examples include humans’ lack of proper respect for nature and their place within it [18]; the social and economic structure of society [12]; or the history of male dominance and sexist oppression of females [4]. The general concern for the biotic and abiotic community as a whole [20] leads to the alternative classification of the outlook as an ‘holistic’ environmental ethic [13, 17].

Sporadic demands for a non-anthropocentric ethic can be found throughout the history of philosophy, and the field gained a little momentum with the advent of Darwinism. The philosophical community only really began to take these ideas seriously in the early 1970’s [21], and the emergence of both the ‘biocentric’ and ‘ecocentric’ outlooks owes as much to developments in science as it does to cultural changes [22]. Progress in biology, ecology, environmental science and the understanding of animal behaviour have all played an important role, both in the factual basis used to defend the various philosophies (e.g., animals can feel pain, have consciousness; some, like humans, have a sense of self-awareness; ecosystems are dynamic and interactive; the environment is being damaged) and in their applications in practical policy (e.g., animal welfare, environmental law).

3.5. RELIGIOUS DIMENSIONS

Anthropocentric and non-anthropocentric ethics are important in contemporary environmental movements and affect their concerns and agendas. Such ethical outlooks may also have deep roots in cultures and religions. Anthropocentric elements can be found embedded in the largely western religious traditions of Christianity, Islam and Judaism (even if these traditions also harbour non-anthropocentric ideas). Religious beliefs about the purpose and actual creation of the world often centre around the emergence and role of human beings — salvation is largely seen as the salvation of humanity, the ultimate goal of all history being fulfilment of a divine purpose for the human being. In contrast, and notwithstanding that they come in many forms, such religious traditions as Buddhism and Hinduism do not in general have the same anthropocentric profile as the religions of western origin [19]. Non-anthropocentric ideas are most clearly embedded in many indigenous religious traditions, reflecting the intimate interplay between human beings and a spiritually-conceived understanding of nature and living things. The revival of local and regional consciousness in different parts of the world has stimulated the importance of these traditions and contributed to contemporary environmental concerns.

Of course cultures may have arisen within a changing religious framework, or without any framework at all, or in one that has positively chosen not to believe in a deity (atheism). All cultures, too, will undoubtedly contain a mixture of believers in one deity or another, atheists,

agnostics and those who wish to be described in other ways. Individuals in society may adopt different positions at different stages in their life, or under different circumstances. For the purposes of this report, however, it is the way these positions are reflected in legal instruments and standards that is of interest.

3.6. SCIENTIFIC ‘BELIEFS’

Challenges to some of the conclusions and attitudes towards man and nature that have arisen from purely religious beliefs have stemmed from the results of scientific enquiry through scientific method. The natural world around us and its origins, is now described in terms of testable and reproducible explanation of theories and ideas, held together by a set of ‘logical’ statements. In many respects the discoveries made by science do not challenge religious beliefs in themselves, but conclusions drawn from these discoveries — on evolution (particularly the evolution of human beings), on the chemical basis of life, genetics and so on — have undoubtedly affected individual and even societal views of religious beliefs. Nevertheless, it is useful to recognize that individuals may still arrive at the same end point with regard to attitudes to man and nature, as a result of religious beliefs, scientific ‘logic’, or indeed from any other starting point.

3.7. THE CONTEMPORARY POSITION

The history of ethics has developed in different cultures along different routes. Historically ethics has focused upon human beings, their dignity, rights and welfare. More recently, cultural views have been affected by the discoveries of science, by education, by technological advances in communication and travel. Perceptions of the way the world works — in terms of cause and effect — has changed dramatically. In many respects this may not have changed the ethical position of societies or of individuals within them. Furthermore, it is impossible to predict how such attitudes may change in the future; although the rate of change of cultural attitudes and ways of life is certainly increasing [23]. One of the outcomes has been a greater worldwide concern for other forms of life, for nature and the environment in general, and the value accorded them by society. There is a growing awareness that the world is not solely there for the satisfaction of human needs, and that human beings are obliged to consider the existence and protection of animals, plants and larger ecosystems (including abiotic components) — even if their survival or reproductive capacity are of little or no significance to the future of the human species to this planet.

4. LEGAL ASPECTS

A real test of contemporary commitment at national level to the overlapping motives arising from considerations of ‘cultural pluralism’ is the extent to which they have been expressed in international law, and the manner in which this has been implemented. This is particularly the case in the context of environmental protection and issues of human rights and welfare.

Such international legislation, applicable to various geographic scales, encompasses a wide range of relevant subject areas: human rights; sustainable development; environmental protection; conservation; and certain aspects of waste and pollution control. The various pieces of international law also differ in their legal construct and weight. The most basic is that of ‘soft law’ such as that arising from UN Conference Resolutions.

Much of the early concern with respect to the natural world was centred around the loss of individual species or of unique natural areas and thus, on the basis of scientific advice, various **conservation** measures have been undertaken. Lists have been compiled of ‘endangered’ species and, in many cases, measures have been taken to protect them. Particular problems have arisen where such species are migratory. Patterns of migration, and total life histories have had to be studied and these studies have, in turn, led to international conservation agreements with respect to such fauna, particularly birds, to safeguard their ability to migrate across their species range. Other threats to endangered species, such as trade in the species themselves, or in their products (e.g. skins) have also had to be addressed.

A greater understanding of the highly complex inter-dependence of wildlife, which cannot be sustained simply by conserving individual species, has also led to the study of the total variety of life on the planet in terms of biological diversity — or **biodiversity** as it is now termed — on various geographic scales. The subject of biodiversity is now generally taken to include three different sets of studies: the diversity of habitats (or of ecological complexes); the diversity of species; and the diversity of the genetic variability **within** each species.

Natural populations of many wildlife species are, however, variously and naturally volatile over different time scales and over different areas. Thus attempts may be made to protect particular species within given (and often relatively small) areas but the species may move out of the area for perfectly natural reasons. Areas subject to special protection measures are also frequently rather isolated from one another. The needs to maintain biodiversity, in a general sense, have therefore led to a somewhat different approach from earlier attempts at nature conservation by providing for the general protection of much larger areas of both natural and ‘man-made’ habitats within which wildlife communities may flourish. The **protection of such habitats** often requires measures to be taken with regard to what might be regarded as ‘stressors’ in a general sense. These include abstractions from the areas, discharges into them, and the use made of them by man.

4.1. UNITED NATIONS INSTRUMENTS

One of the earliest relevant statements, indicative of the will of different nations to develop a consensus approach to environmental matters, was the UN General Assembly’s *World Charter for Nature* in 1982 [24]. This recognized that terrestrial and marine ecosystems were, literally, life support systems. It also introduced ethical considerations, as in:

“Every form of life is unique, warranting respect regardless of its worth to man, and, to accord other organisms such recognition man must be guided by a moral code of action. ... Nature shall be respected and its essential processes shall not be disrupted.”

The resultant interest in environmental concerns, at a global level, had widespread repercussions.

The interface between global concerns about ‘nature’ and the underlying causes of the human pressures placed upon it had first been articulated in the *Stockholm Declaration of the United Nations Conference on the Human Environment* (1972) [25], but obligatory language did not appear (i.e. States shall ...) until the *Rio Declaration on Environment and Development of 1992* [26]. This Document produced the first real consensus amongst developed and developing States on the need for agreed ‘norms’ of international environmental protection. It was the first attempt to draw up some core principles of law relating to the subject. The

Declaration was explicitly anthropocentric in character although, at the insistence of a number of countries, it did not restate the Stockholm Declaration's initial principle of the human right to a 'decent environment'.

The 1992 Rio Declaration [26] contains a total of 27 Principles, not all of which refer explicitly to environmental protection. But the following statements are clearly relevant to the further development of a consensus on environmental protection in the context of radiological protection. They are as follows:

- Human beings are “... entitled to a healthy and productive life in harmony with nature.” (P1);
- States have the responsibility to “... ensure that activities within their jurisdiction or control do not cause damage to the environment of other States ...” (P2);
- The right of States to development must be fulfilled to meet, equitably, “... developmental and environmental needs of present and future generations.” (P3);
- Environmental protection “... shall constitute an integral part of the ...” sustainable development progress (P4);
- “States shall co-operate ... to conserve, protect and restore the health and integrity of the Earth's ecosystem.” (P7);
- “... each individual shall have appropriate access to information concerning the environment that is held by public authorities ...” (P10);
- States shall “... develop further international law regarding liability and compensation for adverse effects of environmental damage.” (P13);
- The “... precautionary approach shall be widely applied by States according to their capabilities ...” to protect the environment (P15);
- States should “... recognize and duly support ...” the identity, culture and interests of indigenous people, and “... their knowledge and traditional practices ...” to “... enable their effective participation in the achievement of sustainable development.” (P22);
- States should “... respect international law providing protection for the environment in times of armed conflict ...” (P24); and
- “Peace, development and environmental protection are interdependent and indivisible.” (P25)

The Rio Convention also established a Commission on Sustainable Development. In considering the functioning of such a Commission, however, it is also necessary to consider other Commissions that have arisen under the *Charter of the United Nations* (1945) [27]. Of particular interest is that established in 1946 on Human Rights [28], because — as will become evident in the next section — human rights' issues are also of relevance in environmental management practices.

4.2. THE ROLE OF THE IAEA

Annex II of the *United Nations Framework Convention on Climate Change, Agenda 21* (1992) [29] sets out, in a series of Chapters, a number of issues and subject areas that need to be addressed in relation to the achievement of sustainable development.

Chapter 22 is concerned with the *Safe and environmentally sound management of radioactive waste* and identified within it the roles of Member States and of the IAEA. For example, it is recommended that States should:

- “Support efforts within IAEA to develop and promulgate radioactive waste safety standards or guidelines and codes of practice as an internationally accepted basis for the safe and environmentally sound management and disposal of radioactive wastes.”
- “Promote proper planning, including environmental impact assessment where appropriate, for safe and environmentally sound management of radioactive waste, including emergency procedures, storage, transportation and disposal, prior to and after activities that generate such waste.”

Since the Rio Declaration of 1992 the IAEA has set out in its *Safety Fundamentals for Radioactive Waste* [30], the objective of protecting human health and the environment now and in the future without imposing undue burdens on future generations and taking account of impacts beyond national borders. The relevant principles are:

- Principle 2: “Radioactive waste shall be managed in such a way as to provide an acceptable level of protection of the environment.”
- Principle 3: “Radioactive waste shall be managed in such a way as to assure that possible effects on human health and the environment beyond national borders will be taken into account.”
- Principle 4: “Radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today.”
- Principle 5: “Radioactive waste shall be managed in such a way that will not impose undue burdens on future generations.”

It should however be noted that Chapter 38 of Annex II states that all UN Agencies have a role to play in the implementation of Agenda 21 “*within their respective competence*”. The respective competence of the IAEA is much broader than that of radioactive waste management. Among other things, the IAEA is authorised “*to establish or adopt ... standards for protection of health and minimization of danger to life and property ... and to provide for the application of these standards ...*” [31]. Thus, the IAEA could therefore play a much larger role than that which is described in Chapter 22 in order to fulfil the spirit as well as the letter of Agenda 21.

4.3. OTHER RELEVANT INSTRUMENTS

Further, since the 1992 Rio Convention, several other Conventions or Agreements have addressed specific subject areas including Climate Change (*Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 2001) [32] and Biodiversity (1992). A number of them have also addressed ‘sustainable utilization’ issues that have an environmental protection component – including those on Migratory Fish Stocks (1995) [33], the exploitation of Tropical Timber (1994) [34], and Combating Desertification (1994) [35]. All of these contain an underlying concern for a more rational approach to conservation within a sustainable development context.

Conservation law itself, as with ‘pollution’ law, has evolved at an international (but not necessarily at a global) level. Its development is of interest not only because of its reflection of an underlying ethic in relation to the environment, but because its existence already frames and delineates some of the requirements to demonstrate, explicitly, that the environment is protected from controllable sources of ionizing radiation.

4.3.1. Regional instruments

One geographic area that has received specific attention is the Antarctic, with the general Treaty of 1959 [36] followed by specific legal instruments relating to its living marine resources and then environmental protection in general. In terms of specific environmental compartments, there are also several conventions relating to protection of the atmosphere (e.g. *United Nations Protocol on Substances that Deplete the Ozone Layer* (1987) [37]) and of the oceans (*London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter* (1972) [38]) with respect to the discharge or dumping of polluting materials. Wildlife conventions have primarily related to the trade in endangered species (*Convention on International Trade in Endangered Species of Wild Flora and Fauna* (1973) [39]; *Lusaka Agreement on Co-operative Enforcement Operations Directed at Illegal Trade in Wild Flora and Fauna* (1994) [40]), although the existence of these treaties is indicative of the fact that agreement has been reached to draw up a list of species that are endangered simply on the basis of their quantity (i.e. how many of them) rather than on the basis of their potential value to the ecosystem or to man. The need for transboundary protection for migratory species has also been recognized (*Convention on the Conservation of Migratory Species of Wild Animals* (1979) [41]) and of areas necessary to achieve migration, such as the *Convention on Wetlands of International Importance, Especially as Waterfowl Habitat* (1971) [42], and *The Council of Europe Convention on the Conservation of European Wildlife and National Habitats* [43]. Liability for recompense for damage to the environment has also been formulated in law with respect to oil pollution (*International Convention on Civil Liability for Oil Pollution Damage* (1969)) [44]. Thus the existence of such a variety of conventions and agreements itself illustrates a broad level of agreement that the environment does need to be protected in various ways and that damage to it can be quantified and subsequently addressed in certain circumstances.

The more recent trend, however, has been to attempt to protect much of the environment on a broader scale, including that ‘occupied’ by people. Thus across the European Union a large number of Natura 2000 sites (Special Protection Areas and Special Areas of Conservation) in the *Council Directive on Conservation of Natural Habitats and of Wild Fauna and Flora* (1992) [45] exist that have to be maintained in, or restored to “*favourable conservation status*”. Regulators of the release of any substances with a potential to affect “*features of interest*” within such areas — which can be very large, terrestrial and aquatic — need to demonstrate explicitly how they will affect the attainment of such conservation objectives. More recently this approach (i.e. attaining “*favourable conservation status*”), has been extended to all surface fresh waters across the European Union, plus their associated estuarine and marine waters via the *European Commission Council Directive Establishing a Framework for Community Action in the Field of Water Policy* (2000) [46].

There are, of course, many other examples of a consensus emerging on the interpretation and expression of environmental protection that have not been incorporated into law.

Other measures taken since Rio, of relevance to UN Agencies, are the establishment of an Inter-Agency Environment Co-ordination Group (IAEG) steps to establish a Global Environment Monitoring System (GEMS); plus the production of a Global Environment Outlook Series (1st issue was in 1997) [47].

4.4. SUMMARY OF PRINCIPLES INCLUDED IN INTERNATIONAL INSTRUMENTS

Our scientific understanding of ecology is therefore such that we are aware that the world's ecosystem has many inter-dependent parts, and this is now reflected in international law that has been drawn up within a multi-cultured international society. Such law usually requires individual States to:

- ensure that activities within their jurisdiction or control do not cause damage to the environments of other States;
- maintain ecosystems and ecological processes that are essential for the functioning of the biosphere;
- maintain biodiversity; and
- observe the 'principle' of optimum sustainable yield in the use of living natural resources.

5. AREAS OF AGREEMENT

As indicated in Section 3, three of the main ethical concepts in the field of environmental ethics are anthropocentrism, biocentrism and ecocentrism. On the understanding that these three 'value-bases' are mirrored in many religious and cultural beliefs, albeit for different reasons, they form a reasonable starting point for further reflection on the relevance of ethics within a legal framework of environmental protection. Moreover, the types of distinctions are also reflected in the priorities assigned to, and the nature of studies carried out within, programmes of scientific research, i.e., focusing on humans, animals, individuals, populations, or ecosystems, and thus the information about these research objects that might be discerned.

It is also important to recognise that despite the debates that are inherent in any field of philosophy, a certain amount of coherence can occur between different outlooks. Supporters of different ethical outlooks may disagree quite strongly over why certain factors are relevant to environmental protection, and which principles should be superior in cases of conflict, but they may still find room for consensus on some common features. For example, much of the field of medical ethics reflects the derivation of a set of principles to guide practice that can be agreed upon by both utilitarian and deontological proponents [5]. A similar pluralism can be seen in the principles for human radiological protection, as noted above.

It is useful to explore the extent to which the three ethical concepts might support general principles within environmental protection. The following questions are relevant: could an anthropocentrist support a principle because of consideration of human interests; a biocentrist because of the interests of individual living organisms; and an ecocentrist because of consequence for species, habitats or ecosystems? Furthermore, the types of conflicts that can arise between the different views shed additional light on differences that may arise where trade-offs are necessary, or where management decisions may vary over time, circumstance or

nations. Conceptualising, understanding, and respecting the different ethical and world views can provide a constructive framework for the global debate on international environmental protection policy.

A number of philosophers have examined possible similarities amongst different ethics [16, 48, 49]. The present report has identified five common features of current international environmental legislation that reflect a consensus reached by signatories from many cultures, with ‘world views’ from the full spectrum of ethical outlooks. These features, which may be described as general principles, are the following: sustainability, maintaining biodiversity; conservation; environmental justice; respect for human dignity. In the following sections, the way in which these principles and their implications may be viewed by proponents of the three representative ethical outlooks are examined.

5.1. SUSTAINABILITY

The substantive elements of sustainable development include the ‘right’ to (economic) development; the integration of economic development and environmental protection; the sustainable use of national resources; and inter-generational equity. These elements are often linked to the idea of attempting to balance the needs arising from economic growth, social justice and the maintenance of biodiversity. However, it is not clear whether this implies a trade-off amongst them, or a drawing up of the boundaries between them.

Anthropocentrists would have little problem supporting the principle of sustainable development because of the importance given to human interests. The biocentrist and ecocentrist might identify with the concept of maintaining biodiversity as a criterion that reflects the inherent worth of the ecosystem and its components, but clearly any supporter of non-anthropocentrism would have misgivings about the value given to economic growth and development. Indeed, some may reject the concept of sustainable development on this basis, and would argue that protection of the environment in the future can only be achieved by radical changes in human behaviour. Nevertheless, there would be general agreement that the components of sustainable development that relate to inter-generational equity and biodiversity (termed here ‘sustainability’) are valid, although there may be differences in detailed application of these aspects.

Within sustainability, impacts on future generations are particularly important from the point of view of both economic growth and social justice. Such impacts carry weight for both anthropocentrists and the non-anthropocentrists. For an anthropocentrist, the interests of humans have direct relevance in themselves and, assuming that many detrimental effects on future generations can stem from some form of environmental effect, these interests will be indirectly relevant to the biocentric and ecocentric viewpoints. Few who subscribe to purely biocentric or ecocentric outlooks categorically ignore consequences on humans. However, proponents of the various outlooks might disagree on the number of generations to be included in the evaluation and the relative weighting between generations.

Signatories to the Rio Declaration acknowledged the importance of indigenous people and traditional practices in the achievement of sustainable development. Both anthropocentrists and non-anthropocentrists can support this principle. Nevertheless, proponents of all three viewpoints would demand a further evaluation of the traditional practice itself: namely its implications for human rights and environmental consequences.

5.2. MAINTENANCE OF BIODIVERSITY

Although disagreement within the scientific and philosophical communities exists about the precise interpretation of biodiversity, and how biodiversity might be maintained in practice, there is a general consensus that maintenance of biodiversity is a central principle in environmental protection.

Supporters of both anthropocentric and non-anthropocentric views could agree that maintenance of biodiversity is a valid objective because of consequences for human interests or for the future generations of all organisms, or because of respect for the diversity of nature in itself.

Maintaining the variety of the gene pool could also be justified from both anthropocentric and ecocentric viewpoints, the former because of its potential benefits for present and future generations, the latter because it is an inherent component of what an ecosystem is. However, the ecocentrist may attach value to both the biotic and abiotic components of the environment, such that the concept of biodiversity would not alone be a sufficient criterion for environmental protection. A biocentrist may well find genetic variability only indirectly relevant, in the sense that a variable gene pool can be important for reproductive success and for the survival chances of the offspring of individual organisms.

In the sense that biocentrists attach moral standing to all individual members of a particular species, it might follow that they would give moral consideration to all living members of an ecosystem. But this is highly contingent on what attribute it is in those individuals that they find morally-relevant. Those attaching moral standing to all living things *per se*, when forced to make a choice, are constrained to prefer the situation of having a greater number of individual members of the same species, over a situation of having, totally, a lower number of individual entities but distributed throughout a variety of species. A pine plantation containing many trees would be deemed better than a smaller natural forest containing more variety. This is not concordant with the concept of biodiversity.

5.3. CONSERVATION AND PRESERVATION

Conservation efforts are usually directed towards the protection of ecologically important or vulnerable species or habitats or features of geological interest. The concept of 'importance' or 'vulnerability' may reflect the fact that a species, habitat, or geographic feature is endangered, under ecological stress, unique, or simply valuable in itself. Over recent decades, conservation of flora and fauna has seen a general movement from protection of endangered species to the protection of the habitats on which they depend.

Proponents of both anthropocentric and non-anthropocentric outlooks could recognise a principle of conservation: the former because of direct consequences for human interests or indirectly because of human respect and enjoyment of special habitats; the latter because either habitats or the individual organisms have value in themselves. Disagreements might arise from perceptions of the relative worth of wild compared with domesticated animals, man-made or natural environments, and individual members of habitats or the habitats themselves. The fundamental conflict for all such outlooks, however, is the degree to which the conservation principle might override human interests.

Humans often show preferences for the interests of one species over another for various reasons: personal attachment, beauty, rarity, utility and so on. Thus, an anthropocentrist might weigh the importance of various species differently from the biocentrist or ecocentrist. Moreover, the individualist biocentrist might interpret and apply the principle of conservation differently from the holistic ecocentrist. For the former, the number of individual life forms, for example, affected would be the prime criterion; for the latter it would be the inherent worth of the ecosystem itself. Further, an ecocentrist may be concerned that the concept of 'habitat' protection implies that abiotic components of the ecosystem are given value solely for their ability to support life, or even for human enjoyment, rather than as being value of value themselves.

5.4. ENVIRONMENTAL JUSTICE

The principle of environmental justice, also embodied in the 1992 Rio Declaration [26], relates to issues of liability, compensation and distribution. Among other things, it takes account of the fact that inequity can and does arise between the distribution of environmental benefits and harms, and attempts to redress this inequity either by redistributing the benefits of actions or policies, or by demanding compensation for causation of detriment. The principle has strong links to the mechanisms of achieving environmental protection and, in practice, could include a number of subsidiary principles such as the precautionary approach, polluter pays, best available technology, etc.

Although initially the concept may appear strongly anthropocentric, the types of detrimental effects encompassed within environmental justice include direct harm to humans, indirect detriment caused by damage to the environment, as well as damage to the environment itself (both habitats and inhabitants). Thus the concept is of significance to both anthropocentric and non-anthropocentric outlooks. It is, however, somewhat complicated by the fact that two types of justice are relevant in environmental protection: distributive justice and retributive justice.

5.4.1. Distributive justice

Transboundary pollution is one area where the principle of distributive justice can be important. Similar problems with distribution of benefits and risks can occur within a nation, i.e. over religion, class, race, gender (or due to unequal distributions of pollutants in the environment). It is generally considered unfair that one group may receive the benefits of a particular industrial practice while others bear the risk. Both anthropocentrists and non-anthropocentrists would agree on this, even if the non-anthropocentrists would have a broader definition of effects than the anthropocentrist. However, when forced to make choices and comparisons, proponents of all viewpoints might balance harm to non-humans against harm to humans, and harm to individual members of the ecosystem against whole ecosystems quite differently.

The distribution of benefits and risks over space is not the only issue for consideration under this principle; distributions over time are also relevant. As discussed for sustainability, it is important to consider balancing and trade-offs between living and future generations.

5.4.2. Retributive justice

Proponents of all the ethical outlooks would recognise that the environment can be damaged by exposure to radiation and that it should be possible to quantify and compensate for that

damage [44], but they might disagree on why the damage matters, what level of damage/change qualifies for compensation, who should be compensated and on which grounds, and who bears the responsibility for compensating.

Anthropocentrists would support compensation on the grounds that environmental damage can negatively affect human interests and that those humans have a right to compensation. As with the application of the principle of distributive justice, the biocentrists and ecocentrists might include a broader range of effects and changes than the anthropocentrist, but these views need not be incompatible. Indeed many people would see environmental damage as a wrong in itself, and something that should be punished and corrected. Thus, if an industry harms (or changes) the environment in some way then it should be held accountable for that action. One need not identify a particular group of humans who have been harmed: causing environmental damage could be seen as an act that is in itself ethically reprehensible.

The notion of retributive justice has a strong deontological basis. Deontologists not only justify compensation on the basis of the individual rights of those who have been affected but also on the basis of responsibility and retribution. Current debates within environmental law consider whether or not individual species or biotic communities should have *legal standing*². Should a human representative be able to sue the polluter on behalf of ducks, trees or environments? [50]. Retribution also has relevance for utilitarian- or consequence-based ethics. Many with a consequentialist, anthropocentric view might include issues of liability, legislation and compensation as the driving forces for environmental protection. In this approach there would also be an acceptance that the most practicable way of making potential polluters conform to regulatory standards is to demand compensation if they do not.

5.5. HUMAN DIGNITY

Respect for human dignity, rights and self-determination forms the cornerstone of the Charter of the United Nations:

“The purposes of the United Nations are: ..to develop friendly relations among nations based on respect for the principle of equal rights and self-determination of peoples ... to achieve international co-operation in solving problems of an economic, social, cultural or humanitarian character, and in promoting and encouraging respect for human rights and for fundamental freedoms for all without distinction as to race, sex, language, or religion (Chapter I, Article 1).” [27]

Drawing on the principle of human dignity, philosophers can argue that respect for human rights arises for many reasons: the status of humans as rational creatures; the fact that human rights should be treated as ends in themselves; the inherent worth of humans; the capability of humans to feel pleasure and pain; or the fact that observations of human rights violations provoke empathic feelings of unhappiness in other humans.

Proponents of all three ethical outlooks recognise that human interests count in evaluation of environmental impact, but they disagree on why those interests count and how they should balance the interests of humans against animals and plants. Respect for human dignity lies at the heart of anthropocentric and deontological ethics; and even for the most radical ecocentrists, human interests count by virtue of humans being part of the ecosystem.

² Legal standing: the right to be represented in a court of law.

Some who hold the more extreme anthropocentric views may claim that only humans are worthy of moral consideration, but the majority of contemporary ethicists acknowledge that moral status can be extended to other living beings [51]. As already pointed out, the standards and criteria used to demarcate moral standing vary considerably, both between and within the various non-anthropocentric, biocentric and ecocentric outlooks. Such different outlooks are also reflected in the views of many indigenous peoples and non-western religions. This will in turn influence the relative weighting granted to human dignity against the other principles, and thus influence the choices made in practice.

As with the principle of environmental justice, human dignity may appear to have a purely anthropocentric basis. However, in practice, this principle can be a powerful mechanism for recognizing and respecting both biocentric and ecocentric outlooks. If humans are concerned about the effects of pollutants on other living organisms or offended by the presence of a contaminant in the ecosystem (irrespective of the possible harm to biota), the principle of human dignity implies that these points of view need to be addressed.

5.6. GENERAL APPLICATION OF DIFFERENT ETHICAL OUTLOOKS TO A FRAMEWORK FOR ENVIRONMENTAL PROTECTION

It can reasonably be demonstrated that proponents of all three ethical outlooks (anthropocentrism, biocentrism and ecocentrism) show a certain degree of consensus on all of the above principles. These principles were also supported at a Consensus Conference on Protection of the Environment in October 2001 [52], and during a relevant IAEA Specialists Meeting held in November 2001 [53], as being a reasonable basis on which to develop a framework for environmental protection. Different ethical beliefs or views may lead to disagreements about why the various principles are relevant to environmental protection, their respective hierarchy and how they are interpreted or applied in practice. But the five principles provide much common ground for development of practical policies, while respecting the diversity and relevance of the three ethical outlooks.

In view of the types of harm that radiation exposure can inflict on the environment, all three outlooks will certainly need to be taken into account in the development of a framework of environmental protection. However, there will always be extreme views and it is interesting to consider the implications of some of these.

A strong anthropocentrist might contend that the existing system of protection focusing on man was sufficient. But practical experience and legal developments mean that, in many countries, the anthropocentrist would need to accommodate a more equitable consideration of the interests of future generations, greater respect for other human values and attitudes towards natural resources, and may need to acknowledge that at least some human interests can be overridden by concerns for either other life forms or the ecosystem itself.

The overarching concern for individual members of various species, implicit in biocentrism, can present practical problems in balancing the interests of individuals against an objective of protecting diversity of species. The difficulty in applying a biocentric outlook to environmental protection has been noted by a number of philosophers [13, 16, 17]. It is, though, widely acknowledged that biocentrism has had, and continues to have, considerable influence in issues of animal welfare (such as the use of animals in research and agriculture). The outlook also has applications in the protection of endangered species and strong roots within many world religions. The difficulties in applying a biocentric approach to protection

of the environment in general should not be taken simply to imply that effects on individuals would not be considered as part of such an approach. Indeed, it may be difficult to demonstrate effects on a population or species level and, for practical reasons, it may be necessary to make decisions based on information on individuals. This may, however, be rather different from affording individuals value from an ethical standpoint.

It is, perhaps not surprising, that although the ecocentric ethic is not widely accepted today, it is thought likely to have an increasing impact on the development of environmental protection legislation in the future. Much of the current debate within both philosophy and environmental management and legislation is on how those with an anthropocentric ethic can learn from or adjust to ecocentric views. An ecocentrist would not limit the scope of environmental protection to the protection of living species (biota), but would also include abiotic components of the environment.

The application of these ethical views to the abiotic components of the environment is of particular interest. In so far as the effects of radiation on abiotic materials may affect the biotic component, then they are an integral part of that issue. But such effects are unlikely. Of greater importance is the issue of the mere **presence** of radionuclides in the environment — even in the absence of any biotic component. Such presence, it could be argued, may be relevant to the principle of conservation where ‘conservation’ is taken to include the ‘preservation’ of, say, a pristine environment in a ‘pristine’ state (i.e. free of contamination). It may also be argued by some that the presence of radionuclides, if allowed to increase, would eventually lead to harmful concentrations (‘pollution’) rather than mere presence (‘contamination’), and thus be in conflict with the principles underlying the concept of sustainability. But the more challenging situation is likely to be one in which the (un-natural) presence of radionuclides in specific places or generally in the environment is upsetting to some people and thus their views — which could, for example, be based on religious grounds, as in keeping a ‘holy’ place unsullied by human activity — have to be accommodated by virtue of our respect for human dignity.

6. APPLICATION OF COMMON PRINCIPLES TO PROTECTION OF THE ENVIRONMENT

6.1. APPLICATION OF THE PRINCIPLES OF SUSTAINABILITY, BIODIVERSITY AND CONSERVATION

In assessing the impact of ionizing radiation on biota, the first three of the five common principles (sustainability, biodiversity, and conservation) can be applied directly. These three principles can be used in combination with both the known scientific information relating to deleterious biological effects of ionizing radiation and the scale of such effects (exposure or dose) as part of an assessment framework to evaluate the possible impact of radiation on the environment or biota within it.

The principle of sustainability implies that the environment or an element within the environment is a resource to living organisms, including man as well as other species. Adherence to this principle implies that impacts on future generations and productivity are of particular concern and that the quality of the environment therefore should not be diminished over time. Maintaining biodiversity and conservation (or habitat protection) are important considerations in their own right, but they are also essential features of the application of the

principle of sustainability. As indicated earlier, under normal circumstances, the primary impact of ionizing radiation is on living tissue. Thus, the main focus for protection of the environment from the effects of ionizing radiation is likely to be on the protection of biota from radiation-induced early mortality, increased morbidity, reduced reproductive success and deleterious hereditary effects. Occurrence of each of these would influence sustainability, maintenance of biodiversity and conservation.

6.2. APPLICATION OF THE PRINCIPLES OF HUMAN DIGNITY AND ENVIRONMENTAL JUSTICE

In making environmental management decisions, there is a need to combine the sense of protecting biota for their own sake with the need to weigh human interests relative to what might be viewed as the interests of biota, and to reflect the different interests of individual humans within a population. The two other principles — those related to human dignity and to environmental justice — inform these judgements.

There are many facets to the application of the principle of environmental justice (with its components of **distributive justice** and **retributive justice**) and the principle of human dignity. Some of these facets can be illustrated by considering a few examples. Note that the discussion here is certainly not comprehensive and is not intended to be in any way prescriptive.

If a situation arises when some biota have been harmed, then the principle of environmental justice could lead to a consideration of ‘compensation’ for environmental damage. This situation might arise, for example, after an accident or in some other circumstances where ionizing radiation is having a deleterious effect on biota or a habitat. Compensation could involve restoration of a habitat or ecosystem, or provision of an alternative habitat, both of which would be reflecting what is seen as amelioration of the interests of biota. Another compensatory approach could be a retributive penalty on those humans responsible.

Harm in terms of effects on biodiversity, conservation and sustainability is not constrained by national boundaries. Hence — and this is an example of the application of the principle of distributive justice — it would be inappropriate to artificially constrain assessment of impact and such assessments need to take account of harm to all parts of the environment (or biota) that could potentially be affected.

The principle of human dignity can inform judgements made between the interests of humans and biota, providing some support for preference to be given to human interests relative to those of biota. The same principle can help to resolve issues that arise with different human interests. Humans who are affected in some way by the actual or potential for environmental harm from radiation may have differing views on the significance of such harm, depending on their cultural background and ethical beliefs. Although decisions may be being made within a clear framework built around the principles of biodiversity, conservation and sustainability, the principle of human dignity lends support to the idea that those affected should be involved in making the decision — there should be what is often called **informed consent**.

The principle of distributive justice could provide the basis for the idea that those humans who do not receive any of the benefits from a practice that involves the emission of radionuclides should not have their interests affected by any environmental harm arising from it and if they do, that some compensation may be appropriate.

7. CONCLUSIONS AND THE WAY AHEAD

The development of legal instruments and protection frameworks are strongly influenced by the cultural background of the people developing and adopting them. This cultural background has religious, non-religious, ethical and scientific elements that can vary greatly amongst IAEA Member States. In developing an international framework for protection of the environment from the effects of ionizing radiation, it is therefore necessary to recognize and take account of these different viewpoints and this report represents a step in this process.

It is not possible to define a single ethical framework that uniquely defines the objectives of environmental protection. In this report, we have discussed three ethical outlooks or views, representing the ways in which people view the environment and their interaction with it. These are anthropocentric, ecocentric and biocentric ethics. Five broad principles have also been identified that are incorporated in international legal instruments, and thus represent a consensus reached by signatories from many different cultural backgrounds. These are: sustainability, maintenance of biodiversity, conservation, environmental justice and human dignity.

It has been demonstrated that proponents of all three ethical outlooks are likely to show a substantial degree of consensus on the above principles, although their views on the relative importance of these principles would vary. There is also a consensus emerging that these principles provide a reasonable basis for the development of a framework for environmental protection [52, 53]. Under normal circumstances, the main direct impact of ionizing radiation on environmental media relates to its inter-action with living tissue. Thus, the assessment of effects on biota is likely to be the primary focus of a framework for protection of the environment from ionizing radiation.

In order to develop a practical framework for assessing the impact of ionizing radiation on biota, it is necessary to link the five principles with scientific information relating to radiation-induced changes. Four types of effect have been considered to be relevant (morbidity, early mortality, reduced reproductive success and deleterious hereditary effects), in this report and elsewhere [54, 55].

The challenge now is to build on this ethical base and set of protection principles, the scientific and management framework that will guide Member States in implementing programmes to assure adequate protection of biota. The activities needed to meet this challenge are to:

- Define the options for measurements and estimation in safety assessments.
- Consolidate and interpret the existing relevant data on the effects of ionizing radiation on biota in the natural state and on the behaviour of radionuclides in the biotic and abiotic parts of the environment.
- Identify where the most significant gaps are in the data base and undertake research programmes to obtain the needed data.
- Develop the management options for making decisions that will be adaptable to the variety of situations in all Member States.

Progress is being made in all these areas by a variety of organizations as discussed below.

The effects on biota that have been discussed are those that relate directly to the principles of protection. They are unlikely to be directly observable in the field. There is a need to identify changes in biota or the environment in general that can be observed and that are indicative of the effects.

Sets of such indicators or ‘observables’ have been discussed as part of the continuing IAEA work on this subject. These range from physical measures such as concentration of radionuclides in environmental media, and radiation dose and dose rate, to biological measures such as scorable cytogenetic changes, observable satellite DNA and immune deficiency. Defining such observables is beyond the scope of the present report, and will be the subject of further consideration by IAEA and other organizations. It is worth noting here, however, that the selection of such endpoints has scientific and ethical dimensions. Some have technical advantages — that they are indicative of some or all of the biological effects; suited for early warning or for compliance purposes. However, ethical considerations, particularly issues related to human dignity, may promote consideration of additional endpoints, for example for public information purposes.

There are other issues with respect to measurement and assessment that need resolution and consensus before clear guidance can be provided to Member States. These include the choice of the target organism for dose estimations, i.e., the degree of approximation to real organisms and real exposure geometries that might be appropriate in different circumstances, and where and when the definition of reference organisms might be appropriate. In addition there is the selection of the relative weights to be accorded radiation of different qualities that reflect their relative biological effectivenesses.

These topics have been discussed in recent meetings [52, 53, 56] and in a variety of documents (e.g. [2]). The options for resolving the issues are becoming clearer and there would appear to be a role for international organizations such as the IAEA, UNSCEAR and the ICRP, which has recently established a Task Group, to consider the subject of environmental protection, in helping to bring about a consensus. The International Union of Radioecology (IUR) has also been involved in evaluating knowledge on the effects of radiation on living organisms, frameworks for protection and ethical considerations [52, 57] and may also be expected to have a role in this process.

There have been a number of reviews by international and national agencies that have summarized much of the data that exists on the effects of radiation on biota and on the behaviour of radionuclides in the abiotic and biotic environment, for example, UNSCEAR [58], IAEA [59], the US Department of Energy [60] and the Environment Agency of England and Wales [61]. The FASSET project, being undertaken as part of the EC 5th Framework Programme [62, 63], also has as one of its objectives the provision of a database for information on the effects on biota. It is anticipated that one of the results of these projects will be further guidance to the scientific community on where the gaps are in knowledge of effects.

At recent meetings [53, 56] there have been descriptions of frameworks for assessment and management of environmental protection from ionizing radiation, developed or being recommended in some Member States. Although there are similarities (for example, a graded or stepwise approach) between some, there are differences in detail. The coherence that is desirable between the approach to be taken with ionizing radiation and with other environmental contaminants has not been defined, nor has the coherence that may be possible

or desirable between protection of the environment and protection of humans. Resolving these issues and bringing about a consensus will be an important role for international organizations.

The purpose of this report is to prompt feedback and discussion on the underlying ethics and principles of environmental protection and their relationship to the development of a protection framework from ionizing radiation. This will be a significant step towards the development of guidance on a practical environmental protection framework.

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