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Journal of Environmental Radioactivity 74 (2004) 171–183
JOURNAL OF ENVIRONMENTAL RADIOACTIVITY
www.elsevier.com/locate/jenvrad

An ethical dimension to sustainable restoration and long-term management of contaminated areas

Deborah Oughton [a,*], Ellen-Marie Forsberg [b], Ingrid Bay [a], Matthias Kaiser [b], Brenda Howard [c]

[a] *Department of Plant and Environmental Sciences, Agricultural University of Norway, P.O. Box S003, 1432 Aas, Norway*

[b] *The National Committee for Research Ethics in Science and Technology (NENT), Oslo, Norway*

[c] *CEH, Lancaster Environment Centre, Library Avenue, Lancaster LA1 4AP, UK*

Abstract

Experience after the Chernobyl accident has shown that restoration strategies need to consider a wide range of different issues to ensure the long-term sustainability of large and varied contaminated areas. Thus, the criteria by which we evaluate countermeasures need to be extended from simple cost–benefit effectiveness and radiological protection standards to a more integrated, holistic approach, including social and ethical aspects. Within the STRATEGY project, the applicability of many countermeasures is being critically assessed using a wide range of criteria. Attention is being given to issues such as practicability, feasibility, capacity and environmental side-effects, as well as social factors such as public perceptions of risk, communication of information and the need for dialogue and consultation with affected communities, and ethical aspects such as informed consent and the fair distribution of costs and doses. Although such socio-ethical factors are now the subject of a substantial field of research, there has been little attempt to integrate them in a practical context for decision makers. Within this paper, we specifically consider the ethical aspects of restoration strategies and suggest practical means by which these can be taken into account in the decision making process, introducing a value matrix. The paper covers two critical areas: evaluation of individual countermeasures, and use of the matrix to ensure transparent and systematic consideration of values in selection of a restoration strategy.

* Corresponding author. Present address: University of Oslo's Ethics Programme, Forskningsparken, Gaustadalleen 21, 0349 Oslo, Norway. Tel.: +47-649-48250; fax: +47-649-48359.

E-mail address: deborah.oughton@ipm.nlh.no (D. Oughton).

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doi:10.1016/j.jenvrad.2004.01.009

Keywords: Countermeasures; Radioactivity; Ethics; Restoration; Value matrix; Justification

1. Introduction

In radiation protection policy, the primary objective of countermeasure implementation is usually dose reduction. In order that an action be justified, the benefits from dose reduction or averted dose should outweigh the costs of implementing the countermeasure; in optimisation, one is usually aiming for the *most* cost-effective option (ICRP, 1989; 1991). However, investing money to reduce exposure to radiation is a trade-off, and one that is not without controversy in radiation protection (Bengtsson and Moberg, 1993). For example, it has been suggested that society invests too much money to reduce exposures; that this money would be better spent reducing other health risks; that the differences between investments in Western and developing societies is immoral; and that it is difficult to justify spending more money to reduce some exposure sources than others (Cohen, 1980; Becker, 1991; Jaworowski, 1999). Even based on the two criteria of monetary cost and dose, a decision on how to reduce exposure to radiation will be an ethical judgement: theoretically, we are making choices about which lives to save and at what cost.

In deciding which countermeasures are practicable, most previous evaluations have concentrated on technical or economic constraints. For example, that the slope of the hill is too steep to allow ploughing, that there is insufficient labour, or simply that the countermeasure is too expensive. However, recent ICRP recommendations acknowledge that the costs of countermeasures may be both social and economic, and that there may be benefits other than dose reduction (ICRP, 2000). With respect to nuclear accidents, there has been an increased awareness that countermeasure evaluation can include a variety of social and ethical considerations (Oughton, 1996; Morrey and Allen 1996; Hériard Dubreuil et al., 1999; Kelly, 2001; Nisbet and Mondon, 2001). Stakeholder evaluation of countermeasures suggested that many countermeasures (especially in the UK) were as likely to be rejected on socio-ethical grounds as technical and economic grounds (Nisbet, 2002). Examples included a strong aversion to any measure that would bring about contamination of previously uncontaminated foods (e.g. mixing milk from different sources) or environments, and an awareness of the problems of contaminated foodstuff appearing in the black market. Finally, legal constraints can play an important role, particularly with respect to environmental legislation (e.g. habitat protection) and labour rights, but also include foodstuff intervention limits and dose limits.

Regarding social issues, it is clear that countermeasures may impact on community or cultural values in a number of ways (Hunt and Wynne, 2002). For example, a countermeasure may specifically affect an ethnic minority (which can, in turn, raise equity issues), a cultural heritage (with implications for present and future generations) or regional identity (with implications for people's sense of well-being). Additional benefits for the community can be gained from protecting such factors. Disruptions to existing social and cultural patterns—such as those requiring changes in employment or lifestyle—are generally taken as negative. Beneficial consequences might include the generation of employment opportunities. Whilst not all dimensions of social impacts are reducible to ethical components, many of the underlying dimensions can be addressed through ethical assessment, and in some cases impacts can be properly integrated into judgements.

Acknowledgement of these developments has been an important part of the STRATEGY 5th Framework EU project—Sustainable Restoration and Long-Term Management of Contaminated Rural, Urban and Industrial Ecosystems (www.strategy-ec.org.uk), which includes a number of countermeasure evaluation criteria such as practicality and acceptability, socio-ethical aspects, environmental consequences and indirect side-effect costs (Howard et al., 2002). In practice, however, there is a danger that inclusion of these additional assessment criteria will prove problematic. For example, difficulties may arise due to:

- the many dimensions to the criteria;
- the fact that different people will be affected in different ways;
- the complexity of the issues (many countermeasures have both positive and negative social and ethical consequences);
- the various "trade-offs" that may be required when making choices;
- possible lack of agreement within society on what is practical or acceptable, let alone on how to "put a price on" such non-monetary side-effects; and
- the lack of established procedures, and experience, in systematically incorporating these dimensions in decision-making.

Deciding on a remediation strategy based on a multi-criteria evaluation is going to require a whole suite of trade-offs and value judgements. If such a selection is going to be ethically and rationally defendable, decision-makers require advice on what criteria are important to consider and why, and also a methodology to ensure a systematic, transparent and publicly justifiable procedure for balancing these criteria. The aim of this paper is to offer such advice and to give suggestions for such a methodology (i.e. a value matrix) that may be applied.

2. Ethical aspects of individual countermeasures

Previous work has identified a number of general ethical issues that will be relevant for any risk assessment, including radiation protection (Shrader-Frechette, 1991; Oughton, 1996, 2000; Shrader-Frechette and Persson, 1997). These include questions such as: whether (i) the distribution of cost and benefits is equitable; (ii) the risks are imposed or voluntary; (iii) stakeholders[1] have been involved in the

[1] Although increasingly referred to in risk management, the use of the term "stakeholder" can raise problems since there are various definitions and interpretations of the word, including (in English) something akin to a legal claim. In this paper, we use the term very generally to indicate affected or interested parties. An interpretation that is perhaps closest to the German term "Betroffene".

decision-making process; and (iv) the action carries a risk of serious environmental damage. Within STRATEGY, these have been extended and revised to provide a preliminary evaluation of the main ethical, social and legal aspects of possible countermeasures. As part of the STRATEGY project, participants have produced a database containing 101 templates of countermeasures applicable in rural, agricultural, industrial and urban areas, including 15 social/human countermeasures (e.g. compensation, medical check-up) and a set of countermeasures related specifically to waste treatment (Howard et al., 2002; Nisbet et al., 2003; Andersson et al., 2003).

A short summary of the main ethical issues considered is included below, and represents an overview of the types of questions and ethical criteria against which each individual countermeasure can be evaluated. Obviously, the list is not exhaustive and is intended to provide only an illustration of some of the issues that might be considered within a value matrix. The descriptions and examples are rather general since the actual issues will be site and context specific.

2.1. *Self-help/disruptive*

"Self-help" considers the extent to which the affected persons themselves can implement the countermeasure, and their degree of control or choice over the situation. Voluntary countermeasures that are carried out by the public or affected individuals themselves, or that increase personal understanding or control over the situation, are usually deemed positive as the action respects the fundamental ethical values of autonomy, liberty and dignity. Concrete examples include the provision of counting equipment, dietary advice and certain agricultural procedures that could be carried out by the farmer. On the contrary, imposed countermeasures that are highly disruptive, infringe upon liberty, or restrict normal practices are usually judged to be negative. Examples would include relocation, bans on amenity use, or a radical change in farming practice.

2.2. *Free informed consent of workers (to risks of radiation exposure and/or chemical exposure) and consent of private owners for access to property*

The issue of consent is strongly linked to the fundamental ethical value of autonomy. Employers have a duty to obtain the informed consent of any worker who may be exposed to chemical and or radiation risk. This is particularly important if lower paid workers (e.g. cleaners for industrial countermeasures) are employed to carry out the measure, as it has been suggested that the necessary conditions for free informed consent are often violated for these groups (Bullard, 1990; Shrader-Frechette, 2001). The increased risk may justify some form of compensation via higher wage premiums, but the opportunity for certain sub-groups of the population to make a profit at the expense of others can have negative social consequences (e.g. increased inequity—see below). Furthermore, compensation itself can raise questions of whether or not this may coerce people into taking risks they would otherwise not have (Bullard, 1990; Rawles, 2002).

2.3. Informed consent regarding consumption of foodstuff

In cases where foodstuff are already contaminated due to the accident, consent of consumers can be an issue, but is complicated by the question of who exactly has the obligation to obtain consent—authorities, farmers, producers, retailers—since they are not directly responsible for causing the contamination. Countermeasures bringing about a change in dose distribution because they cause previously uncontaminated food to contain radionuclides can raise even more complex issues of consent and responsibility (e.g. mixing milk sources or feeding livestock with contaminated fodder). Those responsible for carrying out the countermeasure might be deemed to have a special obligation to obtain free informed consent from affected consumers/producers. In both cases, informed consent may necessitate a specific need for labelling and other forms of information provision.

2.4. Distribution of dose, costs and benefits

The way in which a countermeasure may influence the distribution of costs, risks and benefits, has significance due to the fundamental ethical values of equity, justice and fairness. Costs, benefits and risk may vary over both space and time, and between different members of a community. Dose distribution is obviously a main consideration for radiation protection, and many countermeasures that reduce collective dose (man Sv) may also change the distribution of dose, for example, from consumers/users/farmers to workers/consumers/populations around waste facilities. The question of who is paying the monetary and social costs of the countermeasure and who will receive the benefits must also be addressed. Some countermeasures, and sets of countermeasures, result in an equitable distribution of cost and dose reduction, such as investment by tax payers to reduce activity concentrations in a common food product; others are less equitable, for example, when a reduction of dose to the majority is only possible at the expense of a higher dose, cost or welfare burden, on a minority (e.g. banning all farm production in a small community). Another question is whether the countermeasure has implications for vulnerable or already disadvantaged members of society (children, ethnic or cultural minorities)?

2.5. Liability and/or compensation for unforeseen health or property effects

Employers usually hold legal and ethical responsibilities over their employees, and contractors or industries may be held legally or financially liable for any damage they may cause to public or private property. The matter of who bears liability is relevant both from the point of responsibility (moral and legal) and because of links to equity issues. Liability can become particularly important if outside contractors are paid to carry out the countermeasure, both for the contractor themselves—Will I be sued if the countermeasure causes unforeseen damage?—and the workers/property owners who may risk injury—Will I be compensated if the countermeasure causes me damage?

2.6. Animal welfare issues

Animal welfare is concerned with the amount of suffering the countermeasure may inflict on non-human sentient animals. In the context of agricultural countermeasures, these will be most relevant to farm animals, but could also include zoo exhibits, pets or wild animals. For example, a ban on use of recreational areas may have implications for dogs. There are a number of philosophical debates around the question of why one should value non-human living beings, and whether or not they have moral standing (Regan and Singer, 1989; Oughton, 2003). Nevertheless, in many countries, animal welfare issues are covered by law, and may result in both legal and ethical constraints on some countermeasures.

2.7. Change in public perception or use of an amenity

If a countermeasure has some effect on the public's use of a particular amenity (such as a park), then this will have an influence on the acceptability of that countermeasure. But such effects can have deeper relevance than whether or not people are able to use the amenity. Perceptions can include, for example, that something has changed from being "natural" to "unnatural" or "clean" to "damaged". This is an issue with which the public has a strong tendency to attach moral relevance (Thompson, 1997), and certainly impacts upon people's sense of their quality of life.

2.8. Uncertainty

Uncertainty in this context can be taken to refer to an evaluation of the risk (environmental, technical, social) associated with the countermeasure, and relate to the question of what the actual consequences of the countermeasure implementation will be and the probability that that outcome will occur. Uncertainties can arise due to variability (e.g. environmental factors influencing ecosystem transfer of radionuclides, or differences in individual susceptibility to disease) and statistical error. In some cases, uncertainties can be reduced by further research, thus knowledge from previous experience of countermeasures will be important. In evaluating individual countermeasures we need to consider: What are the main uncertainties associated with the countermeasure? What action might be taken to avoid or reduce these uncertainties, and are some inevitably indeterminate? What are the consequences of being wrong?

2.9. Environmental risk from ecosystem changes, groundwater contamination, etc.

Countermeasures that change or interfere with ecosystems (e.g. ploughing or fertilising unimproved pastures) may produce negative environmental consequences. In addition to the obvious questions of uncertainty, environmental risk raises a variety of ethical issues including consequences for future generations, sustainability, cross-boundary pollution, and balancing harms to the environment/ animals against benefits to humans. The ethical acceptability of the countermeasure will be highly dependent on the ecological status of the area and the degree to which the action diverges from usual practice. In most cases, environmental legislation must be considered.

2.10. Environmental consequences of waste generation and treatment (chemical and radioactive)

Countermeasures that produce waste will raise both equity and environmental risk issues. Waste disposal can lead to a "redistribution" of radiation exposures, and the environmental impact of disposal sites will need to address both ethical and legal implications. For example, balancing human (present and future generations) and non-human (animal, environment) interests. Hence, any countermeasure involving the generation of waste and/or its treatment will have ethical relevance (and controversy) in itself. Treatment of waste in situ can be positive as it avoids problems arising from "redistribution" of exposures to persons living close to disposal site. But, in situ treatment may also have negative side-effects due to complicating future waste removal or "causing" contamination of soil. These issues are raised briefly within the relevant countermeasure templates and those templates dealing specifically with waste treatment.

2.11. Doses, costs and side-effects

The averted dose and the calculated cost of countermeasure implementation have direct consequences for the welfare of society and/or individuals, and are thus also important ethically relevant aspects. These issues are covered in separate sections within the countermeasure templates, hence they have not been included specifically under ethical aspects. Other non-monetary consequences that may influence people's welfare, well-being or "happiness" have been included in the template sections on social impacts and constraints (Hunt and Wynne, 2002), as well as the methodology for evaluating side-effect costs (Alvarez and Gil, 2003). All these consequences will need to be addressed within an ethical evaluation of countermeasures and restoration strategies.

3. Main differences between evaluation of individual countermeasures and holistic strategies

Individual countermeasures each have ethical, legal and social factors that will bear on their acceptability and effectiveness. However, when combined into a holistic strategy, the overall impact on a region's population and environment also needs to be evaluated. Whilst individual countermeasures may be satisfactory, their combined use within a restoration strategy may lead to an unfair distribution of costs, doses and benefits across the population. On the other hand, countermeasures can be combined to ensure a more even distribution, or adjusted to ensure that minority populations have either consented to, and/or been compensated for, any prior inequity.

Whether or not a countermeasure is rejected or accepted in practice will also depend on the available alternatives. An unpopular countermeasure may become acceptable if the only other alternatives are both more expensive and more socially disruptive; a viable countermeasure may become inappropriate if there is a less ethically problematic alternative. Hence, the eventual selection of a holistic strategy (i.e. the group of countermeasures) will require a holistic evaluation, including a systematic comparison of the available countermeasures. This can, in turn, raise a new set of ethical and social issues, related specifically to the judgements and trade-offs that will be needed when making choices between alternatives, and the process by which this selection is carried out.

Both the evaluation and the selection of countermeasures will need to be based onsite- and context-specific data, including guidelines for collecting relevant information on both the site itself and effects of individual countermeasures, procedures for evaluating the decision-making process and recommendations for communication and participation (Hunt and Wynne, 2000). As a procedure for ensuring transparent and systematic consideration of ethical issues, we suggest a matrix approach to help map the various values at stake.

4. Making ethical decisions on restoration strategies

Good practical ethical decision-making is built upon three conditions: high quality and relevant information (*facts*); ethical argument informed by relevant ethical theories (*values*); and moral *judgement*. In pluralistic societies, views on both facts and values typically differ, which makes it difficult to ascertain that all relevant information has been collected and that there is no bias towards particular ethical approaches (Forsberg and Kaiser, 2002).

Rather than relying on an overarching ethical theory to evaluate actions (usually resorting to an appeal to either utilitarian or deontological doctrines), a principle-based approach in applied or practical ethics holds that some general moral norms are central in moral reasoning, and that these may be constructed as principles or rules (Childress, 1998). There is a huge variety of principle-based approaches and, arguably, the most successful in practical ethics are those that adopt a pluralistic view, and can find a broad degree of support from different ethical theories or cultural beliefs. One of the most famous and widely used examples of principle-based ethics is that of Beauchamp and Childress (1994), who identified four basic principles that form the foundation of modern medical ethics: (i) *respect for autonomy* (a norm of respecting the free-will and decision-making capacities of self-governing persons; (ii) *non-maleficence* (a norm of avoiding the causation of harm); (iii) *beneficence* (a group of norms for providing benefits and balancing benefits against risks and costs); and (iv) *justice* (a group of norms for distributing benefits, risks and costs fairly).

While Beauchamp and Childress addressed issues concerning primarily the relationship between doctor and patient (or the public and the health service), there is a greater complexity in using the approach in societal decision-making, which has to cover a much wider area of concern, often including animals and the environment. Inspired by medical ethics, Ben Mepham transferred Beauchamp and Childress' approach to a practical scheme for addressing broader policy related problems, suggesting that the various principles, values and stakeholders can be best summarized in the so-called "ethical matrix" (Mepham, 1996, 1999).

The approach we propose takes its starting point in three fundamental principles, namely:

1. To promote *well-being* and minimise health risks, welfare burdens and other detriments to affected stakeholders
2. To respect the *dignity* or *integrity* of affected stakeholders
3. To recognise the norm of *justice* and aim to treat everybody fairly and ensure an equitable distribution of goods among affected stakeholders.

The preparatory matrix shown in Table 1 represents a detailed specification of these three general principles as derived by a number of co-operating researchers in STRATEGY. It encompasses all the values that were considered relevant and it may be used as an example by an actual decision-making group. Many of the issues can be traced to those identified as relevant for the ethical and social evaluation of individual countermeasures, and will have several relevant further specifications according to the particular case in question (Oughton et al., 2003).

In practice, a matrix can aid a decision-making group by giving an overall picture of the ethical status of the issue at stake. Different countermeasures can affect different groups in different ways, and the matrix can be used to help identify the relevant information required for decision-making (i.e., the facts, values and stakeholders affected). In this way, a bias towards certain kinds of values may be avoided, and the matrix can be used to address conflicts between values in a systematic way, without, necessarily, having to invoke full-fledged theories. However, a method for getting a grip on facts and values will not be sufficient. Even with all the relevant information on the table and with a systematic representation of different values, moral *judgement* must be exercised (Forsberg and Kaiser, 2002). A central question for any decision-making process is that of who is to judge? For decisions that concern the whole of society, and for STRATEGY, *stakeholder* involvement is a central element for ensuring a justified and publicly acceptable conclusion.

If follows that matrix construction and evaluation should be performed in a participatory process with stakeholders. Public involvement in decisions is important as different groups will contribute with local knowledge in addition to technical, expert-based knowledge (e.g. Wynne, 1989; Bay and Oughton, 2001; Nisbet and Woodman, 2000). Selection between different countermeasures will require trade-offs and value judgements. The matrix can be used to help in weighting and/or ranking the importance of those values by the affected stakeholders, and making the ethical dimension of decision-making more transparent. Whatever the reason for selecting a strategy or deciding that a particular countermeasure is impracticable or unacceptable, it is important that the reasons are made explicit and (if necessary) open to revision at a later date.

Table 1
Illustration of a tentative value matrix developed for use in a radiation accident situation

Stakeholder	Examples	Well-being (example: health and economic welfare	Dignity/integrity (example: choice/consent/(legal) rights	Justice/distribution (Is any sub-group of stake-holders worst-off?)
Owners/employers	Government Farmer House dweller Land owner Hotel owner Shop owner Business proprietor Factory owner Local authority	Doses to humans Loss/gain in income Loss of property Damage to, or reduction in value of, property Loss of taxes Compensation	Self-help Consent Property rights Being allowed to pay their duties Contract fulfilment No disruption No insecurity Liberty	Possibility for conflict between different industries or projects
Workers/employees	Tennant farmer Farm workers Factory workers Contractors Countermeasure workers Immigrant workers Other employees	Doses to humans Fear of job loss Gain/loss of income Insecurity Family relationships Compensation	Traditional skills and practices Trust and loyalty to local farmers Consent Training	Possibility for disputes and social inequity
Users/community	Neighbours Recreational Tourists Public amenity (library, town hall, playground, park) Local community	Access Aesthetic value Empathy Isolation Community values Tourism Compensation	Respect for public heritage and footpaths Community sense Personal control Self-help Liberty	Potential conflict of age/sex/ cultural minorities Availability of alternative amenities
Consumers	Consumers Secondary food producers Other secondary producers (e.g. timber)	Doses to humans More expensive goods Loss of jobs Insecurity	Information Choice Self-help Intervention limits	Potential conflict between different income groups concerning diet and possibility of self-gathering
Future generation	Future food production Future clean air and water Future users of recreational areas, etc.	Loss of opportunities to use areas, resources, common goods, etc	Respect for the right to keep living according to basic human values	No one future group be sacrificed for the presumed good of other future groups
Environment	Farm animals Wild animals Pets Other biota Ecosystems	Dose to biota Other toxic/health effects Compensation	Endangered species Loss of habitat Right to life consistent with their nature	Potential conflict between farm and wild animals, between ecosystems

Table 1 (*continued*)

Stakeholder	Examples	Well-being (example: health and economic welfare	Dignity/integrity (example: choice/ consent/(legal) rights	Justice/distribution (Is any sub-group of stake-holders worst-off?)
Waste location stakeholders (if different from accident location)	Including all the above stakeholders connected to the waste site.	Uncertainty/risk estimates: Possibilities for monitoring, retrieval and treatment must be known Compensation	Consent Self-help Information etc.	Potential conflict between stake-holders close to disposal site

5. Advantages and disadvantages of using a value matrix—experience

An advantage of the matrix is that it is able to cover most of the relevant values that should be considered in a certain decision area. And although the matrix represents a relatively new methodology, it has been tested within evaluation processes and has been demonstrated to be an appropriate tool for use in participatory and deliberative decision processes (Kaiser and Forsberg, 2001; Mepham, 1999, 2000). It has also been successfully tested in a recent end-user exercise connected to the STRATEGY project (Cox et al., 2004). The conclusion in both Mepham's and NENT's studies was that a value matrix can work relatively well for the purpose of structuring a discussion. There were, however, certain practical problems connected to specifying the principles and weighting the specifications, agreeing on the facts, and undertaking the final evaluation. Also, the matrix is a rather cumbersome tool that takes time to explain to participants. These practical problems are taken up both by Mepham and the NENT project (Forsberg and Kaiser, 2002). The general conclusion suggests, however, that the advantages in some cases of complex decision-making may outweigh the practical problems related to the process.

6. Conclusions

Rather than seeing the inclusion of ethical and social values as an additional burden on top of what is already a complicated process, our view is that ethics can be a practical tool to aid decision-makers. We suggest that a systematic consideration of ethical and social issues, including an ethical justification of the decision-making procedure itself will eventually make countermeasure selection more transparent and less controversial for society.

A value matrix is a tool to ensure that all relevant concerns are being taken into consideration and to clarify the ethical basis upon which eventual decisions are made. There is no deduction of the correct ethical answer from the evaluation matrix; the matrix is not a substitute for ethical judgement, it is a way of doing it. As an isolated tool it is not of much help—a tool must necessarily have someone who handles it. But when a value matrix is combined with a stakeholder process the real benefit of both the matrix and the participatory approach appears.

Acknowledgements

The STRATEGY project is being carried out under a contract (FIKR-CT-2000-00018) within the research and training programme (Euratom) in the field of nuclear energy, key action: nuclear fission and whose support is gratefully acknowledged. The paper is the sole responsibility of the authors and does not reflect Community opinion, and the Community is not responsible for any use that might be made of data appearing in this publication. We gratefully acknowledge the contributions of other STRATEGY participants.

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