Identification of functionally active genomic features relevant to phenotypic diversity and plasticity in cattle

Deliverable 8.5

Framework to enable professionals to address societal dimensions of livestock breeding

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This deliverable consists of an ethical framework that is meant for wider dissemination and a report that discusses the framework's background and application. Both parts of the deliverable should be made available in the public domain. This deliverable will form the basis of the stakeholder workshop which WP8 is organizing (deliverable 8.6).

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1. Summary of results

There are several reasons why breeding companies and others stakeholders in farm animal breeding may want to have better ethical discussions about (developments in) animal breeding. This report presents a tool that facilitates having discussions that include a wider range of publics and draw on a variety of ethical perspectives.

Part I of the tool consists of questions that serve to define the scope of discussion. Which breeding technique(s) or practice(s) should be discussed? Should it be discussed from an 'ideal' or 'non-ideal' perspective? Should the discussion focus on new or existing ethical concerns? And which ethical concepts or perspectives should be applied? In part II, the ethical concepts and perspectives selected are translated into specific questions to be addressed in the actual ethical discussion. Part III, finally, involves selecting an ethical approach for reaching a conclusion based on the answers provided in part II, and formulating a decision or standpoint about the breeding practice or technique discussed.

The tool is based on an inventory of societal and ethical issues with respect to breeding (provided in earlier reports), but also on general criteria for good ethical tools. The tool developed strives for *comprehensiveness* by offering a wide range of ethical perspectives for discussions. It serves *transparency* by making the scope of discussion explicit and by showing how ethical concepts motivate asking specific questions. It aims to be *user-friendly* by explaining ethical concepts in terms that are easy to understand for users not trained in ethics and translating them directly into relevant questions. Finally, the tool is *flexible*: it can be tailored to needs of its users.

2. Introduction

A. *The need for broader discussion about agricultural animal breeding*

How humans breed animals for agricultural production has changed significantly over the past decades. Contemporary breeding programmes do not only aim for high productivity (for example milk yield in dairy cows), but also address various other breeding goals, such as feed efficiency, disease resistance, and longevity (Cole et al. 2020, EFFAB 2020, Seidel et al. 2020). Moreover, techniques have been developed that enable breeding more effectively, so that more 'genetic progress' towards such breeding goals can be made. Important innovations have been the shift towards breeding on the basis genomic information ('genomic selection') and the introduction of assisted reproduction techniques that allow generating more offspring from top-ranking female breeding animals (Boichard & Brochard 2012, Crowe et al. 2021, Pryce & Deatwyler 2012). Genomic selection and assisted reproduction techniques are frequently used in tandem, which reinforces the effectiveness and competitiveness of the breeding programme (Lund et al. 2021, Thomasen et al. 2016, Voisine & Sirard 2022).

Compared to some other biotechnological innovations with potential applications in agricultural animal breeding (notably cloning and genetic modification), these developments have been relatively uncontroversial. The ethics of using genomic selection and assisted reproduction techniques in animal breeding has been addressed by some academics (Coles et al. 2015, Holloway & Morris 2008, 2012, Holloway et al. 2021, Mark & Sandøe 2010, Kramer & Meijboom 2022, Turner 2010, Twine 2010, Voisine & Sirard 2022), but has not attracted widespread scholarly attention or overt public concern. Moreover, although there has been discussion about the merits of genomics among farmers and breeders, genomic selection has become a standard breeding procedure in many livestock species and breeds (Banks 2022, Lonkila & Kaljonen 2018, Lund et al. 2021).

The widespread adoption of these breeding techniques seems to reflect the perception that there is, fundamentally, 'nothing new' about how animals are bred nowadays (Lund et al. 2021; cf. Kramer & Meijboom 2022). Genomic selection does not involve inserting genes from another species into an animal's DNA, nor does it require editing an animal's genetic material by any other laboratory techniques. It thus avoids some of the main objections that have been raised against biotechnologies like transgenesis (e.g. PABE 2001; Macnaghten 2004) and genome editing (e.g. Eriksson et al. 2018, De Graeff et al. 2019): genomic selection does not 'cross species boundaries', for example, or create animals that could not arise through 'natural' processes. Genomic breeding involves selecting and crossing animals that are considered to have desirable

traits, and breeders have been doing just that for decades, except that selection decisions are now informed by genomic data.

This perception also sets the scene for further innovations in animal breeding. New breeding techniques that are perceived to be similar to established techniques are likely to find acceptance (Lund et al. 2021, Naab et al. 2021). When discussing the societal and ethical acceptability of applying genome editing in livestock breeding, for example, a common argument is that genome editing is not like traditional genetic modification: it does not involve inducing more or less random mutations or introducing DNA from one species into the DNA of another. At least when producing genetic variants that (can) also occur in unedited populations, genome editing would according to this argument be similar to traditional breeding, just quicker and more efficient. The apparent implication is that genome editing does not raise significant public or ethical concerns.

There is nonetheless a need for wider discussion about (developments in) animal breeding, for various reasons.

Firstly, innovations in agricultural animal breeding could be discussed as potential solutions to societal or ethical issues. There is an interest in breeding animals who excrete less methane or who need less feed while producing meat or milk, for example, so as to reduce animal agriculture's climate impact (cf. Kramer & Meijboom 2020). In addition, some have proposed using breeding technologies to improve animal health and welfare (*ibid.*): to make animals more resistant to diseases that frequently lead to large-scale culls, or to breed animals who lack features (e.g. horns) that are in current practice commonly removed by harmful physical interventions (e.g. dehorning). Insofar as such breeding goals are ethically desirable and can be promoted through technological innovations, an ethical argument can be offered in favor of these technological innovations. But it clearly remains relevant to consider any ethical concerns with regard to these innovations and, if there are any, whether the ethical pros outweigh the cons. From a Responsible Research and Innovation (RRI) perspective, moreover, an important question is whether an innovation is the right type of response to an issue, which typically depends on how that issue is understood. A common objection to developing breeding innovations that could help to address animal health and welfare problems, for example, is that such a solution would not address the root cause of these problems, namely that animals are expected to adapt to unsuitable living conditions (e.g. Middelveld & Macnaghten 2023). Justifying a breeding innovation from an ethical perspective thus requires showing that the innovation is an appropriate means to legitimate purposes.

Secondly, even innovations that are continuous with current practices in significant respects deserve careful ethical consideration. As Kramer & Meijboom (2022) have argued, ethical problems in animal breeding often arise from a succession of similar decisions rather than one 'ethical game changer' (cf. Schultz-Bergin 2018). The welfare problems with which breeding has been associated – such as bone fragility in fast-growing broiler chickens – were the result of many breeding decisions progressively prioritizing productivity (Farstad 2018; Fernyhough et al. 2020; Rauw et al. 1998), and the use of invasive reproductive technologies also intensified in a stepwise manner (Niemann & Seamark 2018; Turner 2010). Even if none of these steps was ethically disruptive by itself, they did raise significant ethical concerns collectively. It is hence important to discuss not only what is new about particular innovations but also whether they solve, perpetuate, or worsen any ethical problems in animal breeding (Kramer & Meijboom 2022). In other words, the general direction of developments in breeding needs to be questioned critically.

Thirdly, it should not be assumed that such discussion is unnecessary because current practices appear to be widely endorsed by society. While a majority of EU citizens consume animal products, over 80% of respondents in a recent survey agreed or strongly agreed that the welfare of farmed animals in their country should be better protected than it currently is (European Union 2023). The well-known 'meat paradox' is that many people eat meat even though they are troubled by the idea that animals suffer in its production (Bryant 2019, Loughnan et al. 2010). People who eat meat may employ coping mechanisms to reduce the psychological tensions which this paradox generates, but often do acknowledge ethical concerns about meat production or even concede that switching to a vegetarian or vegan diet would be more ethical (Bryant 2019; Onwezen & Van der Weele 2016). Similarly, a 'cheese paradox' has been found among vegetarians, who often have ethical concerns about dairy farming but still consume dairy products, which results in cognitive dissonance (Docherty & Jasper 2023). These phenomena show that attitudes towards animal production practices cannot be inferred from consumptive practices but should be studied separately (Te Velde et al. 2002). Few studies have addressed public attitudes towards breeding techniques that are widely used today (or apparently small developments thereof); most research has focused on attitudes towards genetic modification and genome editing (e.g. Frewer et al. 2014; Van der Sluis et al. 2022). One recent study (Naab et al. 2021) does suggest that genomic selection is less controversial than modifying or editing animals' genes in the laboratory. But study participants were critical of applications that did not serve animal welfare or that would change animals' species-specific characteristics, and they were concerned that breeding technologies would be used to adapt animals to undesirable production practices (instead of adapting those practices). Pieper et al. (2016) found that a majority of German survey respondents rejected the use of advanced reproduction techniques in dairy production. Lund et al. (2023) found that

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many Danish respondents also perceived the use of advanced reproduction techniques negatively, but generally did accept the use of semen from bulls that had been bred in programmes exploiting such techniques.

It deserves note here that public views on how humans should treat animals are not static. Lund and colleagues speculate that the increased use of reproductive techniques in humans may have reduced concerns about using such techniques in animal breeding, which could explain why respondents were less negative about such techniques than the respondents in Pieper et al.'s (2016) earlier study. On the other hand, vegetarianism and veganism are on the rise in certain parts of the world, and ethical views concerning animal agriculture are among the main motivations for people to abstain from consuming animal products (Martinelli & Berkmanienė 2018; Vestergren & Uysal 2022). Public concern about the treatment of animals in animal agriculture may thus be increasing in at least some societies. For this reason too, one should not assume too easily that what society has accepted for a long time does not deserve ethical discussion.

Finally, other stakeholders may have ethical concerns that deserve to be discussed, irrespective of general publics' attitudes towards animal breeding. Morris and Holloway (2012) and Lonkila and Kaljonen (2018) discuss how farmers and small-scale breeders relate to new breeding technologies based, in part, on ethical values. In a quantitative study, Lund et al (2021) found that while 61% of Danish dairy farmers considered the combined use of ovum pick up, in vitro embryo production, and genomic selection ethically acceptable, about 6% disagreed or strongly disagreed, and 33% were conflicted or undecided. The point is that many farmers and breeders do not simply accept breeding techniques but consider the ethical dimensions of such techniques important. The same is certainly true for animal advocacy NGOs (e.g. CIWF 2022).

We conclude that discussing the ethical dimensions of animal breeding practices and techniques remains important. An important commitment of Responsible Research and Innovation (RRI) is to include the ethical perspectives of stakeholders and wider interested publics in such discussions (e.g. Stilgoe et al. 2013, Sykes & Macnaghten 2013). Three motivations for opening up discussions on innovations to wider publics have been distinguished in RRI literature, each of which seems relevant here.

On an instrumental motivation, addressing the ethical views of stakeholders and citizens aims to ensure support for potentially controversial practices or innovations (Stirling 2008; Sykes & Macnaghten 2013). Given the long time-scale on which animal breeding must operate, it seems prudent for breeders to anticipate how societal views towards breeding will turn out. The use of contemporary breeding techniques is not controversial today, but Lund et al. (2023) observe that many people are either ignorant

or undecided about the use of these technologies and that it is unclear how public attitudes will develop. Lund and colleagues state that public moral outrage about advanced breeding techniques is not unthinkable and urge the breeding industry to ensure that their use of these techniques would be acceptable to knowledgeable and engaged citizens. The observation that the adoption of breeding techniques depends in part on farmers' ethical views (Morris and Holloway 2012; Lonkila and Kaljonen 2018) also offers an instrumental motivation for breeding companies to engage with such views.

On a normative motivation, engaging with the ethical concerns of wider publics is in itself the right thing to do (Stirling 2008; Sykes & Macnaghten 2013). From the perspective of democracy or equity, it can be argued that people ought to have a say on matters that are important to them (Sykes & Macnaghten 2013). One could argue along these lines that stakeholders and citizens should be enabled to share their concerns about animal breeding. This is indeed what the Code of Good Practice for Farm Animal Breeding Organisations (EFFAB 2020) professes to do. This voluntary code "aims to contribute to the mutual understanding between breeders/farmers on the one side and the society on the other side" (EFFAB 2020: 4), and it proposes continuous consultation as a way to take the values, needs and concerns of consumers and other stakeholders into consideration.

On a substantive motivation, the point of including more voices would be to have substantively better discussions and reach better conclusions (Stirling 2008; Sykes & Macnaghten 2013). Stakeholders such as farmers for example have local knowledge about the conditions under which animals will be farmed and can indicate their preferences as producers, retailers may know consumer preferences, concerned citizens may raise societal and ethical issues that do not occur to breeding companies or policy-makers, etcetera. Including all these voices in deliberations about animal breeding could help to ensure that the decisions reached reflect these considerations in a balanced way.

In sum, there are various reasons to reflect on the societal and ethical dimensions of (developments in) animal breeding. The current report presents a tool that can facilitate such deliberations.

B. *Towards a tool for broad ethical discussions about agricultural animal breeding*

The tool developed, which is presented in a supplementary file to this report, serves to facilitate ethical discussions about animal breeding. This includes both discussions that aim to reach practical decisions (for example when breeding companies consider adopting a new breeding technique or when policy-makers consider regulating such a

technique) and more open-ended discussions (for example when NGOs or citizens discuss breeding practices just to develop an opinion about them).

The tool aims to support ethical discussions or deliberations that are 'broad' in three senses. In the first sense, it serves to support deliberation about (innovations in) a wide range of breeding techniques or practices, including those that often go undiscussed. Societal and ethical debate currently focuses strongly on the potential use of new genomic technologies (primarily genome editing) in animal agriculture (e.g. Middelveld et al. 2023, Yunes et al. 2021), while ethical issues in existing practices or comparatively small innovations receive much less attention (cf. Van der Sluis et al 2022). As discussed earlier, however, it is important not to neglect the ethical issues associated with such practices and innovations.

In the second sense, broad deliberations include a diversity of voices. Some non-governmental organizations have called attention to welfare impairments in certain animals bred for high productivity, such as fast-growing broiler chickens, but the involvement of stakeholders (other than breeding companies or cooperatives) and citizens generally seems to be limited.

In the third sense, a broad debate addresses a wide range of ethically relevant considerations. Several ethicists and critical animal scholars have pointed to the limitations of focusing on animal welfare in ethical discussions about animal breeding (e.g. Bovenkerk 2020; Kramer & Meijboom 2022; Twine 2010). The ethical concerns of general publics also go beyond welfare. Public engagement studies (Macnaghten 2004, Naab et al 2021) have found, for example, that people oppose interventions in animals that they consider 'unnatural' and believe that animals should retain their *telos* (the set of behaviours that are characteristic for a species).

The last two senses in which discussions on the ethical and societal dimensions of livestock breeding can be 'broad' are interrelated. Involving various (stakeholder or citizen) publics in a debate may help to cover a greater range of ethical considerations, as people with different backgrounds often bring different perspectives to the table. Conversely, broadening the range of societal and ethical perspectives recognized as relevant facilitates the inclusion of wider publics in the debate; their inclusion will at least be more meaningful if the alternative ethical perspectives they advance are acknowledged as such. The range of considerations to be included is also related to the techniques or practices to be discussed. Having ethical discussions about innovations that are continuous with existing practices in significant respects means that considering whether these innovations introduce 'game changing' ethical problems is unsatisfactory; it seems appropriate to (also) consider to what extent such innovations solve, perpetuate, or worsen ethical problems in animal breeding (Kramer & Meijboom 2022).

The tool we have developed facilitates broadening the debate in all three senses. Its scope is not limited to genetic engineering technologies with potential applications in animal breeding, such as genome editing, but includes breeding practices and techniques which have received less attention (notably developments in selection and reproduction techniques). Moreover, it offers a wide range of ethical perspectives that are applicable to such technologies. Finally, by explaining relevant ethical perspectives in lay terms, it aims to enable discussion participants from various backgrounds to draw on such perspectives. Having someone with training in philosophical ethics present when applying the tool may still be helpful, but responsibility for applying the tool fruitfully and critically should be shared among all participants.

None of this is meant to suggest that the tool supplies everything that is needed to have productive ethical discussions. It does not offer extensive factual knowledge about animal breeding, nor guidance on how to select and recruit discussion participants. Although factual knowledge is crucial in ethical discussions and although the selection of participants is normatively significant, the tool focuses on presenting ethical concepts and perspectives that those involved can draw on.

C. Relation to previous work within the BovReg project

The tool presented in this report builds on three earlier reports that were written within the EU-funded project 'BovReg: Identification of functionally active genomic features relevant to phenotypic diversity and plasticity in cattle', in a work package addressing societal and ethical aspects of genomic livestock breeding.

The first public report (deliverable 8.1, Kramer and Meijboom 2020) sketched the scientific, legislative, and policy context of contemporary livestock breeding. It also considered what values are implied in EU agricultural policy, presented societal concerns that have been raised regarding other (bio)technologies, and considered to what extent these concerns might apply to innovations in genomic livestock breeding.

The second report (deliverable 8.2, Kramer and Meijboom 2021) elaborated on the ethical perspectives implied in the first report and added perspectives drawn from academic literature addressing the ethics of genomic breeding. Combining the results of this analysis with those of the first report, it sketched a provisional inventory of societal and ethical dimensions of genomic livestock breeding.

The third deliverable (Kramer and Meijboom 2022) then took the discussion to a meta-ethical level by asking how ethical debate on innovations in livestock breeding should be scoped. Which ethical concepts should be within the scope of discussion? Should only newly arising ethical issues be addressed, or do pre-existing ethical problems in livestock breeding deserve discussion, too? Should a breeding innovation be

evaluated as a technique existing on itself, or should specific practical applications be considered? Recognizing that different discussion contexts may call for differently scoped discussions, deliverable 8.3 argued that there should be broadly scoped discussions in at least some contexts.

These reports have generated various ethical perspectives on livestock breeding, including perspectives the significance of which may not always be acknowledged. For example, deliverable 8.2 showed that critical animal scholars have offered critiques of genomic selection based on concepts that authors working in an Anglo-Saxon applied ethics tradition did not recognize as capturing ethical perspectives. Our work has thus been aiming to increase the range of considerations recognized as relevant in discussions on livestock breeding, and the tool presented here aims to make bringing such considerations into actual discussions easier.

The tool reflects our work package's commitment to Responsible Research and Innovation. In a nutshell, RRI requires opening up discussions on ethically significant innovations to wider publics and reflecting on the assumptions and value systems underpinning innovation (e.g. Stilgoe et al 2013). The tool represents our final step in opening up discussions on livestock breeding to wider (stakeholder) publics and enable them to reflect on its ethical dimensions meaningfully.

D. Structure of the report

The body text of this deliverable is organized as follows. Section A discusses the notion of an 'ethical tool', distinguishes different types of ethical tools, and presents quality criteria for tools known as 'ethical decision-making frameworks'. Section B then presents our ethical framework for livestock breeding, discusses how it can be applied in practice, and relates it to the quality criteria identified in section A.

3. Core report

A. *Different types of ethical tools and quality criteria for ethical decision-making frameworks*

As explained in the Introduction, this deliverable presents a tool to facilitate ethical deliberation on innovations in livestock breeding. But what exactly is an ethical tool, what kind of ethical tool is most suitable, and what makes a tool of that kind good or bad?

A European project aimed at developing tools for the ethical assessment of new technologies in agriculture and food production defined ethical tools as:

"practical methods designed to improve ethical deliberations by broadening the values considered and/or stakeholder involvement" (Beekman et al. 2006: 14).

Following this definition, ethical tools are means to capture a wide range of values associated with an issue and/or to broaden stakeholder involvement. The ultimate end of an ethical tool is to improve ethical deliberations.

Ethical tools are usually designed for users that are not experts in academic ethics (Moula & Sandin 2015). This accords with the aim of improving ethical deliberation by broadening stakeholder involvement: stakeholders in agricultural biotechnologies or livestock breeding cannot be expected to engage in ethical deliberation fruitfully if the tools they are provided require expertise in academic ethics.

Second, ethical tools typically avoid committing to a particular ethical outlook or theory (Moula & Sandin 2015). They are instead pluralist, in the sense that they combine a variety of ethical perspectives that do not constitute or derive from one overarching theory. This serves both the inclusion of diverse stakeholders and the breadth of ethically relevant aspects considered: stakeholders in today's society bring diverging ethical perspectives to the table and no single ethical theory can be expected to cover all of these satisfactorily.

Third, ethical tools are paradigmatically "heuristic devices rather than decision-making algorithms" (Moula and Sandin 2015: 264); they help to identify ethically relevant aspects of some issue but do not offer a fixed procedure for arriving at ethical decisions. Using an ethical tool does not amount to making calculations or determining what ought to be done in some other highly standardized manner. Still, tools that only serve to broaden the discussion by bringing in additional perspectives may not satisfactorily improve ethical deliberations. Reaching a well-grounded conclusion requires not only considering all relevant arguments but also weighing these against each other. Ethical tools may also aim to support this part of the process, in one way or another.

Different types of tools can be distinguished according to the type of process they are meant to support (Beekman et al. 2006, Beekman & Brom 2007, Moula & Sandin 2015).

The first type of tool aims to facilitate ethical decision-making by public or private bodies, the second type is meant for public consultation and involvement, and the third type for value communication by corporate actors.

The ethical tool presented in the following section of this report is meant primarily as a tool of the first type, that is, as a decision-support framework. It offers a set of perspectives that decision-makers in public or private bodies can draw on to reach well-considered ethical views and decisions concerning innovations in livestock breeding. We believe that the ethical tool presented is also relevant for ethical deliberations by parties who are not involved in decision-making with respect to livestock breeding, for example non-governmental organizations interested in animal agriculture or even concerned citizens or other members of general publics (although some users may want to play the Democs-game that was developed in this work package instead). Because the tool also facilitates such discussions and supports decision-makers by improving their ethical discussions, it could appropriately be called a discussion-support tool rather than a decision-support tool. We will continue to call it a decision-support tool, but suggest that the 'decision' to be reached can be an ethical standpoint that does not have direct implications for the practice of animal breeding. The tool's focus is substantive rather than procedural: it present ethical concepts or perspectives to be considered in deliberations about animal breeding but does not offer ethical criteria for the design of deliberation procedures.

What is required of this type of ethical tool? In other words, what makes for a good or bad ethical decision-support framework for innovations in livestock breeding?

First, an ethical decision-support framework should be *complete* or *comprehensive* in the sense that it identifies (or adequately helps to identify) all values, facts, principles, and arguments that are relevant to the issue at hand (Moula & Sandin 2015, cf. Kaiser et al. 2007). The framework should not be missing items that would significantly change the decisions reached by competent users. Comprehensiveness is thus an important quality to ensure that an ethical decision-making framework indeed helps to make good ethical decisions.

Second, a sound framework is *transparent* in the sense that it makes clear how the decisions reached are motived by the values, facts, principles, and arguments considered (Moula & Sandin 2015, cf. Kaiser et al. 2007). Transparency as such may not improve the quality of the ethical conclusions and decisions reached but does support their legitimacy (and thus the legitimacy of using the tool) in a democratic context. If a framework is meant for use in a context that does not require justifying the decisions reached to parties not involved in the decision-making process, the extent to which it facilitates transparency becomes less important (Moula and Sandin 2015).

Third, an ethical decision-support framework should have *"an ability to guide users to a decision ... and also provide theoretical justification of the decision-supporting mechanism"* (Moula and Sandin 2015: 274, italics in original). A framework that serves

to generate ethical considerations may not be helpful for reaching a decision unless the framework also offers well-grounded guidance on how to translate these considerations into a decision, or at least an ethical standpoint about the issue at hand.

Finally, all ethical tools should be *user-friendly*. Moula and Sandin (2015) state that user-friendliness does not directly relate to the aim of facilitating ethical deliberation and decision-making, but instead concerns the economic resources and time that must be spent in applying the framework. Moula and Sandin apparently reason that a user-unfriendly framework can still be applied competently if their users invest much time (and thus for professional users also money) in its application. It seems doubtful, however, that all users will in practice spend a lot of time in applying a user-unfriendly framework. User-friendliness is thus likely to affect the quality of ethical deliberations and decisions after all.

Summing up the small body of literature explicitly addressing criteria for ethical tools (as opposed to the vast amount of literature proposing various kinds of ethical tools), four criteria for ethical decision-support frameworks can be identified. Such a framework should help to identify all values, facts, principles, and arguments that are relevant to the issue at hand ('comprehensiveness'), should offer theoretically grounded guidance on how to translate these values, facts, principles, and arguments into a decision, and should be easy to use competently for non-specialists in ethical theory ('user-friendliness'). Moreover, many contexts require tools that help to make clear how decisions were reached: which values, facts, principles, and arguments were considered and how were translated into decisions ('transparency').

These criteria were taken into consideration when developing a tool for discussions on the ethical and societal dimensions of innovations in livestock breeding, but we did not strive to build all the relevant facts about livestock breeding (or guidance on how to identify such facts) into the framework. We did however aim for *flexibility* by developing a tool that is easy to adapt according to the needs of its users or their context.

B. An ethical decision-support framework for innovations in livestock breeding

The ethical framework we have developed is presented in Annex A. This section explains the different parts of which the ethical framework consists, discusses how it relates to the quality criteria for ethical tools provided in the previous section, and offers some general remarks on how it can be applied.

It deserves note that while the framework as presented in this deliverable does feature all the relevant content, its does not have the ethical tool's final format. Outside of the bounds of the current project, and going beyond the aims declared for it, we are developing an online version of the tool. This tool will include the content of the

framework as presented in this deliverable, but will present it in a flexible, appealing, and user-friendly format. This online tool will be made available Open Access in early 2024.

The core of the framework or tool is a list of questions to be answered, which fall into three different parts.

Part I consists of questions that are meant to define the scope of discussion. What potential breeding innovation or changing in breeding practices is to be discussed? What alternatives to implementing this innovation merit discussion? Should this innovation be discussed from an ideal or non-ideal ethical perspective? Should the discussion focus on new ethical issues introduced by the innovation or on how it relates to existing ethical issues? Part I also presents a wide range of ethical concepts or perspectives and asks the user to consider which of these concepts should be included in the discussion. Each concept is preceded by a selection box that is checked by default, but can be unchecked when users collectively consider the associated concept incoherent or irrelevant. Many of the ethical concepts that are provided are explained briefly in a glossary and some also receive a more extensive explanation.

Presenting a range of ethical perspectives that may be relevant for discussions on animal breeding is meant to serve the tool's comprehensiveness. At the same time, we strived to keep the tool user-friendly by limiting the amount of ethical perspectives to an acceptable number. The explanations provided were also meant to serve the tool's user-friendliness: non-ethicists should be able to understand the explanations that come with the ethical concepts and should thereby be able to apply these concepts. Requiring users to explicitly define the scope of their discussion and select ethical perspectives to be applied serves transparency. It makes insightful on what ethical perspectives and scoping choices the ethical discussion (and its eventual conclusion) is based. Finally, the tool flexibly allows users to determine which ethical concepts to apply and to add ethical perspectives which they framework does not recognize yet.

The framework does not provide facts about breeding practices that are relevant to ethical discussions about such practices, nor about animals and how breeding can affect them. This limitation with respect to the framework's comprehensiveness means that users must bring relevant factual knowledge to the discussion themselves. Users who lack such knowledge may want to play the Democs-game on livestock breeding, which was also developed in the current work package and includes cards that provide relevant information on animal breeding, instead of or prior to having an ethical discussion by means of the tool offered here.

Part II consists of questions that belong with the ethical concepts selected for discussion. Only questions that fit the selected concepts need to be answered. Answering these questions identifies ethically relevant considerations with respect to the innovation under discussion.

Posing these questions explicitly (and sometimes posing several questions to cover a single ethical concept) was meant to serve user-friendliness and transparency. The questions provide the user with workable interpretations of the ethical concepts selected and give insight into the connections between these ethical concepts and the user's considerations with respect to the issue at hand. The questions are also formulated in relatively simple terms and kept short, again in the interest of user-friendliness.

Part III consists in weighing the ethical consideration identified in part II. This requires, first, that an approach for weighing ethical considerations is selected. The framework distinguishes several approaches for users to select between. (And, for even greater flexibility, the option to provide a custom approach.) This means that the framework is not directly action-guiding: it does not prescribe any particular approach for how to balance the various ethical considerations that users may have identified in part II. Rather, the framework requires users to decide which approach is most appropriate, first on an individual level and then on a group level. Discussions about which approach to take need not be held again at every occasion when particular breeding innovations are considered. It may makes sense to have a separate, more general discussion about how to arrive at ethical conclusions, and follow the approach agreed upon at that occasion in subsequent discussions about more particular issues. In this sense, the framework provided is primarily a template or blueprint for a decision-guiding ethical tool, which is completed when users decide on an approach for weighing ethical considerations and reaching an overall conclusion. This open-endedness of the tool serves its flexibility: it can be adapted depending on the (diversity of) ethical commitments of its users. In the interest of transparency, however, users are required to explicitly select one of the approaches or a custom approach for arriving at ethical conclusions.

It should be noted that although the framework consists of consecutively number parts and questions, it need not be followed in a strictly linear order. As already mentioned, it may make sense to have a separate discussion about which approach to apply when weighing ethical considerations in order to reach an overall conclusion. The same applies to some of the scoping questions which comprise part I. Users may want to have separate discussions, for example, about the relation between an ideal vision for breeding and making the best decisions in non-ideal circumstances. They may also want to have separate discussions about the relevance of particular ethical concepts or perspectives. Finally, it is of course acceptable to return to an earlier part of the framework return or a question already answered. It may turn out, for example, that ethical concepts that seemed relevant for the discussion at hand are not applicable after all, that the scope of discussion has not been set appropriately for other reasons,

etcetera. The suggested order of parts and questions should not become a straightjacket for the framework's users.

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4. Conclusions

A tripartite tool was developed and presented that facilitates having broad ethical discussions about (innovations in) farm animal breeding.

Part I of the tool offers questions that help to define the scope of discussion. Which breeding technique(s) or practice(s) should be discussed? Should the discussion be held from an 'ideal' ethical perspective and offer a vision for breeding in perfect circumstances, or should it be held from a 'non-ideal' perspective and address improvements that are realistically attainable on the short or middle term? And which ethical concepts or perspectives should be applied? Part II consists in answering ethical questions that serve as concrete translations of the ethical concepts selected for discussion in part I. The answers provided feed into part III, which involves selecting an ethical approach that allows drawing an overall conclusion in the face of conflicting considerations and formulating that conclusion.

The tool is meant to facilitate ethical discussions that are broad in three senses. In a first sense, this tool should (also) support discussions about breeding techniques and practices that have received relatively little public or scholarly attention (compared to highly controversial techniques such as cloning and genetic modification). It does so, among others, by explicitly questioning whether the focus of discussion should be on new ethical concerns raised by innovations in livestock breeding, or whether one should also address how existing concerns will be modified by new techniques or practices. In a second sense, the tool aims to ensure that ethical discussions about breeding cover a broad range of ethical perspectives. It does so by providing a plurality of ethical concepts and approaches for the user to consider. In the third sense, the tool should support discussions which include a wide range of publics. While the tool does not offer procedural criteria for which publics to include, it does aim to explain ethical concepts and perspectives in easy-to-grasp terms and to translate them into relatively simple questions.

The tool seems to meet general criteria for good ethical tools. It includes a variety of ethical perspectives and is in that sense *comprehensive*, although it does not provide the facts about breeding and animals that are necessary to have productive ethical discussions. It serves *transparency* by making the scope of discussion explicit and by showing how ethical concepts motivate asking specific questions. It aims to be *user-friendly* by explaining ethical concepts in easy-to-understand language and translating these questions into questions to be answered in the actual ethical discussion. Finally, the tool can be tailored to the needs of its users: the user can exclude or include ethical concepts from the scope of discussion, can select or add approaches for weighing ethical considerations, and apply different parts of the framework at different times or in non-linear order. The tool presented here can thus be seen as a template or blueprint for developing more specific ethical tools.

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6. Annexes

[Insert Excel-files here]

A TOOL FOR ETHICAL DISCUSSIONS ABOUT INNOVATIONS IN AGRICULTURAL ANIMAL BREEDING

1. Which potential innovation in animal breeding (henceforth: "innovation *X*") is to be discussed?

   Livestock breeding practices are often interrelated in practice. For example, the use of genomic evaluation may motivate increasing the use of advanced reproduction techniques in female animals with high genetic potential for breeding. It can be important to consider how a change in one practice will influence other practices.
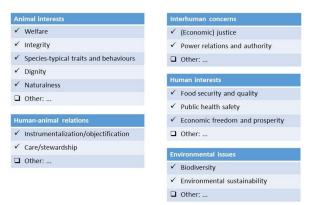
2. In your own words, what would be the goal of implementing innovation *X* in breeding? Why does implementing innovation *X* in animal breeding deserve consideration in the first place?

3. To what extent should the discussion about innovation *X* address:
   (a) a vision for animal breeding in an ideal world
   (b) potential improvements in animal breeding that seem realistic on the short or middle-long term?

   A discussion that is held from an ideal perspective aims to settle on a vision about how to breed animals in the most ethical way possible (if at all). This vision need not be realistic on the short or middle-long term. A discussion that is held from a non-ideal perspective aims to settle on realistic improvements in how animals are bred. These improvements need not result in a situation that is considered perfect, ethically speaking. Taking a non-ideal perspective means taking context constraints into account and trying to find an optimal balance between ethical desirability and feasibility.

4. Which alternatives to implementing innovation *X* merit discussion, given the answers provided to questions 2 and 3?

5. To what extent should the discussion focus on:
   (a) new ethical questions raised by innovation *X*
   (b) the impact of innovation *X* on existing ethical concerns about animal breeding?

   Not only new ethical concerns raised by X may deserve consideration. In many cases it is also important to discuss whether X solves, perpetuates, or aggravates existing ethical issues. This means that X should typically be conceived as a step in a wider development that may or may not be ethically desirable. See also Kramer & Meijboom 2022.

6. Which of the following ethical concepts/perspectives should be applied?

   For a brief explanation of some of the concepts/perspectives presented, see the 'glossary' tab. For some longer explanations, see the 'extended explanations' tab .

Animal interests	Interhuman concerns
✓ Welfare	✓ (Economic) justice
✓ Integrity	✓ Power relations and authority
✓ Species-typical traits and behaviours	❑ Other: ...
✓ Dignity	**Human interests**
✓ Naturalness	✓ Food security and quality
❑ Other: ...	✓ Public health safety
Human-animal relations	✓ Economic freedom and prosperity
✓ Instrumentalization/objectification	❑ Other: ...
✓ Care/stewardship	**Environmental issues**
❑ Other: ...	✓ Biodiversity
	✓ Environmental sustainability
	❑ Other: ...

7. Answer the questions that relate to the ethical concepts/perspectives selected in response to question 6:

   Human interests

   a. Does innovation *X* affect food security or quality in a positive or negative way?

   This question relates to the ethical concept of food security and quality

   b. Does innovation *X* affect public health safety in a positive or negative way?

   This question relates to the ethical concept of public health safety

   c. Does innovation *X* respect stakeholders' freedom to pursue their economic activities and/or lead to economic prosperity?

   This question relates to the ethical concept of economic freedom and prosperity

| d. | Does innovation *X* advance other significant human interests? | *This question relates to the 'human interests: other...' category* |

Animal interests

e.	Does innovation *X* have positive or negative consequences for animals' health?	*This question relates to the ethical concept of animal welfare (insofar as welfare consists in or depends on health)*
f.	Does innovation *X* result in positive or negative experiences (such as pleasure or pain) for animals?	*This question relates to the ethical concept of animal welfare (insofar as welfare requires the absence of negative subjective experiences and the presence of positive ones)*
g.	Does innovation *X* impair animals' natural behaviour?	*This question relates to the ethical concept of animal welfare (insofar as welfare requires the ability to perform natural behaviour)*
h.	Does innovation *X* change any behaviours or physical features that are typical for the species of animal concerned?	*This question relates to the ethical concept of species-typical traits and behaviours*
i.	Does innovation *X* compromise the wholeness or intactness of animals?	*This question relates to the ethical concept of (physical) integrity*
j.	Does innovation *X* change the behavioural or mental characteristics of animals?	*This question relates to the ethical concept of (behavioural and mental) integrity*
k.	Does innovation *X* degrade animals or disrespect their inherent worth as beings who pursue their own good?	*This question relates to the ethical concept of dignity*
l.	Do animals generated by means of innovation *X* differ in relevant ways from animals that are generated without human interference?	*This question relates to the ethical concept of naturalness (insofar as the 'product' of breeding can be considered natural or unnatural)*
m.	Does the process of generating animals with the help of innovation *X* differ from natural reproduction in an ethically significant way?	*This question relates to the ethical concept of naturalness (insofar as the 'process' of breeding can be considered natural or unnatural)*
n.	Does innovation *X* raise other ethical issues that relate to how animal interests are affected?	*This question relates to the 'animal interests: other...' category*

Human-animal relations

o.	Does innovation *X* involve seeing or treating animals as a (mere) means to human ends?	*This question relates to the ethical concept of instrumentalization/objectification*
p.	Does innovation *X* involve treating animals with appropriate care and express an attitude of responsibility towards such animals?	*This question relates to the ethical concept of care/stewardship*
q.	Does innovation *X* raise other ethical issues that concern how humans relate to animals?	*This question relates to the 'human-animal relations: other...' category*

Environmental issues

r.	Does innovation *X* affect the genetic diversity of animals *within* breeds in a positive or negative way?	*This question relates to the ethical concept of biodiversity*
s.	Does innovation *X* affect the genetic diversity of animals *among* breeds in a positive or negative way?	*This question relates to the ethical concept of biodiversity*
t.	Does innovation *X* affect the extent to which animal agriculture is environmentally sustainable (including its impact on climate change) in positive or negative ways?	*This question relates to the ethical concept of environmental sustainability*

Interhuman concerns

u.	Are the (economic) burdens and benefits of innovation *X* distributed fairly among human stakeholders?	*This question relates to the ethical concept of (economic) justice*
v.	Does innovation *X* lead to undesirable shifts in power relations or authority among stakeholders?	*This question relates to the ethical concept of power relations/authority*
w.	Does innovation *X* raise any other concerns about relations among human stakeholders?	*This question relates to the 'interhuman concerns: other...' category*

Part III: weigh ethical considerations and reach a conclusion/decision

8. Which approach (or combination of approaches) should you, as an individual, take for weighing the ethical considerations identified in part II?

Approaches for weighing ethical considerations individually

- ❏ Setting principled ethical limits
- ❏ Relating innovation *X* to an ideal vision for breeding
- ❏ Maximizing (human and animal) wellbeing
- ❏ Assessing innovation *X* in terms of good and bad human attitudes
- ❏ Prioritizing/scoring ethical considerations intuitively
- ❏ Other:...

For an explanation of the approaches presented, see the 'Glossary' tab

Which approach should the group of discussion participants take for reaching a conclusion/decision about innovation X ?

Approaches for reaching ethical conclusions as a group
❏ Settling on one of the approaches for weighing ethical considerations individually
❏ Seeking convergence between different approaches for weighing ethical considerations individually
❏ Seeking agreement about the reasons for disagreement
❏ Establishing a procedural solution (voting, vetoing, etc.)
❏ Other:…

10.   Draw a conclusion/decision about innovation X by applying the approach(es) selected

Ethical concepts/perspectives

Care/stewardship	An ethical requirement on human-animal relations is that humans care properly for animals that depend on them (usually animals that have come to depend on humans because of human actions). This requires taking an attitude of stewardship or responsibility when dealing with such animals.
Dignity	An animal's dignity can be understood as her right not to be degraded and to have her inherent worth respected. It is based on animals' ability to pursue their own good, based on their own wants and desires.
Economic freedom and prosperity	It can be argued that breeders should be left free to pursue their economic activities as they see fit (unless there are overriding reasons to regulate their activities), out of respect for breeders' autonomy as human beings. Society may also have an interest in allowing breeders to pursue such activities, namely insofar as these generate wider economic prosperity.
(Economic) justice	(Economic) justice requires that the (economic) burdens and benefits of breeding are distributed fairly among human stakeholders. One possible justice concern is that expensive breeding techniques may only benefit breeders or farmers who can afford them, while economically disadvantaged breeders or farmers become even less competitive. On the other hand, breeding can arguably reduce economic injustices by improving the yield of local breeds or breeds that are well-adapted to farming in difficult environmental circumstances.
Instrumentalization/objectification	Instrumentalizing or objectifying animals means seeing or treating them as a (mere) means to human ends. Doing so fails to respect animals as a beings with a value and interest of their own, and can be seen as an ethically problematic way for humans to relate to animals.
Integrity	Respecting an animal's integrity means leaving her physically intact and not durably changing her behaviour or mental characteristics (unless any of these things are in the animal's own interests). Performing invasive physical procedures on animals can also be considered a violation of their integrity, even if the animals do not change in notable ways.
Naturalness	The notions of naturalness and unnaturalness can be applied either to the 'product' or to the 'process' of animal breeding. Animals that have been bred by humans can be considered natural insofar as they (physically and behaviourally) resemble animals that are born without human interference. On the other hand, the procedures performed in breeding can be considered unnatural to the extent that they depend on technology or human control.
Power relations and authority	The introduction of technological practices tend to shift power relations and authority among human stakeholders. This shift usually favours those who control the technologies concerned and disfavours those who do not. New breeding practices may for example make individual farmers more dependent on powerful breeding companies or discredit their traditional ways of knowing and breeding animals.
Species-typical traits and behaviours: *telos*	*Telos* refers to the (set of) behaviours which are characteristic of animals of a particular species – the way of life that constitutes the 'pigness' of a pig, the 'cowness' of the cow, etcetera. An animal's telos depends on the mental and physical characteristics that members of her species naturally have. Being able to live according to telos is generally held to be in animal's interest.
Welfare	Welfare is the extent to which an animal is feeling and doing well. A good level of welfare requires the absence of negative states and the presence of positive ones. Relevant factors for welfare are the extent to which an animal is healthy, has her needs met, and is able to engage in normal species behaviour (among others).

Approaches for weighing ethical considerations individually

Setting principled ethical limits	Setting principled ethical limits means treating certain ethical considerations regarding innovation *X* as 'show-stoppers'. As a matter of principle, one might for example reject any breeding technique that harms or compromises the integrity of animals in certain ways, that involves mixing genetic materials from different species, etcetera. Application: Consider whether any ethical consideration makes innovation *X,* as a matter of principle, ethically unacceptable or obligatory. Theoretical background: This approach relates to the ethical theory known as *deontology* . Deontology states that certain ethical principles set constraints on actions that should not be overridden by appealing to the good consequences of such actions. *Rights-based deontology* states that (human and/or animal) individuals have rights that may never be violated, expect if doing so is necessary to avoid even more serious rights violations. The most important rights, according to most rights approaches, relate to actions that may *not* be done to individuals. A main right for animals would be the right not to be harmed intentionally, for example.
Relating innovation *X* to an ideal vision for breeding	This approach involves assessing whether innovation *X* brings one's vision of how breeding would ideally be practiced closer or further away. Application: Consider (i) to what extent implementing innovation *X* would be a step in the right direction by solving ethical issues in breeding, (ii) to what extent implementing innovation *X* would leave ethical concerns about breeding unaddressed, and (iii) to what extent implementing X would worsens ethical concerns about breeding. Theoretical background: This approach aims to integrate *ideal* and *non-ideal* ethical perspectives. An ideal perspective proposes a vision about how to breed animals in the most ethical way possible (if at all). This vision need not be realistic on the short or middle-long term. A non-ideal ethical perspective aims to settle on realistic improvements in how animals are bred. These improvements need not result in a situation that is considered perfect, ethically speaking. Taking a non-ideal perspective means taking contextual constraints into account and trying to find an optimal balance between ethical desirability and feasibility. These two perspectives can be integrated by considering whether innovation *X* is both feasible and a step towards an ideal situation.
Maximizing (human and animal) wellbeing	This approach involves assessing innovation *X* in terms of its consequences for the wellbeing/welfare for humans and animals. Innovation X is on this approach ethically desirable if implementing this innovation leads to more total wellbeing than not implementing it. Application: Focus on ethical considerations that relate to human and/or animal wellbeing. Decide whether any positive impacts of implementing innovation *X* on human and/or animal wellbeing are likely to outweigh any negative impacts. Theoretical background: This approach relates to the ethical theories called *consequentialism* and *utilitarianism.* Consequentialism requires taking whichever action will have the best overall consequences, as calculated by aggregating all the positive and negative outcomes that alternative actions will produce. The most common form of consequentialism, utilitarianism, takes only positive and negative consequences for the wellbeing of sentient beings (i.e. humans and animals) into account. How benefits and harms are distributed across individuals is not relevant on a consequentialist perspective: it is legitimate to harm some individuals if doing so produces the best overall outcomes.
Assessing innovation *X* in terms of good and bad human attitudes	This approach involves evaluating innovation *X* in terms of good and bad human attitudes towards other beings (including other humans, animal and the world at large). Application: Consider which human attitudes would be expressed by deciding to implement innovation *X* . To what extent would doing so express good human attitudes, such as compassion, temperance, care and responsibility? To what extent would it express bad human attitudes, such as greed or hubris? Decide which of these attitudes is the most important for the ethical evaluation of innovation *X* . Theoretical background: This approach relates to the ethical theory called *virtue ethics.* Virtue ethics evaluates actions based on which character traits these actions express, and whether these are good or bad character traits. In the current context, virtues are those character traits which make a breeder a good breeder *and* good person.

| Prioritizing/scoring ethical considerations intuitively | This is the default option when none of the other approaches for weighing ethical considerations is selected. It involves reaching an overall judgment about innovation X that does not derive from applying ethical principles or theories, but from some feeling or understanding as to which ethical considerations with regard to innovation X are most important.

Application:
Upon reflecting on the various ethical considerations with respect to innovations X, weigh or score these on the basis of a subjective (but considered) evaluation. Draw an overall conclusion which takes the relative importance of the various considerations into account. Even if individual ethical considerations receive a score in this process, the overall conclusion need not be based on any kind calculation performed on such scores.

Theoretical background:
This approach is based on the (meta-)ethical theory called *intuitionism.* Intuitionism states that ethical principles or theories are insufficient (or even unnecessary) for drawing good ethical conclusions. Ethical concepts help to identify ethically salient aspects of actions, but ethical judgments are (at least in part) based on emotion or an overall understanding of what matters most in the case at hand. |

Welfare	Animal welfare has a negative side that can be understood as the absence of bad welfare states (as in the 'five freedoms' approach) and a positive side that can be understood as the presence of good welfare states. Three main types of (human wellbeing and) animal welfare can be distinguished: (1) mental state theories, in particular hedonistic theories, according to which welfare consists in the absence of unpleasant experiences such as pain and in the presence of pleasant experiences; (2) desire-satisfaction theories, according to which welfare depends on whether one's desires or preferences are or are not fulfilled; and (3) objective list theories, according to which welfare depends on certain objective states an animal is (not) in, independent of the animal's experience of being in those states and independent of whether the animal desires to be in that state. For the sake of the framework's simplicity, animal health has also been included in this category, on the assumption that there is a strong relation between animal health and welfare. (Which is not meant to suggest that good health is a sufficient condition for good welfare, nor even that it the former is a necessary condition for that latter, although that seems more plausible.) Again for the sake of simplicity, 'health' is also intended to cover 'robustness' – which we understand roughly as an animal's ability to sustain good health in unfavorable circumstances. A fourth condition for welfare that has been advanced is that an animal should be able to engage in natural or species specific behaviour, but it can perhaps be argued that this is implied in the other conditions (or in the concept of telos, see below).
Dignity	Sara Ortiz (2004) has defined the concept of animal dignity as "the uninhibited development of those functions and operations that a member of the species can normally perform". Ortiz holds that using animals for human ends does not conflict with dignity if the animal is also respected as an end in itself, which requires allowing it to develop those functions which define the good for animals of its species. Balzer et al. (2000) have argued that non-human organisms can be ascribed a dignity (Würde) based on their inherent value, which depends on their having their own good, their pursuit of individual goals, and their being organic entities. This dignity is violated if the performance of those functions and operations that a member of a species can normally perform is infringed upon. Heike Barankze (2012) rejects extending secular ideas of human dignity to animals. The only possibility is to understand Würde der Kreatur theologically, as 'Kreatur' suggests. Animals then have an inherent value or goodness based on being created by God. However, such an interpretation is not universally acceptable precisely because of its particular religious background. A concept closely related to dignity is the concept of inherent worth. Following Paul Taylor [XXXX], inherent worth can be distinguished from intrinsic value, which applies to experiences that are valued for their own sake, and inherent value, which is the value assigned to objects not because of their commercial or practical importance but because of their beauty, historical importance, or cultural significance. To ascribe an entity inherent worth is to consider it worthy of respect: moral agents should treat it as something that (ceteris paribus) ought not to be harmed or interfered with (Taylor XXXX: 72). This includes recognizing that the entity has a good of its own – i.e. a good that does not refer to the good of other entities – and adopting an attitude of respect for such entities. The appropriateness of respect does not follow logically from the recognition that the entity has a good of its own. Rather, respect for such entities is a basic or foundational attitude through which moral agents "subscribe to a set of standards of character and rules of conduct as their own ethical principles".
Integrity	The concept of animal integrity has been defined as the "wholeness and intactness of the animal and its species-specific balance, as well as the capacity to sustain itself in an environment suitable to the species" (Bovenkerk et al. 2002, Rutgers & Heeger 1999). A violation of an animal's integrity can thus involve (1) its losing its wholeness or intactness, (2) a change in its species-specific balance, or (3) its loss of ability to sustain itself in an environment that suits the species. A loss of wholeness or intactness involves for instance the amputation of a limb. A change in species-specific balance occurs for instance when animals are bred that are no longer able to deliver their young without a caesarian section or that grow so fast that they die young because of a malfunctioning metabolism (Rutgers & Heeger 1999). (A definition of species-specific balance is hard to find, however, and it has been argued that it collapses into the final aspect of integrity; see Ortiz 2004.) Finally, a loss of ability to sustain itself in an environment suitable to its species may occur if an animal through domestication, breeding or genetic modification is unable to live in surroundings that members of its species normally dwell in (where some have argued that a 'suitable' environment need not be a 'natural' environment; see Ortiz 2004). Bovenkerk et al. (2002) and Rutgers & Heeger (1999) argue that the concept of integrity does not merely refer to objective or biological qualities of animals, but is partly normative. There are various ways an animal's wholeness or intactness may be compromised, but not all of these are considered a violation of integrity. For instance, docking a dog's tail may be considered a violation of integrity when performed for aesthetic reasons but not when performed for medical reasons; in general 'violation of integrity' refers to human-caused changes that are not performed for the animal's own good. Bovenkerk et al. (2002) and Rutgers & Heeger (1999) argue that the notion of 'violating animal integrity' is not without philosophical difficulties, but does capture an important intuitive objection to changing animals in certain ways and appears to be workable in practical contexts (Bovenkerk et al. 2002). It helps to formulate arguments against human interference in animals and animal functioning that are not for the animals' own good, and these arguments may apply where arguments based on welfare, rights, or telos fail.
Instrumentalization/ objectification	The concepts of instrumentalization and objectification have been applied to characterize and criticize the use of animals in (intensive) farming. Accounts of instrumentalization and objectification have drawn inspiration from various sources, in particular the ethics of Kant and feminist philosophy, and capture different ethical perspectives. Instrumentalization and objectification may be defined along Kantian lines as treating others or ourselves as mere means to ends rather than ends in themselves (Bos et al. 2018, Bovenkerk & Nijland 2017). Animals are treated as mere means to ends, and are thus instrumentalized, if they are used in ways that they would probably not consent to (Korsgaard 2011) or treated as if their value consisted in their utility for others (Regan 2004). Feminist accounts understand objectification as a cluster concept that is applied when someone treats a person: (1) as a tool for one's purposes; (2) as lacking in autonomy and self-determination; (3) as lacking in agency or activity; (4) as interchangeable with other objects; (5) as legitimately violable; (6) as something that can be owned, bought, sold, etcetera; (7) as something whose experience and feelings need not be taken into account; (8) as identical to her body (or body parts); (9) as defined by her appearance to the sense; or (10) as silent or lacking the capacity to speak (Nussbaum 1995, Langton 2009a). Feminist analyses focus on the objectification of persons and take sexual objectification as their main concern, but have been extended to the objectification and instrumentalization of animals in (industrial) agriculture. Brom (1997) and Kramer and Meijboom (2022c), finally, have conceptualized instrumentalization in terms of the intentional relations 'X sees Y as an instrument', 'X treats Y as an instrument', and 'X turns Y into an instrument'. When any of these relations applies between a human (X) and an animal (Y), the human does not see and treat the animal as being with intrinsic value, but as a means to human ends.
Telos	On Rollin's (1986, 2015) influential account, telos is related to the 'form of life' or 'basic nature' of the animal, which for a pig constitutes its 'pigness', for a dog its 'dogness', etcetera. Telos not only characterizes what it means to be an animal of some species, but also explains what things matter to animals of that species: living according to its basic nature or form of life means that an animal lives a good life for a pig, a dog, or whatever species it is a member of. Proponents of this account have held that changing an animal's telos (through genetic engineering or breeding) is ethically wrong if the animal's life will be worse because of the change, and right if the animal's life will be improved. Michael Hauskeller (2005) has connected an animal's telos more strongly to an animal's bodily constitution. According to Hauskeller, an animal's bodily constitution refers to the kind of activities that animals of its species typically perform and that constitute the good life for animals of this species. It is in an animal's interest to be willing and able to pursue the kind of life to which fits its bodily constitution. Going back to its historical roots, Kramer & Meijboom (2021) have developed an alternative account of telos, according to which telos is the set of goods that animals of a species characteristically pursue and are well-equipped to attain. This account considers the good life species-relative insofar as species-membership determines which good life can be successfully pursued, but allows that the good life for one species (e.g. gods) may be inherently better than the good life for another species (e.g. men). It can explain why impairing animals' ability to realize their telos and removing desires related to their telos may both be bad for the animals involved.
Naturalness	'Nature' and 'naturalness' have been found to be important concepts shaping peoples' responses to genetic engineering (MacNaghten 2004). Genetic engineering, and biotechnology more generally, were thought to 'go against nature', and even if the technology would meet genuine and important human needs, the unease about its unnaturalness would result in ambiguous evaluations. The appeal to nature seemed to reflect an attempt to articulate a position regarding rapid technological advances for which people have few conceptual resources at their disposal. This was apparent in the frequent opposition of the natural to what is human-controlled. Siipi (2008) distinguishes three general types of reasons to consider entities natural or unnatural. History-based reasons "refer to the history and origin of an entity" (ibid.: 75) or in other words to the process by which an entity has been created. Property-based reasons address the entity's "current (non-historical) properties and features" (ibid.: 75), and relation-based reasons concern its relations to other entities, including agents that consider the entity natural or unnatural. Siipi notes that different types of entities can be considered natural or unnatural, including objects or beings, traits of objects or beings, events, actions, activities, behaviors, and states of affairs.