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A global study to identify a potential basis for policy options when integrating animal welfare into the UN Sustainable Development Goals

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A previously developed methodology to rate the strength of the impact of improving animal welfare on achieving each of the 17 SDGs and the impact of achieving each SDG on animal welfare was used at the third Animal Welfare Global Forum of the World Organisation for Animal Health. Data from 95 participants from key stakeholder categories and organisations involved in animal welfare were analysed. The resulting 'map' of the relative strengths of these associations confirmed the expected co-benefits of improving animal welfare and achieving the SDGs. Differences at regional level and according to the economic classification of the country were also identified. This paper focuses on using this 'map' as a potential guide for how organisations interested in improving animal welfare could identify potential new allies for strategic partnerships to facilitate the implementation of different policy options. For example, a strategy can be to collaborate with those organisations where the impact is of similar mutual benefit, e.g. between improving animal welfare and achieving SDG 3 (Good health and well-being). Organisations in these two areas are already aligning themselves in the 'One Health' movement. Another strategy can be to align with organisations for whom achievement of their goal has the greatest impact on animal welfare, even if the impact is not mutual e.g. by collaborating with organisations working to achieve SDG 16 (Peace justice and strong institutions) and SDG 4 (Quality education). Achieving these goals was considered to have a large impact on improving animal welfare, equivalent to that of achieving SDG 3. In summary, this study can help organisations working in the area of animal welfare identify previously untapped areas of potential support, so tailoring their efforts efficiently, while at the same time themselves supporting movement towards the Agenda 2030. Simply put, the co-benefits make collaboration worthwhile, potentially opening up opportunities that would be

unavailable when organisations are working independently towards their own respective goals.

KEYWORDS

animal welfare, sustainable development goals, policy, animal welfare impact, co-benefits, synergies, SDG

Introduction

Over the last decades, there has been a shift towards an increased moral attitude towards animals. This is perhaps most noticeable in relation to farm animals and in Europe, resulting in an ever-increasing consumer demand for better animal welfare (AW) and related legislative and private initiatives to improve and ensure the welfare of animals (European Commission, 2016; George et al., 2016; Alonso et al., 2020; Pelé et al., 2021). A recent example of this shift and its consequences is the 'End the Cage Age European Citizens Initiative' which generated almost 1.4 million signatures across Europe calling for a ban on the use of cages for all farm animal species in the EU. This made the European Commission commit to put forward a legislative proposal by the end of 2023 to phase out cages for farmed animals across Europe by 2027. In addition, food companies have responded to these societal demands and implemented, for instance, welfare assurance and monitoring schemes (Rowe et al., 2021). The protection and enhancement of farm AW has become an increasingly important component of livestock systems (Buller et al., 2018) and thereby an integral part of the social acceptability and thus sustainability of animal-based food supply chains.

However, the welfare of animals is not only about changing values and it is not only in Europe that these changes are apparent or needed. AW can be linked to issues like antibiotics use, food safety and human health (One Health) and, in many countries, animal health and welfare can be directly related to food security, adequate nutrition, work conditions and livelihood in general (One Welfare) (Garcia Pinillos et al., 2016; Tarazona et al., 2020). Moreover, good AW contributes to the improvement of productivity, and associated profitability, (McInerney, 2004). AW is also increasingly linked to biodiversity (Broom et al., 2013; Hultgren et al., 2022) as illustrated in the first-ever resolution to be tabled and approved with explicit reference to AW, the Animal Welfare – Environment – Sustainable Development Nexus resolution (UNEP, 2022). In summary, these examples confirm the importance of AW for sustainable development.

The United Nations Sustainable Development Goals (SDGs) were adopted in 2015 (UN, 2015). The SDGs constitute a set of goals towards a future without poverty and hunger, and safe from the worst effects of climate change and loss of biodiversity. The aim is to reach the goals by 2030. The SDGs have a wide scope, but the role of domesticated animals as well as wild animals, including fish, is hardly mentioned and their welfare is not mentioned at all (Keeling et al., 2019; Torpman and Röcklinsberg, 2021).

Nevertheless, several global organisations recognise the need to address AW issues for the aforementioned reasons and explicitly aim to develop policies to progress towards achieving SDGs as well as AW goals. Thus, the Global Agenda for Sustainable Livestock (GASL), consisting of over 110 institutional members including governments, members from the private sector and civil society, non-governmental organisations (NGOs) and research communities, not only identified nine SDGs that have significant, direct links to the livestock sector but also included animal health and welfare as an important sustainability domain that will frame the Global Agenda's future activities (Schneider and Tarawali, 2021). GASL's position is further supported by intergovernmental and multi-lateral organisations such as the Food and Agriculture Organisation (FAO), the International Livestock Research Institute (ILRI), the World Organisation for Animal Health (WOAH, founded as OIE), the International Fund for Agricultural Development (IFAD), the World Bank Group, which includes the International Finance Corporation (IFC) and others.

These organisations play key roles in analysing scenarios, building consensus and policy making towards sustainability. However, the 2030 Agenda is so all-encompassing, it is difficult to get an overview of the many interconnections, and knock-on effects of work in one area, on movement towards goals in another area. To support the identification of policy options and strategies that optimise progress towards the SDGs as well as AW goals, there is a clear need to understand the associations between AW and the SDGs.

Keeling et al. (2019) presented a methodology to rate the strengths of the associations between AW and SDGs and evaluated the extent to which achieving the UN SDGs is compatible with improving AW and vice versa. The results indicated that although AW is not explicitly mentioned in the SDGs, working to achieve the SDGs is compatible with working to improve AW. These results were further explored and

compared to the previous work in a follow-up study in which the methodology was applied again and expanded to explore different contexts and development of views over time (Olmos Antillón et al., 2021). This study further supported the positive role of AW in the success of the UN's strategy and indicated that the magnitude of the anticipated impacts is modified by the stakeholder, context and experience.

Thus, although the results of our preliminary studies suggested a mutually beneficial relationship between improving AW and achieving SDGs, this needed to be confirmed on a wider group of people, for example people from low-income countries and a more geographically and professionally diverse group of stakeholders. Therefore, in the current paper, we tested the methodology on a much larger and global group whilst also exploring the potential support that this methodology may offer to identify policy options. The latter has been explored specifically in the context of the WOAH's own policies and tools.

Methodology

Data and information were gathered during the third WOAH Animal Welfare Global Forum, organised on this occasion, in collaboration with the Centre of Excellence in Animal Welfare Science and the Swedish Centre for Animal Welfare at the Swedish University of Agricultural Sciences, the latter being a WOAH Collaborating Centre on Animal Welfare. The meeting attendance was by invitation to WOAH Members (National Animal Welfare Focal Points), WOAH Animal Welfare Collaborating Centres and International Organisations with Collaboration Agreements with WOAH. The invitation was sent to 226 potential participants. Background information on the attendees (attendees' professional profile/demographic data) was collected through a questionnaire during registration.

The information gathering exercises were spread over the three days of this virtual (*via* Zoom, a videoconferencing platform) meeting, which was split into two sub-meetings, each in one of two time zones. Whilst participants could join the session most convenient to them regardless of their region, the first session (Time zone 1) was planned at a time convenient for the Middle East, Asia and the Pacific regions. The second session (Time zone 2) considered a time convenient for America, Europe and Africa. When discussing the links between improving AW and moving towards achieving each SDG and vice-versa, participants were told to consider AW to mean the physical and mental state of an animal in relation to the conditions in which it lives and dies (WOAH, 2022a). They were also asked to bear in mind different animal species and to think globally.

On day one, participants were introduced to the SDGs and their links to AW in different presentations. They were given instructions for the group exercises. They were also informed about the seven-point scale that they were asked to use during the exercises to rate the strengths of the links between improved AW and achieving the SDGs and vice versa. The scale ranged from indivisible (score +3: where the successful achievement of the SDG is inextricably linked to improved AW), to cancelling (score −3: where it is impossible to reach both the SDG and improved AW at the same time) (Nilsson et al., 2016; Keeling et al., 2019). Participants from each of the two time zones were divided into nine groups and each group provided with one facilitator from the organising team. In the group work, independent scoring of the links between AW and four given SDGs were carried out. Since the links were rated in both directions i.e., the impact of improving AW on achieving the SDG (an AW→SDG score), and the impact of achieving the SDG on improving AW (an SDG→AW score), this resulted in 8 scores per person. After the scoring, each group discussed the members' individual scores and was asked to come to a consensus score for two (pre-defined) of the four assigned SDGs. The latter process gave insight into the level of agreement and into how the group perceived the strength of each link. Their comments and consensus scores were collated onto a slide to present to the larger group the following day.

On day two, a preassigned rapporteur from each group presented the group work in a common session for all participants from that time zone. Presentations addressed the identified synergies and conflicts around each of the different links. After hearing this information, all participants were asked to do their own independent scoring on each AW→SDG and SDG→AW link using the Zoom polling feature, after which the floor was opened for discussion. Comments sent *via* chat and verbal interventions were recorded and transcribed verbatim.

On day three, which was a combined meeting of both time zones, a presentation of the preliminary results from the scoring parts of the exercises was given and followed by another discussion. Additional written comments and verbal interventions from this session were also recorded and transcribed verbatim.

Analyses

Not everybody attended the first two days and not all people scored all questions, hence the number of data points included in the different analyses varied. An initial descriptive analysis was done with the independent individual scores. The mean scores were determined for each SDG versus AW, taking into account the direction of the assessment. A Wilcoxon-signed-rank test was used to evaluate if there was a difference in the scores given by participants on the impact of achieving a specific SDG on AW versus the impact of improving AW on the achievement of an SDG. Countries were grouped in two different ways: according to average income in that country and according to its

geographical location. In the first analysis, countries were classified as low income, low/middle income, upper/middle income and high income as defined by the World Bank (World Bank, 2022), although low income and low/middle income countries were later combined due to the small number of participants from these countries. In the second analysis, countries were grouped according to the five WOAH geographic regions; Africa, Americas, Europe, Middle East and the combined Asia, Far East and Oceania region (WOAH, 2022b). Differences were analysed using Kruskal Wallis. Differences in how participants scored on day 1 and day 2 were analysed using Paired sign ranked tests. Differences in scores according to the gender of the participants were analysed using Mann Whitney U tests. All analyses were done using Excel and SAS® software (version 9.4). That this analysis involved multiple comparisons should be taken into consideration when interpreting the results.

As part of the registration procedure, potential participants were informed and had to agree to their responses in the exercises being analysed. During the meeting, participants were reminded that their comments were being recorded. Participants were informed that all data would be made anonymous.

Qualitative analysis of the discussions was carried out. Transcribing and structuring of the topics taken up by participants was done by the same person. Rationales from the discussions on days 2 and 3, both verbal and in writing, and notes from the slides presented on day 2 were organised by SDG, by direction of the link and on whether it had a positive or negative impact. All authors then contributed to refining the text in the table. Duplicated concepts were removed and rationales edited to improve clarity and to present the points made more succinctly. Subsequently, the recordings of the meetings (days 2 and 3) were listened to again, to ensure concepts were not missed or misinterpreted.

Results

Profile of the voting participants

Initially, 144 participants out of the 226 invited registered to the forum (Figure 1). Of those registered, 95 participants. (32 females and 25 males, with known details, and 38 participants, with unknown gender/geography details, 17 on day 1, 21 on day 2) attended at least one of the two first days and from whom information (i.e. SDG-AW relationship vote) was available for further analysis. Fifty-seven known details participants attended both days. The 95 participants were from Veterinary Services, WOAH Animal Welfare Collaborating Centres, NGOs, the private sector or categorized themselves 'other'. They came from 58 different countries as illustrated in Figure 2. The majority had a background in veterinary and/or animal science.

Scoring the strength of the links between improving AW and achieving the SDG

The average scores for the expected impact of achieving the SDG on improving AW (average Score=1.89) and the impact of improving AW on achieving the SDG (average score=1.38) did

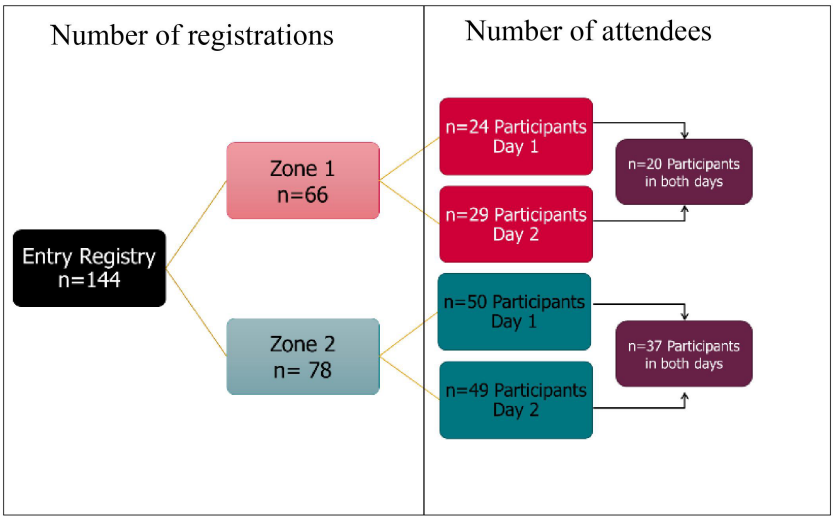

FIGURE 1
Number of participants registered from each time zone and the number attending each day of the forum.

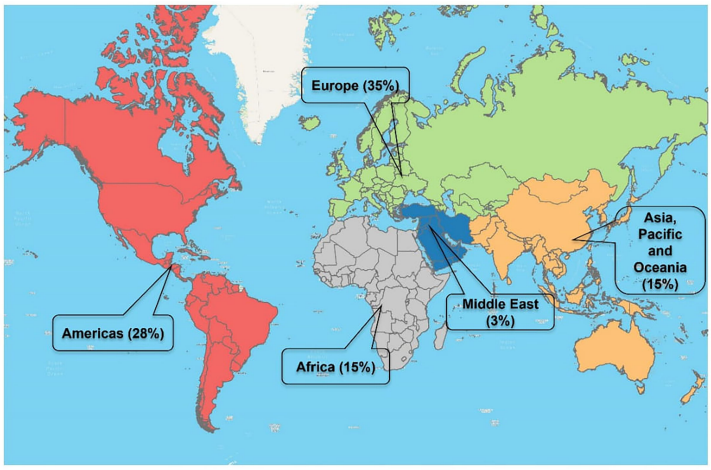

FIGURE 2
The global distribution of participants attending the forum. The colours indicate the five regions used by WOAH. The proportions of participants from the different economic regions according to the World Bank classification (World Bank, 2022) were 20% from the combined low and low/middle income countries, 26% from upper middle income countries and 62% from high income countries.

not differ between the two time zones (Figure 3). Since the mean score was positive for all SDGs, only the positive range of the full scoring scale (-3 to +3) is shown. The strongest co-benefits were between improving AW and SDG 3 (Good health and well-being), SDG 14 (Life below water) and SDG 12 (Responsible consumption and production). The weakest co-benefits were between improving AW and SDG 5 (Gender equality), SDG 7 (Affordable and clean energy) and SDG 10 (Reduced inequalities). Agreement around rating the impact of improving AW on achieving the SDG and vice versa varied according to the SDG and to the direction of the scoring. This is illustrated in two heat maps (Figure 4).

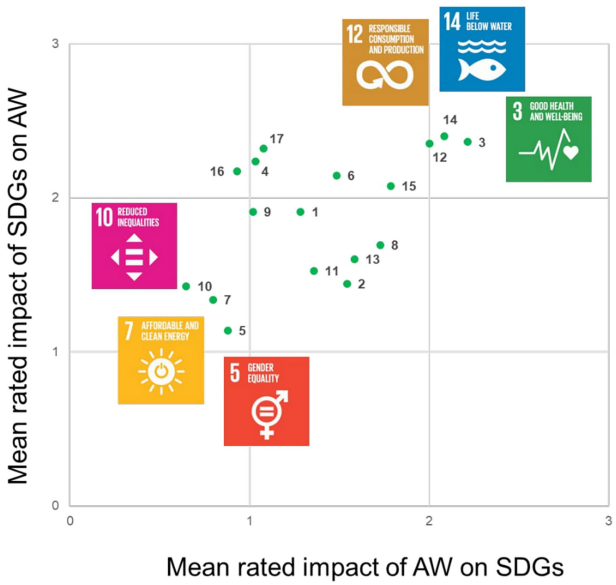

FIGURE 3
Average score for the impact of improving animal welfare on achieving each SDG against the impact of achieving each SDG on improving animal welfare. Scores could range between -3 (it is not possible to achieve both aims at the same time) to +3 (the two aims are linked and achieving one means that the other is achieved also).

A

SDG →AW	n=	% of votes for each scoring						
		-3	-2	-1	0	1	2	3
SDG 1	67	0	0	0	3	16	67	13
SDG 2	72	1	0	8	4	32	38	17
SDG 3	66	0	0	0	5	6	38	52
SDG 4	59	0	0	0	0	10	56	34
SDG5	65	0	0	2	28	32	32	6
SDG6	62	0	0	0	0	13	60	27
SDG7	59	0	0	3	12	41	36	8
SDG8	66	0	0	2	0	36	52	11
SDG9	56	0	0	2	2	14	68	14
SDG10	68	1	0	1	9	32	51	4
SDG11	70	0	0	0	4	51	31	13
SDG12	65	0	0	0	0	8	49	43
SDG13	53	0	8	4	2	19	43	25
SDG14	60	0	0	0	5	5	35	55
SDG15	51	2	0	0	0	14	53	31
SDG16	58	0	0	0	2	19	40	40
SDG17	65	0	0	0	0	9	49	42

B

AW →SDG	n=	% of votes for each scoring						
		-3	-2	-1	0	1	2	3
SDG 1	67	0	1	1	12	42	39	4
SDG 2	72	1	1	6	3	29	42	18
SDG 3	66	2	0	0	2	17	32	48
SDG 4	59	0	0	2	25	42	29	2
SDG5	65	0	0	0	37	42	18	3
SDG6	62	0	2	2	13	29	40	15
SDG7	59	0	0	0	47	34	10	8
SDG8	66	0	2	0	3	23	65	8
SDG9	56	0	2	0	38	23	30	7
SDG10	68	0	0	7	37	43	10	3
SDG11	70	0	0	1	17	43	21	17
SDG12	65	0	0	0	6	17	48	29
SDG13	53	0	0	6	8	28	40	19
SDG14	60	0	0	0	5	3	70	22
SDG15	51	0	2	2	2	24	51	20
SDG16	58	0	0	7	28	34	28	3
SDG17	65	0	0	0	26	42	31	2

FIGURE 4
(A) Heat map of the variation in scores for the impact of achieving the SDGs on improving animal welfare (SDG→AW). **(B)** Heat map of the variation in scores for the impact of improving animal welfare on achieving the SDGs (AW→SDG).

Differences in scoring according to the direction of the impact

There were ten SDGs for which the scores for the impact in one direction differed significantly from the scores in the opposite direction (Figure 5 and Table 1). In all significant cases the expected impact of achieving the SDG on improving AW (SDG→AW) was scored as more positive than the impact of improving AW on achieving the SDG (AW→SDG). For the other seven SDGs the strength of the link between the SDG and improving AW did not depend on the direction of the intervention. This means that improving AW would have the same impact (whether low or high) on the SDG that achieving the SDG would have on improving AW.

FIGURE 5
Second day average scores, according to the direction of the association. The mean scores for the impact of achieving the SDG on improving animal welfare (dashed green line) and the impact of improving animal welfare on achieving the SDG (dotted blue line).

Table 1 Mean scores of the impact of improving an SDG on AW and the impact of improving AW on the SDG, based on the scoring by participants on day two.

SDGs	SDG → AW (Mean score)	AW → SDG (Mean score)	P-value
SDG 1: No poverty	1.9	1.3	P < 0.0001
SDG 2: Zero hunger	1.4	1.5	P = 0.54
SDG 3: Good health and well-being	2.4	2.2	P = 0.47
SDG 4: Quality education	2.2	1.0	P < 0.0001
SDG 5: Gender equality	1.1	0.9	P = 0.092
SDG 6: Clean water and sanitation	2.2	1.5	P = 0.0001
SDG 7: Affordable and clean energy	1.3	0.8	P = 0.0004
SDG 8: Decent work and economic growth	1.7	1.7	P = 0.48
SDG 9: Industry, innovation and infrastructure	1.9	1.0	P < 0.0001
SDG 10: Reduced inequalities	1.4	0.7	P < 0.0001
SDG 11: Sustainable cities and communities	1.5	1.4	P = 0.24
SDG 12: Responsible consumption and production	2.4	2.0	P = 0.018
SDG 13: Climate action	1.6	1.6	P = 0.43
SDG 14: Life below water	2.4	2.1	P = 0.002
SDG 15: Life on land	2.1	1.8	P = 0.063
SDG 16: Peace, justice and strong institution	2.2	0.9	P < 0.0001
SDG 17: Partnerships for the goals	2.3	1.1	P < 0.0001

SDG → AW: Impact of achieving the sustainable development goal on improving animal welfare. AW →SDG: Impact of improving animal welfare on achieving the sustainable development goal.

Regional, economic and gender differences

When looking at the differences in scoring between countries based on their income level, the only significant difference (P=0.014) was found in SDG 14 (Life below water). Upper/middle income countries gave a lower score (1.5) for the impact of achieving this SDG on improving AW compared to high income (2.6) and the combined low/middle income countries (2.7).

When looking at countries based on their geographical location, there were four significant differences when the analysis considered either direction. Regarding the expected impact of improving AW on achieving an SDG, there was one significant difference (P=0.016) and this was for SDG 11 (Sustainable cities and communities). There seemed to be a split into two distinct groups: the lowest scores for the AW→SDG 11 association were given by the WOAH regions Americas (0.9), Africa (1.0) and Europe (1.0), whereas the grouped WOAH region Asia, Far East and Oceania (1.8) and the Middle East (2.0) scored it highest. For the scoring in the reverse direction, i.e., the impact of achieving the SDG on improving AW, there were significant differences between the regions for SDG 2 (Zero hunger, P=0.002), SDG 8 (Decent work and economic growth, P=0.028) and SDG 11 (Sustainable cities and communities, P=0.013). For the SDG 2→AW association, participants from the Americas gave the lowest score and Middle East the highest score (0.7 and 2.8 respectively). For the SDG 8→AW association, participants from the Middle East region gave the lowest score whereas participants from the Asia, Far East and Oceania region scored it highest (1.3 and 2.3 respectively). Finally, for the SDG 11→AW association, participants from the Americas and from Africa both gave the lowest scores and the Middle East the higher score (1.1, 1.1 and 2.0 respectively). Note that it was also participants from the Middle East region that had given the highest scores for the expected impact of improving AW on SDG 11.

When looking at the difference in score based on gender, there was no difference in the scoring according to the gender of the participants for any of the SDGs or when considering all SDGs together into an overall score. For AW→SDG the mean score was 1.3 for females and 1.2 for males. For SDG→AW the mean score was 1.9 for females and 1.8 for males.

Changes in scoring across meeting days

Analysis of the scores given by people on day one, before they had taken part in group discussions, compared to the score given by the same individual on day two, when they had heard the views of other participants, differed both according to the direction of the scoring (AW→SDG or SDG→AW) and according to which goal was being considered.

For the impact of improving AW on achieving the SDG, there was a general decrease in the overall average score from 1.8 to 1.4 from Day 1 to Day 2. This was mainly attributable to significant decreases in the scores for SDG 4 (Quality education, P=0.004), SDG 10 (Reduced inequalities, P=0.008), SDG 12 (Responsible consumption and production, P=0.04), and SDG 17 (Partnerships for the goals, P=0.001). The exception was for

SDG 3 (Good health and well-being) where there was a significant increase in the score from Day 1 to Day 2 for the impact of improving AW on achieving the SDG (P=0.016). When considering the impact in the reverse direction, i.e., impact of achieving the SDG on improving AW, there was a general increase in the overall average score from 1.4 on day 1 to 1.9 on day 2. This was mainly attributable to significant increases in the scores for SDG 4 (Quality education, P=0.001), SDG 7 (Affordable and clean energy, P=0.03), SDG 9 (Industry, innovation and infrastructure, P=0.02), SDG 14 (Life below water, P=0.02), and SDG 17 (Partnerships for the goals, P=0.02). However, while participants' opinions on the potential impact changed between the two days (i.e., for some SDGs, it reduced in one direction and increased in the other direction), this was not the case for all SDGs. There were nine SDGs for which there was no significant change despite the discussions around these topics.

Qualitative analysis of group discussions

A summary of the participants' key rationales supporting the score they gave during the sessions is presented in Table 2. The rationales are organised by SDGs and by direction of the impact. Both positive and negative (italic) impacts are included in the table as and when provided by the participants. This summary is based on comments by all participants and so is a greater number than was available for the analysis of the scoring.

Discussion

The results from this study showed that stakeholders estimate overall positive associations between AW and SDGs in both directions and the strengths of the estimated associations for the different SDGs are similar to those found in previous studies (Keeling et al., 2019; Olmos Antillón et al., 2021).

Demographic

The present study was done with a substantially larger group (n=95) than in the previous two studies (n=12 and n=15 respectively), and with participants from different regions throughout the world. The previous studies were conducted with scientists and students respectively, compared to this one with participants from Government and other National Competent Authorities, as well as regional WOAH Collaborating Centres and NGOs. Although the participants at this WOAH workshop cannot be considered a representative group for all citizens, the composition of the participants suited the aim of the workshop, which was to support policymaking by this particular group. The abbreviation 'AWO' is used in the following discussion to refer to 'animal welfare organisations' i.e. all groups, businesses and institutions that have an interest in AW and not only NGO's.

Identifying strategic partnerships

There are many policy options, tools and means of implementation. The 'integrated and indivisible' nature of the 2030 agenda (UN, 2015) means that no one sector will be able to manage the transformation alone and that collaboration is a potential basis for many policy options when integrating AW into the SDGs. One could argue that organisations aiming to improve AW, i.e. AWOs, could identify potential new allies for strategic partnerships by orientating themselves in our 'map' (Figure 3), which reflects the relative strengths of the associations between achieving an SDG and improving AW. These partnerships could lead to innovative ways of working as well as mobilizing expertise and hard to reach resources. Indeed, AWOs could broaden the support they get, or that they offer, and thereby strengthen the impact of their strategies to improve AW by including goals that are the primary focus of other organisations.

For example, the three SDGs for which there were strongest co-benefits with AW were SDGs 3, 12 and 14 (Figure 3). A potential policy option for an organisation with improving AW as a primary goal could thus be to approach organisations that have improvements in the area of human health (SDG 3), responsible consumption and production (SDG 12) or sustainability of aquatic systems (SDG 14) as their primary goal, with a view to collaboration. The proposal to these other organisations would be that supporting policies that lead to improvement in AW, would actually help them achieve their own goal. In return, AWOs who support organisations working towards SDGs 3, 12 or 14 would gain through the 'spin off' effect of improved AW. By combining their efforts, the organisations would increase their target audience, their supporting networks and thus their impact. Simply put, the co-benefits make collaboration worthwhile, potentially opening up opportunities that would be unavailable when organisations are working independently towards their own respective goals. Collaboration would also help prevent or mitigate any trade-offs (Nilsson and Weitz, 2019)

A second example of how to identify strategic partnerships, focuses on the relative strengths of the links in the two directions. For SDGs 2, 3, 8 and 13, the strength of the impact is almost identical irrespective of the direction (AW→SDG and SDG→AW) (Figure 5). This would imply that in any collaboration between organisations, the benefits are likely to be equally mutually beneficial, although the magnitude of the perceived impact may vary. That collaboration between organisations aiming for improving AW and improving human health and well-being (SDG 3) could be both strong

Table 2 Participants' key rationales supporting their score of the *positive* and *negative* impact of achieving the SDG on achieving animal welfare and vice versa.

SDG	Achieving SDG on improving AW	Improving AW on achieving SDG
1 	• Less poverty might move the focus from human livelihoods to improving animal welfare with potentially more resources available to improve their welfare or facilities. • Meat consumption might increase which might have a positive or negative impact on AW depending on the way the product is produced.	• Improving welfare may improve livelihoods through improved animal health and productivity, *but it may incur additional costs; a potential barrier to ending poverty by pushing farmers unable to implement these standards out of the market.* • *Animal welfare is not driven by poor class but rather by individual behaviour.*
2 	• Animal welfare may improve as people will be less desperate to find food and will treat animals better. • *Production systems in place to ensure global food supply may not consider AW. The aim is to achieve nutritional balance through sustainable production system.*	• Sustainable local farming considering animal welfare during production and transport will improve healthy livestock production (productivity) thereby contributing to reduce hunger sustainably, to achieve food security and to improve nutrition.
3 	• One Health and One Welfare are positively linked, but ethical treatment of animals and good management of zoonoses must be reinforced. • *The wellbeing of people does not affect wildlife as much as other groups of animals.*	• The rate of injuries caused by animals to people who are working with them may improve. • Better AW may improve animal health, reduce the need for antimicrobial agents, thereby reduce the risk of AMR which could be passed on to humans. • We need ways of improving animal welfare within economic and practical constraints.
4 	• Better education and increased awareness may help consumers, adult and children citizens and people working with animals reflect on and improve animal welfare (e.g. more empathy, better understanding), *but other factors such as economic conditions and policies can mitigate impact.*	• *The link is less clear. If you can improve animal welfare, you are likely to have better education already, not necessarily an improved education as a result.*
5 	• May improve diversity of opinion and representation in places where you have animals, which may bring different ways of solving issues. This could help animals.	• Both organisations [World Bank and FAO] have shown that there is a direct correlation between improved animal welfare and enhancement of women empowerment, in particular in small holder families.
6 	• Clean water and better sanitation are important for both humans and animals. It may reduce potentially infectious diseases thereby improving animal welfare. • This is an integral part of the accepted 5 freedoms.	• Animal welfare management should consider appropriate use and management of water and how to avoid water pollution due to residues (e.g. medicines, cleaning products) and inadequate manure management. • *Animals kept outdoors may impact ground and surface water if not managed appropriately.*
7 	• Less pollution improves animal health and welfare. • Energy available to improve animal housing conditions. • *Windmills and hydro-electric plants do kill animals (both terrestrial and aquatic) and may have a possible impact on landscape.*	• Better welfare which improves productivity may have a lower energy consumption or generates more money that could be used to invest in clean energy.
8 	• Decent work may make people feel better and when people feel better, they can treat animals better. • Economic growth may mean investments to improve infrastructure for animals. • *May increase illegal trade in wildlife due to more resources to afford wild animal trophies.*	• Improving animal welfare that improves animal health may be beneficial for economic growth and may provide job satisfaction.
9 	• It may improve handling, transport and housing of animals and access to veterinary care. • Innovation may offer solutions that promote animal welfare, reduce the use of laboratory animals, reduce food waste (thereby reducing the number of animals needed), but there are competing interests.	• It can support economic growth which in turn can support innovation, infrastructure and development of resilient industries.
10 	• If society treats people well and equally, animals will be well treated too: less inequality, potentially less conflict thereby reducing impact on animal casualties or suffering.	• Improving animal welfare moves towards a caring society which would transfer towards inequalities. • Protection of biodiversity/wildlife reserves can help indigenous communities. • *Regulation for welfare improvements could increase inequality for groups not aligned with those policies due to socio-economic reasons.*

(Continued)

Continued

SDG	Achieving SDG on improving AW	Improving AW on achieving SDG
11 	• Sustainable cities or communities, may have better livestock transportation practices and better understanding of consumption needs linked to more sustainable production. • *It depends on how 'sustainable' is defined and whether AW is considered in the policies.*	• Contribute to making cities and human settlements inclusive, safe (e.g., reduce rate of injuries caused by animals), resilient and sustainable. • Responsible ownership of companion animals improves animal welfare and may reduce disease transmission, contributing to sustainability.
12 	• Consuming responsibly may mean producing only what we need, reducing pressure on animal production, thereby improving their life. *However, 'responsibly' has different meaning between communities; improvement of AW is not guaranteed.* • Consumers may pay the right price for products. The more you value the production from an animal, the more you value what you eat.	• It may decrease disease burden thereby reducing the need to use antimicrobials making food production more sustainable. • The more you value the welfare of an animal, the more you value how your food is produced. • *Consumption pattern is broader than animal welfare. Animal welfare will have marginal impact, enabling at best.*
13 	• *Addressing climate change may mean bringing animals indoors (where effluent can be managed in a closed system) and reducing pen size both potentially affecting animal welfare.* • It may reduce direct effect of climate on animals (droughts, floods, spread of diseases), thereby improving their welfare.	• Changing production methods to improve AW could contribute positively *or negatively*, e.g., 'lower loss of animals due to diseases' versus 'slower animal growth increases feed per kilo produced'. • Compassion for animals is often linked to compassion for the climate and environment.
14 	• Sustainable selection of fish for aquaculture better adapted to the environmental conditions, improved catching methods, reduction of plastics or abandoned fishing gear in the oceans and seas will improve fish habitat and welfare.	• Improving terrestrial animal welfare may improve production reducing resources needed, thereby reducing pollution that could leak into the water. *But other actions will be needed to achieve this SDG.*
15 	• More responsible ownership of companion animals; Reducing wildlife trade; Reducing zoonoses transmission; Development of extensive methods of production; More suitable habitat for wildlife to flourish – all have the potential to improve animal welfare and are good for biodiversity.	• Providing a natural environment to encourage natural behaviours (e.g., trees for free range poultry), can benefit the environment, land restoration and biodiversity. Although it could take away land for other purposes. • Better population management (e.g., dogs) will benefit wildlife and better life on land.
16 	• In a stable and peaceful world, people may be more considerate to animals, *but it depends on the government's policies and priorities.* • Reducing illegal wildlife trade and organized crime around animals may improve the wellbeing of wild animals.	• *Improving animal welfare in itself will have a minimal impact on peace, justice and strong institutions, as even peoples' suffering and wellbeing is insufficient to drive building peace and justice.* But, considering animal welfare may teach people to appreciate better well-being and peace.
17 	• Communication and collaboration between stakeholders can create opportunities to improve animal welfare at local, national and global level. *But AW can be improved even without partnership or priorities may differ between partners.*	• Potential link to the one health concept. • *Animal welfare does not have a clear impact on partnership but potentially enabling.*

and equally beneficial, may be one of the reasons behind the growing alignments within the One Health movement. Nevertheless, our analysis would suggest that organisations with improving AW as a primary goal could consider the policy option of collaboration with organisations that have SDG 2 (Zero hunger), SDG 8 (Decent work and economic growth) and SDG 13 (Climate action) as their primary goal. Even if the perceived benefits are lower than when the focus is only on the strongest links, all enable the achievement of the other goal (Nilsson et al., 2016).

On the other hand, for SDGs 4, 16, 17, there is a large asymmetry in the strength of the impact depending on the direction (Figure 5). Achieving these goals is expected to have a large impact on improving AW, but improving AW is expected to have a much lower impact on achieving these SDGs. In practice, this might mean that organisations with these goals as their primary aims could be less motivated to collaborate with organisations that have a focus on AW, since the potential benefits are lower to them. Nevertheless, from the point of view of the AWOs, the potential benefits of collaborating with an organisation, e.g. to achieve the SDG 16 goal of 'Peace, justice and strong institutions', is likely to have a similarly high impact on improving AW as will collaborating with an organisation to achieve the goal of (human) health and well-being (SDG 3). The dilemma for AWOs is the extent to which they can actually contribute towards achieving big societal goals, such as SDGs 4, 16 and 17, even in collaboration. It may be that in the end, their (often limited) resources are better prioritised towards collaborating on goals they have greatest potential to help achieve, such as SDG 3.

Despite the prevailing view that achieving the SDGs has a stronger impact on improving AW, than improving AW has on achieving the SDGs, for many SDGs the strength of association was very similar, irrespective of the direction of the scoring. A

commonality for just these SDGs, might be the ease with which people could see the contribution of improved AW. This is probably most noticeable regarding the impact of animal health on human health (transmission of zoonotic diseases, antimicrobial resistance etc.).

Which animals are we talking about?

We have used the very broad question of 'improving animal welfare' and asked participants to consider all categories of animals when estimating associations between AW and SDGs. The outcome of which SDGs had the strongest links is therefore most suited to organisations that have that broad remit. In a more targeted version of the exercise, perhaps for an AWO focused on improving the welfare of a specific category of animals, e.g. livestock, or a specific animal production species, e.g. cattle, the outcome 'map' may be different. In such an example, one would not expect the association between AW and SDG 14 (Life below water) to be rated highly, whereas it would be if the AWO focused on improving the welfare of marine mammals or fish. Similarly, the exercise could be repeated with a specific context in mind, e.g. improving the welfare of pets kept in shelters or animals kept in zoos, or on a subset of SDGs.

This speculation is supported by some of the discussions where participants indicated they had difficulties to decide on a score, which would differ according to the animal they had in mind or personal experience, as some participant reflected:

> *"The score could depend on what category of animals we are talking about (e.g., pet animals versus farm animals)." (SDG4: Quality education)*
> *"It will also depend on what areas of animal welfare you focus on." (SDG 9: Industry, innovation and infrastructure)*
> *"…the main difference could be ascribed to what type of animals the different participants in the groups were thinking of […] whether it was mainly pet animals, farm animals or wild animals…" (general comment).*

These types of uncertainties lift up the importance of discussion in association with the scoring exercises and the benefits of a more specific context (Olmos Antillón et al., 2021). For the remainder of this discussion, we will focus on organisations that have the goal of improving the welfare of all categories of animals, as reflected in our exercise.

Identification of targets and contexts

The foundation for our methodology comes from work that explored interactions between targets (sub-goals) of the SDGs in a given context (Nilsson et al., 2016; Weitz et al., 2018). However, since AW is not mentioned in the SDGs, we modified their approach to work at the higher level of the goals and we did not specify any context. In effect, we acted as though there was an 18th SDG called 'Improving animal welfare' (Visseren-Hamakers, 2020). However, now that the overall positive associations have been identified, we propose that the next step is to identify targets and contexts.

With regard to identifying targets, then two potential scenarios can be envisaged. First, when a specific SDG of interest has been identified by an AWO using the 'map', and an allied organisation(s) working within this area has been identified for collaboration, then the next step is to focus on the targets that are associated with that specific SDG. These targets are already defined (UN, 2015) and the organisations can work together to prioritise the target that will achieve the co-benefits our research suggests will arise from their collaboration. Second, for an AWO with a broad remit of 'improving animal welfare' as its goal, it is likely that there is no single SDG, but a whole suit of potential SDGs of interest. This has both advantages and disadvantages with regard to prioritising targets. The clearest advantage is that it gives AWOs more potential targets to select between (since there are several SDGs) and a greater number of potential allies for collaboration. The disadvantage in this more complex network may be the risk of conflicts between targets. However, this can be checked by repeating the scoring exercise on the matrix of interactions between the targets of interest. Indeed, this methodology was originally developed to rate associations between targets rather than between SDGs.

In most earlier studies of synergies and conflicts between SDGs, the context is the starting point and the aim to find the win-win within that context. According to the argument being developed in this paper regarding integrating AW into the SDGs, the context is decided at a much later stage of the process. This lack of a pre-defined context, give greater flexibility for the organisations in these new alliances to identify the context of mutual interest. Of course, it does not exclude that a specialised AWO working with a particular species or in a particular country may not already from the start have a clear context in which it wants to work when integrating AW into the SDGs.

In addition to targets and context, also important are the tools that are used by the two organisations to achieve their policy goals and the complementarity of the policy tools. There are different types of tools that can be used to promote certain policy goals. In relation to AW policy, tools are for instance, rules and regulations, education and training, institutional arrangements, research, self-regulation, incentives, and information provision, among others (FAWC, 2008; Costantini et al,. 2015). Our results also support the importance of communication, since we found some evidence for changes in scores over the days of the meeting.

It is important to consider critical and complex interactions when implementing these tools. Even if very few negative

interactions between AW and the SDGs were identified during this exercise, there is still a possibility for AW to be impacted negatively if choices made to achieve SDGs ignore the impact on AW. Managing trade-offs to limit the potential negative effect is very important.

> *"We can improve the well-being of wildlife as well as the well-being of farmed animals, if consumers and producers are making good decisions," SDG 12 (Responsible consumption and production)*
> *"In a stable world, animals will have a better life but it depends on the government and how they want to run the country. [Their] priorities." (SDG 16: Peace, justice and strong institutions).*
> *"Impact [positive or negative] on animal welfare may differ between types of stakeholders, i.e., depends on between which organisations the partnership is based…" (SDG 17: Partnerships for the goals).*
> *"If the economic growth is prioritised, we have seen examples that it is not always a positive correlation with AW." (SDG 17: Partnerships for the goals).*

Regional, economic and gender differences

A clear advantage of the larger number of participants in this exercise is that it allowed additional analyses. For example, the strength of the scores given for the links to some SDGs according to region and the economic status of the home country of the participant could now be analysed and resulted in some significant differences. The distribution of participants is not balanced, most noticeably with those countries in the low and low/middle economic classifications being under represented. One reason is the variation in number of people around the world collaborating with the WOAH, which will have affected the distribution of initial invitations. A further reason why there were fewer participants registered from the lower income categories of countries may be that these countries cannot (or choose not to) prioritize participation in these workshops, even when they are held online. However, it may also be that a larger proportion of people from just these regions were among those where we could not link the username to a registered participant during the meeting.

Nevertheless noteworthy, and supporting the robustness of these differences, is that there was an association that was significant in both directions (SDG→AW and AW→SDG) in the analysis using the WOAH regions and this was for SDG 11 (Sustainable cities and communities). Other regional and economic differences related to SDG 2 (Zero hunger), SDG 8 (Decent work and economic growth) and SDG 14 (Life below water) were only significant in the direction of the impact of achieving the SDG on improving AW. Overall, this result implies that while for the other SDG-AW associations policy options can be global, for these four SDGs, policies may need to be at the regional or national level. Some participants commented on the differences between countries in whether they see AW as a trade issue or not, to differences in the implementation of AW standards and to awareness of AW generally.

> *"Implementation of animal welfare differs between developed and developing countries…" (SDG 10: Reduced inequalities)*
> *"…the scores really depend on your perspective and local context." (SDG 11: Sustainable cities and communities)*
> *"Strong regulation (or push) for welfare improvements could increase inequality with groups that are not aligned with those policies due to socio-economic reasons" (SDG 10: Reduced inequalities)*
> *"There is much variation in the way of living between regions (urban, intensive, rural) and there needs to be education/awareness on the importance of animal welfare" (SDG 11: Sustainable cities and communities)*

There was no evidence for a gender difference in the scoring for any SDG, or overall. This is in contrast to the well-documented difference in attitudes to animals often reported (e.g., Phillips et al., 2011; Randler et al., 2021). However, this may be explained by the fact that both the men and the women in our study population were working either directly or indirectly within the area of animal health and welfare. That knowledge and awareness of animal welfare issues may be more important than gender could have accounted for the earlier finding that the gender of state legislators did not influence how they voted on farm AW protection bills (Tauber, 2013).

An aspect that did influence how individuals scored the strengths of the expected impacts between improving AW and achieving the different SDGs was the discussion on the topic and the possibility to hear the views of others. When comparing the average scores of people at the start of the exercise with the average scores later, the impact of improving AW on achieving the SDG decreased, whereas the impact of achieving the SDG on improving AW increased. This overall pattern is a consequence of the many significant changes for the individual SDG-AW associations, and it is perhaps how being part of the discussion influenced participants' scoring around the different SDGs that is of most interest for future investigation. For example, this general pattern was not the same for all SDGs, showing that some areas were more sensitive to discussion than others.

Furthermore, a decrease in one direction did not necessarily imply an increase in the opposite direction, showing that the two directions were evaluated independently by participants. Individuals were only asked to vote on a few SDGs on day 1 and then on all SDGs on day 2, which limited the number of individuals who voted on the same SDG. Nevertheless, when comparing the votes of these people we see that if there was a significant difference, it was usually to reduce the strength of the anticipated impact. The exception to this trend was a significant strengthening among these participants on the impact of improving AW on achieving SDG 3 (Good health and well-being) over the course of the exercise.

Concrete example of identifying targets and context: The WOAH situation

Governing authorities use different mechanisms to promote policies to achieve predefined goals according to whether the outcome is considered 'public good' or not. A public good, in economics, has been described as a product or service that is non-excludable (i.e., one cannot exclude individuals from enjoying its benefits when the good is provided) and non-depletable (i.e., one individual's enjoyment of the good does not diminish the amount of the good available to others) (Encyclopedia Britannica, 2022). However, discussions on whether AW can be considered a 'public good' are ongoing; at least for farm animals (Fernandes et al., 2021).

The WOAH included AW under its mandate in 2002, and is committed to developing standards and policy tools which can support AW improvement globally. The WOAH could strengthen its contribution to achieving the SDGs through its AW policies and strategies.

The WOAH's core mandate is instrumental in supporting efforts to meet the UN SDGs targets, especially if WOAH Standards are integrated in the regulatory framework of all National Veterinary Services and are effectively implemented. Other examples include the implementation of the four strategic pillars of the WOAH's Global Animal Welfare Strategy adopted in 2017 (WOAH 2022c), the WOAH Aquatic Animal Health Strategy launched in 2021 (WOAH, 2022d) and the WOAH Strategy on Antimicrobial Resistance and the Prudent Use of Antimicrobials published in 2016 (WOAH 2022e), which could contribute to the achievement of SDGs 3, 8, 12, 14, 15, and vice versa; therefore, WOAH would benefit from partnering with additional organisations targeting these SDGs seeing that a similar level of benefit is reciprocal (e.g., little difference between direction for SDGs 3, 8, 15 and high scores despite the difference for 12 and 14).

Similarly, in March 2022 the United Nations Environment Programme (UNEP) joined, the Tripartite FAO-WOAH-WHO alliance to form a Quadripartite Collaboration for One Health (WOAH, 2022f). The new Quadripartite includes initiatives that support the improvement of AW, which in turn could contribute to the achievement of UN SDGs 2, 3, 13. Moreover, the adoption of the resolution on the animal welfare–environment–sustainable development nexus in February 2022, during the Fifth session of the United Nations Environment Assembly of UNEP, will boost an in-depth analysis on how AW could support the achievement of the SDGs.

Nevertheless, reflecting further on this discussion, it may be that WOAH, in addition to its existing collaboration with the Quadripartite, should expand its relationship with additional organisations targeting the achievement of other SDGs, such as SDG16, to increase the probability of achieving improved AW.

Conclusions and next steps

The estimated overall co-benefits between improving AW and achieving the SDGs hold even with a larger group of participants, and we could even identify some variation around the strength of these estimates between participants from different regions for some SDGs. This study further emphasised that AW can be improved due to co-benefits of achieving the SDGs (even if some are expected to have a bigger impact on AW than others), especially if policies, decisions, and priorities are set in a way that AW is taken into consideration. The authors believe this exercise could be a roadmap for organisations interested in improving animal welfare to identify allies and to make themselves attractive for collaboration around policies to realise the co-benefits. The work could also support the increasing efforts related to theory of change by organisations. The next step is to explore interactions between goals, and especially between targets in specific contexts, with a view to identifying policy options for real-life situations.

It would be interesting to reproduce this methodology, but with participants other than those with interest in animal health and welfare, to see if these people's perception (based on their expertise in other fields) mirror the expected improvements on the SDGs and AW obtained in this study. It would offer new opportunities to create shared accountability in our increasingly complex world.

Data availability statement

Data are available from the corresponding author on reasonable request.

Author contributions

LK, HB and LS conceived the original idea. All authors took part in the data collection. GOA and BSL performed the quantitative data analysis and EM the qualitative analysis. All authors took part in the writing and revisions. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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