MERCY FOR ANIMALS

Farmed Animal Opportunity Index (FAOI)

Methodology

Introduction

The Farmed Animal Opportunity Index (FAOI) is a composite index[1] that measures the potential for work related to farmed animal protection using relevant socioeconomic and scale-oriented indicators. The index serves as a preliminary, fundamental stage in a larger analysis to evaluate the scope of interventions to help farmed animals.

This document outlines the statistical methodology and framework adopted to create the index. It also outlines the limitations of the index and some guidelines on its use.

Dimensions and Indicators

Theoretically, the FAOI has four dimensions: the three pillars of effective altruism—scale, tractability, and neglectedness—plus global influence, which we consider highly important for our analysis. However, due to a lack of quantifiable data relevant to "neglectedness," only the remaining three dimensions were retained. In all, 19 indicators were selected on the basis of relevance and the availability of data for countries in the analysis and allocated to one of the three dimensions. Following are definitions of each indicator.

Scale

This dimension captures the scale of the problem. A higher value for any of the indicators suggests greater potential impact for farmed animals.

1. **Farmed land animals and farmed fishes**
   Definition: Estimated number of animals slaughtered for domestic food supply in 2017, according to the following FAOSTAT items: eggs, hen, in shell; meat, buffalo; meat, cattle; meat, chicken; meat, duck; meat, goat; meat, goose and guinea fowl; meat, pig; meat, rabbit; meat, sheep; meat, turkey; milk, whole fresh, buffalo; milk, whole fresh, cow; milk, whole fresh, goat; milk, whole fresh, sheep. This is aggregated with the estimated number of farmed fishes in 2015 based on FAO tonnage and estimated mean weight in a species category, as identified by FishCount. The species category list can be found at FishCount. Measured in billions of individuals.
   Source: FAOSTAT, Livestock Primary
   Source: FishCount

2. **Human population**
   Definition: Number of people counted as citizens of a country in 2019. Measured in millions of individuals.
   Source: UN Population Prospects

Tractability

This dimension seeks to answer the question, If we intervene, how likely are we to succeed? The indicators in this dimension are key social, political, and economic aspects that are relevant to our advocacy and help us determine the potential for success, especially regarding institutional work.

3. **Income spent on food**
   Definition: Percentage of total consumption expenditure spent on food. Consumption expenditure in the domestic market is equal to consumer expenditure by resident households plus direct purchases in the domestic market by nonresident households and minus direct purchases abroad by resident households. This variable was reversed to ensure uniform directionality with the outcome variable.
   Source: USDA ERS

4. **Gross national income per capita**
   Definition: Total domestic and foreign output claimed by residents of a country plus factor incomes earned by foreign residents minus income earned in the domestic economy by nonresidents. Measured in current U.S. dollars.
   Source: World Bank and OECD

5. **Urban population**
   Definition: Percentage of the population residing in urban areas.
   Source: United Nations Population Division

6. **Education**
   Definition: Average number of years of schooling. Original source data from UNESCO Institute for Statistics (2019), Barro and Lee (2018), ICF Macro Demographic and Health Surveys, UNICEF Multiple Indicator Cluster Surveys, and OECD (2018).
   Source: UNESCO

7. **Internet penetration**
   Definition: The internet penetration rate corresponds to the percentage of the total population of a given country or region that uses the internet.
   Source: Internet World Stats

8. **Scope and nature of giving and volunteerism**
   Definition: Percentage of people who reported donating in the month before their interview for the Gallup 2017 World Poll, which surveyed 1,000 individuals per country in 146 countries and asked a range of questions, including about giving behavior. This is averaged with the percentage of people who reported volunteering in the month before their interview for the 2017 Gallup World Poll.
   Source: CAF World Giving Index

9. **Globalization**
   Definition: Economic, social, and political state and extent of globalization.
   Source: KOF Globalization Index

10. **Corruption**
    Definition: Perceived degree of public-sector corruption, according to experts and businesspeople.
    Source: Corruption Perceptions Index 2019

11. **Democracy (prevalence of democracy)**
    Definition: State of democracy in a country, determined using the Democracy Index, which assesses five categories for 165 independent states and two territories: electoral process and pluralism, civil liberties, the functioning of government, political participation, and political culture.
    Source: EIU Democracy Index

12. **Ease of doing business**
    Definition: Procedures, time, cost, and paid-in minimum capital required for a small- to medium-size limited liability company to start up and formally operate in each economy's largest business city. This variable was used as a proxy for the ease of starting a nonprofit.
    Source: World Bank, Doing Business

13. **Gender equality**
    Definition: Composite degree of inequality in achievement between women and men in three dimensions: reproductive health, empowerment, and the labor market as of 2018.
    Source: UNDP, Gender Inequality Index

14. **Political stability and absence of violence/terrorism**
    Definition: Perceptions of the likelihood of political instability or politically motivated violence, including terrorism, as of 2018.
    Source: World Bank, World Governance Indicators

15. **Size of informal sector**
    Definition: Percentage of GDP accounted for by the shadow or informal sector as of 2015.
    Source: IMF, Shadow Economies Around the World

16. **Innovation in food systems**
    Definition: State of innovation in a country's agricultural landscape as of 2017.
    Source: Global Innovation Index

*The FAOI evaluates only one group of indicators related to "generic tractability." We must also consider other tractability indicators related to what we term "movement-specific tractability." We can gather data for these indicators through surveys and more-qualitative analysis. Movement-specific tractability involves variables of particular relevance to animal protection organizations: among others, the general population's knowledge, attitudes, and behavioral intentions regarding farmed animals; availability of plant-based alternatives; existing animal welfare laws; and number of influencers advocating for farmed animals. Filling in these variables gives us a better sense not only of how likely we are to be effective in general but of which campaigns are most likely to work well in a particular country or region.

Global Influence

This dimension caters to our belief that policies and trends in highly influential countries are more likely than those in less influential ones to affect other countries—for better and for worse. A recent example is George Floyd's death in the United States, the world's most influential country, and the rapid growth of the Black Lives Matter movement, which spread to dozens of countries in a matter of days and amplified the call for racial justice worldwide.

Global influence is calculated according to the degree of cultural influence a country exerts on the rest of the world, as well as its levels of international trade in meat and live animals.

17. **Global influence**
    Definition: Degree of a country's cultural influence on different countries in the world.
    Source: Elcano Global Presence Index

18. **Meat trade**
    Definition: Absolute value of meat exported minus meat imported. Categories include bovine meat, mutton and goat meat, pig meat, and poultry meat. Measured in 1,000 tonnes.
    Source: FAOSTAT, New Food Balances

19. **Live animal trade**
    Definition: Absolute value of animals exported minus animals imported. Categories include buffaloes, cattle, chickens, ducks, rabbits and hares, turkeys, goats, sheep, and pigs. Measured in millions of individuals.
    Source: FAOSTAT Trade Data

Missing Data

These 19 indicators were selected according to their relevance and the availability of data for countries in our analysis. While several additional indicators were shortlisted, those missing data for 25 percent or more of the countries were excluded. Conversely, we had to exclude from our analysis some countries we had initially included, such as Cyprus, Estonia, Luxembourg, and Malta, due to unavailability of data for multiple indicators.

Variables where only one country's value was missing were imputed using a cold-deck imputation method.[2] More advanced multiple imputation techniques[3] were used for other variables where cold-deck imputations were not applicable: innovation in food systems, volunteerism and giving, soft power, globalization, and gender equality.

For food innovation, which was missing for Myanmar and Taiwan, a truncated regression[4] with a lower limit of zero and an upper limit of 100 was employed to impute three missing values, given the continuous and bounded nature of the variable range. Globalization, which was missing for Taiwan, was also imputed using the same truncated criterion. Predictive mean matching was used to impute values for volunteerism and giving, which was missing for Vietnam. Soft power, which was missing for Hong Kong and Taiwan, was imputed using predictive mean matching as well. In each instance, the missing data point was replaced by the mean of the imputed estimate across the generated datasets.

$$\alpha^* = \frac{1}{M} \sum_{m=1}^{M} \alpha_m^*$$

where α^* is the imputed value and M is the number of imputed datasets. For the above multiple imputations, M=20. At no point were previously imputed values used to impute other missing data.

Uncertainty Checks

To check the validity of our missing data imputation techniques, we deleted observations for certain countries and imputed them under the same criteria and compared the imputed value with the true value. Both the truncated regression and predictive mean matching provided values close to the true value. Additionally, to test the validity of imputed values, we bootstrapped mean parameter estimates in over 500 replications; the estimates were identical to the imputed means with standard errors matching to the thousandth decimal place.

Transformation and Normalization

Gross national income was log-transformed to reduce skewness. Political stability was transformed to fit into a zero to five range to avoid negative values. The directionality of percentage of income spent on food, size of formal sector, and gender equality was reversed to align with the outcome variable. Since the variables are not measured on the same scale or in the same unit, normalization is needed to allow for aggregation. We used a min-max normalization rule, which used the theoretical bounds (i.e., a prespecified minimum or maximum possible value of the variable) or observed bounds (i.e., the minimum and maximum value of the observed spread of data in the sample) depending on the parameter's data specification.

$$z_i = \frac{x_c - min(x)}{(x) - min(x)}$$

Aggregation and Weighting

Each dimension is the arithmetic mean of the normalized values of its constituent indicators. The FAOI is the geometric mean of the scale, tractability, and global influence dimensions.

$$FAOI_c = \prod_{j=1}^{J} x_{j,c}^{w_j}$$

where FAOI is the index score for country c; $x_{j,c}$ is the value of the dimension; j = *scale*, *tractability*, and *global influence* for country c; and w_i is the weight of dimension j, with the weights aggregating across dimensions to unity:

$$\sum_{j=1}^{J} w_j = 1$$

Geometric aggregation avoids the issue of full compensability,[6] which is observed in additive aggregations. Full compensability implies that low levels of performance in one indicator cannot be compensated equally by high levels of performance in another. Aggregating geometrically also incentivizes improvement in performance in dimensions where a country is performing poorly by accounting for the differences in marginal utility (the resulting change in the index score from a one-unit increase in a dimensional score) at different levels of performance. For example, an increase in a dimensional score from 8 to 9 is rewarded more in a geometric aggregation than an increase from 88 to 89. In an additive aggregation, both would be treated equally. Additionally, (positive) data that is not comparable—and composed of variables measured on a ratio scale—can be meaningfully aggregated only using geometric functions.

Weighting is a key part of the analysis. The weights *between* dimensions may be adjusted to reflect users' own decision-making priorities. However, the weights *within* a dimension are not flexible. The potential for doing a factor analysis was explored. A Kaiser-Meyer-Olkin (KMO) test[7] was carried out, which returned a value of 0.8482, suggesting that a factor analysis would be appropriate for the current data. This was unlike the case in the pilot version of our index, which considered only 19 countries in South, East, and Southeast Asia on 23 indicators. Improving our # of countries to # of variables ratio allowed an exploratory factor analysis to be viable in this global scenario.

Before conducting the analysis, two indicators that were initially considered—percentage of population in the middle class and freedom of press—were removed due to extremely high correlations with a number of different indicators. The factor analysis was run on the remainder of the indicators.

Bolstering our initial assessment (and to our relief), the factor analysis allocated the indicators between dimensions in the exact same manner that we had. Based on the factor analysis, we identified dimensional weights by calculating the proportion of the total variance in the dataset contributed by each individual dimension. We did not estimate the individual indicator weights using the factor loadings due to the high number of individual indicators under consideration. These statistically determined weights of the dimensions are as follows:

Scale: 0.16
(or 16 percent)

Tractability: 0.69
(or 69 percent)

Regional Influence: 0.15
(or 15 percent)

Another alternative, as has been suggested by several people whose feedback on our pilot Asia index was requested, would be to use opinion-based weights. Allowing for opinion-based weights across a large number of indicators introduces reliability issues, as it could bear high cognitive load on the user and induce the risk of circular thinking. If the number of indicators were under 10, a weighting scheme based on opinion would still be an acceptable alternative. In lieu of a smaller number of variables and the statistical conditions needed for a more advanced weighting scheme, we moved forward with an equal-weighting scheme *within* dimensions. Several other landmark composite indices, including the UN's HDI, use this robust approach.[8]

Users of the FAOI may still, however, alter the weights *between* dimensions according to their assessment. Since the decision involves only three values, it is less likely to cause the cognitive issues delineated above. However, we strongly encourage that the inter-weight spread reflect the reference weights of the statistically determined weights: that is, tractability should hold the largest weight, followed by scale and global influence, in that order.

The default weights were assigned according to extensive discussions between Mercy For Animals decision-makers and experts, and they are as follows:

Scale: 0.25
(or 25 percent)

Tractability: 0.55
(or 55 percent)

Regional Influence: 0.20
(or 20 percent)

Tractability was given the largest weight, not only because it reflects the weights from the exploratory factor analysis but because we consider it a woefully undervalued dimension in decision-making in the AR movement. While going where the problem is greatest is important, we *must* ask, Will we succeed there?

Limitations

One of the concerns with equal weighting within dimensions is that if any two indicators are highly correlated, double counting results in the index score. As a first step in the factor analysis, we explored the correlation structure of the data and systematically excluded indicators that had high correlations with multiple other indicators. However, some relatively strongly correlated pairs were retained because of the conceptual relevance of individual variables. Therefore, double counting exists to a small extent in the FAOI. Additionally, some of the external indices that are incorporated in this index, such as the Global Innovation Index, capture some of the individual factors included in the FAOI already. This marginally contributes to double counting as well.

Several variables that we would have liked to include in the analysis were not quantifiable and therefore not included. A key indicator that we would have liked to include was attitudes toward animals. However, due to a lack of reliable international data on this subject, we were unable to do so. Instead, we pivoted to using a proxy, gender equality, which has been shown to be directly proportional to attitudes toward animals. Mercy For Animals is currently leading an effort to collect primary data on attitudes toward animals in all the countries included in the FAOI.

Another limitation is our inability to incorporate neglectedness as a dimension. Neglectedness aims to capture the degree to which animal issues in these countries have been neglected. While neglectedness is not a dimension that was ultimately included in the index, it warrants some attention. Our initial choice for an indicator was the number of animal rights groups in each country and their capacity for interventions, specifically for farmed animals. But after conducting fairly in-depth internet research and communicating with staff at organizations active in various Asian countries, we realized that a full, consistent list of animal advocacy groups (particularly those that focus at least partially on farmed animals) would be impossible to accurately compile.

Consequently, we pivoted toward considering a detailed proxy variable: World Animal Protection's Animal Protection Index (API). The API grades countries according to their animal welfare policies and legislation. Although this doesn't necessarily reflect how neglected the country is by our movement, it is a good, reliable indicator for investigating the degree of neglect of animal issues, regardless of the number of organizations working on them. The poorer a country's performance on the API, the higher its degree of neglect of animal issues by any stakeholder, not just the AR movement. Two points led us not to incorporate the API: first, the lack of an obvious directionality with our outcome variable, potential of farmed animal advocacy; second, the unavailability of the API for several of the countries that were shortlisted for the FAOI. For these reasons, the API was determined not to be a suitable proxy/indicator to represent neglectedness in the index and was not included in the analysis.

Future versions of the FAOI will try to correct for some of these limitations and more.

Conclusion

This index provides a system for ranking countries according to their potential for effective interventions to help farmed animals. Rankings are based on available data. That said, we emphasize that using the index should be a preliminary step to guide or inform further research into the factors considered, as well as those not included here. Mercy For Animals, for instance, conducted detailed scoping studies of the six highest-ranked countries in our East and Southeast Asia iteration of the index before making decisions on whether to expand into that region, as well as the type of work that will have the greatest impact in each country (e.g., movement building, legislative advocacy, corporate engagement). Please read our considerations document to better understand how the FAOI should fit into your international work planning.

Our intention with the FAOI is to push the movement's focus beyond scale and inform organizational and philanthropic decision-making by incorporating and quantifying tractability, offering a more complete view of the opportunity for impact and potential challenges. The FAOI is designed to be your first stop when deciding where to make the most impact for animals.

References

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