PEER EDERER - The role of meat in society, economics, and culture

Wood et al. 2023

Featured Article

"Cellular agriculture": current gaps between facts and claims regarding "cell-based meat"

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Implications

- There has been a significant increase in the number of scientific articles related to "cell-based meat" ('CBM'), which is in line with the current interest from the scientific community and consumers, but mainly from investors, food industry, and regulatory bodies.
- Despite the billions of dollars being invested in "cellular agriculture", there are significant technical, ethical, regulatory, and commercial challenges to getting these products widely available in the market. In addition, the widespread adoption of such technologies can exacerbate global inequity between affluent and poor individuals and between high- and low-income countries.
- Current 'CBM' products are not identical to the products they aim to replace. First, there is still considerable dissimilarity at the level of sensory, nutritional, and textural properties, while important quality-generating steps in the conversion of muscle into conventional meat are missing. Second, many societal roles of animal production beyond nutrition can be lost, including ecosystem services, co-product benefits, and contributions to livelihoods and cultural meaning.
- Detailed production procedures are not available, making it impossible to corroborate the many claims related to their product characteristics and sustainability.
- 'CBM' companies arguing that the cost of all technology will eventually be significantly reduced often quote Moore's law. However, biological systems like 'CBM' have natural limits and feedback mechanisms that negate this law.

https://doi.org/10.1093/af/vfac092

Key words: animal and alternative proteins, "Cellular agriculture", "Cultured meat", food biotechnology, future foods, precision fermentation

Introduction

In alignment with an emerging Silicon Valley–style outlook on the future of food, a bold 2019 report by the think tank RethinkX claimed that by 2030 the U.S. meat and dairy industries would be bankrupt due to "cellular agriculture" taking over their traditional markets (Tubb and Seba, 2019). This claim was based on their view of how quickly precision fermentation and "cell-based meat" ('CBM') technology would be developed and scaled, so they could compete on price parity with traditional livestock production (Leroy et al., 2023). However, estimates on future evolutions differ wildly. For example, a 2018 report ordered by the Flemish government predicted that the consumption of "clean meat" may start in approximately 2040 (van Diepen et al., 2018). Ten years ago, however, it was already touted that "clean meat" would be available in the market by 2017 (EC, 2012). By now, it is clear that it is difficult to make predictions and that many technical challenges remain before such products can become commercially available. Nevertheless, over the past few years, billions of dollars have been invested in these technologies related to cellular agriculture (including precision fermentation and CBM) and hundreds of new start-ups have been created around the globe (Boukid and Gagaoua, 2022). The terminology for developed products is still under discussion; for recognizability, we will use the term "cell-based meat", though the term "meat" imparts characteristics that have not been proven, as we will discuss. The reasons for proposing new protein alternatives, including 'CBM', are diverse and divergent, but mainly related to ethical concerns about animal welfare and the possible impact of animal protein production on the environment (Siddiqui et al., 2022). This paper briefly describes the technical, regulatory, and consumer challenges facing both precision fermentation and CBM and examines their potential to disrupt

Croney and Swanson 2023

Featured Article

Is meat eating morally defensible? Contemporary ethical considerations

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Implications

- Despite growing global demand for protein, the ethical justification for meat consumption is increasingly questioned.
- Ensuring human rights to food requires moral deliberation.
- The role of meat in addressing growing global needs for food must be considered in the context of food safety, security, quality, access, and affordability. Animal rights, welfare, climate change, and natural resource conservation must also be addressed.
- Though natural resource scarcity may limit or eliminate production of meat in future, potential for technological innovation and agroecology approaches to offset animal, environmental, and socio-ethical harms offers a justification for retaining some degree of meat production and consumption currently.

Key words: ethics, meat alternatives, meat consumption, meat production, moral deliberation

Introduction

Because of the enormous projected growth in the human population, the United Nations has called for significant increases in global food production to meet anticipated demand (Croney et al., 2018; FAO, 2021). Consumers are increasingly interested in learning about the food they eat, including where and how it is produced. What form that food should take, however, is increasingly the subject of public debate.

https://doi.org/10.1093/af/vfac097

Protein derived from animals has figured prominently in human diets unless constrained by religious or other beliefs. Moreover, demand for animal protein has been demonstrated to increase as people in developing nations begin to experience greater prosperity (Delgado et al. 2003; Croney and Anthony, 2014). This dynamic is unsurprising given scientific findings identifying the consumption of meat as a defining factor in the evolutionary development of the human brain (Burini and Leonard, 2018 and in this issue, Leroy et al., 2023) and the role that high quality, easily digestible protein plays in human growth and development (Klurfeld, 2018). Despite these benefits, in developed areas of the world where food security and access are relatively high, the ethical justification for meat consumption is increasingly challenged, resulting in polarized, highly contentious discussions. Frequently cited ethical concerns relate to the rearing and killing of animals for food, animal quality of life in modern large-scale, intensive systems of production, and the related impacts on the environment and human health (Verbeke and Viaene, 1999; Baltzer, 2004; Botonaki et al., 2006; Croney and Anthony, 2014; Croney et al., 2018; Godfray, 2018).

For those for whom food security and accessibility are assured, these and other ethical dimensions of food production have become more significant. Accordingly, some members of the public in food-secure nations have shifted to "ethical consumerism", electing to purchase food products they perceive to be less socially and environmentally harmful (Croney and Anthony, 2014), while avoiding those not aligned with their values (Morgan et al., 2016). Evidence of such purchasing shifts was found by McKendree et al. (2014) who reported that 14% of U.S. consumers surveyed had reduced their consumption of pork by 56% on average because of animal welfare concerns. Siegrist and Hartmann (2019) reported that consumers who were more health conscious and those who perceived there to be high environmental impacts of meat were more likely to choose meat substitutes. Further, a 2020 U.S. Gallup poll reported that 23% of Americans had reduced their consumption of meat, with ethical concerns such as those related to environmental and animal welfare impacts influencing their choices (McCarthy and DeKoster, 2020).

Several companies have taken note, resulting in significant investment and effort towards the development of plant-based alternatives to meat, such as Beyond Beef and Impossible

- "Cell-based meat"
- Morally defensible

Prof. Peer Ederer

Societal dimensions of meat - economics and ethics

Peer Ederer is the founder and director of GOALSciences, the Global Observatory of Accurate Livestock Sciences, which has the mission to research and communicate scientific evidence about the role of animals in the global food system. He has an MBA degree from Harvard University, a PhD in financial economics and holds an adjunct professorship for innovation studies. He has extensive experience in strategy advisory to private companies and public bodies in the global food system and is a frequent presenter on related topics. He has been engaged in scientific research in cooperation with globally leading universities from around the world and is a member of the Scientific Council of the World Farmers Organisation. **Corresponding author**: peer.ederer@goalsciences.org.

PEER EDERER - The role of meat in society, economics, and culture

Ederer et al. 2023

Featured Article

Affordability of meat for global consumers and the need to sustain investment capacity for livestock farmers

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[‡]International Livestock Research Institute, Nairobi, Kenya
[§]School of Public Leadership, Stellenbosch University, Stellenbosch, South Africa
[||]South African Environmental Observation Network (SAEON), Pretoria, South Africa
[¶]Embrapa, Brasília, Brazil

Implications

- All livestock species are in their own respective ways a key pillar of the global food system, by economic, social, and cultural values. The most frequent, but by no means the only valuable purpose, is to provide meat for food. Meat is a nearly indispensable nutrient-dense food to global consumers. While many nutrients in meat are of key importance, protein offers itself as a sentinel proxy for the analysis.
- Depending on which assumptions one makes, there is either no gap in global protein supply for human nutrition, or protein supply needs to be expanded by around 80% over current levels to meet all nutritional needs of the global citizenship. Given global demographics until 2050, the same assumptions make the difference between whether global protein supply needs to grow only by a manageable 20% or need to increase by about 150% over today.
- Independent of whether a protein (and nutrients) gap exists or not, in 2017 a minimum nutritional adequate food basket was financially out of reach for three billion people in the world, or 37% of the total population. This percentage is likely to have risen by 2022. The situation is mostly driven by the high costs for protein and other nutrients rich foods.
- The quantity and affordability gap calls for an expansion of production of all protein and nutrient-dense sources, including from animals such as meats, dairy, eggs, and fish, and at more affordable prices to the final consumer. Significant investments in livestock production systems are required, especially in lower-income countries. Investment conditions in these countries are, however, poor due to high levels of debt, weak and fragmented institutional capacity, weakly developed commercial markets, and low supply of human capital, all of which exacerbate the challenge.
- Application-oriented research and concerted strategic actions have proven to be successful tools to raise investment levels in livestock production *systems* and making them economically, socially, and environmentally sustainable.
- Livestock farming holds good potential for increasing food security and improved environmental performance, which also applies as much to smallholders. Smallholder's current often poor productivity is not caused by their size, but by a lack of coordinated sectoral strategy and a lack of capital investment. When combined with innovative business models and nationally aligned policies, smallholder farming thrives on all performance dimensions, ecologically, culturally, socially, and environmentally.

Key words: affordability of meat produces, investment capacity, livestock farming economics, protein availability, returns on livestock research, smallholder livestock farming

https://doi.org/10.1093/af/vfad004

Polkinghorne et al. 2023

Perspectives

Challenges and opportunities for defining the role and value of meat for our global society and economy

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Implications

- There is currently a significant need to develop future leaders and scientists across the meat industry, encompassing enterprises from livestock to commercial meat product production, research organizations, government, industry bodies, and educational institutions as well as funding for effective research on meat production and products. New models are needed to counter the reduction in traditional delivery through postsecondary education, especially at facilities that also conduct research. An essential element should be greater collaboration at institutional, government, country, and global levels which will demand open sharing of resources and expertise.
- Timely access and early commercial application of scientific advances to improve productivity, human dietary, and environmental outcomes help to supplant the pursuit of controlling intellectual property and related revenue, a return to more open science and shared resources. A careful study of the issues discussed here reveals that two major changes are required: 1) Greater involvement of large and small commercial meat business enterprises (beneficiaries of much of the research outcome), in investing/funding and 2) to maintain and increase industry's involvement, scientists need to deliver timely solutions.
- To ensure viability and create research opportunities, new models for development and delivery of science that advances the mission to improve the production of high quality, safe, nutritious, and affordable meat will need to diverge from the historic "silos" of individual disciplines and evolve to highly collaborative and integrated arrangements where various sciences embrace their common base and are enriched by the mutual contact. Cooperative structures that encourage active collaboration and targeted funding across research, educational, government, and commercial groups need to become the norm as the traditional model of meat science delivered through large government-funded institutions has almost passed. The industry will need to increase engagement and scientists will need to collaborate across disciplines to deliver tangible results to maintain critical mass and ensure that livestock industries are able to continue their path forward based on scientific and technological improvement for the benefit of society.
- Lack of—or reduction of—sustainable funding has contributed to a reduction in young scientists choosing meat science as a career, and competition for limited and shrinking funds has resulted in reduced collaborative problem-solving projects and more salary competition between business and research-related roles. Industry identifies talented researchers and often leverages their skill for research management into business management. This funding reduction began decades ago, and

Key words: anti-meat rhetoric, collaboration, industry engagement, research engagement

https://doi.org/10.1093/af/vfad002

- "Cell-based meat"
- Morally defensible
- Affordability and livelihoods
- Future challenges

Prof. Peer Ederer

Societal dimensions of meat - economics and ethics

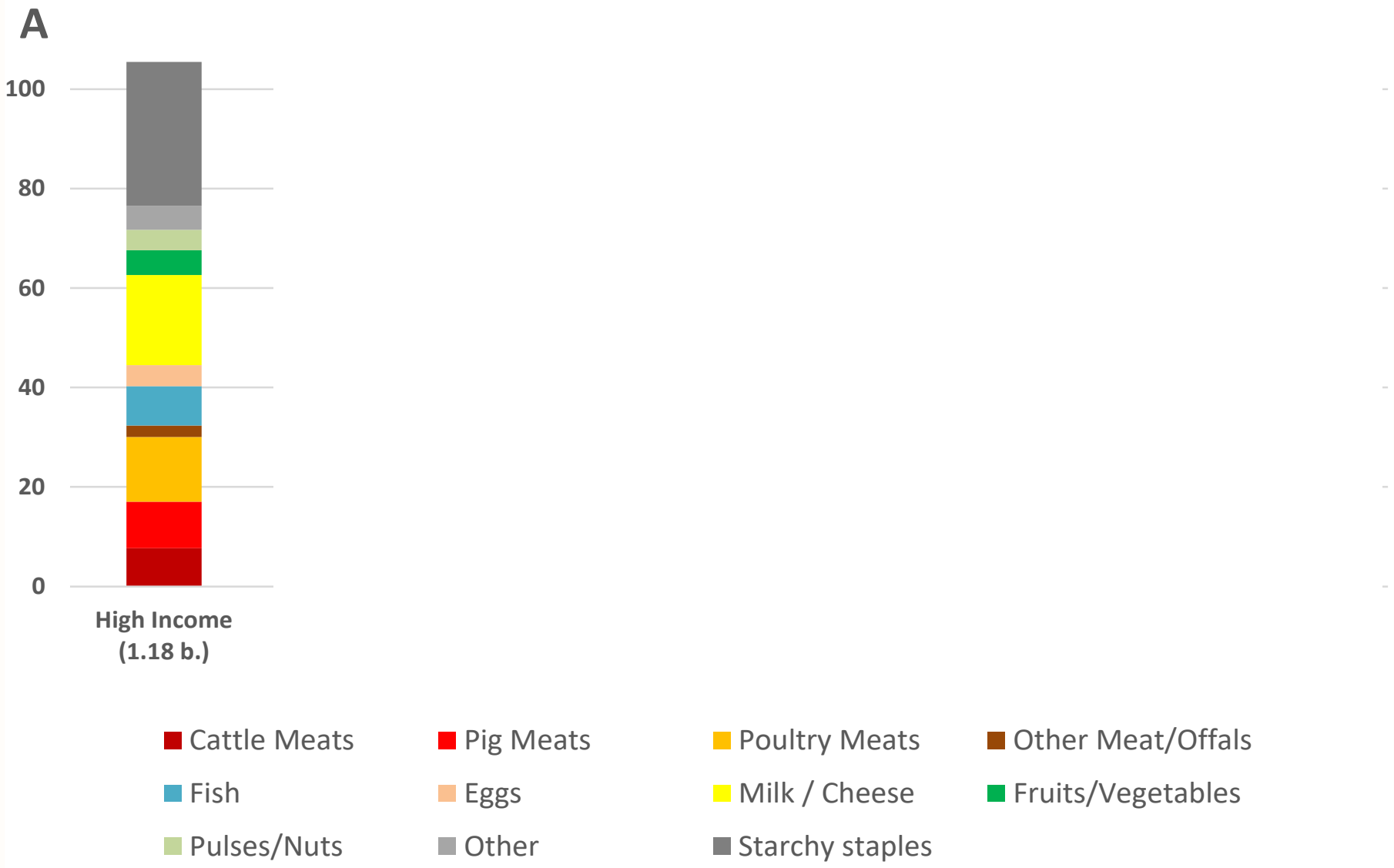
Peer Ederer is the founder and director of GOALSciences, the Global Observatory of Accurate Livestock Sciences, which has the mission to research and communicate scientific evidence about the role of animals in the global food system. He has an MBA degree from Harvard University, a PhD in financial economics and holds an adjunct professorship for innovation studies. He has extensive experience in strategy advisory to private companies and public bodies in the global food system and is a frequent presenter on related topics. He has been engaged in scientific research in cooperation with globally leading universities from around the world and is a member of the Scientific Council of the World Farmers Organisation. **Corresponding author**: peer.ederer@goalsciences.org.

Three slides on protein and money

GOAL Sciences

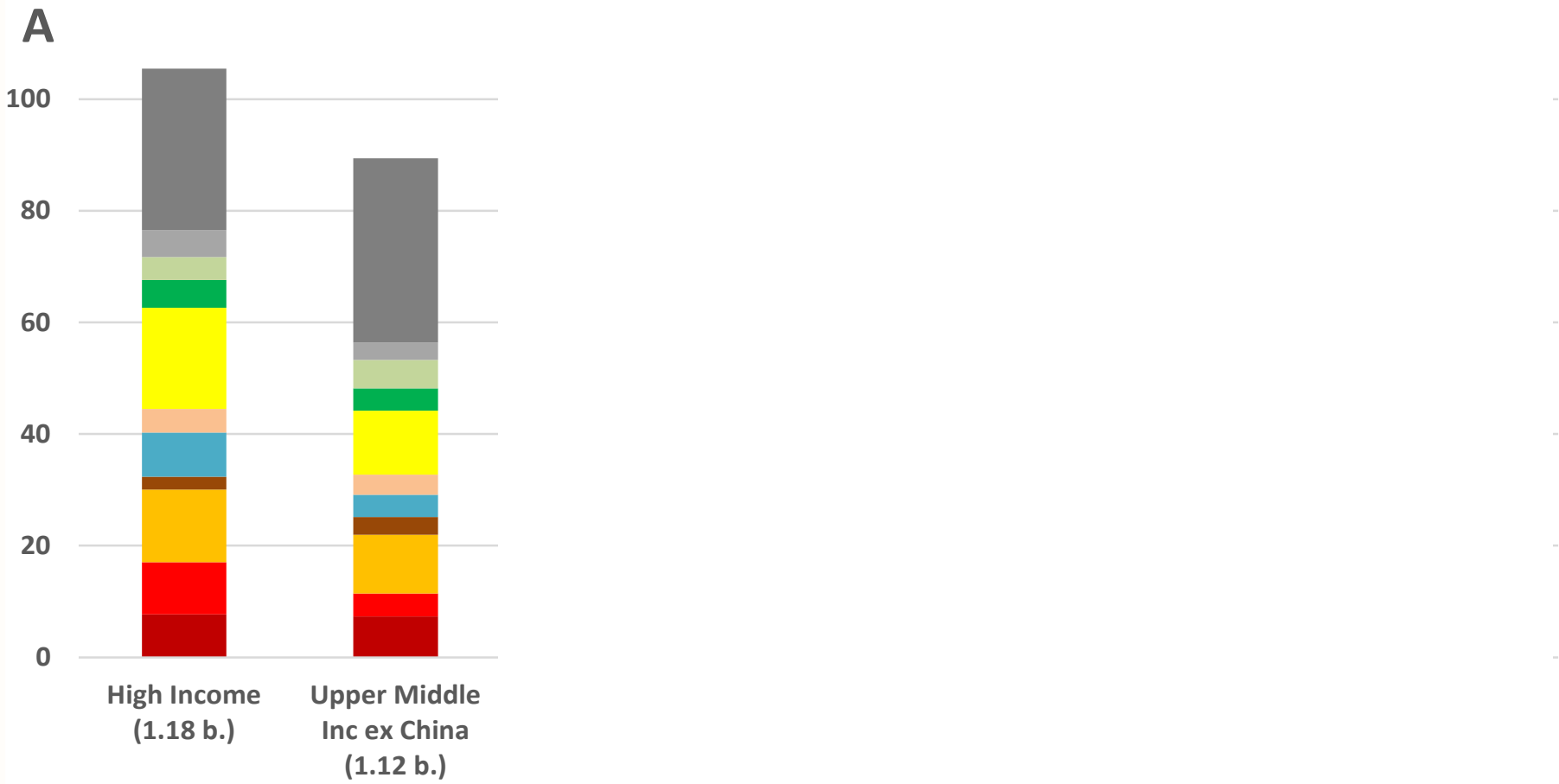
Availability of protein around the world

Grams per person per day



Availability of protein around the world

Grams per person per day



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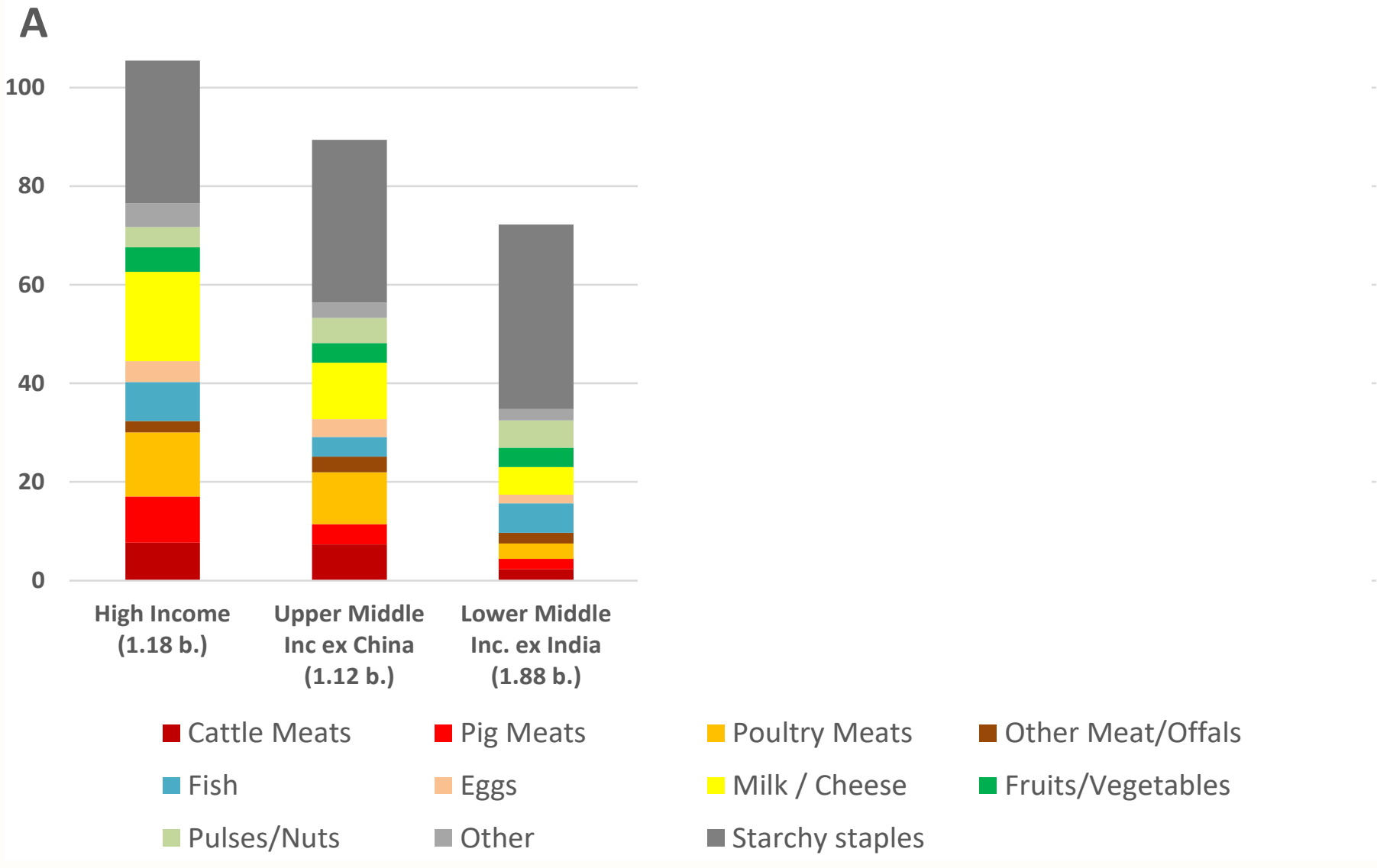
Availability of protein around the world

Grams per person per day



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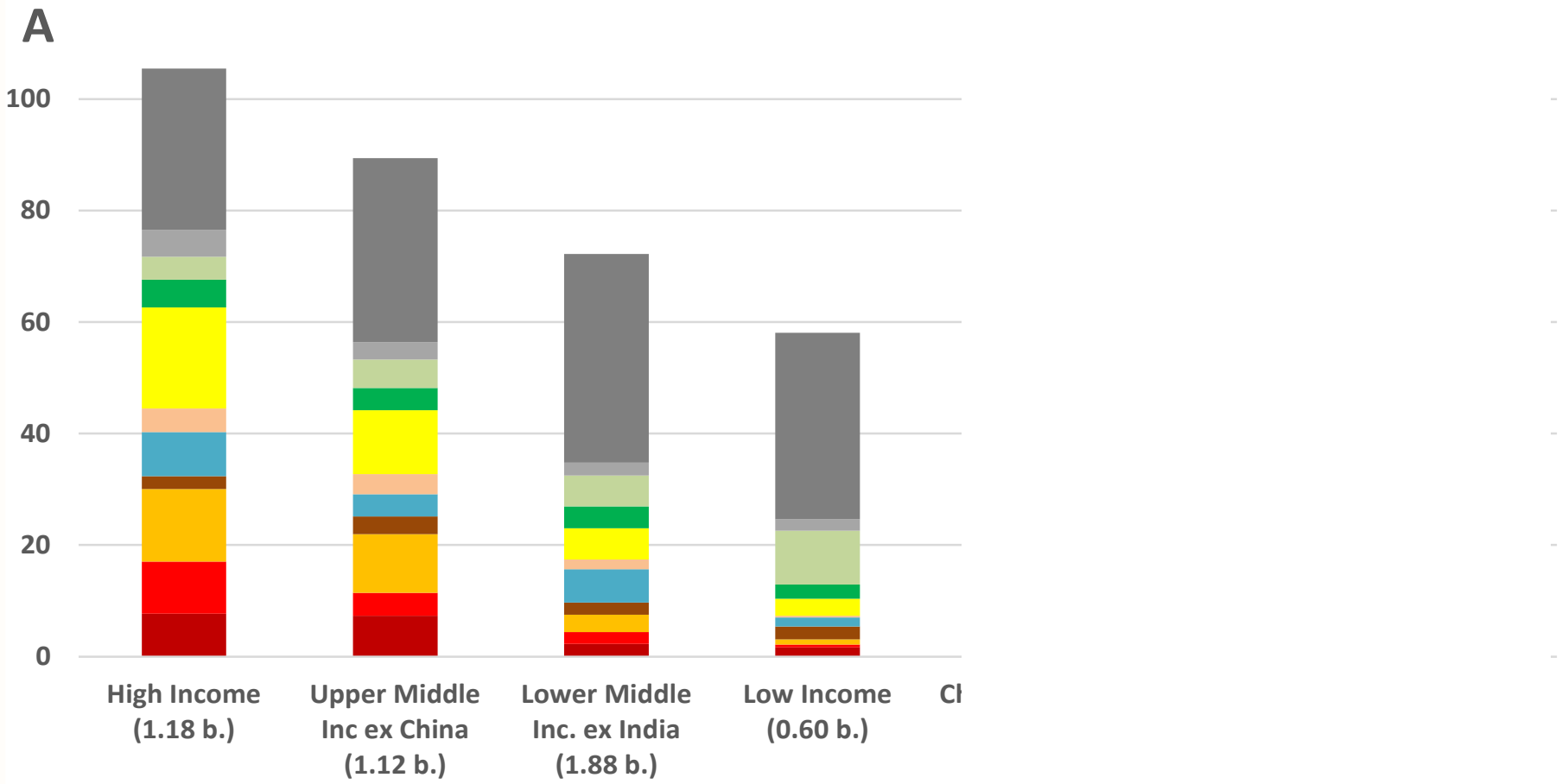
Availability of protein around the world

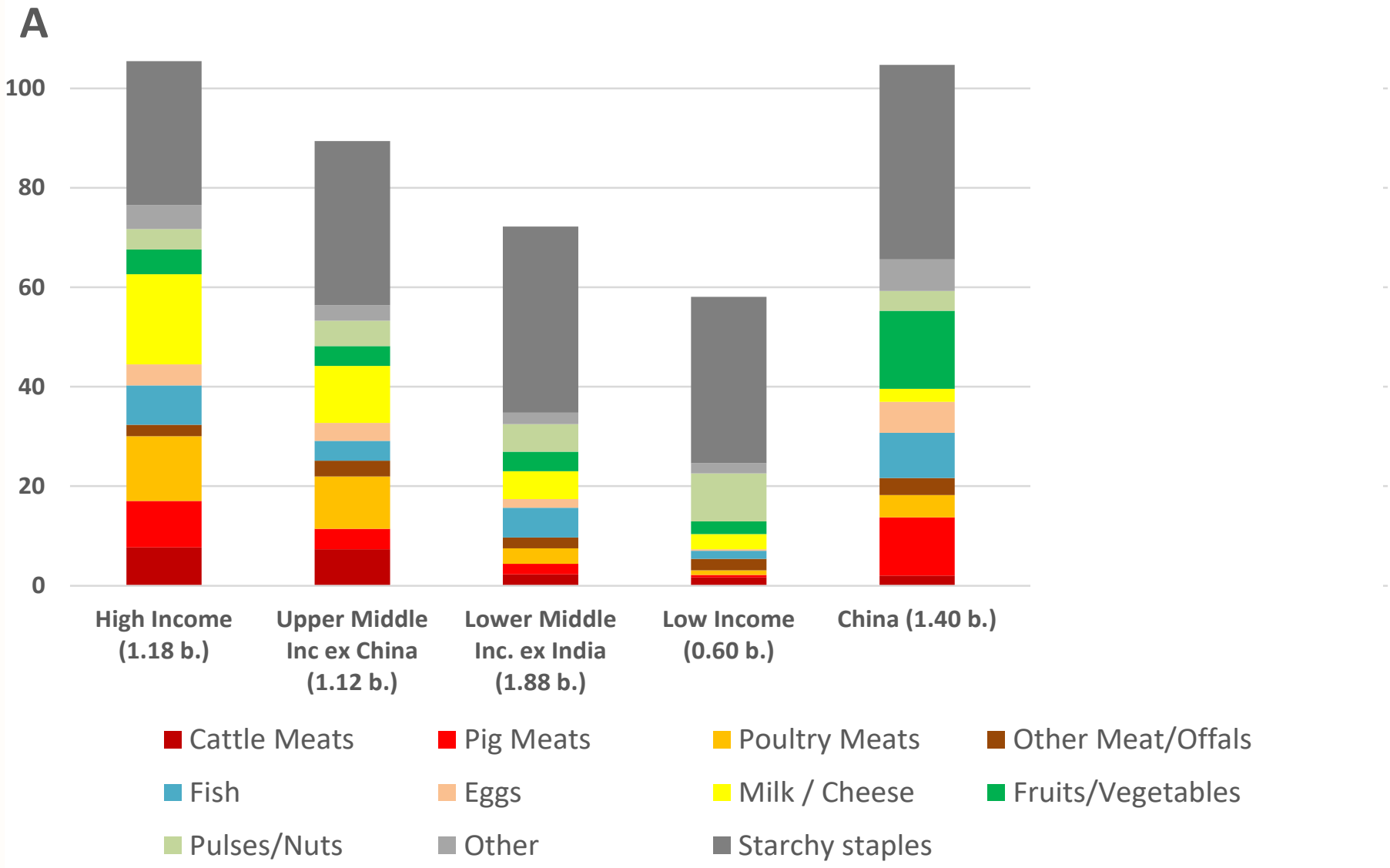
Grams per person per day



GOAL Sciences

Availability of protein around the world

Grams per person per day



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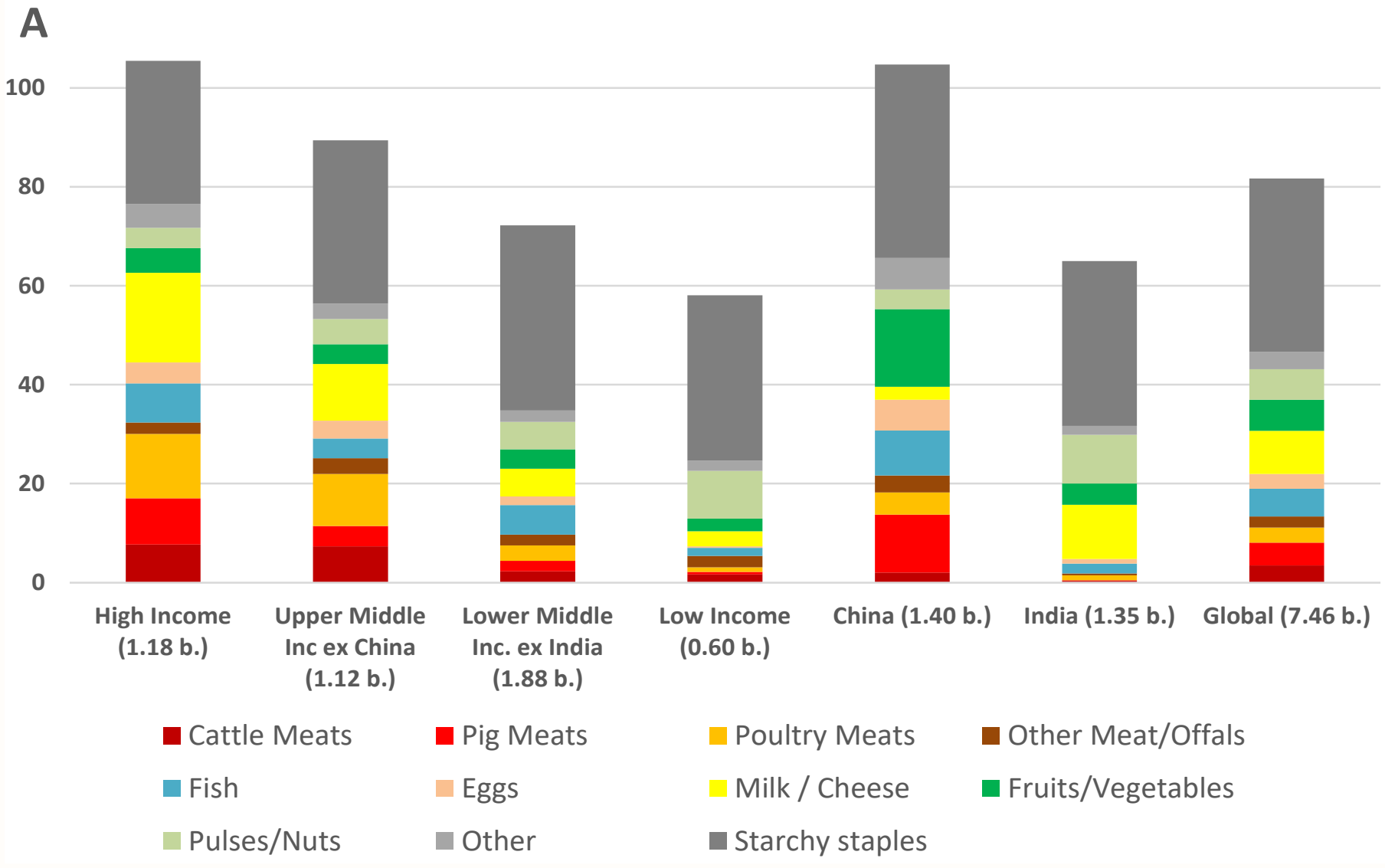
Availability of protein around the world

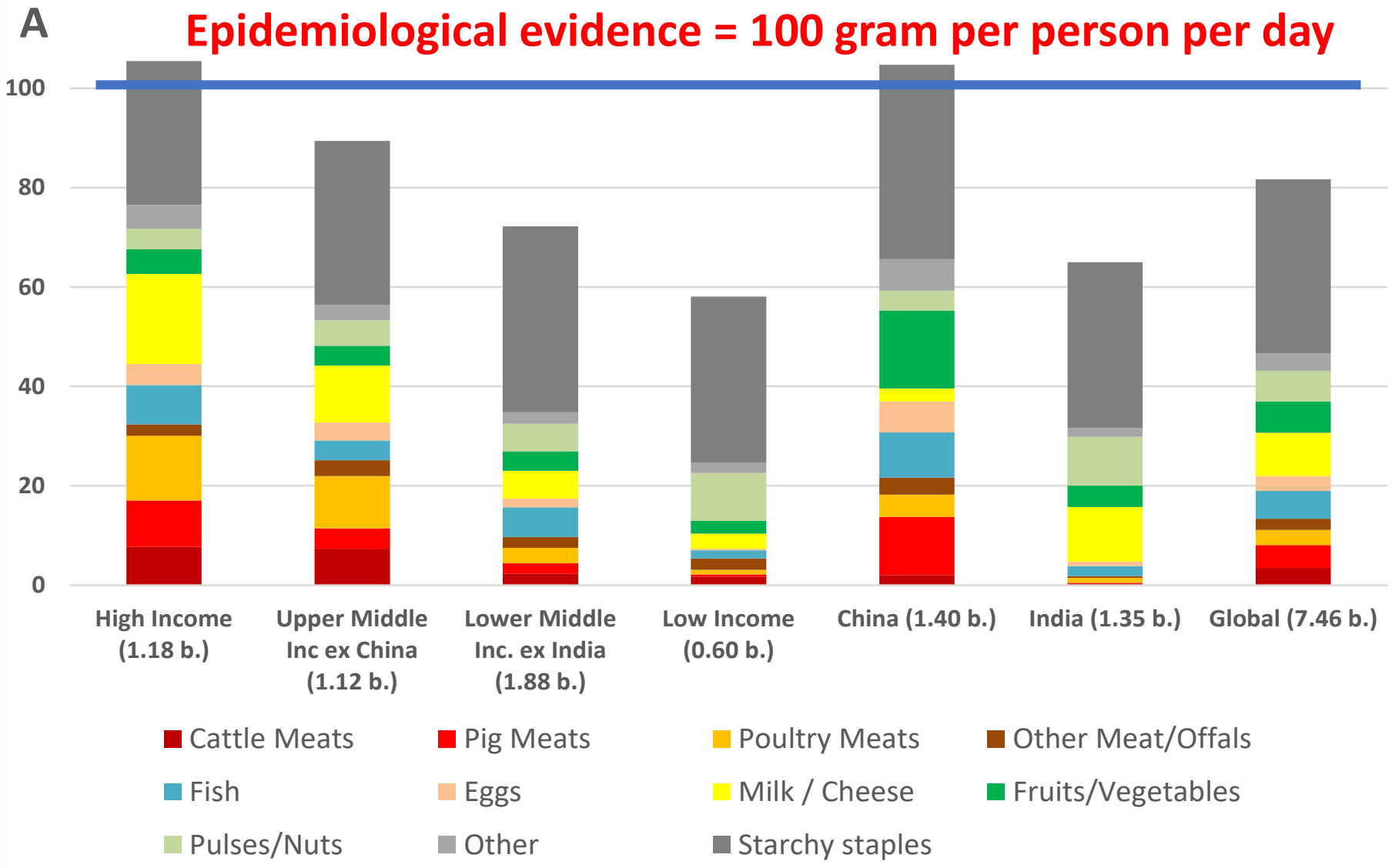
Grams per person per day



GOAL Sciences

Availability of protein around the world

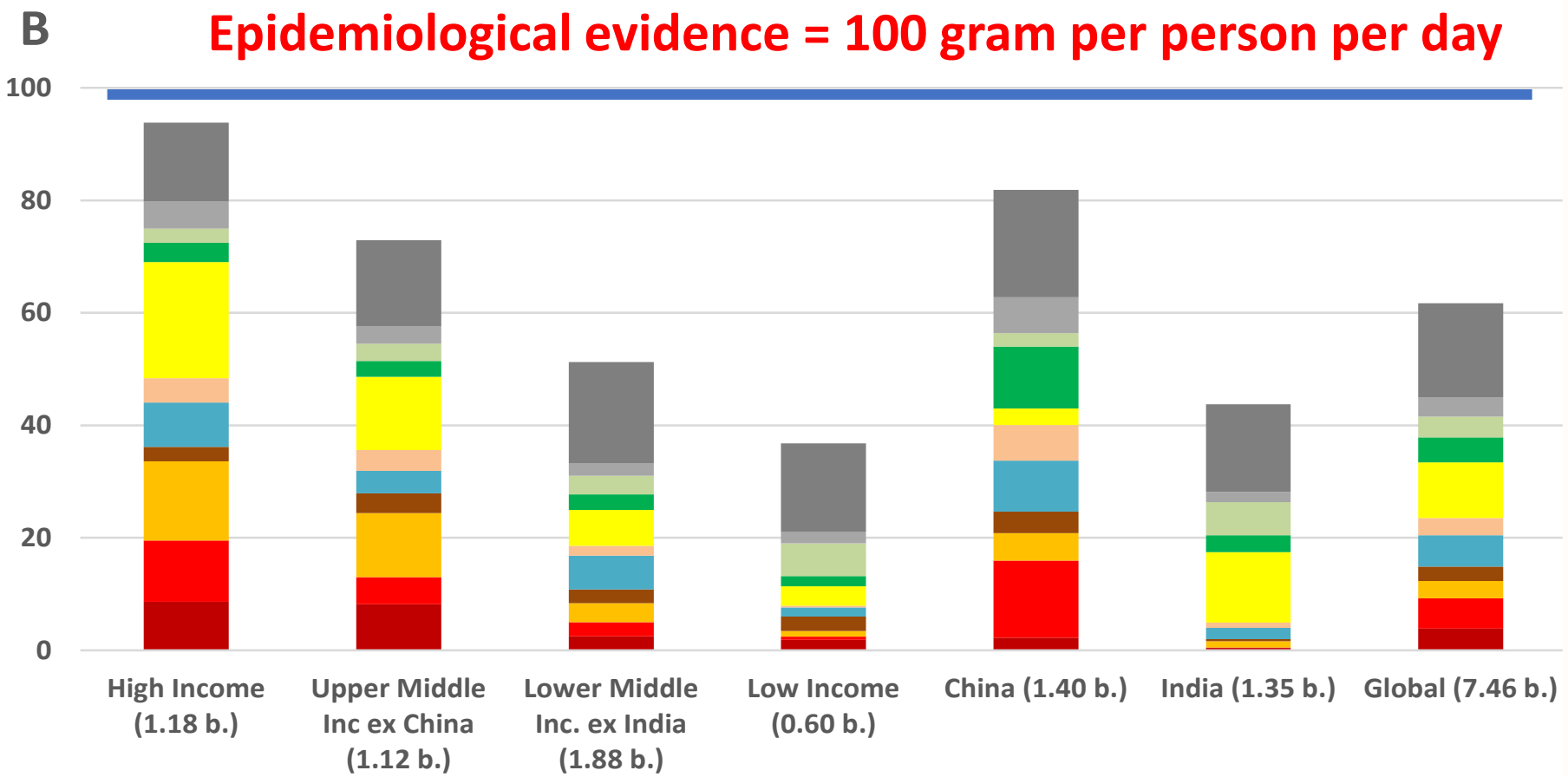
Grams per person per day



GOAL Sciences

Bio-available adjusted protein around the world

Grams per person per day



Source: Computations by GOALSciences on the basis of FAOStat

Cattle Meats
Pig Meats
Poultry Meats
Other Meat/Offals
Fish
Eggs
Milk / Cheese
Fruits/Vegetables
Pulses/Nuts
Other
Starchy staples

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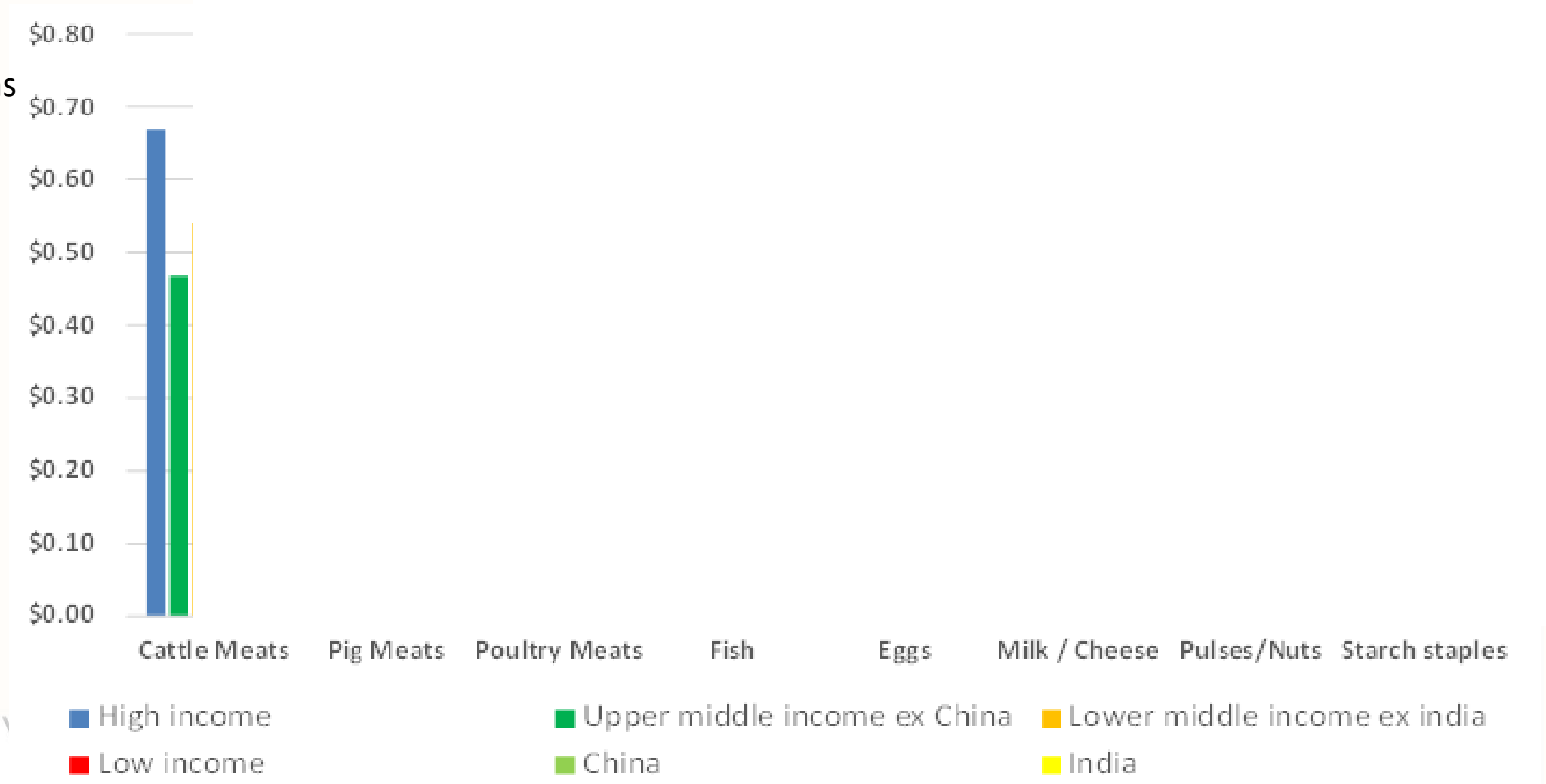
Cost of bio-available proteins by source and region, on purchasing power parity basis

PPP $ / 10 grams

GOAL Science

Cost of proteins by source and region

PPP $ / 10 grams



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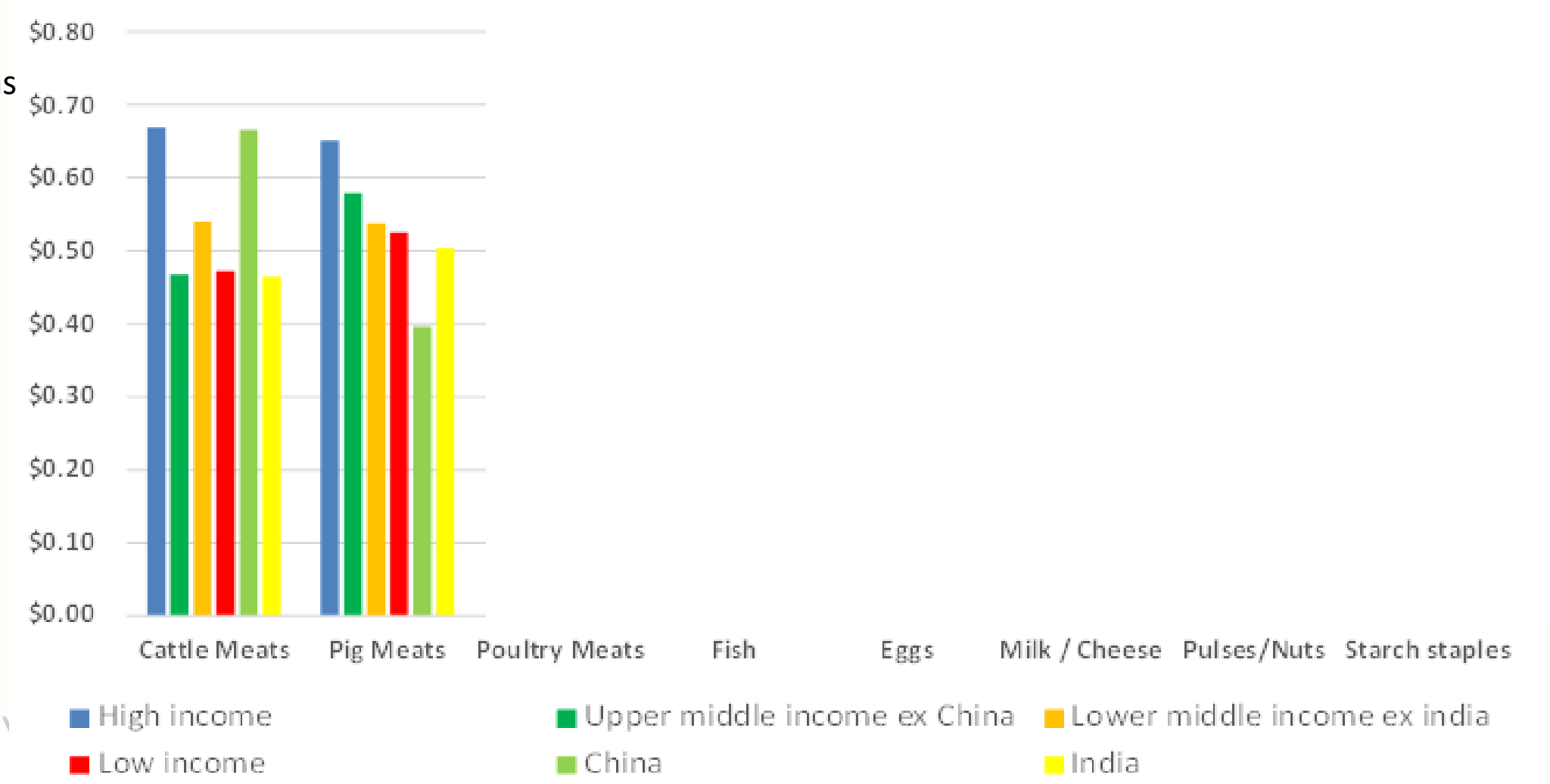
Cost of proteins by source and region

PPP $ / 10 grams

GOAL Science

Cost of proteins by source and region

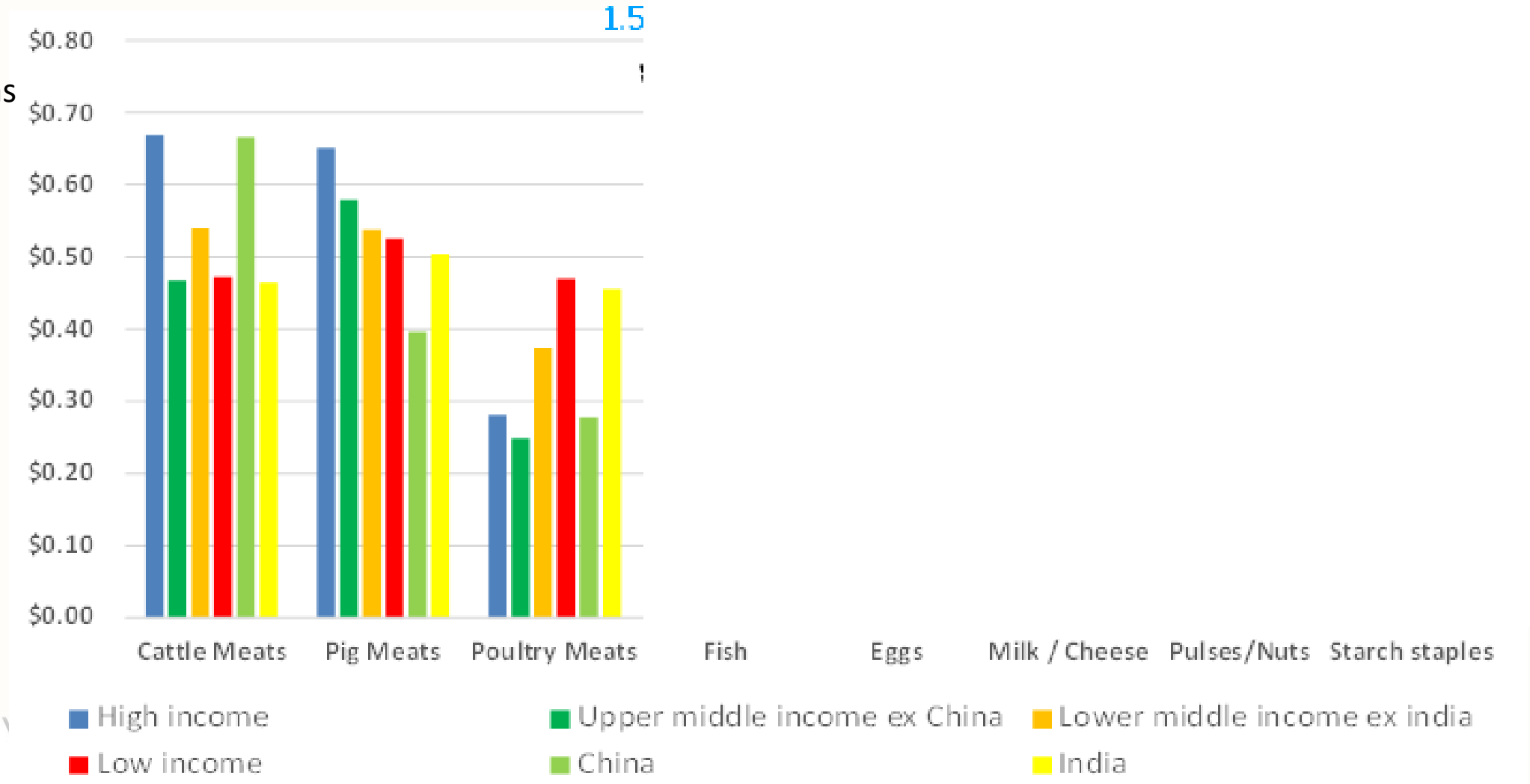
PPP $ / 10 grams



GOAL Science

Cost of proteins by source and region

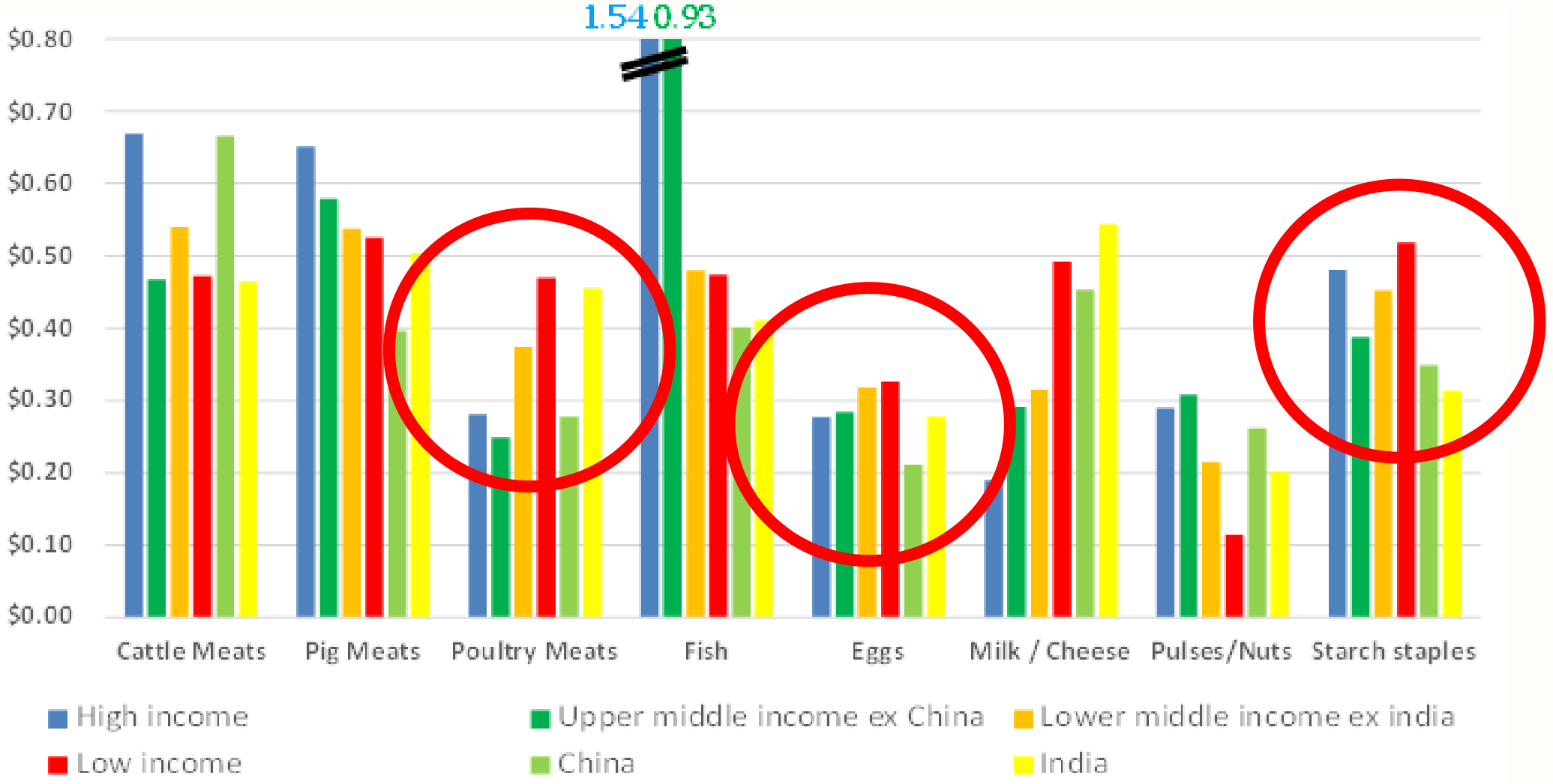
PPP $ / 10 grams



GOAL
Science

Cost of BIOAVAILABLE ! proteins

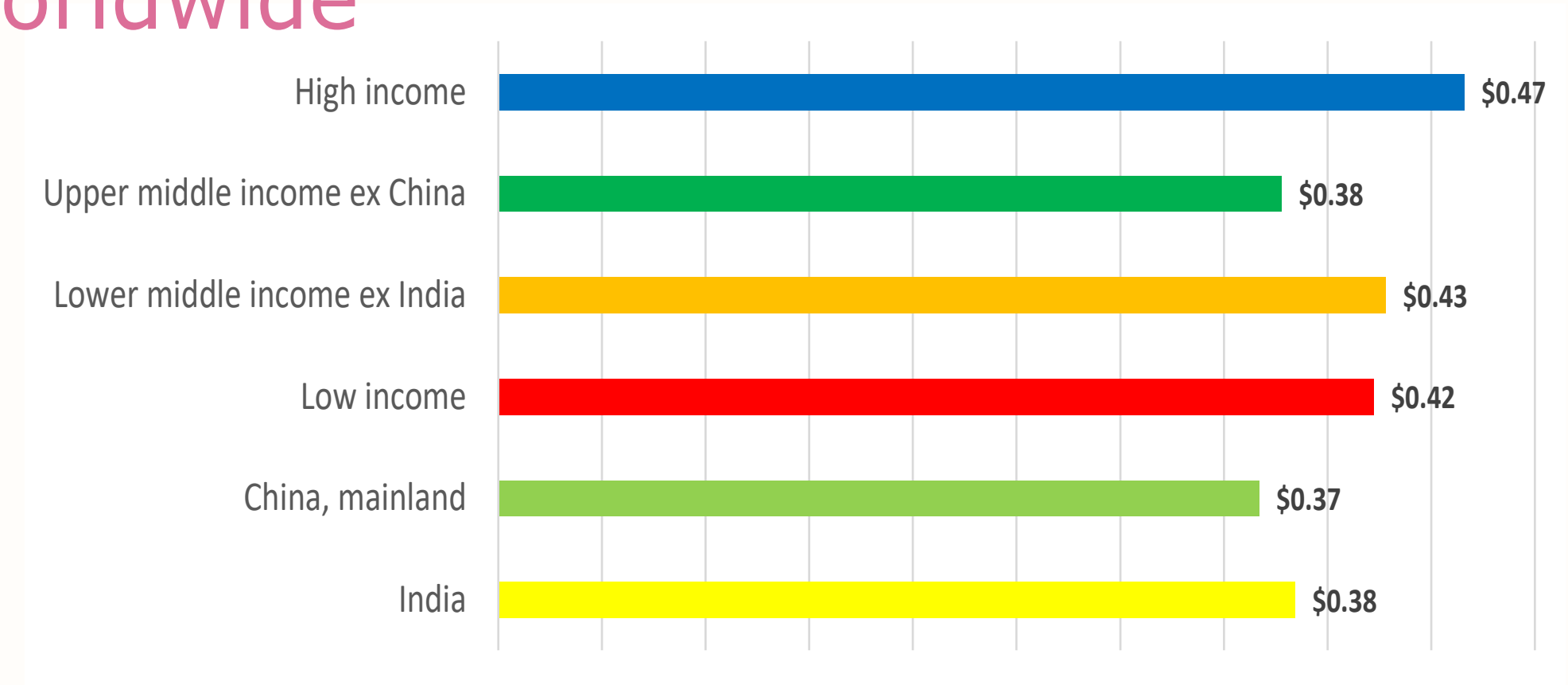
PPP $ / 10 grams



GOAL Science

Source: Computations by GOALSciences on the basis of FAOStat and World Bank ICP data

Cost of 10 gram bioavailable protein worldwide



Source: Computations by GOALSciences on the basis of FAOStat and World Bank ICP data

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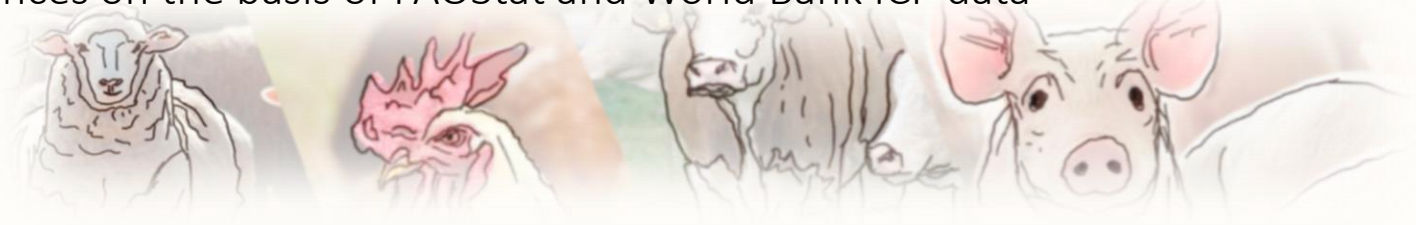

For more:

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PROTEIN

Economics of Protein -
a Documentary

by Peer Ederer

Olena Horodetska
Taras Iliushyk
Bohdana Kalinovska
Elna de Lange
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of GOALSciences

March, 2023

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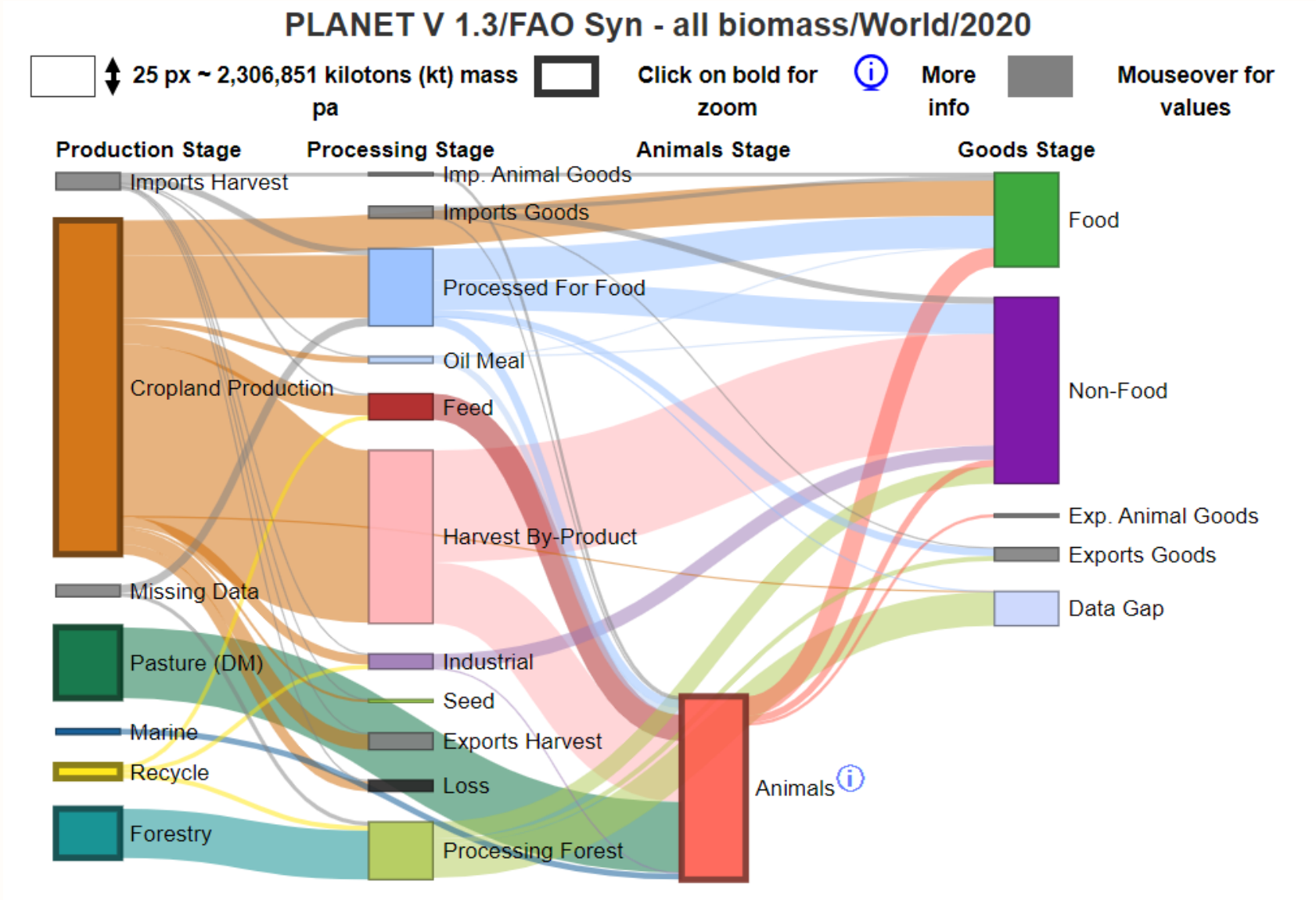

GOAL Sciences

Shifting gears: Why are we here ?

Summer 2019:

In 2021, UN Secretary-General António Guterres will convene a Food Systems Summit as part of the Decade of Action to achieve the Sustainable Development Goals (SDGs) by 2030. The Summit will launch bold new actions to deliver progress on all 17 SDGs, each of which relies to some degree on healthier, more sustainable and equitable food systems.

The SOCIETAL ROLE of MEAT
What the SCIENCE says

As a response and in preparation

In Summer 2019:

eventbrite

Order #950191231

Symposium 'The Role of Ruminants in Sustainable Diets'

General Admission €89.26

The Royal Academies for Science and the Arts of Belgium, Hertogsstraat 1, 1000 Brussels, Belgium

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A dynamic white paper - #AL

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ALEPH 2020

The SOCIETAL ROLE of MEAT

What the SCIENCE says

WORLD FARMERS' ORGANISATION

SCIENTIFIC COUNCIL

GOAL Sciences

SAFER Foods

"SAFER" Foods for a Sustainable World

- For Discussion -

Towards Sufficient, Affordable, Farm-anchored, Ethical and Regenerative Diets and Food Production Systems

https://www.wfo-oma.org/wp-content/uploads/2021/02/WFO_SAFER-Foods-for-a-Sustainable-World.pdf

The SOCIETAL ROLE of MEAT

What the SCIENCE says

Sustainable Livestock 2-pager for the UN-resolution – based on SAFER Foods

Human civilization has been built on livestock from initiating the bronze-age more than 5000 years ago towards being the bedrock of food security for modern societies today.

Livestock is the millennial-long-proven method to create healthy nutrition and secure livelihoods, a wisdom deeply embedded in cultural values everywhere.

Sustainable livestock will also provide solutions for the additional challenge of today, to stay within the safe operating zone of planet Earth's boundaries, the only Earth we have.

The SOCIETAL ROLE of MEAT
What the SCIENCE says

Animal Frontiers – April 2023

The SOCIETAL ROLE of MEAT
What the SCIENCE says

System Summit fo[r] Sustainable Livestock, wh[ich] we believe is a most appropriate statement to conclude this editorial piece. It reads: "*Human civilization has been built on livestock from initiating the bronze-age more than 5000 years ago toward being the bedrock of food security for modern societies today. Livestock is the millennial-long proven method to create healthy nutrition and secure livelihoods, a wisdom deeply embedded in cultural values everywhere. Sustainable livestock will also provide solutions for the additional challenge of today, to stay within the safe operating zone of planet Earth's boundaries, the only Earth we have.*"

Acknowledgments

This Special Issue of Animal Frontiers has been the product of 36 coauthors, and many more unnamed researchers who provided the groundwork for evidence and insights. We are more thankful than words can express for them to contribute their knowledge to this publication. Fourteen authors also presented their findings at the International Summit on the Societal Role of Meat, which was conducted on October 19/20, 2022 in Dublin. The Summit was hosted by Teagasc, the Irish Agriculture and Food Development Authority. Numerous helpers at Teagasc made the Summit possible, among whom we must especially single out the untiring organizational efforts by Dr. Kaye Burgess and Ciara McDonagh. We owe our sincere gratitude to them. At the Summit we were fortunate to welcome close to 200 leading decision makers from the global meat sector, hailing from public administration, associations, the meat and livestock production industries, and the sciences. Across four workshops, they provided invaluable feedback for refining the line of reasoning and avenues for further investigation. Almost 400 viewers watched the proceedings online. The sessions were skillfully moderated by Diana Rogers, Dr. Peter Ballerstedt, and Dr. Theo de Jager. A pre-workshop with around 50 participants for inviting feedback was organized by the Global Meat Alliance in Sacramento, California on September 2, 2022, under the masterly stewardship of Ashley Gray, Connor McGovern, and Kit Arkwright. Susan MacMillan has been an always-giving source of support in our communications. Our deep appreciation to all of you! We are also most thankful to the American Meat Science Association to give us the opportunity to provide their annual Special Issue of Animal Frontiers for our topic. The AMSA Managing Editor, Dr. Anna Dilger, and the Editor-in-Chief, Dr. James L. Sartin of Animal Frontiers, and their network of reviewers and production staff in the background have not only been most helpful and supportive, but also enormously patient and yielding to our many extraordinary demands on publishing this Special Issue. Dr. Marianna Behrends provided all coordination between the editors and the authors streamlining the process in an amazing manner. Their dedication to our science cannot be praised enough. As the two guest editors, we want to emphasize that this Special Issue as well as the International Summit in Dublin has been foremost the product of an incredibly dedicated team effort by six individuals, whose lives crossed paths first at the International Congress of Meat Science and Technology and Reciprocal Meat Conference leading us to this mission. Each member of the team already had a full plate of jobs and cleared the deck to make this effort possible. We therefore consider this Special Issue to be the work of all six members of the organizing team, who have as much claim to creatorship as us. Please therefore consider Collette Kaster (CEO, American Meat Science Association), Dr. Mohammad Koohmaraie (President, Meat Division, IEH Laboratories and Consulting Group), Dr. Rod Polkinghorne (CEO, Birkenwood International), and Dr. Declan Troy (Assistant Director of Research, Teagasc) as equal cocreators. And as last but never the least, we must express our thanks to dedicated team members behind the scenes: Urs Boesswetter, Dr. Holly Cuthbertson, Taras Iliushyk, Enrike Maree, and Alix Neveu who diligently supported all the planning, preparation, and execution throughout.

About the Author(s)

Peer Ederer is founder and director of GOALSciences, the Global Observatory of Accurate Livestock Sciences, which has the mission to research and communicate scientific evidence about the role of animals in the global food system. He has an MBA degree from Harvard University, a PhD in financial economics and holds an adjunct professorship for innovation studies. He has extensive experience in strategy advisory to private companies and public bodies in the global food system and is a frequent presenter on related topics. He has been engaged in scientific research in cooperation with globally leading universities from around the world and is a member of the Scientific Council of the World Farmers Organisation. **Corresponding author**: peer.ederer@goalsciences.org

Frédéric Leroy graduated as a Bioengineer (Ghent University, 1998) and obtained a PhD in Applied Biological Sciences at the Vrije Universiteit Brussel (VUB, 2002), where he now holds a professorship in food science and (bio)technology. His research deals with food processing, human and animal health, and interdisciplinary food studies. He is a Board member of various academic nonprofit societies, that is, the Belgian Association of Meat Science and Technology (president), Belgian Society for Food Microbiology (president), and Belgian Nutrition Society. On a nonremunerated basis, he also serves on various Scientific Boards (e.g., the World Farmers' Organization and the FAO/COAG Sub-Committee on Livestock).

The Dublin Declaration – October 2022

The Dublin Declaration

START SIGN SIGNATURES ACTIVITIES | ENGLISH FRENCH PORTUGUESE SPANISH

simultaneously produce high-quality food. Ruminants in particular are also capable of valorising marginal lands that are not suitable for direct human food production. Furthermore, well-managed livestock systems applying agro-ecological principles can generate many other benefits, including carbon sequestration, improved soil health, biodiversity, watershed protection and the provision of important ecosystem services. While the livestock sector faces several important challenges regarding natural resources utilization and climate change that require action, one-size-fits-all agendas, such as drastic reductions of livestock numbers, could actually incur environmental problems on a large scale.

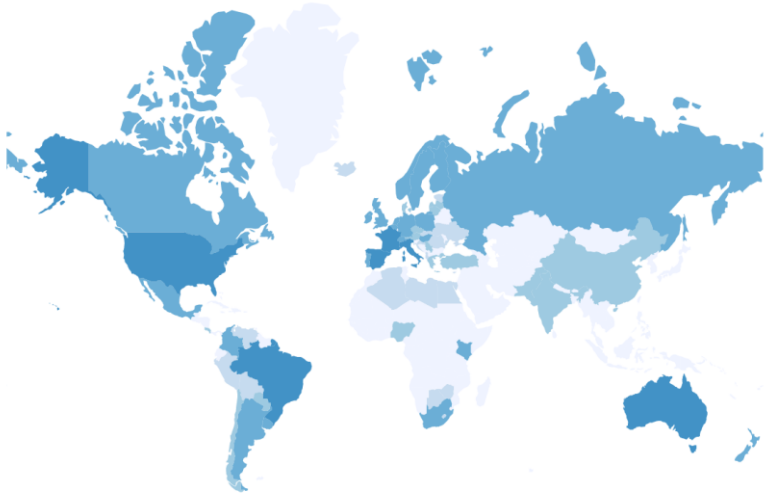
Livestock and Socio-Economics

For millennia, livestock farming has provided humankind with food, clothing, power, manure, employment and income as well as assets, collateral, insurance and social status. Livestock-derived foods are the most readily available source of high quality proteins and several essential nutrients for the global consumer. Livestock ownership is also the most frequent form of private ownership of assets in the world and forms the basis of rural community financial capital. In some communities, livestock is one of the few assets that women can own, and is an entry point towards gender equality. Advances in animal sciences and related technologies are currently improving livestock performance along all above mentioned dimensions of health, environment and socio-economics faster than at any time in history.

Outlook for Livestock*

Human civilization has been built on livestock from initiating the bronze-age more than 5000 years ago towards being the bedrock of food security for modern societies today. Livestock is the millennial-long-proven method to create healthy nutrition and secure livelihoods, a wisdom deeply embedded in cultural values everywhere. Sustainable livestock will also provide solutions for the additional challenge of today, to stay within the safe operating zone of planet Earth's boundaries, the only Earth we have.

For scientific evidence, please refer to presentation recordings from the 19/20 October 2022 International Summit on the Societal Role of Meat. Evidence will also be published in the March 2023 Special Issue of Animal Frontiers.



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