



8th ANNUAL RESEARCH SESSION
SABARAGAMUWA UNIVERSITY OF SRI LANKA
19th DECEMBER 2018



Creating a unified foundation for the environmental, cultural and socioeconomic sustainability through research and innovation

**Abstracts of the 8th Annual Research Session, Sabaragamuwa
University of Sri Lanka**

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**8th ANNUAL RESEARCH SESSION
SABARAGAMUWA UNIVERSITY OF SRI LANKA**

Organized by

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Message from the Vice-Chancellor

Sabaragamuwa University of Sri Lanka

It is a great pleasure and privilege to welcome you to the 8th Annual Research Session 2018 of the Sabaragamuwa University of Sri Lanka. The Annual Research Session is a major event in the university calendar that provides an ideal platform for university academics and postgraduate and undergraduate students to share their research work and present the findings. I am confident that the young academia of our university will be immensely benefited from this prestigious event.

I take this opportunity to congratulate the organizing committee for taking up the challenge and organizing the 8th Annual Research Session in a very professional manner. I have no doubt that the ARS 2018 will offer our university academia a great opportunity to share their experiences in the national and international arena, latest research findings and insights with their colleagues from different fields of interest.

Finally, I hope that all of you will enjoy the ARS 2018 and experience a very stimulating and interesting session.

Prof. M. Sunil Shantha

Vice-Chancellor

Sabaragamuwa University of Sri Lanka

Message from the Director

Centre for Research and Knowledge Dissemination

Sabaragamuwa University of Sri Lanka

It is with great pleasure that I forward this message on the 8th Annual Research Session (ARS) of the Sabaragamuwa University of Sri Lanka (SUSL) which has been an annual event providing a platform to all academics to celebrate their achievements as a professional community throughout the years. Over the past eight years, ARS has established itself as a symposium for disseminating high-quality research in a multi-disciplinary capacity, networking and fostering interaction and exchange of ideas among the academic staff of the Sabaragamuwa University of Sri Lanka.

With many research activities now taking on a global dimension, the theme of this year's ARS, "Creating a unified foundation for the environmental, cultural and socioeconomic sustainability through research and innovation", has created an opportunity for us to share our thoughts and exchange ideas in reaching new heights of research for sustainable development of the nation.

As the Director of Centre for Research and Knowledge Dissemination (CRKD), I am glad our center could facilitate this symposium emphasizing the commitment of the university to promote research and knowledge dissemination. This 8th ARS highlights 75 selected research findings of award winning research and features the most up-to-date research achievements of young researchers from diverse topics of interest. The keynote speech of the well-known scientist Prof. Rohan Samarajiva (Chairman of Information and Communication Technology Agency of Sri Lanka - ICTA) and plenary dinner speech by the eminent scholar and consultant pediatrician Prof. Sanath P. Lamabadusuriya are greatly valued and would undoubtedly encourage the young scientists to be molded to suit the challenges of future.

I appreciate and acknowledge the leadership and guidance of the Vice Chancellor, Prof. M. Sunil Shantha and the support of the Registrar and the Bursar in making this 8th ARS a success. Hence I extend my appreciation to Dr. Sampath Wahala (Chairman - ARS), Dr. Namal Perera (Vice Chairman - ARS), Mr. R. Dangalla (Secretary - ARS), the editorial board and all the faculty coordinators for their tireless efforts in organizing all sessions, making the 8th ARS a success. I would like to offer special thanks to all of the sponsoring organizations for providing their generous financial support. Finally, I would like to thank all the symposium presenters for their contributions which set the foundation of this conference. While I encourage all researchers to participate actively in the interesting presentations and discussions, I wish everyone a successful and fruitful symposium.

Prof. M. Nirmali Wickramaratne

Director

Centre for Research and Knowledge Dissemination

Message from the Chairman of the 8th Annual Research Session 2018

Sabaragamuwa University of Sri Lanka

It is a great pleasure in forwarding this message on behalf of the organizing committee of the 8th Annual Research Session of the Sabaragamuwa University of Sri Lanka. It has grown to be a major academic event conducted to exchange ideas, information in various academic disciplines. The ARS 2018 has 6 sessions encouraging a multidisciplinary approach to research and generating knowledge. Dissemination of knowledge and making avenues to discuss research findings allow the academic community to enhance the critical and logical thinking and to become productive intellectuals. The theme of this year's session is "Creating a unified foundation for the environmental, cultural and socioeconomic sustainability through research and innovation" which encourages to investigate global issues and suggests strategies to improve quality of life of the people across the world.

There were more than 100 abstract submissions received this year and it was a real challenge for the editorial board and the organizing committee to select the highest qualifying 75 abstracts for this session. I thank the researchers who submitted their abstracts and extend my gratitude to the members of the editorial board and the reviewers for their diligent work to uphold the quality of this publication. I also thank the eminent scholars for accepting our invitations and their presence to deliver valuable keynote address and plenary speeches in this 8th ARS 2018.

Being in par with the theme of our event we are happy and privileged to announce that this event is the Sri Lanka's first certified 'Zero Carbon™' research conference in compliance with the certification and guidelines developed by Sustainable Future Group [SFG] following the PAS 2060 global standard produced and published by the British Standards Institution for carbon neutrality. In order to obtain the certification, carbon footprint of the event was assessed covering all activities under the event and certified/registered carbon-offsets were obtained from Ratnapura and Kandy Small Hydropower Projects in Sri Lanka.

I must thank the sponsors; Analytical Instrument, Carbon Consulting Company, Hemsons International and Sustainable Future Group for their generous support.

The successful organization of this event required talented dedications of the organizing committee and I express my appreciation for their hard work. Last but not least our thank goes to the Prof. M. Sunil Shantha, Vice-Chancellor and Mr. V. D. Kithsiri, Registrar and Prof. M. Nirmali Wickramaratne, Director of Centre for Research and Knowledge Dissemination for their support and encouragement.

I sincerely hope that you will find this symposium enjoyable and valuable and wish you all a fruitful academic experience at the ARS 2018.

Dr. Sampath Wahala

Chairman

8th Annual Research Session

ABSTRACTS

OF THE

8th ANNUAL RESEARCH SESSION

SABARAGAMUWA UNIVERSITY OF SRI LANKA

Abstracts of technical sessions of the 8th ARS 2018 are organized as follows;

- Summary of the **Keynote Speech** by Prof. Rohan Samarajiva, Chairman of Information and Communication Technology Agency of Sri Lanka (ICTA) – (pp.02–08)
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 - **Session 01: Academic Presentations - Part I** – (pp.10–17)
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Prof. M. S. M. Aslam
Dr. K. V. D. Edirisooriya Manike
Dr. L. V. Ranaweera
Dr. M.M.P. Sumith
 - **Session 02: First Graduate Colloquium 2018** – (pp.18–29)
Panelists – Prof. Chandana P. Udawatte
Prof. G. L. M. P. Aponsu
Prof. Lal P. Vidhana Aaracchi
Prof. R. M. U. S. K. Rathnayake
Prof. Athula Gnanapala
Dr. A. Sarath Ananda
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Dr. Thilini C. Kananke
Dr. W. Manoj Ariyaratne
Dr. W. S. M. Senevirathne

- **Session 03: Academic Presentations - Part 2** – (pp.31–37)
Panelists – Prof. R. M. U. S. K. Rathnayake
Prof. Athula Gnanapala
Dr. E. M. U. W. J. B. Ekanayake
Dr. E. P. N. Udayakumara
Dr. K. P. L. Nishantha Patabandi

- **Session 04: Academic Presentations - Part 3**– (pp.39–45)
Panelists – Prof. Chandana P. Udawatthe
Prof. D. A. I. Dayarathne
Dr. A. Sarath Ananda
Dr. S. Vasanthapriyan
Ms. T. S. H. Perera

- **Session 05: Presentations on Research grant** – (pp.47–57)
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Prof. D. Achini De Silva
Prof. Lal P. Vidhana Aracchi
Dr. Sundun J. Perera
Dr. K. R. Koswattage

- Abstracts of the Undergraduate **Poster Presentation Session** – (pp.59–89)
Chairman Prof. D. Achini De Silva

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Summary of the talks

Keynote Speech

Contributions from research to solving Sri Lanka's problems

Prof. Rohan Samarajiva

Plenary Dinner Talk

Research and Beyond...

Prof. Sanath P. Lamabadusuriya

Session 1 Plenary Talk

Allergy: An Emerging Epidemic

Prof. Anura Weerasinghe

Session 3 Plenary Talk

Messages from the Deep Time: Present Global Distribution of Ancient Evolutionary Lineages

Dr. Sandun J. Perera

Session 4 Plenary Talk

Inevitability of Smart Organizational Management in Achieving 17 SDGs

Prof. Mohamed S. M. Aslam

Session 5 Plenary Talk

Crop productivity changes under + 2 C future

Prof. Asha Karunaratne

Summary of the Keynote Speech

Contributions from Research to Solving Sri Lanka's Problems

Prof. Rohan Samarajiva

Chairman, Information and Communication Technology Agency of Sri Lanka
(ICTA)

I believe there is broad consensus that we in Sri Lanka face serious problems. We live beyond our means, exporting a few simple items but importing many things worth more than what we earn from the export of goods and services. This results in over-dependence on others, in the form of loans, aid and investment. We expect a lot of services to be supplied by government, including secure and low-stress employment with life-time pensions, but do not support a tax regime that could pay for them. We are growing old before we get rich.

The consensus is much narrower on what the solutions are and whether scholars, within the university and outside and the research they produce, have a role to play. One could even say that ideological positions have hardened on many key issues such as economic strategy to a point where it is not possible even to develop a consensus on a common research agenda.

But before we get to that we must note how much progress has been made in the past four decades.

How far we have come

We have come a long way from when doctors were treating young children showing symptoms of Marasmus and Kwashiokor in Borella in 1973 as a result of misguided economic policies.

We are about to provide grid electricity to all homes. Like many in my generation, I grew up for some time in a home without electricity or a telephone. Those days, for most of our people the most valuable asset was a sewing machine. It's what they took to the pawn shop in an emergency. Since 2012-13, there have been more homes with refrigerators than those with sewing machines. According to the 2016 Household Income and Expenditure Survey, 52.9 percent of households owned refrigerators, versus 39 percent with sewing machines¹.

That's just household assets. A reliable indicator of how well people live is the percentage of their overall expenditure they spend on food. A statistician by the name of Ernst Engel came up with a law (an observed correlation) which said that as people become wealthier the percentage they spend on food declines. Not too long ago, in 1990-91, we were on average spending 2/3rd of our household expenditures, or 64 percent, on food. In 2016, it was 34.8 percent, just over one third². This is irrefutable evidence about a general rise in living standards.

¹ Sri Lanka Department of Census and Statistics (2018). *2016 Household Income and Expenditure Survey*

² Sri Lanka Department of Census and Statistics (2018). *2016 Household Income and Expenditure Survey*

Women now live 78 years on average; men live 72. Back in 1945-47, men lived longer on average than women, to 46.8 years. Women had an average life expectancy of 44.7 years. We are living better and longer, according to the evidence. Having established that we have made progress, I will now turn my attention to some of the challenges we face.

Improving export performance and employment

The British did not bequeath us a dynamic economy. It was, as many in my age group learned in school, based on the export of tea, rubber and coconut. Little value addition was done. Most government revenues came from taxing foreign trade. Reliance on commodity exports made the economy vulnerable to economic cycles. In 1952, a dramatic fall in rubber prices by over 30 percent because of the end of the Korean War led to the Rubber-Rice Pact with China, not some kind of grand gesture of non-alignment.

But today, we are less dependent on commodities. Service exports (if we include remittances from those who work abroad, technically a form of trade in services) yielded USD 14.3 billion in 2017, higher than the USD 11.4 billion earned from goods exports, of which agriculture and mining comprised only 25 percent, according to the 2017 Annual Report of the Central Bank³. Remittances, which none other than the families that generate them appear to be proud of, brought in USD 7.2 billion. Contrary to entrenched perception, more men than women are now engaged in this form of service export and the proportion of skilled workers is increasing. Tourism was the biggest source of conventional service earnings, yielding USD 3.9 billion. Most of our rubber now goes out in the form of value-added tyres, gloves and such. It is second in value only to apparel among industrial exports.

Research priorities facilitating global engagement

Our economy has diversified and is less vulnerable to external forces than in the decades after independence. But the momentum achieved in increasing and diversifying exports was lost as a result of the insular policies of the past decade. Lack of attention to exports and the right kinds of foreign investment have led to greater dependence on borrowing, no longer available at concessional rates, leading to a different form of vulnerability that has to be carefully managed. Comparison with Viet Nam, a country that is directly competitive with Sri Lanka in many areas such as apparel, business process management and even tea is illustrative. Viet Nam's distinctly superior performance in exports despite more or less similar increases in FDI over the 2000-2014 period shows that the right kind of FDI is what matters to exports, not just raw numbers.

The unemployment rate among the 20-29 year-olds is roughly three times the overall rate⁴. They are looking for work, but are unwilling to take what is on offer. As the long lines for the Korean language exams showed vividly, they are not unwilling to work, or even wait in line overnight to qualify for work at acceptable rates of compensation. There are many different explanations. Some see a problem

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https://www.cbsl.gov.lk/sites/default/files/cbslweb_documents/publications/annual_report/2017/en/9_Chapter_05.pdf

⁴ Department of Census and Statistics (2015). Quarterly report of the Sri Lanka labor force survey. First Quarter. <http://www.statistics.gov.lk/samplesurvey/2015Q1report.pdf>

of values we have inculcated in our youth. Some blame parents. Others see a structural problem in that the economy does not produce the kinds of jobs that our young people want. Without robust export performance and diversification into high-value-added production of goods and services, it will not be possible to create the kinds of service-sector jobs our young people seem to want.

Table 1: Viet Nam's and Sri Lanka's investment and trade performance 2000-14, compared

	Vietnam (2000)	Vietnam (2014)	2014 amt as multiple of 2000 amt	Sri Lanka (2000)	Sri Lanka (2014)	2014 amt as multiple of 2000 amt
FDI (USD millions)	1,298	9,200	7.1	173	1,616	9.3
Exports (USD billions)	17	161	9.5	5.5	11.3	2.1

Source: Board of Investment of Sri Lanka

The cause is a structural problem in the economy: its inward orientation in the past decades. As a result we are not making available high-quality jobs. I believe we can produce such jobs only if we think bigger than a market of 20 million people with not very high purchasing power. Despite its history, Viet Nam has taken that route, locking in the external orientation through multiple bilateral and plurilateral trade agreements. It is a member of the WTO and of ASEAN, which is on the path to a single market. It is also part of CPTPP (the Trans Pacific Partnership that was resuscitated without the US) and RCEP (Regional Comprehensive Economic Partnership).

Conventional economic analysis, that I subscribe to, would suggest that we integrate our economy through trade agreements with as many countries as possible, especially with the Bay of Bengal region, which has six of the ten fastest growing economies of world: Bangladesh, Bhutan, Cambodia, India, Myanmar and Lao. And China is just on the other side of Myanmar and is a massive and still growing market. Joining the RCEP, which includes China, India and the entire ASEAN should be even better. If we can capitalize on our rightful place as the gateway to the region, we can create the jobs that will keep our children here⁵.

But the evidence could be stronger. Vietnam, which has sought to integrate itself into global production networks through trade agreements provides strong evidence⁶. I can show that countries that liberalize trade and create policy certainty

⁵ Samarajiva, Rohan (2017). Sri Lanka and China's Belt and Road Initiative, in *The island of the lion and the land of the dragon: Essays on Sri Lanka-China relations*, ed. H.M.G.S. Palihakkara, pp. 67-80. Colombo: Pathfinder Foundation.

⁶ Samarajiva, Rohan (2017 June 14). Considerations for formulating a trade policy for Sri Lanka, *Echelon*. <https://echelon.lk/home/considerations-for-formulating-a-trade-policy-for-sri-lanka/>

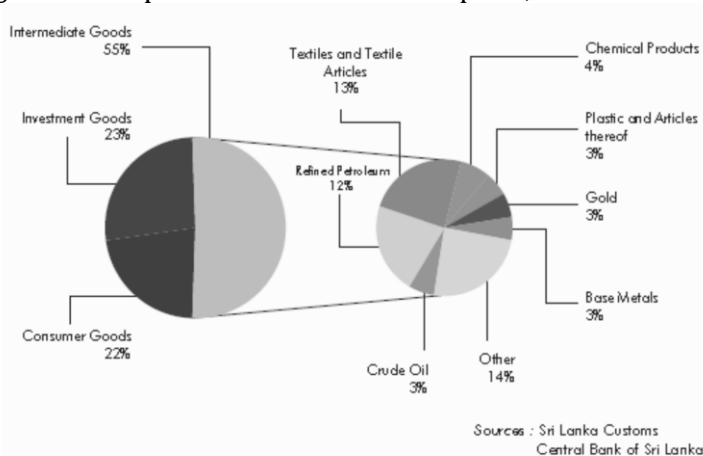
prosper and that those that turn inward do not. But I can only speculate about what our young people really want. If we have this kind of evidence, we may possibly be able to elevate the current discussion on trade agreements above its present unsatisfactory, ideological and post-factual level.

Research priorities based on greater autonomy

However, given the polarized nature of policy discourse in Sri Lanka at this time, it may be useful to also identify research priorities based on different ideological positions. Even those who do not like increased trade and foreign investment, especially within the certainty provided by trade agreements⁷, would have to accept that Sri Lanka has to decrease imports, if it is not willing to do what is necessary to increase exports. This import-restricting option was actually tried out by governments from 1960 onward starting with what were considered luxuries such as cars and reaching the peak in 1973-77, when imports of essential items such as building materials and even pulses and dried fish, the principal sources of protein at the time, were curtailed.

In the vastly more complex economy that exists today, the actions of the 1970s are impractical. Consumer goods are a small part of the country's imports, as shown in the Figure below. The largest proportion is intermediate goods, needed for the production of other things, including exports. The reduction that is likely to have the most impact is refined petroleum and crude oil which amounted to 15 percent of the total imports in 2017.

Figure 1: Composition of Sri Lanka's imports, 2017

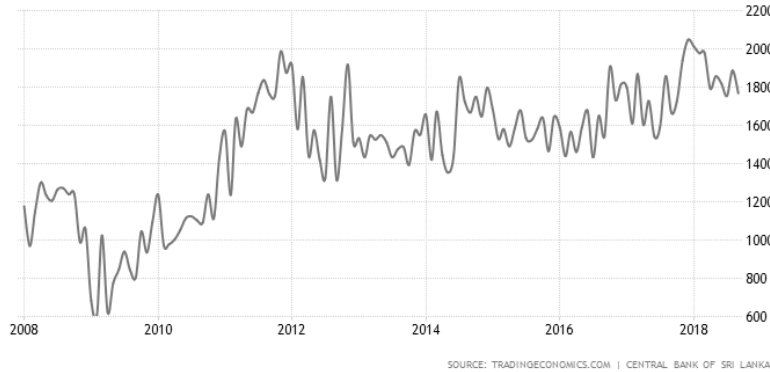


Source: Central Bank of Sri Lanka Report 2018, p. 152.

The two main uses of petroleum imports are for transportation and the production of electricity. As can be seen from Figure 2 below, expenditures on petroleum imports have been rising over the years, with a step change in 2011, shortly after the end of the civil conflict.

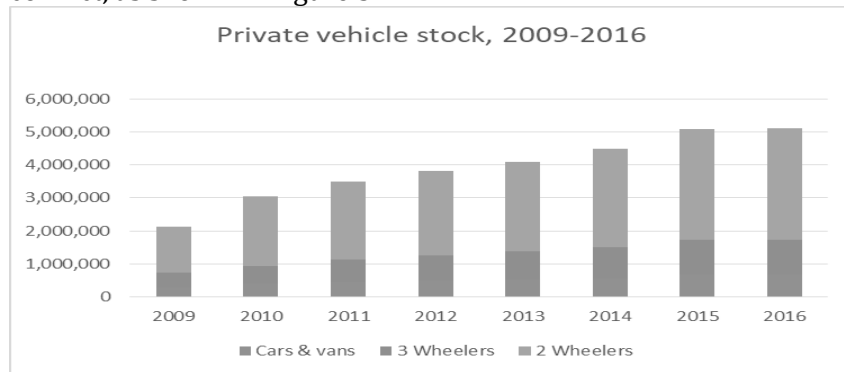
⁷ One has to conclude that the objection is to trade agreements, because the same people who opposed the trade agreement with India (a large economy with low wage levels) also opposed the agreement with Singapore (a small economy with very high wage levels).

Figure 2: Expenditures on petroleum imports (USD millions), 2008-2018



Source: <https://tradingeconomics.com/sri-lanka/imports>

This appears correlated with the spike in motor vehicle imports after the end of the conflict, as shown in Figure 3.



Source: Department of Motor Vehicles

So it would seem that those who want a more insular and independent country would be well advised to conduct research to reduce petroleum imports. The easiest way to do this would be develop transport systems that would rely less on imported petroleum. This could be in the form of vehicles powered by electricity, unless that results in importing still more petroleum products to produce electricity.

So here are research priorities for those wanting a more autonomous Sri Lanka: find ways to move people and goods around that minimize the need for imported fuel; find ways to produce more electricity using renewable sources.

Simply putting in more solar panels and installing wind turbines will not do. Our small grid cannot be balanced if we increase the supplies from these sporadic sources beyond around 25 percent. We will need to rethink the whole electricity system, possibly replacing it with a completely new producer-consumer system unlike any that exists today. That will require much research and innovation.

If that be too radical, a stop-gap solution would be to connect our small grid to the much larger Indian grid across the Palk Strait. That would allow us to increase the proportion of electricity drawn from sporadic sources without destabilizing the grid

and to buy and sell electricity to and from India. But then, we would be back to Indophobia and fears of loss of autonomy, wouldn't we?⁸

Solutions

We need to have a clear understanding of the principal problems facing our society. I have explored in multiple aspects of the problem I consider the most important. There are others, such as our population growing old before we got rich. Many would argue that education, including higher education, is in crisis. Others would point to ethnic reconciliation or our unacceptable rates of child abuse. Underlying everything are mega issues such as global climate change and environmental degradation.

Once we recognize the challenge best suited to our specific skill sets, we then need to engage in rigorous research. That research then has to be taken into the public discourse that is today dominated by myths and falsehoods.

Given all politicians, according to Keynes, are governed by what they learned when in their twenties, some of us have to engage in the hard job of changing their obsolete mindsets:

... the ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the natural encroachment of ideas. Not, indeed, immediately, but after a certain interval; for in the field of economic and political philosophy there are not many who are influenced by new theories after they are twenty-five or thirty years of age, so that the ideas which civil servants and politicians and even agitators apply to current events are not likely to be the newest. But soon or late, it is ideas not vested interests, which are dangerous for good or evil⁹.

The President of the United States refuses to accept scientific consensus on climate change, relying instead on what he learned in his twenties. Most of our leaders revert back to the planned economy thinking of their youth. They refuse to accept the overwhelming consensus among economists that protectionism is counter-productive.

We must do these hard things, subjecting ourselves to the highest levels of quality control. Because the only thing worse than not being engaged with the policy process is its pollution by the introduction of bad research into it. Peer review is seen as the gold standard to prevent this, but it has many shortcomings. In the policy arena, it's not always practical to wait for peer review to be completed. The policy

⁸ Samarajiva, R. (2016 January 4). Global value chains: A bridge too far? *Daily FT*. <http://www.ft.lk/article/515531/Global-value-chains--A-bridge-too-far>

⁹ Keynes, J.M. (1936). *The General Theory of Employment, Interest and Money*. Cambridge: Cambridge U Press, pp. 383-4.

window or opportunity¹⁰ can close before the peer review is completed. Sometimes we have to build peer review into the discourse itself.

In many applied fields we work with open systems. The levels of certainty and exactitude possible with inanimate objects of study within closed systems is not possible in these fields¹¹. The questions we ask and the assumptions we make are shaped by who we are and where we came from. Therefore, we must allow room for difference and debate in public discourse, even when based on research findings. Beyond impractical and idealized notions of the public sphere¹², we need to come up with workable alternatives.

Thank you.

¹⁰ Kingdon, John (1995). *Agendas, Alternatives, and Public Politics*, 2nd ed. New York: Harper Collins, p. 19.

¹¹ Sayer, Andrew (1992). *Method in social science: A realist approach*. 2nd ed. London & New York: Routledge, p. 121-31.

¹² Habermas, J. (1989). *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*, trans. T. Burger and F. Lawrence. Cambridge: Polity.