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Role of the OPA Journal during national issues

Welcome to the inaugural online version of the OPA journal! The OPA Journal provides a platform of scientific communication for professionals in Sri Lanka. It caters for a total membership of over 60,000 under 52 member associations representing catering to 32 disciplines. The journal welcomes articles from OPA membership, addressing national issues based on their expertise and professional experience.

The lead article of this inaugural OPA online journal is on **“The Advocacy Role of Professional Organizations on National Issues.”** The perspective articles to follow will discuss important issues regarding a wide range of areas such as economy, health, environment, logistics and agriculture, based on expert opinion and professional perspective. Original research articles will provide evidence-based solutions for national issues. The “Out-of-the-Box” section will feature the innovations and the “Speaker’s Corner” will be an opportunity the voice the concerns and opinions.

Advocacy role is the cornerstone for any professional organization. This advocacy, motivated by moral and ethical principles, attempts to influence policies by interaction with political, professional, economic and social systems, and institutions. Such advocacy needs to be timely and properly communicated. There need to be very clear understanding of the dynamics of economical, socio-cultural situation and political complexities. We as OPA need to play a major role in political advocacy while avoiding any political biases.

In order to fulfill the advocacy role during the current crisis situation, OPA need to be an authority recognized by society, an authority sanctioned by the broader community and general public. The OPA Journal will strive to be an unbiased voice for scientific approach, equity and social justice. We are in the process towards achieving the status of a peer reviewed, indexed national journal.

The OPA Journal, with the online availability and higher visibility, can be a main platform in promoting and disseminating the advocacy role of OPA during national issues.

Professor Indika Karunathilake
Editor-in Chief
OPA Journal



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Advocacy Role of Professional Organizations on National Issues

Karunathilake, I.M.¹, Perera, B.J.C.², Dharmarathne, S.², Samarasekera, D.D.³,
Palihakkara, U.⁴, Abeykoon, P.⁵

A professional association (organization) is defined as “an organization of practitioners who judge one another as professionally competent and who have banded together to perform social functions which they cannot perform in their separate capacity as individuals” (Merton, 1958; Cogan, 1955). Professional organizations and associations are crucially important for generating the energy, flow of ideas, and proactive work, needed to maintain a healthy profession.

Crisis situations such as wars, political instabilities, economic downfalls, pandemics etc, have heavily influenced the direction of a profession and thereby professional organizations. Pandemics and other crises always offer opportunities for progress or regression, depending on how organizations respond to them.

Advocacy role is the cornerstone for any professional organization. This advocacy role covers a broad scope including healthcare, health system, economics, social justice and professionalism. Advocacy, motivated by moral and ethical principles, attempts to influence policies by interaction with political,

professional, economic and social systems, and institutions. Advocacy requires interaction with policy makers, administrators, professionals and the general public (Brante, 1988; Merton, 1958).

Epidemics and pandemics thrive on inequities and weak social systems. As a consequence, they could have the most severe consequences among groups that are not sufficiently protected by existing policies. COVID-19 pandemic and the current economic crises in Sri Lanka have exposed and exacerbated these social inequities, resulting in disproportionate consequences on vulnerable populations. Such inequities can effectively be addressed by professional advocacy based on strong principles of fairness, social justice, transparency and evidence-based science.

The critical role of advocacy with community and cross-sectorial collaborations, can and should play a significant role during national issues. Such advocacy needs to be carefully assessed strategized, be timely and properly communicated to all stakeholders. For example, there needs to be a very clear understanding of the dynamics of a pandemic, socio-cultural implications and political complexities, before advocacy on it is contemplated.

Professional associations should stringently move away from political bias while playing a major role in political advocacy.

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In order to fulfil the advocacy role during the current crisis situation, the OPA needs to be an authority recognized by society; an expert organisation sanctioned by the broader community and the general public. This recognition can only be achieved by OPA by becoming the unbiased voice, based on a scientific approach, equity and social justice.

Advocacy needs a broader consensus. This can only be achieved by transparent, multi-stakeholder processes. This is not impossible because the potential of OPA to communicate quickly with its members and a range of organizations is very high. In this age of information technology, members can respond in a variety of ways; through phone calls, e-mail, Tweets, and Facebook™ postings. The privilege of participating in advocacy is one of the most important benefits for members of a professional association. When greater numbers unify in one voice, stronger and more powerful arguments can be advanced and sustained to achieve the desired advocacy outcomes. This approach illustrates the subtle difference between an advocacy body and a pressure group.

Advocacy needs to be timely and relevant. The process of developing advocacy statements must be transparent, with full involvement of the membership, where drafts are posted and opened for comment through multiple announcements using a variety of media and formats. All of these comments need to be analysed and deliberated upon to determine the appropriateness of their inclusion within the framework documents. As illustrated by paradoxical quotes, advocacy needs to be timely and combined with meaningful action.

"There comes a time when silence is betrayal." (Martin Luther King)

"Better remain silent, better not even think, if you are not prepared to act." (Annie Besent)

During a crisis, media attention is invariably focused on professional organizations. This has both advantages and disadvantages. Media is essential to get the message across. The basic principles of communication apply, i.e., what is the message and is it timely and relevant? Does it contain factually correct content up to that time? What is the audience and what is the most appropriate media? Media organisations have their own agendas and there are multiple pitfalls if this reality is not clearly understood.

Use of electronic and online media calls for a different set of skills during crisis situations. Unlike in high-level, in-person meetings with top-down environment of high-level events, virtual advocacy can succeed just as well with a bottom-up approach that mobilizes the voices of broader membership and the general public. This opens up the possibility for more creative strategies that reach the intended audience through volume and frequency rather than the precision of direct, in-person approach. However, this is a double-edged sword and can lead to counter-productive results if the subtle difference between an advocacy body and a lobbying group is not clearly grasped.

Professional organizations are a crucial constituent in formulating sound public policies and strategies. OPA consists of a total membership exceeding 50,000 professionals belonging to 50+ professional institutions is in the best position to contribute in the best possible manner to try and clear the dark clouds currently hanging over Sri Lanka.

References

- Brante, T. (1988). Sociological approaches to the professions. *Acta Sociologica*, 31(2), 119-142.
- Cogan, M. L. (1955). The problem of defining a profession. *Annals of the American Academy of Political and Social Science*, 297, 105-111.
- Merton, R. K. (1958). The functions of the professional association, *American Journal of Nursing*, 58(1), 50-54

Multi-Professional Involvement in Managing a COVID-19 crisis in Sri Lanka

Karunathilake, I.M. ¹, Edirisinghe, E.A.S.T. ², Perera, B.J.C. ³, Hamdani, A. ⁴, Randanikumara, S. ⁴, De Silva, S. ⁵, Hewage, M. ⁶, Amarasiri, M.M.P.L. ¹, Kohombange, C. ⁴

Introduction

Since the onset of the COVID-19 pandemic in December 2019, a tumultuous period for health care systems was marked globally and Sri Lanka was in it as well because the health systems had to respond to the challenges posed by the COVID-19 pandemic. In Sri Lanka, many professions altered their departments of working, in order to support patients while managing the COVID-19 crisis as well. In this paper, how the members from various professional groups came together in order to manage the COVID-19 pandemic, is discussed.

What is multi-professional team- work?

In the field of management and organizational science, the concept of teamwork is suggested as the best in stable conditions where people have time and resources to learn how to work collaboratively. Teamwork is characterized by coordinating the expertise available. There is a wide variety of terms used to depict the cooperative and collaborative work of various health professional groups (Finn *et al.*, 2010). The words with the prefix multi' denote several

variegated professional groups working collectively (Payne, 2000). A concern for various professional groups, functions and activities, which are associated with the groups is suggested by the word 'professional' (Payne, 2000). In consideration of the multidisciplinary/multi-professional workings, there are multiple definitions. Fundamentally, all these definitions explain a group of individuals who belong to distinct professional groups or varying disciplines within a particular working group, working collectively. Petrie (1976) defined multi-professionals working as a collection of people from varying health and social care professions but who do not necessarily interact. A broad array of health professional groups, with different knowledge, skills and qualifications, getting together within a particular structure will ensure the provision of health promotion services (Solheim *et al.*, 2007). According to Martin and Henderson (2001), a team is identified as a group possessing a common goal or task, in which the pursuit requires coordination and collaboration of the activities of its members, who have constant and persistent interactions among each other.

Teamwork is essential for the optimal performance level in a health sector (Clark *et al.*, 2009). Collaboration is identified as a means of bringing together strengths of numbers of people and organizations, leading them on to make better decisions; the outcomes of collective working (Jansen, 2008). Naidoo and Wills (2000), stated that teamwork increases knowledge and understanding of each other in the organizations and thereby helping them to clarify their roles while overcoming rivalry of each other within the organization.

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The increase in resources can be used in an effective manner by jointly commissioning the services from the health promoters to develop the health of the people (Jansen *et al.*, 2008b). Joint-working provides a higher degree of job satisfaction for the health promotion staff as it increases the morale for the team and offers mutual assistance for the members in their team (Hosman, 2000).

Teams are complex structures, in terms of membership structure, operations and organizational culture. According to 'Plant's Iceberg Model' the ways and means by which an organization operates are the 'visible' part of teamwork, and the factors which can influence change and organizational development are submerged (Plant, 1989). Therefore, hidden issues related to teamwork should be assessed and addressed in optimizing a team's function.

COVID-19 Crisis in Sri Lanka

In Sri Lanka, the first COVID-19 case was reported on 28th January 2020. Since then up to 08th March 2022, the cumulative number of confirmed cases is 653,661, and the number of deaths and recovered cases are 16,350 and 618,386 respectively (Health Promotion Bureau, 2022). Sri Lanka was able to manage the spread of COVID-19 in 2020 with the imposition of strict lockdown measures, together with collaboration from the Sri Lanka Police and the armed forces. However, since July 2021, Sri Lanka has witnessed a rapid increase in the number of COVID-19 cases which had its onset around May 2021. The number of daily test-positive patients exceeded 5000 and the number of deaths were also rapidly increasing during the height of the surge. The number of healthcare workers and infrastructure capacity available in the hospital system for optimal functioning also rapidly declined due to the fast spread of the coronavirus.

The management of COVID-19 in Sri Lanka via a multi-professional approach

Sri Lanka's COVID-19 response is characterized by a strong focus on the preventive approach and contact tracing with

rational utilization of available resources. Since the reported first local case on 11th of March 2020 (Health Promotion Bureau, 2022), the responses of Sri Lanka towards COVID-19 were prompt, critical, well-organized and coordinated. When a person became COVID-19 positive, he/she was exclusively admitted to a designated government hospital while his/her close contacts were traced actively through an efficient disease surveillance system which was operated by the Epidemiology Unit of the Sri Lankan Ministry of Health (Arambepola *et al.*, 2021). For most of the course of the pandemic in 2021, all patients who tested positive were managed at healthcare institutions. Asymptomatic or mildly symptomatic patients with no or well-controlled comorbidities were admitted to Intermediate Care Centres (ICC) for monitoring and symptomatic management and discharged in 14 days. Those with more marked symptoms, uncontrolled comorbidities and other complications were admitted to hospitals for closer monitoring and specialized management.

Even though this approach was proved to be efficient during the early phase of the pandemic, it became evident with time that it was not sustainable due to the rapid increase in the number of COVID-19 positive cases since July 2021. The number of daily reported test positive patients exceeded 3000 and the actual number of new patients per day was estimated to be around 6000 to 9000, during the peak of the surge. The bed capacity related to COVID-19 patients in the country was increased to 27,000, even by bed allocations from other units of hospitals, as an immediate response. The number of healthcare workers available for effective functioning of the system too decreased with a significant proportion acquiring COVID-19. Thus, the Sri Lankan healthcare system was at a critical tipping point, with an unrivalled increase in demand with rapidly diminishing resources. It was necessary to prevent overburdening the already fraught hospitals as well as the staff (Jensen *et al.*, 2020).

The primary healthcare workers were the frontline personnel managing this pandemic crisis. Due to the rapid increase in the number

of COVID-19 infected patients, the healthcare workforce available for optimal functioning of the system too got significantly reduced, with a noteworthy percentage acquiring the infection and the remaining workforce having to contend with physical and mental exhaustion. A virtual triaging system designed for the identification and evacuation of those who needed hospitalization and facilitated home management for mild and asymptomatic patients was required to counteract and effectively manage the rapid increase in the COVID-19 patients.

The Sri Lanka Medical Association (SLMA) introduced the Doc Call 247 Service in August 2020. This vital service is still being continued with the partnerships of the Ministry of Health, SLMA, '1990 Suwa Seriya' Ambulance Service and with assistance from the Sri Lanka Telecom-Mobitel mobile telephone network. The other mobile telecommunication operators were connected into a single central system by the SLT- Mobitel platform with the deployment of cutting-edge technical portals. In addition to the Interactive Voice Response (IVR), Short Message Service (SMS) and WEB systems, the SLT- Mobitel integrated a Big DATA system which enabled the SLMA to analyse the data reports in real time. The implemented alert system sending periodic monitoring updates to the relevant stakeholders via different channels has warned on the situations, which could occur in the near future, thereby initiating the provision of the facility to develop proactive measures that could be taken to mitigate against the impact. The digital integration of 247 and 1990 Suwa Seriya systems has streamlined the process and ensured an efficient mechanism. The 247 platform and the 1990 Suwa Seriya system was inter connected within a single day. Further customization and changes were done in order to increase the ease of use and to have better visibility at both ends. Partnership between SLMA and 1990 Suwa Seriya was formalized through a MOU.

The objectives were: -

- To decrease the number of non-urgent admissions to the hospitals,

- To provide accurate information to the patients who are receiving home-based care
- To identify and evacuate patients who are in need of immediate and urgent care, to hospitals.

The SLMA initiation of the Doc Call 247 service mainly focused on providing advice to patients and consisted entirely of volunteers ranging from the specialists to medical students. They were able to enter into the system as per their convenience by 'opting in' and 'opting out'. When the doctors were busy, they were able to opt out of the system and when they were not busy, they could join in and answer calls. There was a roster system in place as well, to ensure that a particular number of doctors were available at a given time. There were considerable numbers of medical students, doctors and specialists across the globe, who joined this mission of humanitarian services to serve the country at that most crucial of times.

This portal ensured that those who required hospitalization once there were identified and the ambulance service was called to take them to the hospital, were given the priority for admission to the hospitals, and those asymptomatic or mildly symptomatic were given necessary advice and kept at home with regular medical advice. So far, up to 25th March 2022, Doc call 247 has attended to over 75,000 callers. Out of the 75,000 calls received on Doc call 247, only around 1,500 patients needed urgent care and hospitalization. There was no on-admission deaths reported with 247 service. Those who could be managed at home were given health education and clear advice on what to do, what to avoid and when to seek medical care.

As the Doc Call 247 was a service catering to the needs of the people to their benefit, there were certain obstacles as well, such as issues related to the coordination of the stakeholders due to technical matters and receiving 'prank' and unnecessary calls which wasted the opportunities for another essential caller. New mechanisms were adopted under the guidance of IT professionals to overcome these constraints.

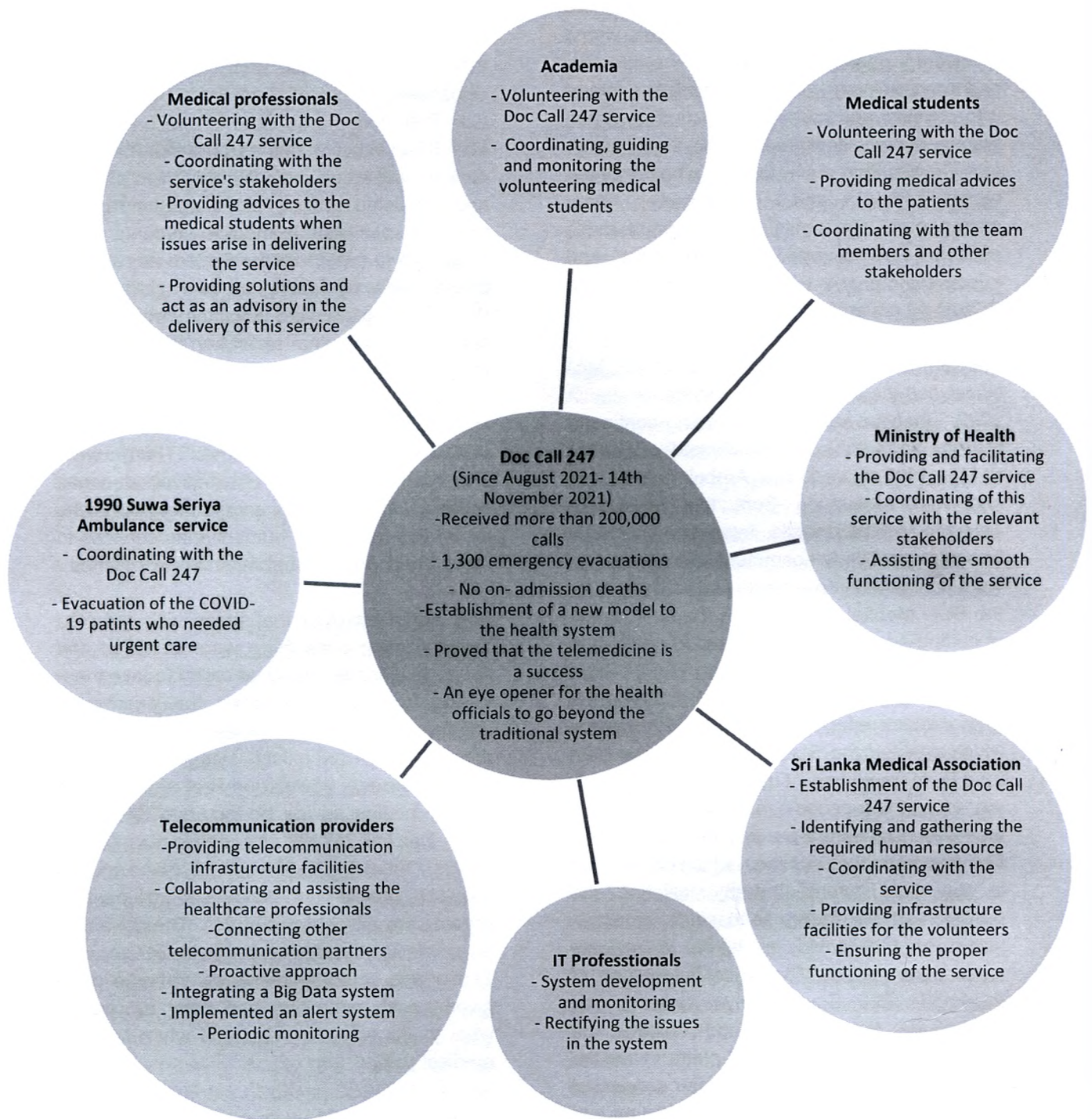


Figure 1: Multi-professional involvement in the Doc Call 247 service

Conclusion

This initiative is a success story of a digital triage system and that has minimized the burden on the healthcare system. The crisis situations needed assistance from all stakeholders including sectors previously underutilized in the provision of healthcare, including the information and communication systems. Although operating in a resource-limited setting, Sri Lanka has been able to integrate its healthcare system with new technology in order to rise to the call of the hour. This has made it possible for the country to reduce the burden on treatment centres as well as healthcare professionals and ensure equity in the distribution of its resources. Furthermore, this innovative approach to healthcare provision must be strengthened in order to meet the ever-increasing demands in the face of the pandemic. It would be a valuable tool in dealing with similar catastrophes and disasters in the future too.

The success of this initiative has demonstrated that the existing infrastructure can cope, the essential technologies are in place, and that health professionals are already familiar with the concept. Institutional support is necessary if this endeavour is to grow and become sustainable, and champions should be identified at all levels; user-driven models that foster a sense of ownership.

The combined impact of the tireless efforts of frontline health professionals and non-health professionals, the island-wide vaccination programme, movement restrictions, together with the integrated helpline information system has reduced the burden on the all-important healthcare services.

References

- Arambepola, C., Wickramasinghe, N.D., Jayakody, S., Hewage, S.A., Wijewickrema, A., Gunawardena, N., Dhanapala, S. and Prathapan, S., (2021). Sri Lanka's early success in the containment of COVID-19 through its rapid response: Clinical & epidemiological evidence from the initial case series. *Plos one*, 16(7), p.e0255394.
- Clark, P.C., Dunbar, S.B., Aycock, D.M., Blanton, S. and Wolf, S.L., (2009). Pros and woes of interdisciplinary collaboration with a national clinical trial. *Journal of Professional Nursing*, 25(2), pp.93-100.
- Finn, R., Learmonth, M. and Reedy, P., (2010). Some unintended effects of teamwork in healthcare. *Social science & medicine*, 70(8), pp.1148-1154.
- Health Promotion Bureau (2022) *HPB Live Updates on New Coronavirus (COVID-19) Outbreak*. Available at: <https://www.hpb.health.gov.lk/> (Accessed: 13 March 2020).
- Hosman, C.M., (2000). Prevention and health promotion on the international scene: The need for a more effective and comprehensive approach. *Addictive Behaviors*, 25(6), pp.943-954.
- Jansen, L., (2008a). Collaborative and interdisciplinary health care teams: ready or not? *Journal of Professional Nursing*, 24(4), pp.218-227.
- Jansen, M.W., De Vries, N.K., Kok, G. and Van Oers, H.A., (2008b). Collaboration between practice, policy and research in local public health in the Netherlands. *Health Policy*, 86(2-3), pp.295-307.
- Jensen, T., Holgersen, M.G., Jespersen, M.S., Blomberg, S.N., Folke, F., Lippert, F. and Christensen, H.C., (2020). Strategies to handle increased demand in the COVID-19 crisis: a coronavirus EMS support track and a web-based Self-Triage system. *Prehospital Emergency Care*, 25(1), pp.28-38.
- Martin, V., Charlesworth, J. and Henderson, E., (2010). *Managing in health and social care*. Routledge.
- Naidoo, J. and Wills, J., (2000). *Health Promotion Foundations for Practice*. Bailliere Tindall.
- Payne, M., (2000). *Teamwork in multiprofessional care*. Lyceum Books.
- Petrie, H.G., (1976). Do you see what I see? The epistemology of interdisciplinary inquiry. *Educational Researcher*, 5(2), pp.9-15.
- Plant R. Practical ideas for managing change and making it stick. *Industrial and Commercial Training*. (1989) May 1.
- Solheim, K., McElmurry, B.J. and Kim, M.J., (2007). Multidisciplinary teamwork in US primary health care. *Social science & medicine*, 65(3), pp.622-634.

Sri Lanka Needs a Return to “Good Agricultural Practices”

Marambe, B.

Introduction

Supporting agricultural development and achieving self-sufficiency in rice have been the prime objective of successive Sri Lankan governments since gaining independence in 1948. As a consequence of the efforts of the scientists, academics, the farming community, and policy decisions taken, the paddy production of Sri Lanka has shown a stable and increasing trend where the country could produce more rice than what we can consume since 2006 (Davis *et al.* 2016; USDA and GAIN 2020), except perhaps during extreme climatic events such as the drought experienced in 2016 and 2017. The long-term progress made by the agriculture sector helped Sri Lanka to cushion the economic impact during the world food-price crisis in 2008 (CBSL 2008). Furthermore, Sri Lanka was also at the top among the South Asian countries on the Global Food Security Index (GFSI) from 2010 to 2019 (GFSI 2021), and dropped to the third position in 2021. In very many years, the rice imports were in quantities less than 1% of the total required, and such imports mainly focused on the tourism industry and those in the society with purchasing power that would opt for specialty rice, such as Basmati.

In 2016 and 2017 the climate change affected our agriculture sector badly, and the country faced a drought that was probably the worst since 1948. Three cultivating and harvesting seasons failed continuously. The government was compelled to import around 748,000 mt of rice to feed our nation to the value of US\$ 301 million in 2017 compared to US\$ 13 million

recorded in 2016 (CBSL, 2017). At that time, the total requirement of rice per year was around 2.4 million mt. The imports in 2017 reached approximately 29% of the requirement (i.e. to feed our nation for about 3.5 months). Sri Lanka bounced back from 2018, producing rice in quantities more than what we required. The trend continued until the end of the *Yala* season in 2021 (Figure 1).

As for paddy farming, 2021 was exceptional, and the country did well to have a good crop harvest. The paddy harvest in 2021 is the sum of the yield in *Maha* season 2020/2021 (3,061,394 mt) and *Yala* season 2021 (2,088,486 mt), a total of 5,149,880 mt. Many factors have contributed to increased paddy production in 2021 (Agriculture Statistics 2022). Despite the lockdown in 2020, the Sri Lankan Government allowed the farming community to work freely in their fields, which is a good move (Marambe and Silva 2021) to support the economy and livelihood of the farming community. This decision, coupled with the timely availability of agricultural inputs such as synthetic fertiliser, pesticides, contributions by the scientists, academia, and more importantly, the farming community who understood the ground realities, as well as the policy decisions made before 27 April 2021, have contributed to reap richer harvests from many food crops in 2021.

By early 2021, the Department of Agriculture had all plans to ‘strengthen the Good Agricultural Practices (GAP) certification programme and popularise precision agricultural technologies in the national crop productivity enhancement efforts (Roshan and Arunapriya 2021).

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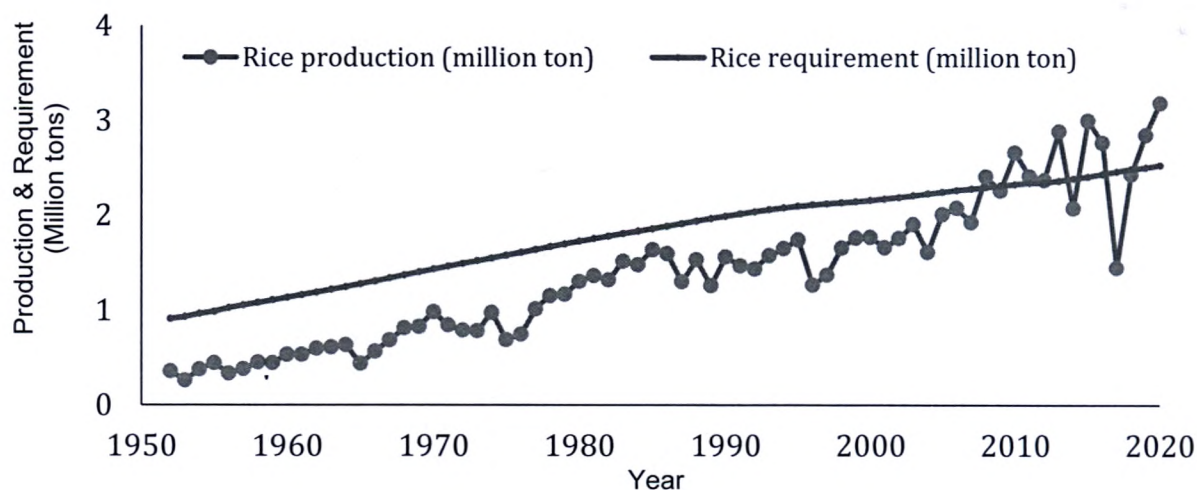


Figure 1. Paddy production in Sri Lanka over a period of seven decades
(Source: Rice Research and Development Institute, Department of Agriculture)

Until the year 2021, the country's agriculture sector was moving in the correct direction with a vision, with experience from over seven decades of scientific research and development.

On 27 April 2021 (Cabinet Decisions, 2021 - unpublished), the government decided to ban the importation of two critical categories of agricultural inputs, i.e. synthetic fertiliser and pesticides. This decision had some legal teeth for its implementation with the issue of an extraordinary gazette notification (No. 2226/48) on 6 May 2021. The import ban was made effective when the previous *Yala* season (March to September) in 2021 had just commenced, and some synthetic pesticides and fertilisers were already imported. Any remains of agrochemicals from the *Maha* season (October to February) of 2020/2021, and some imported later due to the efforts of the Ministry of Plantation and others, would have supported farming in the previous *Yala* season (2021).

The decision to ban the import of synthetic fertiliser and pesticides was finally revoked on 30 November 2021 by the Extraordinary Gazette No 2256/23. However, by the time the decision was revoked, the country had missed the opportunity for timely importation of the agricultural inputs before the dramatic price increase observed in the world market since October 2021. China, with a urea export share of 10% of the global trade, announced the suspension of fertiliser exports until June

2022. This is mainly to ensure availability of fertiliser in China amidst food security concerns (Baffes and Koh, 2021). The fertiliser supply concerns were further aggravated as Russia also announced restrictions on nitrogen and phosphate fertilizer exports for six months (Baffes and Koh, 2021), from 1st December 2021, resulting in soaring fertiliser prices in the world market. The Russian-Ukraine conflict has further aggravated this issue as at present.

The Current Situation

The unpublished databases in Sri Lanka have made it more than evident that the national level paddy yield in Sri Lanka in the *Maha* season 2021/2022 will show a 40-45% drop compared to the average of the previous *Maha* season yields. The paddy harvest continues at the time of preparation of this article, and the losses are even expected to be more. The author attributes this yield drop to the efforts made to have a total shift from synthetic fertilisers to organic fertilisers rather abruptly, as envisaged by the politicians through policy directives. Knowing how organic fertiliser (solid or liquid) works on crops, the fate of organic matter in a tropical environment, and the fact that organic fertiliser alone will not be in a position to provide the required quantity of nutrients at the correct stage of growth of a crop (Meemken and Qaim, 2018), led to an obvious negative outcome. Most of the academia and scientists in Sri Lanka had no difficulty making reasonably accurate

predictions of yield losses beforehand owing to such reasons. Such efforts and scientific facts presented, unfortunately were not considered by the policymakers and their close associates.

The maize farming was doing quite well, producing more than 415,000 mt of maize from the 2020/2021 *Maha* season and more than 50,000 mt from the 2021 *Yala* season (CBSL 2022). However, the absence of synthetic fertilisers and pesticides during the *Maha* season 2021/2022 has resulted in maize production ending in a disaster. The scientists and practitioners now predict that the country will be producing a mere 60,000 kg of maize during the season, which is a massive drop compared to what the country achieved in the previous *Maha* season in 2020/2021.

At face value, the tea sector has performed well. The total made tea production in 2021 was 299 million kg (Forbes and Walker Tea Brokers, 2022), thanks to the excellent weather that prevailed and efforts made by the Ministry of Plantation to import some quantities of synthetic fertiliser. However, this 21 million kg increase experienced compared to 2020 was mainly coming from the tea production during the first five months (Table 1), before any impact of the unfortunate decision imposed. Sri Lanka should have produced around 320 million kg of made tea if not for the drawbacks experienced towards the latter parts of the year. In that scenario, Sri Lanka fell short of expectations; the made tea production during the last three months of 2021 was 12+ million kg lower than that of 2020 (Table 1). Had we sold tea even at a lower price of US\$ 2 (not to undermine the quality of Ceylon Tea), the additional foreign exchange earnings should have been around US\$ 25 million from the last three months of 2021 alone. The tea production in February 2022 has fallen by 20% of that of February 2020 to 18.16 million kg, the lowest monthly production ever recorded since 2009 (12.8 million kg; Forbes and Walker Tea Brokers, 2022).

The decision to continue with organic or “green agriculture” (President’s Office 2021) does not make any scientific sense. Had the

policy makers allowed agriculture to continue in the usual manner in the previous *Maha* season (2021/2022) without disrupting it, in the present economic crisis, the country would have been in a better position in terms of food security. The agriculture sector of Sri Lanka would have faced the *Yala* season of 2022 confidently under the changing global political scenario. At least, the country would have avoided the food import expenditure and the import cost of ‘organic’ fertilisers that did not comply with the standards set by the Sri Lanka Standards Institution. Entry of such sub-standard material could have done more harm to the Sri Lankan environment compared to synthetic fertilisers imported following the set standards.

This situation would make Sri Lanka a predominantly rice-importing country for the foreseeable future. Early this year (2022), the government decided to import 300,000 mt of rice from Myanmar (Cabinet Decision 2022), repeating the situation in the 1940s where we imported 60% of our rice requirement mainly from Myanmar to feed a mere 6 million population and was to receive one million mt of rice from China (Ref: Post-cabinet Press Conference held on 19 January 2022). These two requests alone account for more than 54% of the annual rice requirement of the country. The government has also opened up the trade for anyone to import rice. The Indian rice products were freely available now, even before the Indian credit line was approved recently.

The Way Forward

If the objective is to minimise misuse (overuse, under-use, indiscriminate use) of synthetic fertiliser and pesticides, ensure food and environmental safety, reduce the cost of production, and enhance productivity, the near-perfect solution would be to adopt SLGAP-certification with full government patronage. The SLGAP-certification is free of charge and done by the Department of Agriculture (DOA) and the Department of Export Agriculture (DEA), unlike the costly third-party certification generally carried out for organic agriculture and organic farming. The country requires more trained staff to get this

Table 1. The monthly made-tea production in Sri Lanka during 2020 and 2021

Description	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2020 (million kg)												
High	5,000,699	4,366,890	3,295,665	3,964,026	6,660,337	7,157,374	5,794,315	4,047,227	4,123,627	4,451,673	5,391,251	6,420,313
Medium	3,447,598	3,314,138	2,563,918	2,942,039	5,892,923	4,199,221	4,164,602	3,333,906	3,326,869	3,387,392	4,016,229	4,575,468
Low	13,326,003	10,100,662	7,306,497	13,284,895	15,670,300	15,323,235	16,144,669	14,869,963	14,260,280	15,400,615	15,178,342	17,322,787
Green Tea	164,633	166,708	114,632	74,008	134,572	167,801	175,826	176,107	199,752	217,718	221,205	185,884
TOTAL	21,938,933	17,948,398	13,280,712	20,264,968	28,358,132	26,847,631	26,279,412	21,910,528	21,910,528	23,457,398	24,807,027	28,504,452
2021 (million kg)												
High	4,716,756	4,484,149	6,349,619	6,765,985	7,069,398	5,774,279	5,669,713	4,857,931	3,980,906	4,653,703	4,063,313	4,415,105
Medium	3,250,149	3,529,846	4,884,624	5,392,857	5,801,776	4,352,372	4,675,307	3,734,310	3,560,430	3,902,276	3,137,608	3,102,325
Low	14,911,473	14,200,275	16,930,375	17,234,904	17,282,615	15,556,888	15,565,360	14,864,098	14,782,095	15,205,413	12,647,820	12,705,183
Green Tea	166,819	165,127	246,372	193,762	222,031	254,153	254,586	243,754	240,592	235,539	154,759	194,882
TOTAL	23,045,197	22,379,397	28,410,990	29,587,508	30,375,820	25,937,692	26,164,966	23,700,093	22,564,023	23,996,931	20,003,500	20,417,495

Source: Forbes and Walker Tea Brokers (2022)

process on the ground more progressively and ensure the market mechanisms are in place to support the SLGAP-certified agricultural products.

The SLGAP focuses on adopting the recommendations by farmers judiciously to ensure higher crop productivity and safety, including integrated plant nutrient management systems (IPNS) and integrated pest management systems (IPM, including weed management), embedded with climate-smart agricultural practices. The DOA formally introduced the process in 2016. The Sri Lanka Standards Institution (SLSI) through SLS 1523 has provided required standards for different commodities to support SLGAP farmers and the certification process. Sri Lanka has also prepared the National Guidelines for Climate Smart Agricultural Technologies and Practices in 2019 (MAIRD, 2019), complementing the SLGAP-certification program.

It is now quite obvious that a course-correction of policies is required urgently to come out of the abyss of food shortages brought about by injudicious policies that have been implemented in the recent past.

References

- Agriculture Statistics (2022) <http://www.statistics.gov.lk/Agriculture/>
- Baffes J. and Koh W.C. (2021) Soaring fertilizer prices add to inflationary pressures and food security concerns. World Bank Blogs. <https://blogs.worldbank.org/opendata/soaring-fertilizer-prices-add-inflationary-pressures-and-food-security-concerns>
- Cabinet Office (2022) Importation of Rice required to provide at a reasonable price. http://www.cabinetoffice.gov.lk/cab/index.php?option=com_content&view=article&id=16&Itemid=49&lang=en&dID=11411),
- CBSL (2008) Annual Report 2008. Central Bank of Sri Lanka.
- CBSL (2017) Annual Report 2017. Central Bank of Sri Lanka.
- Davis, K.F. Gephart J.A. & Gunda T. (2016) Sustaining food self-sufficiency of a nation: The case of Sri Lankan rice production and related water and fertilizer demands. *Ambio* 45: 302-312
- Forbes and Walker Tea Brokers (2022) Tea Statistics of Sri Lanka. <https://web.forbestea.com/statistics/sri-lankan-statistics/65-sri-lanka-tea-production>
- GSFI (2021) Global Food Security Index. <https://impact.economist.com/sustainability/project/food-security-index/Index>
- MAIRD (2019) National Guidelines for Climate Smart Agricultural Technologies and Practices for the Dry and Intermediate Zones of Sri Lanka, Ministry of Mahaweli, Agriculture, Irrigation and Rural Development.
- Marambe B. and Silva P. (2021) A Sixty-day Battle to Tackle Food Security – Response of Sri Lankan Government to the COVID-19 Pandemic, *Sri Lanka Journal of Food and Agriculture*, 6(1) 1-6
- Meemken E-M. and Qaim M (2018): Organic Agriculture, Food Security, and the Environment. *Annual Review of Resource Economics*, 10: 39-63
- President's Office (2021) No change in government policy—Only green agriculture <https://www.presidentsoffice.gov.lk/index.php/2021/11/22/no-change-in-government-policy-only-green-agriculture-president-emphasizes/>.
- Roshan A.S.M. and Arunapriya A. (2021) Good Agricultural Practices (GAP): A stepping stone for green agriculture approach in Sri Lanka. 34th Annual Conference Publication, pp 123-126. Organization of Professional Associations of Sri Lanka, Colombo.
- USDA & GAIN (2020): Grain and Feed Annual, United States Department of Agriculture and Global Agriculture Information Network

Repositioning Sri Lanka's Transport and Logistics Sector to Lead the Economic Recovery in Sri Lanka

Kumarage, A.S.

Introduction

The current economic crisis cannot be taken lightly. Early warning signs over decades that all was not well, were ignored. We have simply lived beyond our means. We just have not worked smartly or hard enough to support our lifestyle that we have taken for granted, accompanied by the unrestrained imports and the ever-increasing dole-outs, expanded public services and subsidies. The transport sector was no different. When corrupt leaders took poor investment decisions without heeding professional advice, supported by those who have prostituted their professions, it has not taken long for the pillars of our economic and social well-being to crumble.

The Challenge

The journey of denial of the reality, and the mistaken belief that Sri Lanka can bounce back happily from any mismanagement, is over. The political ideology of living today and paying for it tomorrow and its proponents must urgently be reformed or the perpetrators should be removed. A new journey must begin using hard economics and the science of what we do and how we do them. A new ethical standard and way of managing institutions must be established at all levels of leadership and governance, binding them to policy, processes, established management methods and data-based decision making. This is a prerequisite for the recovery of the transport sector, and with it the economy.

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Transport and Logistics as a contributor to the Economic Crisis

The transport and logistic sector, as have many other sectors such as education, agriculture and industry, contributed significantly to this current debacle. Transport and logistics has failed to deliver its true potential for the economic endeavour of the nation, and in fact, has currently become one of its biggest burdens. This paper dwells on identifying what we need to do, both in the short-term to get over the immediate crisis and simultaneously work towards developing the transport and logistics sector to be positioned as a driver for Sri Lanka's economic revival and long-term regeneration to reach its fullest potential.

Transport and Logistics as a driver of Sri Lanka's Economic Revival

This requires a two-pronged strategy where we address the immediate problems and then proceed to make those solutions drive Sri Lanka towards a truly sustainable economy in the medium to long-term. The most urgent issue and starting point is to reduce our heavy dollar expenditure on transport; especially road transport. Analysis of the import bills from 2014 to 2019 (Sri Lanka Customs, 2022a), shows that 8% of Sri Lanka's import bill is for road vehicles, while a further 10% (at US\$ 50 a barrel) is for fuelling this fleet. The foreign outflows for road construction amounts to a further 3-4% of the import bill. In comparison, this is higher than what the country spends on the import of food, beverages, dairy products, pharmaceutical and medical products, all agricultural inputs including fertilizer, mobile phones and all other consumables that have now been banned or are in short supply (Sri Lanka Customs, 2022a). Thus, reducing this



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economic cost to ease the suffering of many people deprived of other imports essential for life and livelihood, should become an urgent priority.

The strategy identifies the major issues that need to be addressed to relieve the current situation quickly and affordably.

- Reduce consumption of Petroleum Fuel for Transport.
- Redirect towards a sustainable motor vehicle fleet.
- Impose an immediate moratorium on expressway construction and instead
- Invest in modernising the public transport network and improve walking, and cycling,
- Reduce vehicle usage and manage traffic congestion.
- Promote digital technology and supply chain science in transforming transport and logistics operations and
- Reform and Restructure Transport and Logistics Supply and Regulation.

A. Reduce Consumption of Petroleum Fuel for Transport

Around 63% of petroleum imports amounting to US\$ 2,065 million has been used for road transport annually (Sri Lanka Sustainable Energy Authority, 2019). This was when oil was US\$ 50-60 per barrel. At current prices of over US\$ 100 per barrel, this will increase to 20% of our usual import bill of US\$ 20 billion per year. It is possible that oil prices will stay at this level for several years, as in 2008 when it crossed US\$ 100 mark, it held for four years. Continuing dependency on oil will make Sri Lanka's economic recovery well nigh impossible. Private vehicles consume around 80% of this fuel (Weerawardena, 2019), leaving the entire goods and public transport services consuming just 20%, indicating where the problem lies. It is therefore imperative to urgently reduce personal vehicle use. This can be done in different ways in the short-term:

- Peg Fuel Prices to global oil price:

Pump prices of fuel in Sri Lanka even at the current Rs. 300+ per litre are still the lowest in the South Asian region in terms of

US\$/litre (Advocata Ins., 2021) . It is also still lower than its inflation-adjusted price in 2008 when global prices exceeded US\$ 100 per barrel and the US dollar was only LKR 110. In fact, oil crossed US\$ 100 per barrel mark even in 1981-82 during the Iran-Iraq war when the US dollar was just LKR 20. The popular principle of cushioning the people from the shocks of fuel prices in the long-term no longer works. There is just too much oil consumption that eventually it is the heavy consumers, the rich and not the poor that benefit from such subsidy. Unlike other goods, fuel imports should not be restricted or rationed as they are necessary inputs for other economic productions, but they should be pegged at market prices with a reasonable tax component that discourages consumption and encourages alternate use. In many countries, this tax is designated to develop and promote less fuel consuming means of alternative mobility to which people can shift without reducing productivity or convenience. Fuel prices may, if allowed, be raised in stages over 2-3 months giving sufficient time for making ready these alternatives which will be discussed below.

- Tax Readjustment of Vehicle Imports and Revenue License Fees to improve fuel economy:

According to import statistics from 2014-19, (Sri Lanka Customs, 2022b) over half a million motor vehicles are imported annually to Sri Lanka. Of this, 60% are motorcycles and 10% are three-wheelers and less than 10% are goods and passenger transport vehicles including buses. The 50,000 motor cars, which make up 10% of all vehicles imported, cost around \$800 million annually which is one half of the total CIF cost of all vehicles imported. In other words, the 10% of car owners spend 50% of foreign exchange as opposed to the 90% of other vehicle importers who use their vehicles for both private and commercial purposes. While this is a social impediment in itself, it is further aggravated by the concessionary permit system which enables around 10,000 vehicles, mostly cars and SUVs, to

be imported annually at minimal taxes. The loss from this concession has been calculated to be LKR 94 billion per year. This is almost equal to the total tax of LKR 97 billion the treasury has gathered from all car imports annually. This has effectively reduced the average tax on large cars/SUVs over 1,500 cc to only 99%, whereas three wheelers have paid 132% tax, while motorcycles paid 96%. The concessionary permit scheme is an economic disaster as most people buy the most expensive vehicle available so that they get the highest benefit in terms of resale value. Moreover, such vehicles are heavy consumers of fuel thus creating more economic issues. Thus, it is imperative that the permit scheme be scrapped forthwith. This alone will clearly not be adequate to reduce importation of such expensive and fuel inefficient vehicles. As such the vehicle import tax structure needs to be readjusted urgently considering the fuel economy of vehicles. If any concession is to be offered, it should be for electric vehicles, for which a long-term incentive structure and policy framework should be developed simultaneously.

- Moratorium on Expressway Building:

Expressway building has contributed significantly to the intolerable debt accumulation. Moreover, the ones completed evidently have not contributed adequately to the economy to avert this crisis. The cost of the Southern Highway up to Galle completed in 2011 was only US\$ 7 million per km. But the construction cost of the Central Expressway-3 that is being hurriedly awarded now, is estimated at US\$ 42 million per km. The total cost of the spending on expressways since 2001 is around US\$ 7 billion (Kumarage, 2022). It is not hard to imagine overspending of at least US\$ 3 billion in building expressways which, at most carry just 3% of the country's traffic. This shows the scale of corruption and waste that has taken place. The road tolls being collected are barely adequate to recover their cost of operation

and maintenance, let alone repay the loans. This 'highway robbery' should be immediately halted by imposing a short-term moratorium for new road infrastructure until the planning and procurement process that has been systematically corrupted can be reverted.

- Invest on Public Transport, Walking and Cycling Infrastructure:

For decades public transport has been denied any significant funding. Even when it was finally decided in the last few years, attention has been placed on expensive metros, such as LRTs that Sri Lanka neither needs, nor can afford, at present. The current line of funding from the ADB for railway electrification should be expedited instead of pursuing more road projects. The Sahasara Bus modernization programme (Ministry of Megapolis and Urban Development, 2019) costing US\$ 500, for which low interest finance is readily available and cost less than 1/3rd of the US\$ 1,872 million the government is prepared to commit to building the 20 km Central Expressway-3, has been stopped by the Cabinet recently. This can modernise all the 25,000 buses in the country, connect them to an IT-platform, implement a different business model of paying bus owners for the km-operated, together with digital passenger information systems providing real time information and integrated mobility solutions from first/last mile modes made available from a single platform. It can improve the quality of at least 50% of all trips. Concessionary funding for climate change can also be sought urgently to modernize the entire bus service to what is enjoyed in many developed countries in just a short time, thereby reducing the use of private vehicles and reducing emissions of buses. This can then be integrated to the railway network and the same mobility eco-system through modern IT-systems. A car-free day celebrated in over 1,500 cities worldwide (Wikipedia) should be implemented as a symbol of policy change. The public transport in cities such as Colombo, Kandy, and Galle should be developed to convert these cities to global mobility standards and transit-oriented development strategies to create liveable and

green urban spaces that are in demand globally as high-end value adding locations.

- Improve facilities for Walking and Cycling:

For health reasons, more and more urban dwellers look for active mobility opportunities such as cycling and walking. Around 22% of all motorised trips in the Western Province are less than two kilometres in length and are thus walkable or cyclable if the correct infrastructure is provided (JICA, 2015). However, our roads are not provided with such space or safety facilities. We should begin to assign space to foot or cycle users as an immediate policy change at least where space can be provided. This will also be a cost-effective way to improve access to rail and bus transport which can expand to park and ride operations using cycles, particularly for semi-urban and rural areas. Developing sidewalks, pedestrian crossings, to be followed by cycle lanes and walkways, will only cost 1-2% of the annual spending on expressways and yet be used by many more people. Moreover, many countries open selected roads only for cycles and pedestrians on holidays and evenings, which has revived the local economy and created lively public environments. Short-distance food and other deliveries now handled by motorcycles should be incentivised to be moved to bicycles or electric-cycles.

- Reduce Vehicle Use and Manage Congestion:

Even with all of the above, those who have got used to private vehicles and have means of passing off higher fuel prices to others, will continue using their vehicles. However, this causes huge external losses when urban areas get congested especially during peak times. The Government should implement a multi-pronged approach to mitigate congestion, with measures such as imposing peak-period minimum passenger occupancy in selected traffic attracting areas such as Fort, Battaramulla and Nawam Mawatha, introduce bus priority lanes on major corridors, incentivising company transport services and ensure that all major roads are

kept flowing-free throughout the day using modern traffic management technology. It should seek the help of the environmental conscious younger generations to drive this initiative and move Sri Lanka to attain its optimum balance between vehicle use, land availability and environmental sustainability. In addition, work-from-home and compressed work weeks for others who physically report will be encouraged to reduce commuting trips. More reliable online services should be provided to eliminate unproductive physical travel. Delivery of goods will be limited to night-time along major corridors and congested urban streets. Speeds would be monitored to ensure minimum mobility levels are maintained and restrictions revised accordingly on a monthly basis.

B. Position Sri Lanka as a Modern Transport and Logistics Hub to fast-track economic recovery

The current economic crisis is an opportunity to break the many barriers that have long prevented Sri Lanka attaining its fullest economic potential. In the transport and logistics sector, Sri Lanka has stagnated under archaic regulations, inefficient suppliers, outdated delivery methods and technologies and lack of professionalism in management and leadership. Though most transport infrastructure is stagnant in under-capacity, Sri Lanka now has excess capacity in underutilised expressways, as well as some ports and airports. There should be a strategy to speedily use these for economic activities so that they are converted from being liabilities to opportunities for economic recovery by using modern management, regulation, and operation methods, supported by modern smart technology and analytics. Short-term initiatives include:

- Promote Digital Transformation in Transport, Logistics & Supply Chain Management:

The advances in smart technology is being used effectively in revolutionising the way passengers and goods move around the world and within cities. Industry 4.0/5.0

applications such as robotics, Artificial Intelligence, big data analytics, deep learning algorithms, together with optimization sciences, can be applied in stages to ensure that major cities in Sri Lanka and our distribution networks and supply chains become efficient. Targeted funding should be provided for the urgent development of these technologies for Sri Lanka to become a leading technology-based mobility solution provider. The fast-developing field of operations science would be encouraged and applied to integrate the domestic and international supply chains to fully exploit the advantages of Sri Lanka's geographical locations, which has become irrelevant. Only with such leap-frog initiatives in technology can Sri Lanka become a regional logistics hub, a dream that has eluded Sri Lanka for decades. This parallel development of goods and personal mobility will have spin-offs on many dollar earning industries such as tourism, manufacturing, financial services, and technology-based services. This will initiate a long-term economic development strategy in improving Sri Lanka's supply chain efficiency in both domestic and international trade.

- Reform and Restructure Transport Supply and Regulation:

All of the above requires the urgent modernisation of transport suppliers and the reform of regulatory agencies to become industry reformers from being gatekeepers and beneficiaries of the status capable of navigating the modern-day business environment. They should be led by proven sector experts. The focus should be on quality service provision, reduced carbon footprint and increasing fuel efficiency so that Sri Lanka moves specifically towards being able to certify its manufacturing industry well ahead of 2050 when global carbon neutral compliances is sought by Western countries (UNECE, 2022). Technology-driven innovations should be encouraged and rewarded

through competitions and contracts and assisted to become bankable business models. Regulation should be made to synergise the market forces and the civil society enthusiasm in developing lasting win-win solutions. Transport planning and investment should be made law and be integrated to energy policy and urban development plans and in each urban area, transport infrastructure and service provider should be made responsible for ensuring targeted efficiency levels in providing mobility and energy efficiency. Regular monitoring should be in place to identify good practices and to reward and replicate them across the country.

References

- Advocata Institute (2021), Sri Lanka Fuel Price Analysis, www.advocata.org. June 2021
- JICA, Colombo Metropolitan Region Transport Study (CoMTrans), (2015, Ministry of Transport, Sri Lanka. 2015
- Kumarage, A.S., (2022) The hurry to award the Central Expressway Project hara-kiri for Lanka's economy, Sunday Times, <https://www.sundaytimes.lk/220417/sunday-times-2/the-hurry-to-award-the-central-expressway-project-hara-kiri-for-lankas-economy-479790.html>
- Ministry of Megapolis and Urban Development, (2019), Bus Service Modernization & SAHASARA Reforms Project, 2019
- Sri Lanka Customs, (2022a) Import Data, 2014-202112
- Sri Lanka Customs, (2022b) Vehicle Import Data, 2014-202122
- Sri Lanka Sustainable Energy Authority (2019) Sri Lanka Energy Balance 2019.
- United Nations Economic Commission for Europe (UNECE), (2022), The Glasgow Climate Pact – Key Outcomes from COP26, <https://unece.org/climate-change-and-sustainable-transport>
- Weerawardena, W.J. (2019) eEstimates of fuel consumption in Sri Lanka, unpublished, 2009
- Wikipedia, (n.d), Car Free Days, (https://en.wikipedia.org/wiki/Car-Free_Days)

Developing Quantitatively-Driven, Technologically Empowered Supply Chains to Revitalize the Sri Lankan Economy

Perera, N.

Introduction

Sri Lanka gained independence as the second most developed nation in Asia in 1948. Numerous opportunities have presented itself over those years (Seneviratne, 2022). While Sri Lanka has seized on to some of them as a nation, we have failed to grasp most of those opportunities to drive the nation's economy forward. At this point of crisis, various discussions have emerged on how to revitalize the economy. While all efforts must be taken to preserve any industry and exploit the opportunities they present, it is imperative that we focus on new paradigms to find innovative market opportunities to compete with the rest of the world and bolster our economy. Building resilient and cost-effective supply chains is a must to ensure that Sri Lanka prospers. For instance, one of the cornerstones of Germany's success in navigating through the Global Financial Crisis about a decade ago was its heavy investments on research and innovation to develop resilient supply chains that are sustainable and capable of being lean or agile to serve the product need. This concept later gained worldwide acclaim as Industry 4.0 (fourth industrial revolution). The need of the hour is to amass a quantum leap that the likes of South Korea, Japan and Germany recorded after the world war. Even the much talked about Singapore has achieved tremendous heights since its independence

through quantum leaps that have powered their economy. This paper aims to synthesize emerging perspectives across the global supply chain to catalyze economic revitalization in Sri Lanka through technology driven solutions that are backed by a quantitative backbone. Focusing on a knowledge driven economy that empowers our population while supporting the numerous interconnected supply chains provides a big piece of the puzzle in making Sri Lanka a vibrant economy. This fact is further enshrined by the World Economic Forum which predicts supply chain to be one of the fastest growing professional domains for the years ahead (World Economic Forum, 2020).

Supply chain thinking

The term "supply chain" is relatively new in the vernacular. The origin of the term "supply chain" traces back to 1982 when an American consultant named Keith Oliver coined the term to explain the intricate interconnection between various stakeholders working together to fulfill customer demand (Perera & Sugathadasa, 2014). The domain has evolved to concentrate on optimizing the flows of information, materials, and money to add value to all stakeholders connected with the supply chain (refer Figure 1). While the term supply chain has been widely accepted over the past 40 years, it essentially takes the form of a supply network (refer Figure 2) which works cohesively to deliver products/services to satisfy the consumer while also increasing profits/utility of each stakeholder (Perera & Perera, 2022). Stakeholders towards the consumer end of the supply chain are labelled as downstream partners while those that are

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more inclined towards the supply side are

termed as upstream partners.

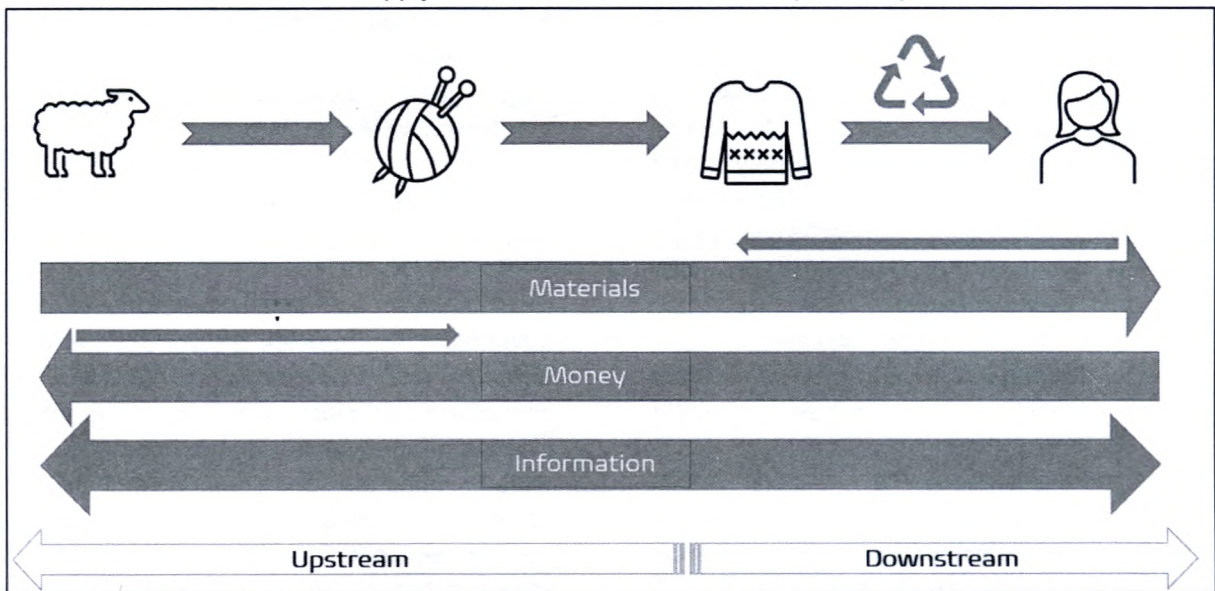


Figure 1: The three flows of the supply chain

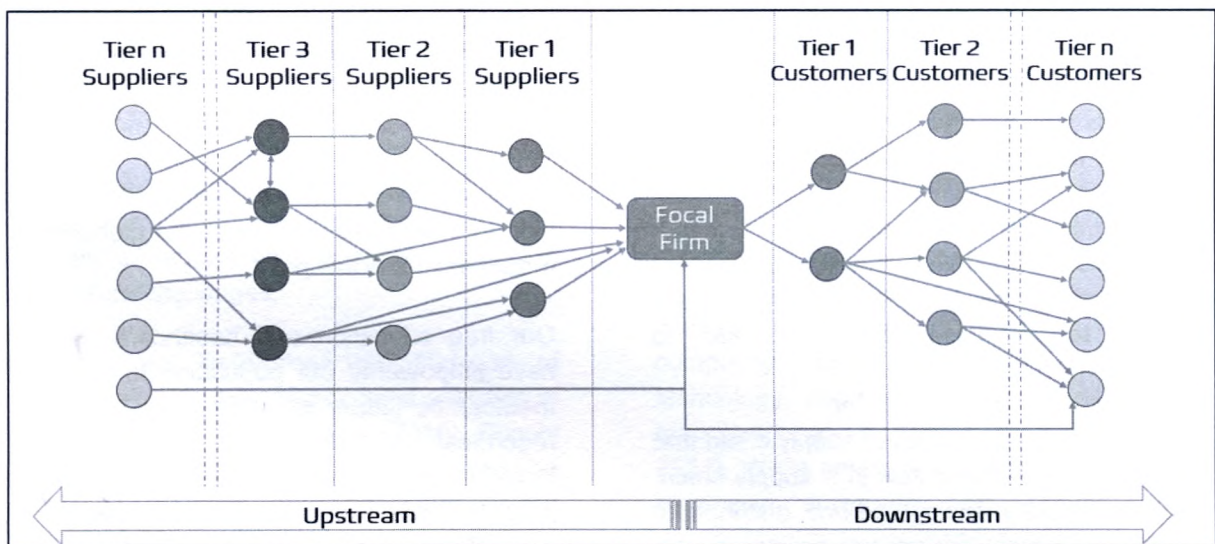


Figure 2: The supply network

A simple example could be an agricultural supply chain. The entire value chain would have numerous stakeholders that are distributed across various tiers/echelons; farmers, collectors, intermediaries, transporters, wholesalers and retailers, etc. The fact that each of these stakeholders have their own set of suppliers complicates matters. For instance, the farmers need fertilizer and if the fertilizer supply is thwarted, that has adverse effects on the harvest of the farmer that trickles down the supply chain. Transporters require fuel to move produce

from production centers to consumption centers. When fuel runs dry, trucks cannot operate which leads to making the harvest obsolete. Therefore, it is evident that optimizing supply chains are pertinent to ensure the resilience and growth of any industry.

There is a school of thought that perceives supply chain management to be a qualitative field. This is mostly dominant in the Sri Lankan context. However, most developed countries perceive supply chains to be a multidisciplinary

field that is mostly quantitative in nature. It integrates fundamentals of Industrial & Systems Engineering, Operations Research (a subdomain of mathematics) as well as management concepts (Perera & Perera, 2022). Sri Lanka must embrace supply chains as such and focus on optimized supply chains that aim (a) to reduce associated costs and (b) increase profits/utility. This must be done without disincentivizing any of the stakeholders. End-to-end integration and holistic thinking are paramount towards building resilient and optimized supply chains.

Lack of awareness of supply chain fundamentals confounds problems of the country further. One of the main theoretical constructs of supply chain management is the bullwhip effect (BWE). BWE relates to the amplification of order quantities across the supply chain from downstream to upstream due to (a) erroneous demand forecasting, (b) rationing and shortage gaming, (c) order batching and (d) price fluctuations (Lee *et al.*, 1997). However, the incompetence of the authorities to maintain proper stocks and prices as well as imposing rations violates the theoretical foundations of supply chain management thereby exacerbating demand. This has led to an artificial uptick in demand as consumers are wary of stockouts and are enticed to purchase frequently due to vulnerability of supply.

Logistics is the subdomain of supply chain that deals with the material flow in a supply chain. Improper route planning, ad-hoc distribution, delays in terminal operations, problems with capacity utilization, etc. have also contributed to the problems we face today. Properly applying latest technologies and operations research techniques can ease these issues to provide a high level of service. Expanding the usage of rail to convey goods should be high on the agenda of any reforms aiming to revitalize the goods transport sector (Kumarage, 2022).

Recent examples of the chaos created around fuel, liquified petroleum gas (LPG) and commodity supply underscores why we need supply chain and logistics professionals who

have a sound understanding of the underlying theories as well as the quantitative knowhow to understand how certain decisions would trigger ripple effects across the supply chain which take weeks and months to resolve.

Understandings our strengths and weaknesses

Sri Lanka has long touted numerous advantages that provide a pivot point to build our economy. Our plantation industry which produces world class crops, our geographical location at the center of the Indian Ocean, various minerals and resources bestowed upon us, the capacity to provide services to the greater region are among a myriad of solutions brought forward. Optimized supply chains are paramount if we are to unlock our true potential in any of these fields.

Evidence suggests that the human capital Sri Lanka possesses cannot be discounted. The nation has succeeded in producing experts in a variety of fields including science, technology, engineering, and mathematics (STEM) as well as humanities. There are many with a Sri Lanka background holding high ranking positions across the globe which further validates this point.

Our free education and healthcare systems have empowered our population to provide a meritocratic ladder to achieve their potential regardless of what their background is. Unfortunately, the country has failed to setup proper mechanisms to harness all of its products to build the nation. This is not so different in the field of supply chain and logistics. Thus, emphasis needs to be given at streamlining education programs to develop professionals capable to tackling the future work world.

Sri Lanka has challenges in competing with other developing economies when concerned with costs. However, we bear an advantage at delivering quality through high-end customer service. This has been the cornerstone of success for the large-scale Sri Lankan apparel manufacturers as well as some conglomerates in which we have acquired sustained local and

international success. Therefore, the country must ensure that it taps on to the local talent in building resilient, technology-driven supply chains with a quantitative backbone. This requires a multidisciplinary approach integrating supply chain professionals with experts in respective industries. Local universities with sufficient support from foreign experts, industry and political leaders must intensify efforts to produce professionals to spearhead the industry in the medium run, while those who possess technical awareness must shoulder key responsibilities in navigating the short-term challenges of bringing the economy to an even keel.

Optimizing our supply chains

Highly qualified professionals alone would be inadequate to build resilient supply chains that can achieve our national aspirations. We must endear ourselves to look at supply chains from a quantitative standpoint focused on cost minimization and profit maximization while safeguarding expected quality standards and ensuring the welfare of all stakeholders involved across the supply chain. Application of state-of-the-art technologies and optimization techniques must be at the forefront of revamping our supply chains to meet future challenges.

Forecasts are considered the lifeblood of supply chains as they trigger most activities in the supply chain (Perera *et al.*, 2019). Supply chains must invest heavily on improving the accuracy of forecasts. This should come in the form of trusting data-driven professionals to develop novel forecasting solutions to accurately predict future demand as opposed to investing in expensive solutions as research indicates that well-trained forecasters can continuously improve forecast accuracy (Hewage, 2021). In fact, we have the capability of developing homegrown solutions driven by explainable artificial intelligence (XAI) and machine learning (ML) to deliver optimized outputs (Hewage & Perera, 2022). Accurate forecasts play a significant role in mitigating the accumulation of inventory that leads to excessive cost generation as well as wastage along the supply chain (Perera *et al.*, 2020).

This is most profound for sectors which contain highly perishable products with a short shelf life as Sri Lanka is not able to afford wastages any further.

Optimizing routing and space allocation are serious concerns that require immediate attention. Underutilizing vehicle capacity and improper route planning gives rise to wastage of fuel. Operations research techniques such as vehicle routing problem, linear programming, mixed integer linear programming, multi criteria decision making, knapsack problem, etc. helps to optimize these problems (Thibbotuwawa *et al.*, 2020, Agustina *et al.*, 2014, Validi *et al.*, 2014). These techniques can derive optimal solutions through various computational packages that are off the shelf or open source. Therefore, the sector needs to pay more attention to increase the usage of analytical computational software that aid optimizing supply chains.

While forecasting, inventory decision-making and operations research are low-cost but highly effective tools, one must recognize the importance of deploying technological innovations across the supply chain. Industry 4.0, which was introduced earlier, encompasses a variety of technologies such as big data analytics, artificial intelligence/machine learning, cloud computing, internet of things (IoT), blockchain technology, augmented reality, additive layer manufacturing, simulations, etc. (Zhang *et al.*, 2021). While some of those technologies are expensive, some are not. Through proper needs identification, these technologies can benefit local industries as well (Lee & Lee, 2015). Especially, technologies such as IoT are quite cost-effective and have the potency to make significant impacts in a local context (Lee & Lee, 2015, Ben-Daya *et al.*, 2019, Abdel-Basset *et al.*, 2018). For instance, IoT has many application possibilities in agricultural supply chains to reduce wastages that amount to nearly 40% of the harvest (Daily FT, 2022).

Other thrust areas requiring attention include forward buying and risk pooling by identifying major cost variations that are likely to impact

the supply chain while ensuring expected levels of service. In addition to this, emphasis ought to be given to smoothen the decoupling points in the supply chain to facilitate seamless integration. Trying to reintegrate the railway system as a core of our goods transportation system too is a timely challenge to mitigate some of the inefficiencies present in the transportation system. This could be further supported through algorithmically developed first-mile and last-mile delivery plans that help towards accumulating and distributing out of predefined collection/distribution centers.

Research and innovation in supply chains

The country must resist the urge to go towards expensive plug and play solutions and try to focus on homegrown innovations that are both cost-effective and efficient. Our aim should be to develop commercializable technologies that generate revenue for local organizations as well as having the potency to be exported, at least to the developing world. As an enclosed system, it is natural that only a fraction of the countries in the world can maintain a positive balance of payment while the others would inadvertently have to survive with a negative balance of payment that leads to budget deficits and economic strife. Sri Lanka must exploit any opportunity that presents towards consolidating our export capabilities and developing technological innovations that can be exported to the developing world is one such fertile area.

A natural question that may arise is how to find funding to support innovation at a time where the country is sinking financially. The simple answer is through international research grants and funding. There are ample opportunities available to attract funding to support novel and practical research and capacity building, especially in developing countries. Unfortunately, the government procedures in place to approve of such international research grants are discouraging and shortsighted. Delays faced due to the numerous hurdles posed by circular PS/SP/SB/Circular/06/2019 issued by the Presidential Secretariat on 19th December 2022 and associated rules and regulations

make the lives of a grant recipient miserable, thereby discouraging them from applying for more international funding. Responsible authorities must take immediate measures to repeal these regulations that only stand against progress and empower universities to bring in foreign currency to invest on homegrown research and innovation. Moreover, these grants aid the country in another way by contributing towards local capacity building without any financial obligations other than transparent spending of the grant money. The wisdom that the country gains from top professors across the globe through joint research carried out through such research grants would be priceless.

Additionally, mechanisms must be put in place to ensure binding policies are made scientifically with the greater good of the country in mind. Moreover, universities should be vested the power of being centers of excellence that are at the forefront of carrying out state-of-the-art research for the benefit of the public. The model which the Fraunhofer Institute implements in Germany is of special importance. As Europe's largest application-oriented research organization, it links industry and academia to cohabitate towards mutual gain. Professors and universities are endowed on competitive basis to expertise on a particular field. Once selected, the relevant professor and the institute has to work tirelessly to solve application-oriented problems in the country while the industry has a gateway to solve their problems at a reasonable cost. The process often hires postgraduate students who also improve their skills and add value to the economy (Fraunhofer-Gesellschaft, 2022). Collaboration between industry, academia and the government is a must to ensure that resilient supply chains are developed in the country.

While Sri Lanka is at the embryonic stages of adopting Industry 4.0, the developed world is already embarking on Industry 5.0. The fifth industrial revolution enables cyber-physical systems to work seamlessly alongside humans and is enabled by the emergence of 5th generation (5G) telecommunication technologies that eliminate lag of information

flow (Demir, 2019). We must aim towards shifting gears to ensure a rapid rise in research and innovation to support Industry 5.0 driven supply chains in Sri Lanka. While implementing 5G technology across the country may not be the need of the hour, providing such facilities around research laboratories may provide them the ability to become incubators of developing cutting-edge technology that has a commercial value. The ecosystem to support such innovations must be established no sooner, so that the country can take a quantum leap in our quest towards development. Needless to say, besides the countries which are rich in minerals/oil and into gambling, all the other developed countries have achieved development through a strong foundation that focuses heavily on science, technology, engineering and management (STEM). Therefore, Sri Lanka should also put trust in our sciences while also retaining the cultural, humane and artistic elements that make us so unique.

Conclusion

Sri Lanka is at crossroads with years of mismanagement and lack of vision bringing us to the brink. Yet, there lies hope in the eleventh hour thanks to the competencies of our younger generations as well as the experience of intellectuals who have contributed to the country over the years despite many hardships. Building resilient supply chains by harnessing those competencies and new technologies provides us a pathway towards economic prosperity. A truly multidisciplinary approach which integrates all stakeholders to maximize the benefits of the supply chain towards mutual success is much needed. The government and the industry should cease being penny wise and pound foolish. Investing in science, technology, engineering, and mathematics (STEM) is pivotal for both the public and private sectors to ensure that Sri Lanka recovers from this fall by becoming a nation that boasts of highly efficient supply chains that are supplemented by cutting-edge technology.

References

- Abdel-Basset, M., Manogaran, G. and Mohamed, M. (2018). "Internet of Things (IoT) and its impact on supply chain: A framework for building smart, secure and efficient systems," *Futur. Gener. Comput. Syst.*, vol. 86, pp. 614–628, (2018), doi: 10.1016/j.future.
- Agustina, D., Lee, C.K.M. and Piplani, R. (2014). "Vehicle scheduling and routing at a cross docking center for food supply chains," *Int. J. Prod. Econ.*, vol. 152, pp. 29–41. doi: 10.1016/j.ijpe.2014.01.002.
- Ben-Daya, M., Hassini, E. and Bahroun, Z. "Internet of things and supply chain management: a literature review," *Int. J. Prod. Res.*, vol. 57, no. 15–16, pp. 4719–4742, (2019), doi: 10.1080/00207543.2017.1402140.
- Daily FT. "Post-harvest losses cost SL Rs. 20 b annually: COPA," <https://www.ft.lk/front-page/Post-harvest-losses-cost-SL-Rs-20-b-annually-COPA/44-716201> (accessed Apr. 10, 2022).
- Demir, K.A., Döven, G. and Sezen, B. 2019. "Industry 5.0 and Human-Robot Co-working," *Procedia Comput. Sci.*, vol. 158, pp. 688–695, 2019, doi: 10.1016/j.procs.
- Fraunhofer-Gesellschaft, "Homepage," (2022). <https://www.fraunhofer.de/en.html> (accessed Apr. 18, 2022).
- Hewage H.C. and Perera, H.N. (2022). "Retail Sales Forecasting in the Presence of Promotional Periods," in *Lecture Notes in Networks and Systems*, vol. 364 LNNS, Springer International Publishing. pp. 101–110.
- Hewage, H.C., Perera, H.N., and De Baets, S. (2022). "Forecast adjustments during post-promotional periods," *Eur. J. Oper. Res.*, vol. 300, no. 2, pp. 461–472, doi: 10.1016/j.ejor.2021.07.057.
- Kumara, A.S. (2022). "Repositioning Sri Lanka's Transport and Logistics Sector to lead the economic recovery in Sri Lanka," *OPA J.*, vol. 11, no. 1, pp. 11–17.
- Lee I. and Lee, K. (2015). "The Internet of Things (IoT): Applications, investments, and challenges for enterprises," *Bus. Horiz.*, vol. 58, no. 4, pp. 431–440, 2015, doi: 10.1016/j.bushor.
- Lee, H.L., Padmanabhan, V. and Whang, S. (1997). "Information Distortion in a Supply Chain: The Bullwhip Effect," *Manage. Sci.*, vol. 43, no. 4, pp. 546–558, doi: 10.1287/mnsc.43.4.546.
- Perera, H.N. and Perera, H.Y.R. (2022). "Applications of Pixel Oriented Mobility Modelling in Transport & Logistics," in *Lecture Notes in Logistics*, Cham: Springer International Publishing, pp. 1–12.

- Perera, H.N. and Sugathadasa, P.T.R.S. (2014). "Investigating Manufacturing Supply Chain Transformations: A Sri Lankan Context"
- Perera, H.N., Fahimnia, B., and Tokar, T. (2020). "Inventory and ordering decisions: a systematic review on research driven through behavioral experiments," *Int. J. Oper. Prod. Manag.*, vol. 40, no. 7/8, pp. 997–1039. doi: 10.1108/IJOPM-05-2019-0339.
- Perera, H.N., Hurley, J., Fahimnia, B. and Reisi, M. (2019). "The human factor in supply chain forecasting : A systematic review," *Eur. J. Oper. Res.*, vol. 274, no. 2, pp. 574–600, doi: 10.1016/j.ejor.2018.10.028.
- Seneviratne, A. "Downfall of Sri Lanka Started In 1948; Accelerated In 1978; Completed In 2022," 2022. Colombo Telegraph, (2022). <https://www.colombotelegraph.com/index.php/downfall-of-sri-lanka-started-in-1948-accelerated-in-1978-completed-in-2022/> (accessed Apr. 18, 2022).
- Thibbotuwawa, A., Bocewicz, G., Nielsen, P. and Banaszak, Z. (2020). "Unmanned aerial vehicle routing problems: A literature review," *Appl. Sci.*, vol. 10, no. 13. doi: 10.3390/app10134504.
- Validi, S., Bhattacharya, A. and Byrne, P.J. "A case analysis of a sustainable food supply chain distribution system - A multi-objective approach," *Int. J. Prod. Econ.*, (2014), pp. 71–87, , doi: 10.1016/j.ijpe.2014.02.003.
- World Economic Forum, "The future of jobs report (2020)," Geneva, 2020. [Online]. Available: <https://www.weforum.org/reports/the-future-of-jobs-report-2020/digest>.
- Zhang, Y. Chen, and Chong, D. (2021). "Industry 4.0 and its Implementation: a Review," *Inf. Syst. Front.*

Economic Crisis in Sri Lanka: The Road Behind and Ahead

Palihakkara, UH

Introduction

At the time of independence, Sri Lanka was at the forefront of many Asian nations in terms of economic and social development. It was the first country in South Asia to adopt an import substitution welfare-oriented policy but the government that was elected in 1977 shifted the course by implementing a market-oriented monetary policy. The onset of the civic conflict in 1983 resulted in a decline in the economic performance of Sri Lanka and thus the government could not continue the momentum. In the aftermath of the civic conflict, despite the external shocks and global financial crisis, the Sri Lankan economy grew at around 6% annually in the latter part of the first decade of the 21st century while achieving a high level of human development, mainly due to the implementation of proper government policies on health and education.

Currently Sri Lanka is facing the worst financial crisis in its history. Sri Lanka's foreign exchange reserves are now virtually non-existent and Sri Lanka has become the first country in Asia-Pacific during the recent past to go into an official default of debt repayments. This article will discuss and analyse the sequence of events that led to the economic crisis Sri Lanka is facing today and the road to recovery.

Current situation

Since its independence, Sri Lanka was facing a BOP (Balance of Payments) crisis and a severe foreign exchange shortage which was

further compounded by the Easter Sunday attack in 2019, COVID-19 lockdowns in 2020, pre-pandemic tax cuts and the loss of access to international capital markets. The GDP growth averaged 4.97% for the period from 2003 to 2021, reaching a record high of 16.12% in the first quarter of 2012, but witnessed a record growth of -16.40 per cent in the second quarter of 2020 (Figure 1).

Foreign Exchange (FX) reserves fell by 24% from USD 3.1 billion in December 2021 to USD 1.7 billion in March 2022 due to debt repayments and economic interventions which aggravated the economic crisis (Figure 2).

The latest Central Bank of Sri Lanka (CBSL) data show that the personal remittances fell to their lowest of USD 5.98 billion in 2021 since 2012. It is now estimated at USD 3.0 billion per annum. By the end of March 2022, the country's gold reserves slipped to a record low of USD 29.3 million, and the banking sector in Sri Lanka fell into deep danger and thus there is a possibility that any bank default could trigger an economic domino effect (Figure 3).

Sri Lanka's debt crisis

Since 2009, China provided USD 7 billion as loans to construct infrastructure projects such as Magampura Port in Hambantota and Mahinda Rajapaksa International Airport in Mattala. In addition, re-fleeting of SriLankan Airlines, and certain other infrastructure projects which can be called "economic duds" swelled the debt burden yielding hardly any return, thereby resulting in a severe BOP problem. This prompted the government to seek an IMF bailout of USD 1.5 billion in 2016 with underlying tax reforms and other conditions. It is also noted that the net official development assistance and official aid

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received in Sri Lanka was reported at current USD 197 million in 2019 (World Bank, 2020).

The graph below reflects Sri Lanka's Total External Debt and Debt Servicing as a Gross National Income (GNI) - 2000-2020 (Figure 4).

Lately, the Sri Lankan government adopted the Modern Monetary Theory (MMT) policy which involves borrowing and printing money via the Central Bank to finance the government expenditure and budget. This ultimately led to overheating of the Sri Lankan economy. In 2021, the international credit rating agencies speculated that it will be difficult for the Sri Lankan government to meet the external debt obligations in 2022 and 2023. Accordingly, Sri Lankan credit rating was downgraded. Towards the end of 2021, Sri Lanka's situation was extremely dire, and against the advice of many, CBSL settled a

USD 500 million International Sovereign Bond (ISB) in January 2022.

With the mounting pressure and the USD selling at LKR 250 in the unofficial market, in March 2022 CBSL was compelled to cap the USD at LKR 230 per dollar against the official parity rate of LKR 201.49 prevailing at the time. However, it was abortive and in unofficial trade, the rupee as quoted at a far lower rate i.e. kerb rate, bringing more pressure on the rupee. Continuous mismanagement of the economy of the country led to a severe financial crisis and default fears, accelerating Sri Lankan rupee declined to a record low and becoming the world's worst-performing currency (UK Financial Times, April 5, 2022). In April 2022, the IMF and World Bank stated that Sri Lanka's foreign debt is 'unsustainable' due to declining foreign reserves, and this is not solely attributable to COVID-19 (Figure 5).

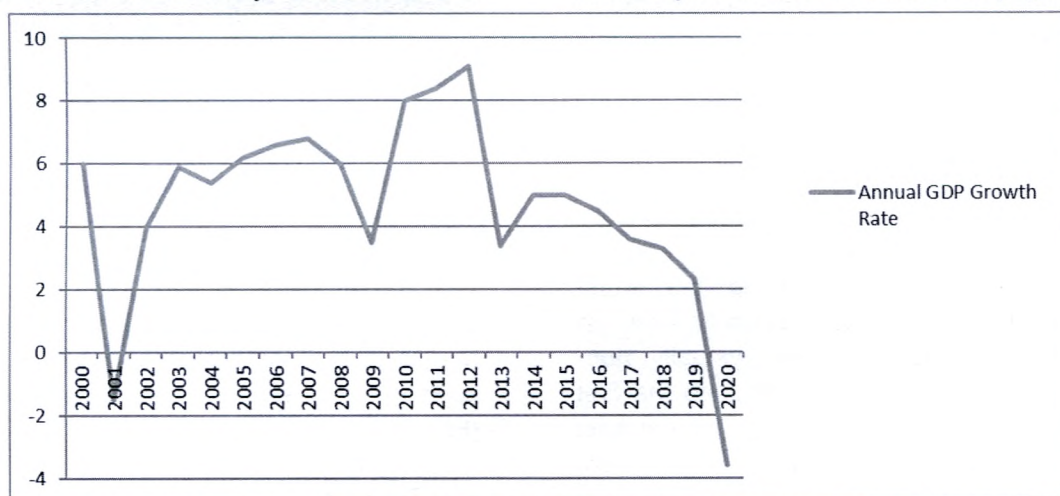


Figure 1: Annual GDP Growth (%) in Sri Lanka, 2000-2020 Source: World Bank, 2022

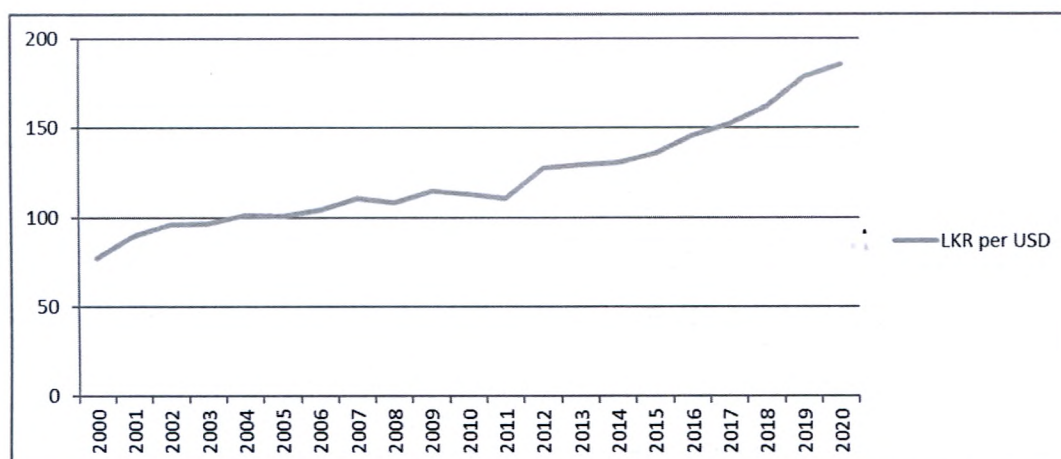


Figure 2: The official foreign exchange rate (LKR/USD) from 2000-2020 Source: World Bank, 2022

The continuous trade deficits for decades have led to the draining of foreign reserves, witnessing a "step-by-step, brick-by-brick", devastation of the Sri Lankan economy, but no government has been able to reverse the situation and Sri Lanka's severe

macroeconomic volatility and recurring BOP concerns were unabated. With persistent trade deficits and budget deficits, ADB in 2019, considered Sri Lanka's economic system as "a tale of two deficits".

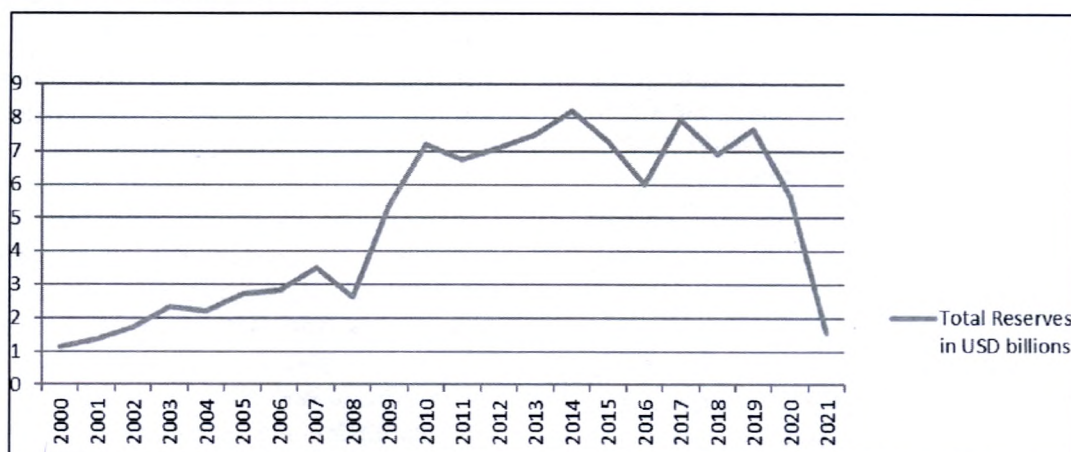


Figure 3: Total reserves in Sri Lanka, 2000-2021 Source: World Bank, 2022

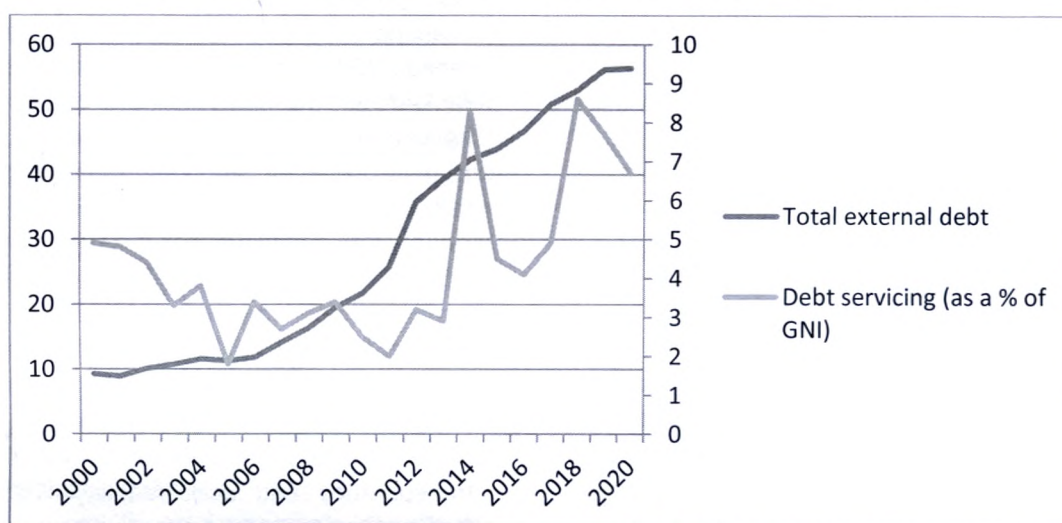


Figure 4: Sri Lankan debt crisis and its servicing, 2000-2020 Source: World Bank, 2022

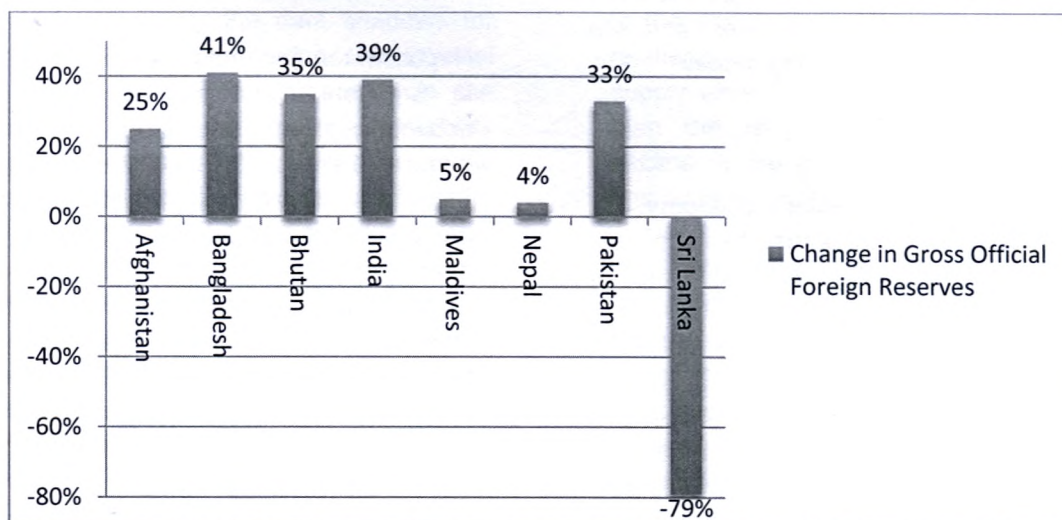


Figure 5: Percentage change in Gross Official Foreign Reserves from 2019 to end of 2021 Source: World Bank, 2022

Realizing the perilous economic situation of Sri Lanka in April 2022, CBSL pre-empted the country's inability to service its future settlements. A 'debt moratorium' was declared as a temporary measure to gain breathing space until a debt-structuring scheme is decided, and official talks with the IMF began on April 18th 2022 for a bail-out. It may eventually help with regaining access to global bond markets. Ahead of the talks, the CBSL on April 08th 2022 imposed a record interest rate hike by a staggering seven percentage points to 14.5% to curb runaway inflation.

Reasons behind the Sri Lankan economic crisis

The structure of Sri Lanka's GDP is "cosmetic". It is manifested through the country's economic crisis and the plummeting Sri Lankan currency, due to reasons discussed above. The situation was accelerated with the Easter Sunday Attack (2019), pre-pandemic tax cuts and the impact of COVID-19 (2020), banning of chemical fertilizer (2021) and lack of optimal governance. The fiscal deficits were more than 10 per cent of GDP in 2020 and 2021; and a rapid increase in public debt to 119% of GDP was noted in 2021. The external debt repayments and the widening current account deficit have led to foreign exchange (FX) shortages, while the official exchange rate with a 'fear of floating' has been de facto fixed since April 2021. Nikkei Asia: October 2021 says "*Sri Lanka's COVID-stricken economy is being likened to a ticking time bomb that could go off at any moment as foreign reserves plummet, the cost of living rises and the Central Bank carries on printing money*".

a. Policy failure

For a long time, Sri Lanka's economy has been plagued by social unrest, bankruptcies, trade deficits, currency instability, and a breakdown in law and order. The failure to maintain – financial stability and long-term growth momentum is central to Sri Lanka's poor economic performance. Successive governments implemented many measures that were detrimental to economic progress. In this regard the paucity of policy coherence is also noted.

b. The import-export gap in Sri Lanka

Despite the implementation of certain policy measures to rationalize imports from time to time, the annual trade deficit of Sri Lanka was between 9 and 15 per cent of its annual GDP from the period of 2008 to 2017. During the last ten years, on average, the trade account balance was more than 400 times of current account balance, impacting the BOP.

With the dwindling foreign reserves and struggling to service its debts and pay for imports, Sri Lanka's current debt-to-GDP ratio has skyrocketed in recent years, increasing from 42% in 2019 to 104% in 2021.

c. Corruption and accountability

With a score of 37 out of 100 in 2021 of the Corruption Perception Index (CPI) of the Transparency International, Sri Lanka was ranked 102 out of 180 countries. Sri Lanka is ranked as the 23rd riskiest country (the second most risky country in South Asia after Afghanistan) for money laundering and terrorist financing according to the Basel AML Index 2020. It has not made much headway in fighting corruption for over a decade.

The 20th Amendment to the Sri Lankan Constitution, adopted in 2020, granted the President unfettered powers, undermining the affairs of the Independent Commissions, transparency and accountability. This has further engendered the level of corruption in the country.

Nepotism too has undermined the rule of law in Sri Lanka and slowed the country's economic growth and bred corruption. In general, there is no "Right Man at the Right Place". Family members, friends and allies of the politicians, although not befitting, have been appointed to lofty, well-paid, state-funded high positions both local and overseas. The allocation of nearly 70% of the island's 2022 budget to the institutions controlled by a few intimately connected persons is also a matter of grave concern.

d. Budget deficit and national debt

In 2019 Sri Lanka had 1.5 million taxpayers and by 2020 the number had fallen to 1.04 million which further declined to 412,000 in 2021. The annual budget deficit over topped 12% of GDP in 2021 as a result of tax cuts, and poor income performance in the aftermath of the COVID-19 pandemic. Due to the limited access to external financing, the government had to rely primarily on bank direct financing of the budget.

Defence is the single largest component of government expenditure in the country. Sri Lanka has the world's 17th largest military in terms of personnel. According to the 2022 budget, the highest allocation of LKR 373.1 billion which accounts for 14.89% of total government expenditure was made to the military.

The economic mismanagement of successive governments weakened Sri Lanka's public finances, leaving its national expenditure above its income, and the production of tradable goods and services to be at an inadequate level. The national debt climbed from 94% of GDP in 2019 to 119% of GDP in 2021. Sri Lanka, unlike many other countries, lacks a cohesive economic policy and does not have a "National Development Plan".

e. Political instability

Political stability and economic growth are deeply interconnected. Sri Lanka's economy has remained under the dark shadows for nearly three decades during the internal strife. The recent economic crisis in the country has resulted in political instability driving the country into further economic uncertainty, creating ripple effects on the political economy and a nationwide uprising.

f. Financial mismanagement

Financial management and economic management are not synonymous but are interrelated to each other. Public sector financial mismanagement is rampant in Sri Lanka. The ubiquitous bribery, deceptive deals, incompetence, ignorance, the pursuit of economically inefficient political

ideologies, flawed financial/ economic models, incorrect policy implementations, and weak accounting systems, can be identified as the major causes of poor public sector financial management that led to the corruption and mismanagement

g. Public debt management

The significant increase in public debt level in Sri Lanka has long been a moot point. It is believed that corruption has had a significant impact on the effectiveness of public debt programs in Sri Lanka. According to a special study conducted by the Auditor General Department on Public Debt, the national debt was LKR 2,142 billion at the end of 2005 and LKR 8,861 billion at the end of 2016, showing an increase of LKR 6.719 billion. Against this, the total assets (financial assets only) were LKR 293 billion at the end of 2005, but rose to LKR 1,087 billion at the end of 2016, alluding a "profit" of LKR 794 billion. Despite the fact that the country's debt is growing rapidly that the assets created by the utilization of that debt were not properly documented and substantiated.

g. Printing money instead of finding solutions

When a government is unable to make ends meet by issuing bonds, it frequently turns to printing money. The CBSL has resorted to printing money instead of finding solutions to economic ills. In 2021 the CBSL has printed almost LKR 1.2 trillion worth of currency to meet the government expenditure. According to the economic literature, there is a direct relationship between inflation and money supply when the creation of money is faster than the real output growth, causing a decline in the purchasing power of money and an inflationary situation in the economy.

h. Business Confidence

The current economic situation of Sri Lanka points to apparent zero attention and ignorance of the economic fundamentals by the Treasury, CBSL and the government driven by chaotic and awkward political and economic environments, business confidence in the country continued to decline. In March 2022, the social and

economic ills in Sri Lanka have caused the business confidence to fall by 18.4% following a 13.8% loss in the previous month. LMD June 2022 issue mentioned that "There are no surprises as the LMD-Nielsen IQ Business Confidence Index (BCI) stays on its slippery course, sliding a perilous 17 basis points to 99 in May from its lowest level this year of 116 in April 2022".

Consequences of the Sri Lankan economic crisis

The world economic situation has deteriorated considerably in recent months, owing mostly to persistent inflation and the on-going crisis in Ukraine. Tightening financial situation also sounds alarm for world economy. Growing global food demand with acute food insecurity is at the top of the global agenda. These foreign shocks are further clogging the Sri Lankan economy.

With vast foreign debt obligations and an increasingly uncertain economic and political environment, Sri Lanka's ability to supply food, gasoline, and other requirements to its people is a serious concern, resulting in rising prices and a scarcity of basic food and other necessities with people lining up under uncomfortable conditions for purchasing basics such as petrol and gas.

The current economic crisis has far-reaching consequences, including increased unemployment, higher government borrowings, firm closures, lower levels of production and productivity, increased income disparity, etc.

The severe food shortage was a major catalyst for the social uprising in Tunisia, known as the 'Jasmine Revolution' which inspired a wave of similar protests throughout the Arab Spring in the Middle East and North African countries.

The management of the economic crisis

In this context, it is absolutely essential that policy and strategy formulation for reversing the current economic trend be seriously considered. It is particularly vital when a

country like Sri Lanka is going through a significant transition or attempting to rebuild after a major meltdown. This requires major fiscal reforms, along with careful consideration of fiscal responsibility standards, and the identification of risks associated with varying forms of borrowing e.g. debt sustainability, foreign currency risk, and the level of interest rate sensitivity which are fundamentals in achieving business confidence among the investors.

As a monetary policy measure, in 2021 Sri Lanka increased the limit on treasury guarantee to 15% of GDP i.e. about 330 per cent of the original limit set by the fiscal responsibility law in 2003, which sought to limit the fiscal profligacy and making difficult to understate and to hide the budget deficits. This affects financial prudence. The effective regulations, capital controls and risk management, play a key role in reducing the likelihood of financial crises and building safeguards against their occurrence.

a. Improving the country's creditworthiness

The significance of a country's credit rating needs to be recognized in improving its credit worthiness. The management of the full spectrum of Sri Lanka's risk and compliance exposure has never been so critical and important. It will be a precursor for attracting investments and capital inflows to the country's economy.

The main economic variables considered in credit rating are: per capita income, GDP growth, inflation rate, economic development and the quality of economic management, ratio of foreign debt to GDP, current account position, real exchange rate, reserves/imports ratio and default history.

b. Debt restructuring.

The European Parliament defines sovereign debt restructuring as an exchange of outstanding sovereign debt instruments e.g., loans or bonds, for new debt instruments or cash through a legal process which involves negotiating lower interest rates, or debt reduction by agreeing to accept a percentage of what they owe: giving more

time for repayment. The following matters are generally considered in a debt restructuring scheme:

- i. Reduction in the amount of debt or the principal amount, also known as haircuts
- ii. Changing the interest rates to be paid or the coupon rates (known as coupon modification)
- iii. Extending the duration of repayment or maturity
- iv. Combination of all of the above

Note: Some measures have already been taken to reverse the economic situation discussed previously.

The road ahead

Debt crises, defaults, and debt restructurings have become common with the establishment of financial markets and cross-border debt flows, since the early 19th century. Many countries had sought the assistance of IMF when their financial situation was dire and some have been able to successfully reform their economies e.g., India had only USD 1.1 billion in hard currency reserves in 1991, sufficient for about two weeks of imports, but the then Indian government took appropriate measures to successfully deal with the situation (India has never defaulted on its FOREX debt obligations). Similarly, EU-IMF programme in Ireland had been a remarkable success. However, many restructuring programmes failed to yield the desired effects e.g., Argentina, Greece and Pakistan. Following the Asian financial crisis, a move was initiated to limit IMF operations for remodelling its loans and policies for the overall economy. However, with the revival of private capital flows to developing countries, this agenda was pushed to the side-line, exposing countries to major risks.

Independent Sri Lanka had never defaulted its sovereign debts until April 2022. It is also noted that since 1965 up to 2016 Sri Lanka had approached IMF 16 times and Sri Lanka is now seeking assistance again from the IMF. Sri Lanka is the first country to seek IMF debt-restructuring in the post-COVID-19 era.

Any debt restructuring emphasizes debt sustainability i.e., a high probability that a borrower's debt is sustainable. The main condition under a debt restructuring program is that a debtor nation has to meet is a demonstrated need for debt relief and its commitment to implement a decided economic reform plan. However the creditors are generally reluctant to restructure debts if it is due to financial mismanagement.

Debt restructuring is a complex process for a country like Sri Lanka with a limited resource base. It will have both negative and positive consequences on the Sri Lankan economy. It is also important to recognize the consequences of defaulting ISB's on account of "cross default".

Even though countries like Argentina and Ecuador had defaulted, they have comparatively a large resource-based economy to get back on a path of recovery with the assistance of the IMF. Generally, the bailouts are expensive both for the nation being bailed out and for the parties providing the bailout funds. The recent financial woes of Greece, Ireland, Portugal, and other nations have reinvigorated the debate over whether to bail out defaulting countries or restructure their debts. The IMF has emphasized on restructuring Sri Lanka's massive foreign debt before finalizing a bailout agreement.

The initiation of debt-restructuring by Sri Lanka, precisely at a time when the country was financially weak, has resulted in the country losing its bargaining power. Furthermore, the debt-restructuring for Sri Lanka will be very difficult due to its debt profile and a limited resource base. A debt-restructuring scheme without any economic reform plan will not create any sustainable solution to the country's sick economy. Hence, it is important to shift gears and move forward with hard reforms before people come down hard on the reforms.

A debt of Paris Club members has to be negotiated at the Paris Club which is an informal club of official creditors whose mission is to identify coordinated and long-

term solutions to a debtor country's payment. Around 10% of Sri Lanka's creditors are members of the Paris Club while Japan is the main bilateral creditor for Sri Lanka.

Alternative approaches for debt restructuring

There are several alternative approaches to debt restructuring which can be mentioned as follows:

- Debt refinancing
- Sale of assets
- Monetization
- Securitization
- Debt-Equity Swaps
- Bail-in
- Recovery of Stolen Assets

The IMF Staff Report on Sri Lanka 2021, released in February 2022 (i.e. before the decision for negotiations with IMF commenced), opines that it is critical to develop a realistic and cohesive approach to restoring macroeconomic stability and debt sustainability without disregarding vulnerable individuals and well-targeted social safety nets. They have also emphasized the significance of restructuring and the need for a stronger monetary policy stance to handle growing inflationary pressures while phasing out the CBSL's direct funding of budget deficits. Further, it advocates a gradual restoration of a market-determined and flexible exchange rate, which is a standard requirement for restructuring sovereign debt. Development of a comprehensive strategy to restore debt sustainability, tightening monetary policy measures to reform governance, and judicious management of the Colombo Port City project, are also highlighted in the report.

After much dilly-dallying, a decision was made in March 2022 to seek assistance of the IMF for a bailout, under which Sri Lanka is seeking USD 4 billion during 2022 to assist in importing essentials and to pay the creditors. It is noted that the CBSL response on 26th March 2022 states that corrective action has already been taken about some critical observations referred to in the IMF Report, but the country's

economic scenario does not support the CBSL statement.

The current deficit situation should be reversed by gradual diminishing of gaps with cautious management of external sector pressures. Maintaining macroeconomic stability with appropriate policies to strengthen non-debt creating foreign exchange inflows would improve the resilience of the sector in the medium term. In the short term, the government must also rationalize expenditure e.g., pruning defence budget, reforming its accounting system for sound decision making and maintaining a competitive real exchange rate.

Successful restructuring of the heavy government debt to a sustainable level of debt will be crucial for re-establishing Sri Lanka's credit reputation and eventual return to a "credible status". Apart from the IMF Director's Report, several professional institutions, chambers, and politicians have come out with various proposals, including the establishment of a currency board for stripping the government of its discretionary power to run large deficits. The Government should seek to improve its institutional quality and apparatus in order to mitigate the negative impact of public debt on economic growth and ensure economic sustainability.

The prevailing crisis will prompt an immediate response by the President and the new government to reverse the adverse economic effects of handling Sri Lanka's grave fiscal situation that requires short, medium and long term strategy formulation with an efficient execution mechanism. The road to recovery looks steep with much sacrifice and effort needed from all concerned.

Conclusion

Sri Lanka is faced with a catastrophic financial crisis amidst diminished liquidity and probable insolvency. The island nation is a highly dependent economy which has become extremely vulnerable to external and financial shocks. It needs foreign currency to pay for imports and to meet financial obligations that

have risen to unsustainable levels. However, Sri Lanka's future continues to remain fragile as the country's current export potential is also extremely weak with low international reserves and persistently large financing needs in the coming years against the country's mounting challenges.

The IMF report 2021 states that "Sri Lanka's economic future looks grim with public debt having risen to unsustainable levels, low international reserves, and persistently large financing needs in the coming years".

Navigating the crisis is arduous. The path to recovery involves crossing many milestones and bridges. Sri Lanka should strive to achieve a strong and inclusive economy with concentrated efforts, and transform adversity into opportunity, emerging stronger and eventually prosperity.

"Our greatest glory is not in never falling, but in rising every time we fall."— Confucius, 551-479 BC, Chinese philosopher.

References

- Al Jazeera. (2022). How Sri Lanka spiralled into crisis and what happens next. <https://www.aljazeera.com/news/2022/5/11/how-sri-lanka-spiralled-into-crisis-and-what-happens-next>
- Auditor General's Department of Sri Lanka. (2018). Public Debt Management in Sri Lanka. http://www.auditorgeneral.gov.lk/web/images/special_report/Public-Debt-Management-finalEnglish.pdf
- BBC News. (2022). Sri Lanka: Why is the country in an economic crisis? <https://www.bbc.com/news/world-61028138>
- Central Bank of Sri Lanka. Annual Report 2021 <https://www.cbsl.gov.lk/en/publications/economic-and-financial-reports/annual-reports/annual-report-2021>.
- Central Bank of Sri Lanka. (2022). Monetary Policy Review- No. 4 of 2022. <https://www.cbsl.gov.lk/en/news/monetary-policy-review-no-4-of-2022>.
- Central Bank of Sri Lanka. (2022). NCPI based headline inflation accelerated further on-year-on-year basis in April 2022. <https://www.cbsl.gov.lk/en/news/inflation-in-april-2022-ncpi>.
- CNN. (2022). Sri Lanka is facing an economic and political crisis. <https://edition.cnn.com/2022/04/05/asia/sri-lanka-economic-crisis-explainer-intl-hnk/index.html>
- International Monetary Fund. (2022). IMF Executive Board Concludes 2021 Article IV Consultation with Sri Lanka.
- The Times of India. (2022). How Sri Lanka fell into its worst economic crisis & what's next. <https://timesofindia.indiatimes.com/business/international-business/explained-how-sri-lanka-fell-into-its-worst-economic-crisis-whats-next>
- VOA News. (2022). Sri Lanka's Poor Hardest Hit by Economic Crisis. <https://www.voanews.com/a/sri-lanka-poor-hardest-hit-by-economic-crisis/6598912.html>
- World Bank. External debt stocks, total (DOD, current US\$)- Sri Lanka. International debt statistics. <https://data.worldbank.org/indicator/DT.DOD.DE.CT.CD?locations=LK>.
- World Bank. GDP growth (annual %)- Sri Lanka. The World Bank Data. <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=LK>.
- World Bank. Official exchange rate (LCU per US\$, period average)- Sri Lanka. International Monetary Fund, International Financial Statistics. <https://data.worldbank.org/indicator/PA.NUS.FCRF?locations=LK>.
- World Bank. (2022). Sri Lanka Faces Unsustainable Debt and Balance of Payment. <https://www.worldbank.org/en/news/press-release/2022/04/13/sri-lanka-faces-unsustainable-debt-and-balance-of-payment-challenges>
- World Bank. Total debt servicing (%of GNI)- Sri Lanka. International debt statistics. <https://data.worldbank.org/indicator/DT.TDS.DECT.GN.ZS?locations=LK>.
- World Bank. Total reserves (includes gold, current US\$)- Sri Lanka. International Monetary Fund, International Financial Statistics and data files. <https://data.worldbank.org/indicator/FI.RES.TOTL.CD?locations=LK>.

Assuring Food Security in Preventing Malnutrition in Sri Lanka

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Introduction

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit 1996).

Food security is a multidimensional concept that includes food availability, food access, utilization and stability (Figure 1). Availability of food includes the provision of food in adequate quantity and appropriate quality through either domestic production or imports, which includes receiving food aid. Access to adequate resources to acquire a nutritious balanced diet is a necessity to fulfil access to food.

In addition, there are several non-food inputs in food security such as clean water, sanitization and healthcare that contribute towards securing nutritional well-being. To be food-secure an individual, a household, and the population should have access to food at all times. Hence, the notion of stability addresses both the availability and access dimensions of food security.

Nearly 193 million population inhabiting 53 countries are in acute food shortage and need of urgent assistance. Thus, the level of hunger was alarmingly high in 2021. Global food insecurity has further deteriorated in 2022 with the repercussions of the outbreak of the Ukraine war on food, energy and fertilizer prices (Food Security Information Network 2022).

The COVID-19 pandemic and the supply chain disruption by the Ukraine War have amplified the global economic fallout, thereby recording the highest-ever food prices worldwide. The impact on food prices is noted to be more apparent in low and middle-income countries, leading them into extreme poverty, hunger and malnutrition (World Bank 2022).

Since the early decades of the 20th century, food security has been a central concern in Sri Lanka due to the prevailing food deficit export-import economy since the 19th century. Being an island nation dependent on imported food supplies, it is highly vulnerable to being undermined by international developments. According to historical evidence, shortages of food during the Second World War and the rationing scheme adopted to ensure minimum food security demonstrated the country's vulnerability to food shortages (Sanderathne & de Alwis, 2014).

Impact on food security in Sri Lanka

Food availability: Rapidly unfolding economic crisis has imparted a massive blow to food availability in Sri Lanka. Sri Lanka's main foreign exchange earning channels including the remittances from migrant workers, apparel exports, primary agricultural exports and tourism, were acutely impacted by the COVID-19 pandemic. This decline in revenues and the unwise decision to defend the Sri Lankan Rupee and the simultaneous uncontrolled printing of money to settle domestic debts, led the island nation into massive inflation (CARE 2022). This directly impacted food imports and subsequently the Government had to curtail food imports which caused a massive blow to the food availability in the country.

The Government of Sri Lanka imposed an abrupt ban on imported chemical fertilizers in April 2021, which also was triggered by the depletion of foreign exchange reserves. This ad hoc policy on

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agriculture diminished the harvests, depleting domestic food production. The cumulative effect of these two factors impaired the food available to the population (CARE 2022).

Food Accessibility: As per the World Bank estimate, nearly 500,000 Sri Lankans have fallen below the poverty line since the inception of the pandemic. Inflation has been driven by monthly increases in prices in both Food and Non-food categories of items. In the Food category, prominent increases were observed in the prices of rice, fresh fruit, milk powder and bread. The latest report of the Department of Census and Statistics of Sri Lanka reflects that nearly 1 in 6 people in the country experience poverty. The official poverty line as reported in July 2022 was Rs.13, 138.

Along with the pandemic, as many industries were faltering, a significant amount of the workforce lost their jobs. Prolonged power cuts, unavailability of fuel for vehicles and machines and lack of agricultural inputs, primarily chemical fertilizer, led to the loss of income for many workers. The reduction of food availability increased prices of the food, mainly impacting protein-rich food products. Thus, soaring prices of food and inadequacy of income are having a negative impact on the food accessibility of Sri Lankans.

Utilization of food: Sri Lanka is blessed with abundant seasonal fruits and vegetables that can be preserved and stored for future use with appropriate science and technology. Being an island nation, the supply of proteins via sea fish is not a tough task. However, a lack of knowledge on the preservation of food has caused a significant waste of excess food products.

With the current economic crisis, public groups are becoming actively involved in assuring food security in communities by strengthening community teams to initiate community kitchens and community food cabinets.

Child malnutrition due to food insecurity

Child growth is recognized as an indicator of the nutritional status of a population. The percentage of children with a low height for age (stunting) reflects the under-nutritional situation of a population that may result from long-term food deprivation. The percentage of children with low weight for age (underweight) is an indicator of acute malnutrition status in a population.

AVAILABILITY	ACCESS
Sufficient quantity of appropriate and quality food is available from domestic production, commercial imports, food assistance or food reserves on constant basis.	Adequate income or other resources to access food through domestic production/ local market or as exchange or as food aids.
STABILITY	UTILIZATION
Availability of adequate food all the times, thus access and utilization of appropriate food is not curtailed even at emergencies or crisis situations.	People utilise food properly through food storing and processing practices while having sufficient knowledge on nutritional health, sanitation etc.

Figure 1: Four dimensions of food security.
(Gunaratne et al., 2021)

Hence, protein-calorie malnutrition will first be apparent in the weight of the growing child and wasting of the child is the first indicator of malnutrition. Even before the COVID-19 pandemic, about 17% of Sri Lankan children under 5 years were stunted and 15% of children were wasted. This situation will further worsen with the current crisis if interventions are not instituted appropriately (CARE 2022).

Although these anthropometric measurements do not change immediately, all possible measures need to be taken to face the risk of malnutrition. According to international organizations, if malnutrition worsens, around 53,000 children are predicted to be admitted to hospitals during the upcoming months.

Ensuring food security

A person becomes food insecure when they lack regular access to safe and nutritious food for normal growth and development and healthy life. Assessing the extent of food insecurity is the fundamental step in the process of ensuring food security. Globally, it is assessed by the grading of the ability to obtain food.

Severe food insecurity is the worst and extreme of food insecurity which signifies practically running out of food and experiencing hunger. Even in moderate food insecurity, people are deprived of access to food and they have to purchase food at the expense of other basic needs. In this scenario,

they mostly consume low-cost and easily accessible food without considering the nutritional aspect, leading to the extreme ends of the malnutrition spectrum. Children who experience food insecurity may also be prone to obesity, overweight and chronic diseases like diabetes (The state of food security and nutrition in the world 2022). All Sri Lankan families should be screened and assessed to determine their food security level and the households that are identified as experiencing severe and moderate food insecurity need to be attended to immediately in order to prevent malnutrition. The grants and funding should be first directed to attend to the acute crisis.

In addressing food security in the long-term to ensure food sovereignty, strengthening food cultivation, fisheries, poultry and dairy industries, food transportation, storage and preservation of food, are of utmost importance. Further, education on nutrition and eliminating the myths and misbeliefs regarding nutrition is fundamental. Strengthening and empowering the communities to assuring food security at the grass root level is the key to a successful process of battling malnutrition.

In achieving the objectives of food security Sri Lanka is blessed with an effective system and infrastructure (Figure 2), which is capable of combating all weaknesses and threats.

STRENGTHS • Well-established public health system. • Well-established governing system. • High female literacy rate. • Empowered communities. • Conducive environment and climate for cultivation. • Availability of science and technology. • Skilled manpower.	WEAKNESSES • Depleted foreign exchange reserves. • Political instability. • Unemployment and reduced purchasing power.
OPPORTUNITIES • International funding and grants.	THREATS • Global economic crisis • Geo-political developments

Figure 2: SWOT Analysis in achieving food security in Sri Lanka

Conclusion

Food security exists when all people, at all times, have physical and economical access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Enhancing food availability, accessibility, utilisation and establishing stability in all forms, are the key essentials in assuring food security. Although malnutrition is widely discussed, it is a long-term sequel to food insecurity. While assessing children's growth is an indicator of adequate food security of a population, assessing the extent of food insecurity prevailing in the country and planning to combat food insecurity is the mainstay in preventing malnutrition. Addressing severe and moderate food insecurity by directing funds and grants is an immediate requirement. Focusing on strengthening food production, industries, transportation and preservation is the mainstay in stabilizing food security. Identifying the strengths, weaknesses, opportunities and strengths in the systems is vital in planning strategies to ensure food security in Sri Lanka.

References

- CARE, (2022), Food security and nutrition crisis in Sri Lanka, Reliefweb, viewed September 2022, <https://reliefweb.int/report/sri-lanka/food-security-and-nutrition-crisis-sri-lanka>
- Cohen, M.J. and Garrett, J.L., (2010). The food price crisis and urban food (in) security. *Environment and Urbanization*, 22(2), pp.467-482, <https://journals.sagepub.com/doi/10.1177/0956247810380375>
- Food and Agriculture Organization (FAO). (2006). Food security. FAO's Agriculture and Development Economics Division. https://www.fao.org/fileadmin/templates/faoit/y/documents/pdf/pdf_Food_Security_Coept_Note.pdf
- Food and Agriculture Organization (FAO), International Fund for Agriculture Development (IFAD), World Food Programme (WFP), World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF), 2022, The state of food security and nutrition in the world 2022, The State of Food Security and Nutrition in the World (SOFI), Rome, viewed 19 October 2022, <https://doi.org/10.4060/cc0639en>
- Food Security Information Network (FSIN), (2022), 2022 Global report on food crises: Joint analysis for better decisions, Food and Agriculture Organization (FAO); World Food Programme (WFP); and International Policy Research Institute (IPRI), Rome; and Washington DC, <https://www.ifpri.org/publication/2022-global-report-food-crises-joint-analysis-better-decisions>

Gunaratne, M.S., Radin Firdaus, R.B. and Rathnasooriya, S.I., (2021). Climate change and food security in Sri Lanka: towards food sovereignty. *Humanities and Social Sciences Communications*, 8(1), pp.1-14, <https://www.nature.com/articles/s41599-021-00917-4.pdf?proof=t>.

Rozaki, Z., (2021). Food security challenges and opportunities in Indonesia post COVID-Advances in Food Security and Sustainability, 6, pp.119-168, <https://www.sciencedirect.com/science/article/pii/S2452263521000021>.

Sanderatne, N. and De Alwis, S.,(2014). National and Household Food Security in Sri Lanka. Colombo: Centre for Poverty Analysis, <https://reliefweb.int/report/sri-lanka/food-security-and-nutrition-crisis-sri-lanka>

World Bank, (2022), 'Food Security Update',15 September, viewed 10 October 2022, <https://thedocs.worldbank.org/en/doc/40ebbf38f5a6b68bfc11e5273e1405d4-0090012022/related/Food-Security-Update-LXIX-September-15-2022.pdf>

World Food Summit. (1996). 'Rome declaration on world food security'. November 1996. Viewed 14 August 2020. <https://www.fao.org/3/w3613e/w3613e00.htm>

Higher Education Opportunities in Sri Lanka

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Strong human capital development is largely responsible for Sri Lanka's continued resilience as a nation in the face of major economic and political setbacks. Sri Lanka's higher education system has made significant contributions to the growth of human capital. Therefore, the country's higher education strategy should focus on enhancing the system's positive aspects and resolving its problems. Sri Lanka has been providing free education since 1945, at primary, secondary, and tertiary levels (Kalugalagedera, and Kaushalya. 2017). The free education system is funded by public funds through taxation. Therefore, provision of free education can be considered a responsibility of the government. In a broad context, free education can be considered an investment where one generation invests in the education of the next generation. It has worked exemplarily well for Sri Lanka and has paid rich dividends in the form of human capital development.

School education is compulsory for children aged 5-16 in Sri Lanka (Vengadeshvaran Sarma, 2018). After completing 9 years of secondary-level education students enter the General Certificate of Education Ordinary Level (GCE O/L) classes, typically two years in duration. At the end of the two years, students face a public examination to become eligible for the GCE A/L (General Certificate of Education Advanced Level) class.

For a student who passes the Ordinary Level examination, there are options to either carry on with secondary school education or get access to vocational training or join the working force. If a student is unable to achieve passes in all mandatory subjects, the student still has the privilege to continue education with Advanced-Level studies in the Arts stream. In addition, they can enter into vocational training centers and technical colleges for certificate-level and diploma courses. In the 2017 GCE O/L examination, 71.03% of school candidates qualified for GCE A/L in 2020. (Department of Examination – Sri Lanka, 2020).

At GCE A/L, students can choose a preferred path in science, maths, commerce, arts or technology streams, based on their performance at GCE O/L. The GCE A/L course consists of two years, at the end of which students are required to face an exam that serves as both a selection test for university admission and an achievement test. In 2020, a total of 251,168 students faced GCE A/L as school candidates, including both first and second attempters. Among them, 165,711 students fulfilled the minimum requirement for entrance to state universities (Department of Examinations - Sri Lanka, 2020).

Sri Lankan higher education institutions are broadly classified into four types:

1. Public higher education institutions with limited access
2. Public higher education institutions with open access
3. Private higher education institutions which are non-profit oriented
4. Private higher education institutions which are profit-oriented

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There is a well-built network of higher education institutes in Sri Lanka, but there's a collective concern regarding resource constraints that limit opportunities for higher education for qualified students. Fourteen (14) public universities belong to limited access public higher education institutions where admission is completely based on the minimum Z-score or a standardized score at the GCE (A/L) examination. These institutes represent a substantial investment of Treasury funds and World Bank loans. Open-access public higher education institutions manage their own admissions but charge a nominal fee from the students. These institutions cater to the demand of the public sector with the support of the University Grants Commission (UGC). It is rare to find a private, non-profit-oriented higher education institution in Sri Lanka, as most are profit-oriented.

The mismatch between the number of students eligible for higher education and the opportunities provided by the state universities creates competition for higher education that may adversely affect the expectations of an average student (Wickramasinghe, 2017). However, a careful review of the opportunities available to students who complete mandatory school education up to Ordinary or Advanced certificate level shows multiple options to continue higher education.

Although 165,711 students achieved the minimum qualification for university entry in 2020, state university facilities were available for only 41,669 students. Additionally, 257,588 students were enrolled to read for external degrees in state universities (University Grants Commission, 2020).

The Open University of Sri Lanka (OUSL) is a state university established to provide lifelong learning opportunities through Open, Distance, and Flexible Education. It provides higher education opportunities for employed persons who wish to enhance their education and those who were compelled to halt their secondary school education (Open University of Sri Lanka, 2014). In 2020, 35,988 students were recruited to OUSL (University Grants Commission, 2020).

In addition to state universities, there are a number of educational institutes that have obtained approval from the UGC, Sri Lanka to

conduct courses at the tertiary education level. These institutions are funded by either the state sector or the private sector. The following institutes are fully or partly funded by the state and managed with varying levels of independence from the respective government and authorities, but admission criteria are determined independently of the University Grants Commission.

- Ministry of Defence: General Sir John Kotelawala Defence University (KDU)
- Ministry of Education: National Institute of Education
- Ministry of Higher Education/University of Colombo: Institute for Agro-Technology and Rural Sciences; Institute of Human Resource Advancement
- Ministry of Skills Development and Youth Affairs: National Institute of Business Management (NIBM); National School of Business Management, Ocean University of Sri Lanka; University of Vocational Technology,
- Ministry of Social Work: National Institute of Social Development (NISD)
- Department of Surveys: Institute of Surveying and Mapping

These institutes cater to a number of students seeking higher education opportunities. For example, the National Institute of Business Management (NIBM) recruited 7,409 students in the year 2020.

Another pathway for Higher Education includes technical and vocational education and training (TVET). TVET in Sri Lanka is governed by the Ministry of Skills Development and Vocational Training and aims to effectiveness and employability of the population, and to provide education and vocational qualifications for lifelong learning. TVET is slowly gaining greater acceptance, but it is still frequently viewed as less desirable than attending university. TVET programs are not well received/perceived which results in low student demand. These perceptions include views that training is associated with manual labor and that TVET programs do not provide any upward social and educational mobility (International Centre for Technical and Vocational Education and Training, 2018). However, the past ten years have seen a rapid increase in enrollments, with TVET institutes providing 103,136 educational opportunities in 2020 (Table 1).

Table 1: Vocational training institutions and number of opportunities

Institutes	Number of Opportunities
Vocational Training Authority (VTA)	24,703
National Apprentice and Industrial Training Authority (NAITA)	14,207
Department of Technical Education and Training (DTET)	25000
National Youth Service Council (NYSC)	13232
Ceylon German Technical Training Institute (CGTTI)	2415
Sri Lanka Institute of Printing (SLIOP)	512
National Institute of Business Management (NIBM)	7482
National Youth Corps (NYC)	11515
NSBM Green University Town	2834
Ocean University	1236
Total opportunities	103,136

Source: (Ministry of Economic policies & Plan Implementation 2021)

The majority of young people seeking higher education seem to be unaware of further options once they complete secondary school education. Students seek higher education opportunities via informal sources of information. When deciding on their course of higher education, most students consult their parents and other family members (Nanayakkara & Wijesuriya 2007). According to a recent study conducted by Bandara & Nuwan, A.N (2021), revealed that general public

awareness on TVET programmes conducted by both private and state sector institutes is above 60%, but they suggest to widened the methods of advertising on TVET programmes through modern communication methods such as social media to increase the awareness on TVET courses which are given more employment prospects on a local and international level such as agriculture oriented courses, animal husbandry, automobile industry training, etc.

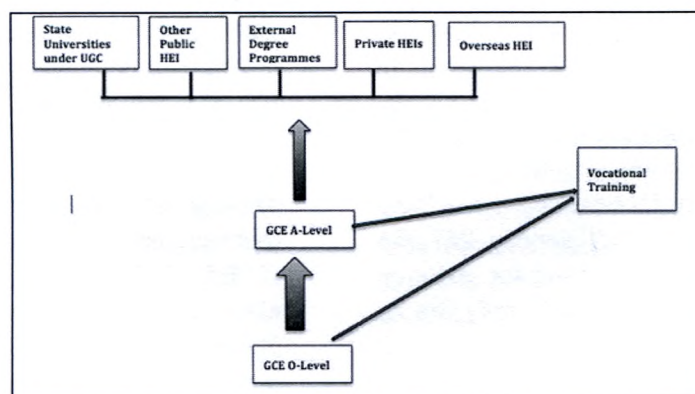


Figure 1: Higher Education Pathways for Sri Lankan Students

It is essential that tertiary education providers focus on marketing their courses while highlighting the direction on employment. Maintaining a career guidance network incorporating schools and all tertiary education providers is a highly recommended strategy to increase awareness of higher education pathways. The state and private sectors should cooperate to develop and sustain this network. (Nanayakkara and Wijesuriya 2007).

Conclusion

Opportunities for higher education should be based on human resources needs of the country and an evidence-based human resources management policy. Continuous improvement of higher education programmes through quality assurance, accreditation and based on current trends of educational science such as outcome based, competency based education, student-centred learning, integration, use of technology such as online learning and virtual reality.

References

- Bandara, H.G.K.N. and Nuwan, A.N., (2021). Study awareness of General Public towards National Vocational Qualification and TVET in Sri Lanka. 02'd National Symposium on Sustainable Plantation Management 2020.
- Department of Census and Statistics Ministry of Economic policies & Plan Implementation Statistical Pocket Book (2021). Colombo: Department of Census and Statistics Ministry of Economic policies & Plan Implementation, pp.73-79.
- Department of Examinations - Sri Lanka Performance of Candidates. (2020) [online] Colombo: Research & Development (School Examinations) Branch National Evaluation & Testing Service, pp.2-4. Available at: <<https://www.doenets.lk/statistics>> [Accessed 11 September 2022].
- Kalugalagedera, T. and Kaushalya, T., (2017). History of university education in Sri Lanka: A literature review. Centre for Poverty Analysis, pp.82-87
- Mohe.gov.lk. (2022). Ministry of Higher Education and Highways. [online] Available at: <https://www.mohe.gov.lk/index.php?lang=en> [Accessed 11 September 2022].
- Nanayakkara, G.L.S. and Wijesuriya, G., (2007). Options for Expanding Access to Higher Education for GCE (A/L) Completers. Colombo. National Education Commission Sri Lanka.
- Sarma, V., Licht, S. and Kalugalagedera, T., (2018). Educational Inequalities in Sri Lanka: National Data and Local Perspectives on Access, Quality and Learning Outcomes, pp.5-6.
- The Open University of Sri Lanka (2014). Strategic Management Plan 2015 - 2020. Nawala-Nugegoda: The Open University of Sri Lanka, pp.1-5.
- TVET Country Profiles Sri Lanka. [online] Bonn: UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training, pp.5-8. Available at: <<https://unevoc.unesco.org/home/TVET+Country+Profiles>> [Accessed 11 September 2022].
- Ugc.ac.lk. (2022). Sri Lanka University Statistics 2020. [online] Available at: https://www.ugc.ac.lk/index.php?option=com_content&view=article&id=2301%3Asri-lanka-university-statistics-2020&catid=55%3Areports&Itemid=42&lang=en [Accessed 11 September 2022].

Reducing Crude Fiber Levels in Made Tea to Minimize the Failing Rates of Pre-Auction Tea Samples – A Qualitative Analysis From Sri Lanka

Samarakoon S.P.¹, Rajapakshe, N.², Wickramaratna, P.³

Abstract

Sri Lankan tea known for generations as “Ceylon Tea” is reputed for its’ taste and aroma the world over. On the global export front, the country holds the position of the third-largest exporter of tea. The tea processing factories for exports continually improve and upgrade to meet required technical and hygienic standards to conform to the international food safety requirements. However, it was revealed that more than 2000 pre-auction tea samples get rejected per annum. Therefore, the objective of the current study is to disclose the main factors which lead to failing pre-auction samples (FPAS) at the qualitative analysis by an expert panel of tea tasters within the last five years. Total population sampling was used as the sampling technique (n=1500). Data were analyzed with the use of SPSS. The dependent variable of the research is failing pre-auction samples (FPAS) while six independent variables have been recognized: water extract (WE), alkalinity (A), acid insoluble ash (AIA), crude fibre (CF), the microbiological requirement (MR) and not true to grade (NTG). Correlation tests were performed in order to test the hypothesis. The regression results of measuring relationships between AIA and FPAS, CF and FPAS, MR and FPAS, and NTG and FPAS signify valid regression models ($p < 0.005$) which explains 47.9 %, 59.4%, 51.5%, and 55.7% variance of the outcome variables respectively. It was revealed that AIA, CF, MR, and NTG are significant predictors ($p < 0.005$) of FPAS since beta coefficient values are greater than 0.7. The investigation intends to give helpful bits of alertness to all the stakeholders of the tea industry so that to put efforts into the reduction of failing pre-auction samples. As per the results, the highest cause of failing pre-auction samples is high levels of crude fiber which cannot be completely controlled during tea processing. Therefore, taking sufficient preventive measures at the factory level to reduce the amount of crude fiber in processed tea is vital. It was revealed that there are significant relationships between acid insoluble ash and failing pre-auction samples, crude fiber and failing pre-auction samples, microbiological requirement and failing pre-auction samples, and not true to grade and failing pre-auction samples.

Introduction

Sri Lankan tea, known for generations as “Ceylon Tea”, is reputed for its’ taste and aroma the world over.

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Sri Lanka is the largest producer of orthodox tea in the world. Currently, Sri Lanka ranks as the fourth-largest tea producer in the world. On the global export front, the country holds the position of third-largest exporter of tea. According to the statistics, the Sri Lankan tea industry has recovered during the COVID pandemic, with significant growth in production and exports in the first quarter of 2021 compared to 2019 and 2020 (Forbes & Walker Tea Brokers, 2022). In the first quarter from January to March 21, tea export earnings were Rs. 65 billion in 2020



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(Forbes & Walker Tea Brokers, 2022). It also increased by 49 billion rupees, from 49 billion rupees in the first quarter. Cumulative production in the first quarter has been 74 million kilograms; an increase of 20 million. The price of FOB tea in the first quarter has been Rs. 939/= per kg, an increase of 13%. The price of FOB has been Rs. 867/kg in 2020 and Rs. 823/kg in 2019 (Forbes & Walker Tea Brokers, 2022). Sri Lankan tea depends mostly on the Commonwealth of Independent States, Russian Federation and Middle Eastern countries' markets. About 70 percent of the bulk tea is exported to these markets (Ranaweera, 2007; Hilal, 2020).

As a mandatory requirement, tea samples are tested weekly by the Tea Tasting Division of the Sri Lanka Tea Board prior to each public tea auction. This ensures the quality and safety of the tea, which is tested by a well-trained tea testing panel. These tests enable all stakeholders in the tea industry to enjoy a safe and secure cup of "Ceylon Tea" tea in accordance with the standards. Skilled tea tasters determine the quality of teas by testing the given pre-auction tea samples.

The export-oriented tea processing factories continually improve and upgrade to meet the required technical and hygienic standards to conform to the international food safety requirements. However, it was revealed that more than 2000 pre-auction tea samples are rejected per annum. I.e., 1,200,350 kg of tea are held without being auctioned. Of these failures, only upgradable teas are sent to factories for reprocessing, but the factory owners incur an additional cost to make the tea suitable. The failure of many samples is an economic loss.

Therefore, the objective of the current study is to disclose the main factors that led to failing pre-auction samples (FPAS) in the qualitative analysis by an expert panel of tea tasters within the last five years. Specifications for approving pre-auction samples are based on the ISO 3720 standard (International Organization for Standardization, 2011) and Sri Lanka Tea Board directives for minimum quality standards (Sri Lanka Tea Board, 2011).

Water extract $\geq 32\%$, alkalinity 1.0% - max. 3.0% , acid insoluble ash $\leq 1.0\%$, and crude fiber $\leq 16.5\%$ are considered in checking compliance with the ISO 3720 standard. In addition, the microbiological requirement is considered as per the Sri Lanka Tea Board directives, whereas true to grade is another factor considered in the pre-auction sample approval process.

Objectives of the Study

The objective of the study was to disclose the main factors which lead to failing pre-auction samples (FPAS) by the expert panel of tea tasters at the Tea Auction, Sri Lanka.

Methodology

The attempt of the current study is hypothesis testing, which is the track of building up a comprehensive theoretical framework for the study. Hypotheses were inferred and subjected to tests to check their acceptance or rejection. In view of that, it is intended to identify the relationships between each specification tested and failing pre-auction samples (FPAS). This investigation focused on the correlation analysis as it makes sense of whether there are relationships between each specification tested and failing pre-auction samples (FPAS). As the research is based on secondary data, in a non-contrived setting, quantitative in nature, and correlational, there was minimum interference. The study particularly analyzed the factors which affect failing pre-auction samples (FPAS). Simple random sampling was used as the sampling technique. The data required for the study was obtained by the Sri Lanka Tea Board. The study area is Sri Lanka. The data were analyzed with the use of SPSS. The dependent variable of the research is failing pre-auction samples (FPAS), while six independent variables have been recognized, namely, water extract (WE), alkalinity (A), acid insoluble ash (AIA), crude fiber (CF), the microbiological requirement (MR), and not true to grade (NTG).

The alternative hypothesis driven were H_1 - there is a relationship between water extract

(WE) and failing pre-auction samples (FPAS), H_2 - there is a relationship between alkalinity (A) and failing pre-auction samples (FPAS), H_3 - there is a relationship between acid insoluble ash (AIA) and failing pre-auction samples (FPAS), H_4 - there is a relationship between crude fiber (CF) and failing pre-auction samples (FPAS), H_5 - there is a relationship between microbiological requirements (MR) and failing pre-auction samples (FPAS), and H_6 - there is a relationship between not true to grade (NTG) and failing pre-auction samples (FPAS)

Results

The P values of the Shapiro-Wilk test are 0.487, 0.114, 0.319, 0.689, 0.444, 0.229, and 0.102 for the seven main constructs, indicating a higher value than 0.05. The calculated Z values of skewness and kurtosis values also confirm that the figures are in the standard range. All the KMO estimations are greater than 0.50. In addition, the BTS is significant at 0.001 (i.e., $p < 0.001$). Henceforth, it is affirmed that the convergent validity is met. To check the reliability, Cronbach's coefficient alpha values were obtained, whereas all the values were greater than 0.7, which suggests that the scale is internally reliable. The mean values obtained were 42.4700 (SD = 0.34563), 3.9565 (SD = 0.23571), 0.1304 (SD = 0.47421), 4.3478 (SD = 0.60963), 26.3043 (SD = 0.77342), 4.6956 (SD = 0.41630), and 4.5652 (SD = 0.45421) for failing pre-auction samples (FPAS), water extract (WE), alkalinity (A), acid insoluble ash (AIA), crude fibre (CF), microbiological requirement (MR) and not true to grade (NTG) respectively. Correlation tests were performed in order to test the above-mentioned hypothesis, and it was revealed that there are significant relationships between AIA and FPAS, CF and FPAS, MR and FPAS, and NTG and FPAS.

The correlation coefficient values were 0.722, 0.801, 0.752, and 0.708, respectively, showing which are significant at the 0.01 level. The regression results of measuring relationships between AIA and FPAS, CF and FPAS, MR and FPAS, and NTG and

FPAS signify valid regression models ($p < 0.005$) that explain 47.9%, 59.4%, 51.5%, and 55.7% of the variance of the outcome variables, respectively. It was revealed that AIA, CF, MR, and NTG are significant predictors ($p < 0.005$) of FPAS, and since beta coefficient values are greater than 0.7, it can be concluded that H_3 , H_4 , H_5 , and H_6 are supported. I.e., there are significant relationships between AIA and FPAS, CF and FPAS, MR and FPAS, and NTG and FPAS.

Discussion

Sri Lanka has established a reputation as a leading producer of tea in the world. There has been increasing disagreement between performance and reputation for the last few years. Therefore, the export-oriented industry is under increasing threats due to a range of domestic issues and international competition. These domestic issues have seriously affected the Sri Lankan tea industry's productivity and efficiency (Wickramasinghe & Cameron, 2003; Hilal, 2020). The study concentrates on contributing to the knowledge pool of productivity and efficiency of tea, by bringing up the facts which create tea that accords with the applicable standards. Convincingly, the investigation intends to give helpful bits of alertness to all the stakeholders in the tea industry so that they can put efforts into the reduction of failing pre-auction samples. It is important to meet all the stakeholders in the tea industry to improve the tea sector. As per the results, the highest cause of failing pre-auction samples is high levels of crude fiber, whereas the maximum possible crude fiber content of black tea is 16.5% as per the ISO 3720 standard (International Organization for Standardization, 2011). Although this cannot be completely controlled during tea processing taking sufficient preventive measures at the field level to reduce the amount of crude fiber in processed tea is vital. It is possible to reduce the number of rejected pre-auction tea samples and contribute to increasing the country's GDP if awareness is created among the stakeholders of the tea industry. Increasing the awareness programs among all the

stakeholders in the tea industry is a necessity to uplift the approving tea quantity for consumption.

Conclusions

There are significant relationships between acid insoluble ash and failing pre-auction samples, crude fiber and failing pre-auction samples, microbiological requirements and failing pre-auction samples, and not true to grade and failing pre-auction samples. The greatest cause of failing pre-auction samples is high levels of crude fiber.

References

- Forbes and Walker Tea Brokers. (2022, January) Tea industry's performance in 2021, prospects for 2022. *Daily FT*
- Hilal, M. I. M. (2020) Sri Lanka's Tea Economy: Issues and Strategies, *Journal of Politics and Law*, 13(1).
- International Organization for Standardization (2011) The Minimum Quality Standards—for "Sri Lankan Origin Teas" and "Other Origin Teas" (ISO Standard No. 3720:2011).
- Ranaweera, S. (2007) Future of Sri Lankan Tea is in Value Addition, *Sunday Times*, 23 December.
- Sri Lanka Tea Board. (2011) Sri Lanka Tea Board Minimum Quality Standards for "Sri Lankan Origin Teas"
- Wickramasinghe, D. W. A., & Cameron, D. (2004). A Cultural Political Economy of Business Strategy in a Developing Country Context – The Case of the Sri Lankan Tea Industry. *Journal of Radical Organizational Theory: Abstracts of the 4th International Critical Management Studies Conference*, University of Cambridge, 323.

Technological Solutions through Time and Motion Study to Enhance Sortie Generation Rate of Aircraft

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Abstract

Maintenance of a high 'Sortie Generation Rate (SGR)' is of utmost importance to sustain the limited number of aircraft available in the roles of Air Power. In the challenges faced during countering asymmetric threats, there was considerable focus on providing technological solutions for problems faced by the armed forces through R&D. However, the possibility of enhancing SGR through technological solutions was not clearly identified during the time. A question arises on what these technological solutions could be?, the solutions can be in the form of efficient technologies such as integration of CMC (Central Maintenance Computers), use of high tech tools and equipment for maintenance, efficient technology for fuselage inspection, efficient Ground Support Equipment (GSE) etc. With the development of the mechanical engineering and IT sectors in Sri Lanka, obtaining feasible technological solutions for enhancement of SGR is not impossible. In addition, there are no known articles that focus on the use of technological solutions, which could enhance the SGR of aircraft to support protracted wars and 'Humanitarian Assistance and Disaster Relief (HADR)' operations in future. As the air forces in future need to provide precise, flexible, rapid and lethal response for military and civil contingencies, the fact that practical technological solutions can be implemented through time and motion study of the existing practices gives significance to this study. The methodology used for the research is qualitative and the research covers a questionnaire in order to clearly identify what processes during sortie generation needs solutions and a literature review on how 'Time and Motion Study' can be used to find technological solutions to enhance SGR. In addition, a SGR model was developed to clearly identify a process that needs improvement through the time and motion study and the qualitative data obtained through the study of various books, journals and internet websites of which a bibliography of the sources are provided. Therefore, the outcome of the study has enabled the development of a SGR model and technological solutions to enhance the SGR. Further development of the SGR model and adjusting the model to corresponding situations can help Air Forces around the world to seek technological solutions to enhance SGR.

Keywords: Air Power, SGR, HADR, Time, Motion.

Introduction

Air power has the ability to fulfil many attributes in 'Principles of War' to a far greater extent than a Land or Sea based force. In the

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ten principles of war the Sustainability principle largely depends on the ability to provide quick and efficient maintenance services to the war making machines. Therefore, to sustain aircraft in its role and do it with least delay is of utmost importance in which 'Sortie Generation Rate' (SGR) is been considered as a key factor in maintaining Air Power.

The effective use of Air Power depends on an Air Force's ability to make the most out of the 'Characteristics of Air Power' whilst overcoming or reducing the 'Limitations of Air Power'.



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Sortie Generation Rate (SGR) means sustainable number of aircraft launches per period. It is an important factor to determine the frequency with which the aircraft can be employed in combat as well as HADR. Sortie generation involves man power and technology in the form of performing pre planned tasks in the form of work. Time is a critical factor that decides the efficiency of the work carried out. Work performed by men or machines involve 'time and motion' which can be optimized according to the requirement. Optimization can be in the form of a procedural change which may decrease unnecessary 'time and motion' or replacement of a man with a machine to achieve the same.

'Time and motion' study is used to analyze the work carried out during the sortie generation can be defined as a combination of business efficiency technique combining the Time Study work of Frederick Winslow Taylor with the Motion Study work of Frank and Lillian Gilbreth. This integrated approach to work system improvement is known as Methods Engineering and it is applied today in to industrial as well as service organizations, including banks, schools and hospitals.

As Methods Engineering is a subspecialty of Industrial Engineering and Manufacturing Engineering, one must take considerable effort to apply its principles to the sortie generation process. However, as the sortie generation process is also related to methods of human integration in an industrial production process which finally prepares a ready to fly aircraft, the applicability of methods engineering is justified. Alternatively, it can be described as the design of the productive process in which a person is involved.

With the view of understanding the various problems faced by Flying Formations of air forces with respect to increase of SGR, a questionnaire was distributed amongst the employees of different Flying Formations. A summary of the main problems faced are as follows.

A. *Lack of sufficient Ground Support Equipment (GSE).*

B. *Available GSE out of date and obsolete.*

C. *Lack of competency and training in manpower to speed up SGR.*

D. *Use of Quick Release (QR) and Quick Attach (QA) technology minimum in aircrafts as well as armaments.*

E. *Use of speedy fault detection systems are minimum.*

F. *Logistics support slow in providing running spares.*

Out of the above problems identified, solutions will be sought for these problems as applicable to the topic of study. Problems related to Logistics Support will not be covered under this study.

Therefore, this research paper will focus on the study of finding technological solutions with prominence to time and motion study, in the process of preparation of aircraft for flight.

Statement of the problem

The ability to use air power efficiently and effectively depends on an Air Force's ability to make the most out of the 'Characteristics of Air Power' and overcome 'Limitations of Air Power' at the same time.

The fighter squadrons and helicopter squadrons involved in HADR face difficulty in enhancing SGR due to existing problems in the process of preparation of aircraft for flight that causes delay and inefficiency which hinders the primary requirement of sustaining airworthiness state.

Therefore, there is a requirement of establishing whether technology can provide solutions for problems faced during preparation of fighter aircrafts and helicopters for flight and thereby enhance the SGR of a small air force.

Hypothesis

The research is Qualitative in nature and therefore does not include a hypothesis.

Methodology

The methodology used for the research is qualitative and the research includes a questionnaire in order to clearly identify what processes during sortie generation needs solutions and a literature review on how 'Time and Motion Study' can be used to find technological solutions to enhance SGR. In addition, a SGR model was developed to clearly identify a process that needs improvement through the time and motion study and the qualitative data obtained through the study of various books, journals and internet websites of which a bibliography of the sources are provided.

The study has enabled systematic analysis and establishment of following facts with qualitative data.

- A. *High SGR Means More Air Power.*
- B. *Identifying Problems Faced During Flight Preparation.*
- C. *Use of New Technologies for Flight Preparation.*

Collection of data

The information and data for this qualitative research paper has been gathered through the study of various books, journals and internet websites. A bibliography of the sources will be available separately at the end of the research paper. The following important details have been summarized from the literature review and are used as data of the research paper.

Analysis and application of data

This chapter will develop a suitable model for the sortie generation process of a fighter squadron/ helicopter squadron by analysing the qualitative data and use that model to study the sortie generation process.

A. *Developing a Sortie Generation Process Model*

As the first requirement in developing a Sortie Generation Process model, let us consider the basic sortie generation model developed as

the Maximum Daylight Flying Model (Figure 1). As shown in Figure 1, the process starts at pre-flight and once end of pre-flight (Operation node B) is reached, the process will proceed towards node C if there is no defect in the aircraft whilst the process will proceed towards node E if repair is required. At the same time once the aircraft lands after flight, if there is no defect, the process proceeds to node F starting 'Wait'. However, if there's a repair, the process proceeds towards node E. This explains how the process occurs. However, the problem in this model is that several key additional processes that need to be considered have been omitted.

Therefore, after development Figure 2 gives an overall flying model that covers the main aspects involved in the sortie generation process. The salient points in this model can be summarized as follows for easy understanding.

- 1) *Pre-flight process starting at node A is the beginning of the sortie generation process.*
- 2) *Once pre-flight inspection phase is completed and there are no defects observed, the process will continue towards node C to enable flight and the sortie is completed once the aircraft lands at node D. However, if a defect is observed during pre-flight inspection, the process will proceed for repair. A repair on the aircraft requires a mandatory pre-flight inspection and therefore the process will reach back to node A.*
- 3) *Once a sortie is completed at node D, if another sortie is required, a TRI needs to be carried out following after flight GHO that ends at node E. The end of TRI will proceed back to node B which is the end of pre-flight inspection state. If any defect is found during the TRI, the process will proceed for repair and end at node A. Therefore, the process that starts at node A and proceeds through nodes B, C, D, E and back towards node B consists of the sortie generation process of a day as pre-flight inspection is only carried out only at the beginning of the flight day.*

4) AFI comes into play once the days flying is over and there are no more sorties for the day. If a defect is found during the AFI, again the repair phase commence and end at node A. If there is no defect, the wait phase takes place until the pre-flight on the following day.

It is evident that the modified flying model 3 given in Figure 1 is a bit complex. Once you remove the 'In Repair' phase, 'In After Flight Inspection' phase and the 'Wait' phase from the model, you can get the model that depicts the sortie generation process for a days flying assuming that no defects occur. This is the most suitable model to study work and motion and therefore, the finalized 'Sortie Generation Process Model' is depicted in Figure 2. It is to be noted that the In-flight element is not considered for the study.

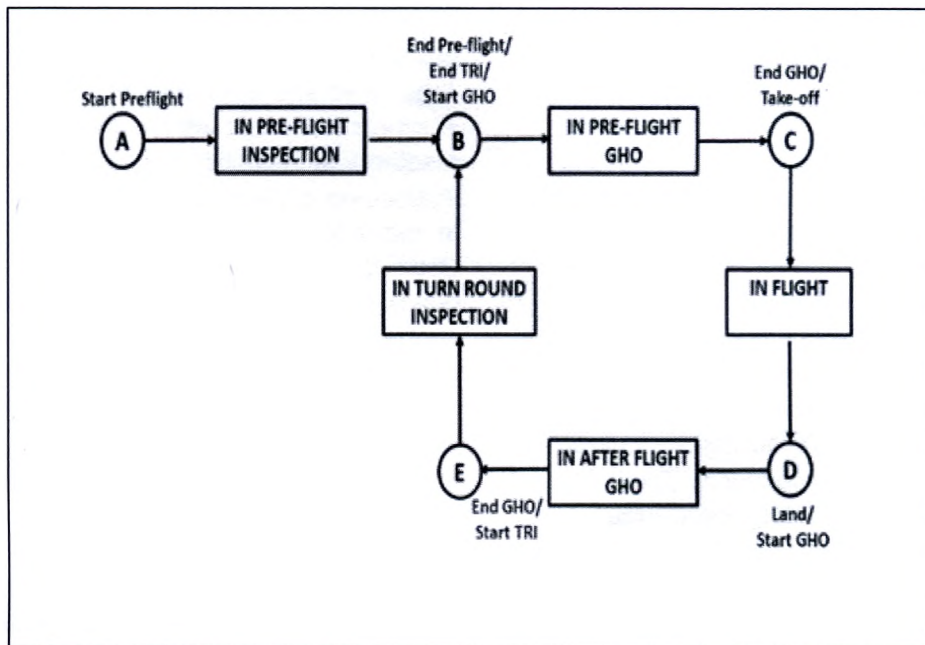


Figure 1: Flying Model, Node B and Node D

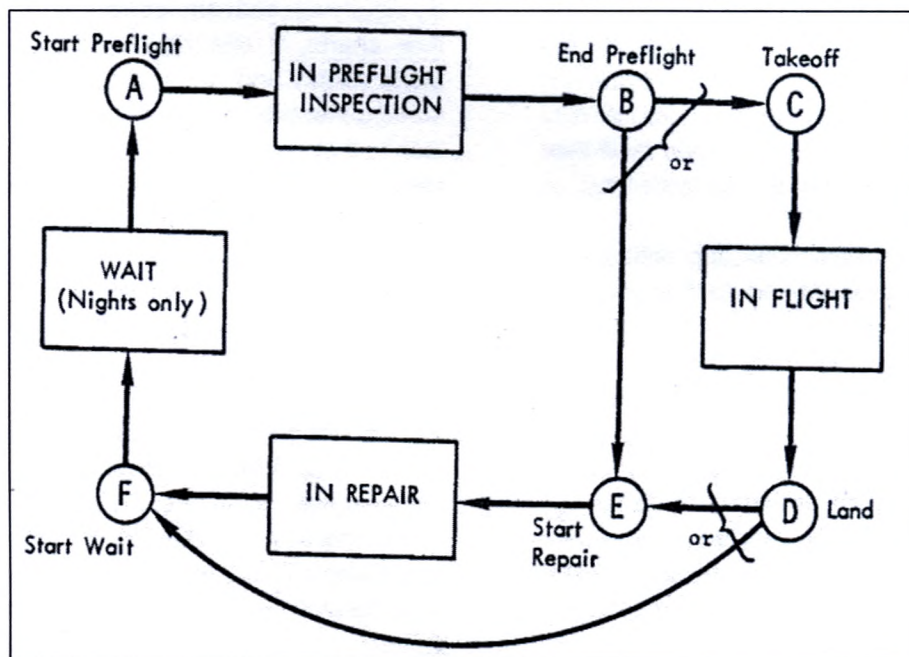


Figure 2: Developed Sortie Generation Process Model

B. Developing Process Charts and Flow Charts for Sortie Generation Process

As per the finalized 'Sortie Generation Process Model' depicted in Figure 2, four main tasks are essential to maintain sortie generation as follows. ('In Flight' phase not considered)

- 1) *Pre Flight Inspection (PFI).*
- 2) *Pre Flight Ground Handling Operations (PF GHO).*
- 3) *After Flight Ground Handling Operations (AF GHO).*
- 4) *Turn Round Inspection (TRI).*

Before going into detail on process charts and flow charts, we need to understand the work force involved in performing the above tasks. In general, in SLAF fighter squadron/ helicopter squadron, the Line Team consist of the following personnel with a summary of their tasks.

- 1) *Airframe Trade – Technician specialized in the Airframe and related components.*
- 2) *Aero Engine Trade – Technician specialized in engines and related components.*
- 3) *Aero Electrical and Instrument Trade – Technician specialized in Electrical items and instrumentation.*
- 4) *Armament Trade - Technician specialized in Armament. (Only if Armament available)*
- 5) *Safety Equipment Trade – Technician specialized in safety equipment.*
- 6) *Air Radio Trade - Technician specialized in radio equipment and avionics.*
- 7) *Supervisor/ Crew Chief – An SNCO specialized in either trade with sufficient experience on the aircraft and its systems.*

Apart from the above four specialties, the technicians are also trained to handle GSE required for the sortie generation process. Therefore, a crew consisting of above seven technicians and few additional technicians of either trade for support, consist in the Line Team. Additional technicians maybe of Airframe, Engine, E&I or Safety trade as per the workload in the particular aircraft type. The typical tasks involved and applicable in the GHO during the sortie generation process are as follows.

- 1) *Power supply to aircraft.*
- 2) *Replenishment of fuel, oil and air.*
- 3) *Armament/ Special Equipment loading and transporting.*

In general, special equipment mentioned above covers, Rescue Hoists, Bambi Buckets, Cargo Hook etc.

In order to prepare a process chart for PFI, the maintenance PFI procedure of a fighter aircraft/ helicopter needs to be studied. Therefore, a typical maintenance PFI of a helicopter dedicated for HADR will be considered and the same will be summarized in simple steps that will ensure the operational readiness of the helicopter.

In order to prepare a process chart for AF GHO, the GHO procedure of a helicopter needs to be studied. Therefore, a typical AF GHO of a helicopter will be considered and the same will be summarized into simple steps.

In order to prepare a process chart for TRI, the maintenance TRI procedure of a helicopter needs to be studied. Therefore, a typical maintenance TRI of a helicopter will be considered and the same will be summarized into simple steps that will ensure the operational readiness of the helicopter.

By Studying and analyzing the process and flow charts, it can be identified that, many tasks (work) and movements (motion) of the sortie generation process can be reduced. The tasks that cause process delays can be identified and can be summarized and highlighted.

- 1) *Identified Process Delays during TRI.*
- 2) *Identified process delays during GHO.*

The above processes can be optimized by either using procedural change or new technology. This study focuses on technological solutions for enhancement of sortie generation rate and therefore, the processes that can be technologically developed will be discussed under a separate topic.

In addition, time study also can be implemented on the different tasks carried out by the technicians during the SGR. However, the reviewed "Ergonomic Time and Motion Studies of Aircraft De-icing Work" explained previously reveal that, extensive measurement of time taken for specific tasks need to be obtained or relevant time data on such tasks need to be available for an effective time study. As there is no provision to measure process task times and no available data on time taken for maintenance tasks, the time study part has been excluded from this study and will not be considered during process improvements.

However, a specific motion study on the tasks carried out on a helicopter and the preparation process during TRI can be carried out to further understand possible process improvements. This requires preparation of a Process Chart and a Flow Chart for activities carried on preparation of helicopters during an HADR operation.

C. Identifying Specific Technological Solutions for Selected Process Delays

Let us understand how technology can provide solutions for the sortie generation process. In order to understand this fact, we need to find what technological solutions can improve the efficiency of or replace man power during aircraft maintenance and GHO.

1) New Technology in Aircraft Maintenance

Robotic aircraft inspection: This method is also developed to increase the efficiency and effectiveness in the fuselage inspection process

2) New Technology in GHO and GSE

Another time consuming process in the flight line is GHO. The processes involved in GHO has been explained and these processes can be made efficient and effective by using new technologies in GHO and GSE. The processes involved in GHO by integrating PF GHO and AF GHO are providing power supply to aircraft and replenishment of fuel efficiently.

Findings

The main finding of this study is the fact technological solutions can be used to counter the process delays found through time and motion study and thereby used to enhance the SGR of a small air force.

The qualitative data obtained through the study of various books, journals and internet websites was analysed to find out the technological solutions that can be used to enhance the SGR.

A. Identifying a Unique Sortie Generation Model for SLAF

As per the sortie generation model depicted in Figure 2, four main tasks are essential to maintain sortie generation as follows.

- 1) *Pre Flight Inspection (PFI).*
- 2) *Pre Flight Ground Handling Operations (PF GHO).*
- 3) *After Flight Ground Handling Operations (AF GHO).*
- 4) *Turn Round Inspection (TRI).*

B. Identifying the Process Delays Encountered During Sortie Generation.

By Studying and analyzing the process and flow charts, it was identified that, many tasks (work) and movements (motion) of the sortie generation process can be reduced. The tasks that cause process delays can be identified and were summarized and highlighted in order to carry out time and motion study.

C. Identifying Specific Technological Solutions for Selected Process Delays

The following technological solutions in aircraft maintenance can be used to reduce process delays.

- 1) *Integration of a Central Maintenance Computer (CMC) with the aircraft systems.*
- 2) *Use of Drones for structural inspection.*
- 3) *Robotic aircraft inspection.*

The following technological solutions in GHO and GSE can be used to reduce process delays.

- 1) Military™ Dual Output Converter Station.
- 2) Hand portable Start Pac™.
- 3) JetPower Ground Power.
- 4) GNY 1736 Midi-Fueler

D. *Time study and motion study are two subject areas that can either be studied separately or combined together.*

E. *Potential technological solutions which can minimize process delays during sortie generation are commercially available.*

F. *New technology that are specifically designed for enhancing SGR for military aircraft and helicopters are minimum in the commercial market.*

G. *Commercially available technology that can be used for enhancing SGR can also be indigenously developed through Research and Development.*

H. *No matter how much technology is used, skilled and trained manpower is required to operate and use the implemented technological solutions.*

Recommendations

To use findings of this study to identify and implement technological solutions to reduce process delays and enhance the SGR of aircrafts.

Formalize the developed Sortie Generation Model for the SLAF and use it to carry out time and motion study and thereby identify and find solutions for the process delay.

Prepare procedure manuals so that friendly air forces can use the Sortie Generation Model to study and overcome their SGR problems.

Encourage the R&D element in Air Force to find indigenous solutions for aircraft maintenance, GHO and GSE related process delays and thereby help increase SGR in

support of military aircraft operations as well as HADR.

References

- Aircraft De-icing, March 02, 2018. <https://aircraftdeicinginc.com/contact-us-1/> C110GPS De-icing Sprayer. Accessed 20 March 2019.
- Aslin, M.J., Patton G.J., 1990. <https://patents.google.com/patent/US4943919>> Central maintenance computer system and fault data handling method. U.S Patent 4943919A. Accessed on 12 July 2019.
- Denardo, E.V., 1967. The RAND Corporation Publishers Santa Monica, California, RM-5145-PR.: A simplified Model of Aircraft Sortie Generation Capability.
- MOD UK, 2009. https://www.raf.mod.uk/rafcms/.../9E435312_5056_A318_A88F14CF6F4FC6CE.pdf>AP 3000, British Air and Space Power Doctrine (Fourth Edition), Ministry of Defence, Wiltshire, UK. Accessed 20 Feb 2019.
- MOD UK, 2014. Joint Doctrine Publication 0-01: UK Defence Doctrine (5th Edition), Ministry of Defence, Wiltshire, UK.
- Pigage, L.C., Tucker, J.L., 1954. Illinois: I.L.I.R Pubs: Motion Study. Motion and Time Study, Eds. 11-22.
- Schulte-sasse, U., 2017. <http://www.aviationpros.com/article/12356941/new-strategies-and-solutions-to-help-meet-ground-handling-challenges>> New Strategies and Solutions to Help Meet Ground Handling Challenges in Aviation Pros. Accessed on 12 May 2019.

A Prospective Study to Explore the Impact of the Vaccination Status on Disease Severity and Mortality in COVID-19

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Abstract

Introduction: Vaccination is considered the tipping point that will contribute to curtail the ongoing SARS-CoV-2 outbreak. In this prospective cohort study, we explored the impact of the vaccination status on the disease severity and mortality in COVID-19 infection.

Objective: To assess the impact of vaccination status on disease severity and mortality in COVID-19

Methodology: The study was conducted over a 3-month period in District Base Hospital Theldeniya, which is a level III and the third major COVID-19 treatment center in Sri Lanka. A total of 179 COVID-19 positive patients were purposively selected. Data analysis was done by R and ER studio.

Results: Of all participants, 87 patients had taken only a single dose, 47 were fully vaccinated (2 doses) while 45 were not vaccinated at all (69 Sinopharm, 37 Covishield, 15 sputnik, 12 Moderna, 1 Pfizer). Out of all, 10.06% became critically ill requiring ICU care and 7.26% needed ventilator support. More than half (59.22%, 106 patients) fully recovered, about a quarter (24.58%) recovered, but required further follow up after discharge. Unfortunately, 29 patients (16.2%) died of COVID-19. Most, i.e.; 16 of the total 29 mortalities were from the group vaccinated with Sinopharm.

Discussion: COVID-19 infection has a clinical spectrum of disease from asymptomatic to critically ill, however, the greatest proportion presented with mild infection. Vaccination status i.e.; fully or partially vaccinated or not vaccinated, and the type of the vaccine showed a significant influence on the disease severity and outcome including mortality.

Conclusions and Recommendations: Vaccination effectively lowers the disease severity as well as mortality. However, the vaccine type and the presence of co-morbid conditions can greatly alter the disease outcome. Our findings strengthen the fact that the vaccination is the sustainer in COVID-19 pandemic control, further gives an insight to the future vaccination schedules.

Keywords: COVID-19 Vaccination, Disease severity, mortality

Introduction

The COVID-19 pandemic, caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2), is the defining global health crisis and the biggest challenge the world is struggling today.

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The novel virus spread around the world within months. On 30th January 2020, The World Health Organization (WHO) declared a Public Health Emergency of International Concern, and on 11th March 2020, a pandemic was declared¹. Since 2021, variants of the virus have emerged and become dominant in many countries, with the new variant being more and more virulent than the former. As of 19th September 2021, it was affecting 221 countries and territories, more than 229 million



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cases and 4.7 million deaths have been confirmed, making it one of the deadliest pandemics in history.

COVID-19 symptoms range from unnoticeable to life-threatening. Severe illness is seen more in elderly and in patients with certain underlying medical conditions. The pandemic has resulted in severe global social and economic disruption, including the largest global recession since the Great Depression of the 1930s³. Not to mention, the pandemic has raised issues of geographic discrimination, health equity as well as public health imperatives and individual rights.

Preventive measures such as social distancing, wearing masks, hand washing, disinfecting surfaces, and quarantining people are recommended. Authorities have implemented travel restrictions, lockdowns, systems for tracing contacts etc. Though current treatments focus on addressing symptoms, work is underway to develop medications that inhibit the virus.

Yet, the safe and effective vaccination is considered the tipping point that will contribute to curtail this outbreak. Since December 2020 several vaccines have been distributed in many countries.

From the very few of vaccines available globally, six vaccines, namely Sinopharm, Astra Zeneca, Pfizer-BioNTech, Moderna and Sputnik V are approved by WHO and authorized in Sri Lanka. Further, Vaccines were distributed District wise. Moreover, by mid- September, Sri Lanka has vaccinated more than 50% of the targeted population, covering over 10million with both vaccines⁴.

Medical treatment in COVID-19 patients in Sri Lanka took place in three tiers⁵;

- Level 1 – Intermediate care centers where only asymptomatic and mildly symptomatic patients were admitted
- Level 2 – Selected COVID-19 hospitals (Divisional and Base hospitals) with consultant cover
- Level 3 – COVID-19 designated specialized/Tertiary care hospitals

District Base hospital- Theldeniya, being a third major Level 3 COVID treatment center in Sri Lanka, has been providing medical care since the first wave of the Pandemic in Sri Lanka. As a Tertiary level treatment Center, having two male and female COVID HDUs (High dependency units) and COVID ICU (Intensive care unit) and separate COVID wards for maternal and paediatric groups; We received patients, from almost all districts of the country, of different severity levels, different medical backgrounds and different levels of vaccination statuses.

Accordingly, this study was designed to explore the impact of the vaccination status on disease severity and mortality in COVID-19.

Methodology

Study Design

A prospective descriptive cross sectional study conducted over 3 months period in COVID treatment unit (in Male and female wards, HDUs and ICU) in District Base Hospital Theldeniya. Quantitatively 179 cases were selected prospectively following getting informed written consent to participate in the study

Selection of Participants

All consented COVID-19 positive patients at COVID treatment Unit, District Base hospital – Theldeniya were taken as participants, excluding who were unaware or unable to provide correct details about their vaccination. Purposive sampling technique was adopted for data collection.

Data collection and Analysis

Vaccination and other clinical data were analyzed by Chi square test of independence variables with 95% confidentiality using R and ER studio.

Level of severity was assessed using the clinical parameters and the mode of oxygenation with their escalation pattern. E.g.

oxygenation started from 2L nasal prongs, 5L oxygen masks, Non Re breathing masks and recorded by using a Likert's scale.

Disease severity was categorized as below6;

- Asymptomatic
- Mild Illness – Individuals who have any of the signs and symptoms of COVID-19 (e.g., fever, cough, sore throat, malaise, headache, muscle pain) without shortness of breath, dyspnea
- Moderate Illness - Individuals who have evidence of lower respiratory disease by clinical assessment or imaging, , and saturation of oxygen (SpO2) =<94% on room air
- Severe Illness - Individuals who have respiratory frequency >30 breaths per minute with excessive use of accessory muscles, and thoraco-abdominal dis synchrony, SpO2) <94% on Oxygen (or for patient with chronic hypoxemia, a decrease from baseline of >3%), ratio of arterial partial pressure of oxygen to fraction of inspired oxygen (PaO2/FiO2) <300 mmHg, or lung infiltrates >50%
- Critical Illness - Individuals who have respiratory failure, septic shock, and/or multiple organ dysfunction

Ethical clearance

Ethical clearance was issued by the Ethical Review Committee, Kandy Society of Medicine, National Hospital – Kandy on 6th January 2022 (Ref No : NHK/ERC/67/2021)

Results

During the 3-month study period, a total of 179 COVID-19 positive patients participated in the research. Among them, 83 (46.37%) were female and 96 (53.63%) were male, and their ages ranged from 15 – 90 years.

Out of the subjects, 110 (61.45%) participants had one or more co-morbidities such as Diabetes mellitus, cardiovascular disease, lung disease, liver disease, Malignancy/ immune-compromised (that included patients on long

term immunosuppressant and special cases like COVID-19 with DHF); and 69 (38.55%) were free from any chronic diseases.

Of the co-morbid patients, 20 (11.17%) had Diabetes Mellitus, 17 (9.5%) had cardiovascular diseases as hypertension, dyslipidemia, ischemic heart disease etc., 7 (3.91%) had lung diseases as Bronchial Asthma, COPD, pulmonary tuberculosis etc., 2(1.12%) had malignancy/Immune-compromised, 1 (0.56%) had renal disease and 3 (1.68%) had other illnesses including liver diseases alone; whereas 45 (25.13%) had two of the above and 14 (7.82%) had combination of 3 or more of the above conditions.

On admission to the COVID-19 treatment unit, 134 patients were vaccinated; 87 (48.60%) patients had taken only a single dose, 47 (26.26%) were vaccinated with two doses while 45 (25.14%) were not vaccinated at all.

From the vaccinated group of (134) patients, most, that is 69 (51.49%) had taken Sinopharm, whereas 37 (27.62%) Covishield, 15 (11.19%) Sputnik V, 12 (8.95%) Moderna and 1 (0.75%) Pfizer/BioNTech.

Total sample considered, 5.59% (10) were asymptomatic, 37.43% (67) patients had mild disease, 26.26% (47) had moderate disease, 20.67% (37) were severely diseased and 10.06% (18) became critically ill requiring ICU care.

In majority, 43.58 % (78 patients) noted highest respiratory rate was in between 20-25breaths/min. There were 22.91% (41) and 17.88 % (32) with respiratory rates between 25-35/min and > 35 breaths/min respectively. Only 15.65% (28) had normal respiratory rate which is less than 20. (Figure 1)

On the contrary, roughly a half of the patients, 50.84% (91 patients) could maintain oxygen saturation more than 94% on air, about a quarter, 25.14% (45 patients) had on air SpO2 between 90-94%, 11.73% (21) had saturation between 85-90% and in 12.29% (22) saturation dropped below 85. (Figure 2)

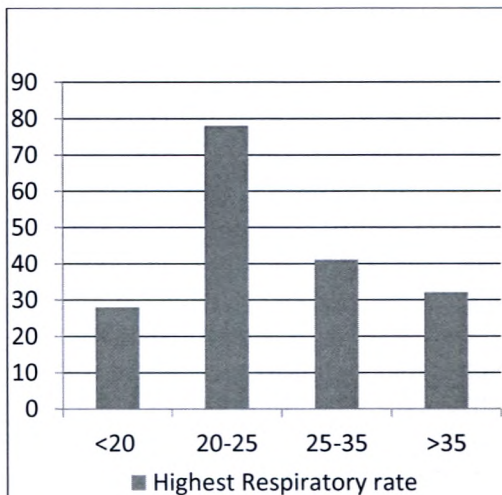


Figure 1: Highest Respiratory rate in admitted Covid positive Patients

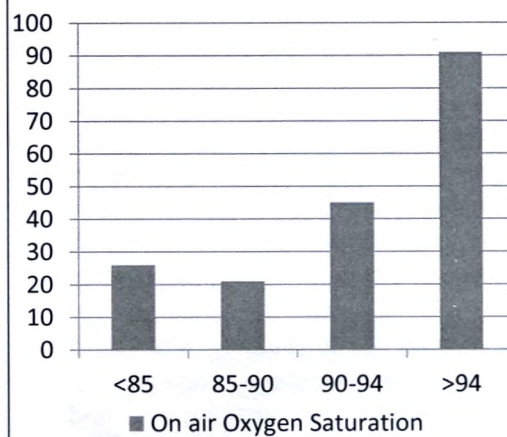


Figure 2: Lowest on air Oxygen Saturation in admitted Covid positive Patients

Further, most of the patients, i.e., 85 (47.48%) did not required supplementary oxygen. 28 (15.64%) were given nasal prong oxygen (up to 4l), 18 (10.06%) were given 4-6l of via face masks, 16 (8.94%) required Non- rebreathing mask (NRBM) with inspired oxygen fraction of about 90%, 4 (2.23%) were given High flow nasal oxygen (HFNO) and 15 (8.38%) needed CPAP (Continuous Positive airway pressure). Among others, 13 (7.26%) ended up being intubated and ventilated.

Of all, 59.22% (106 patients) was fully recovered, 24.58% (44) recovered, but required further follow up after discharge whilst

16.20% (29) died of COVID-19.

There was a statistically significant correlation between vaccination status of the patients and their clinical outcome (chi-square statistic-14.5414, p-value- .005753, significant at $p < .05$). In fully vaccinated group 21.3% (10) died, 70.2% (33) fully recovered, 8.5% (4) needed follow up after discharge; the values for the partially vaccinated and not vaccinated groups were 16.1% (14), 48.3 % (42), 35.6% (31) and 11.1% (5), 68.9% (31), 20.0% (9) respectively ($p = 0.0039$). (Figure 3)

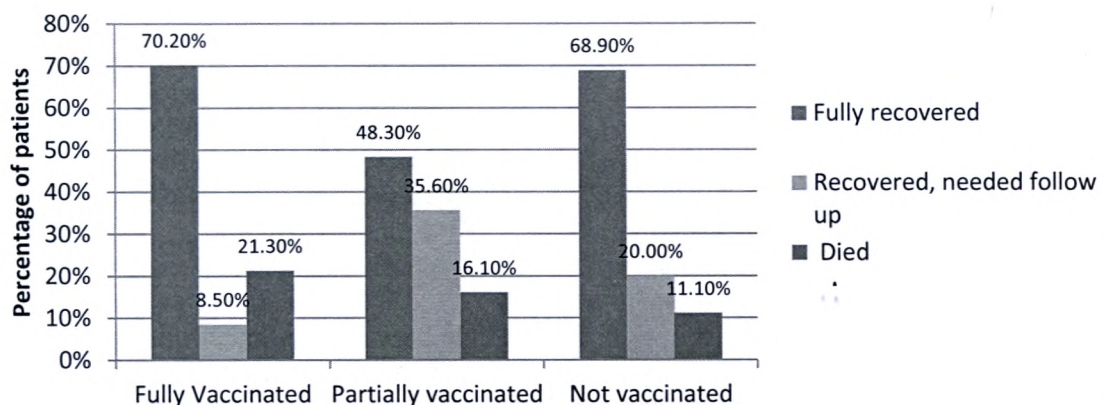
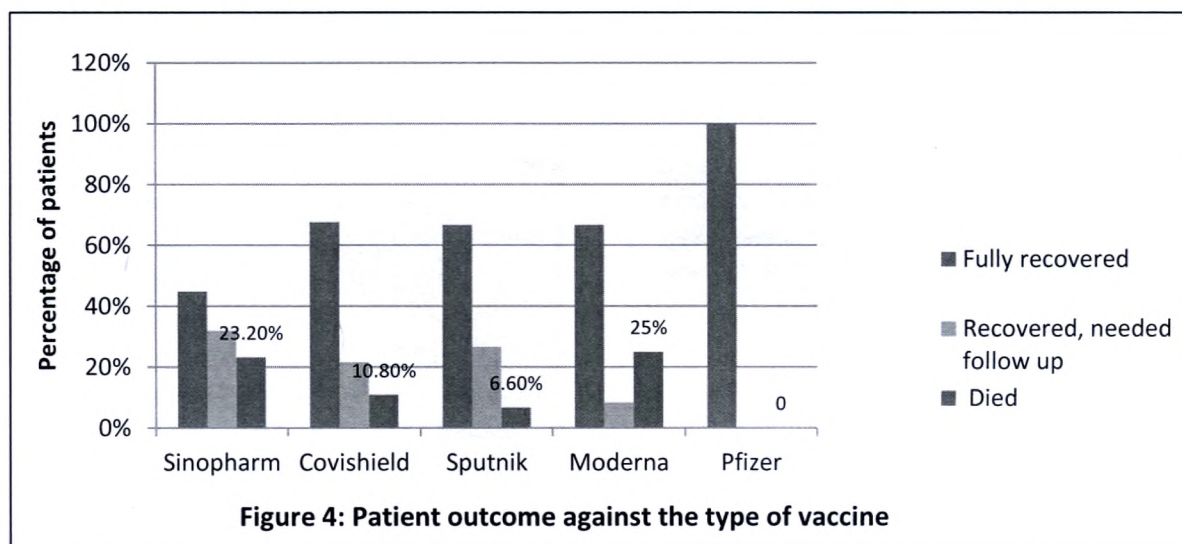


Figure 3: Patient outcome against vaccination status

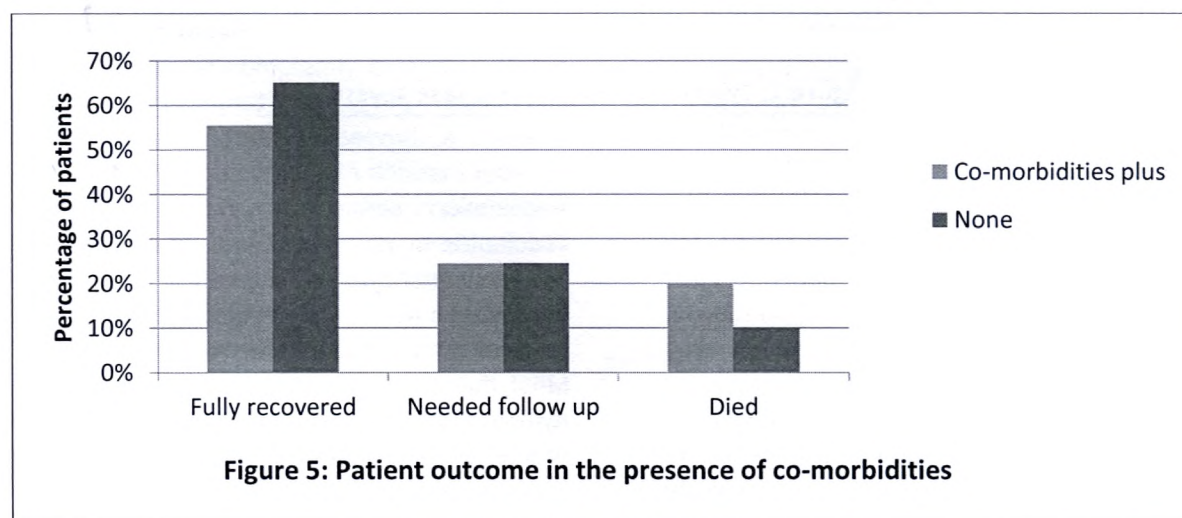
Most, i.e.; 16 of the total 29 deaths were the patients vaccinated with Sinopharm. Out of the subjects who had Covishield vaccine, 10.8% (4) died, 67.6% (25) fully recovered and 21.6% (8) recovered but needing further follow up. In comparison, from the patients who were after Sinopharm vaccine 23.2% (16) died, 44.4% (31) fully recovered and 31.9% (22)

required further follow up at ILD clinic. In the Sputnik and Moderna vaccinated groups; died, fully recovered and recovered needing follow-up were 6.6% (1), 66.7% (10), 26.7% (4) and 25% (3), 66.7% (8), 8.3% (1) respectively. One subject who was vaccinated with Pfizer fully recovered. In not vaccinated group of patients, 11.1% (5) died, 20% (9) needed follow up and 68.9% (31) gained full recovery. (Figure 4)



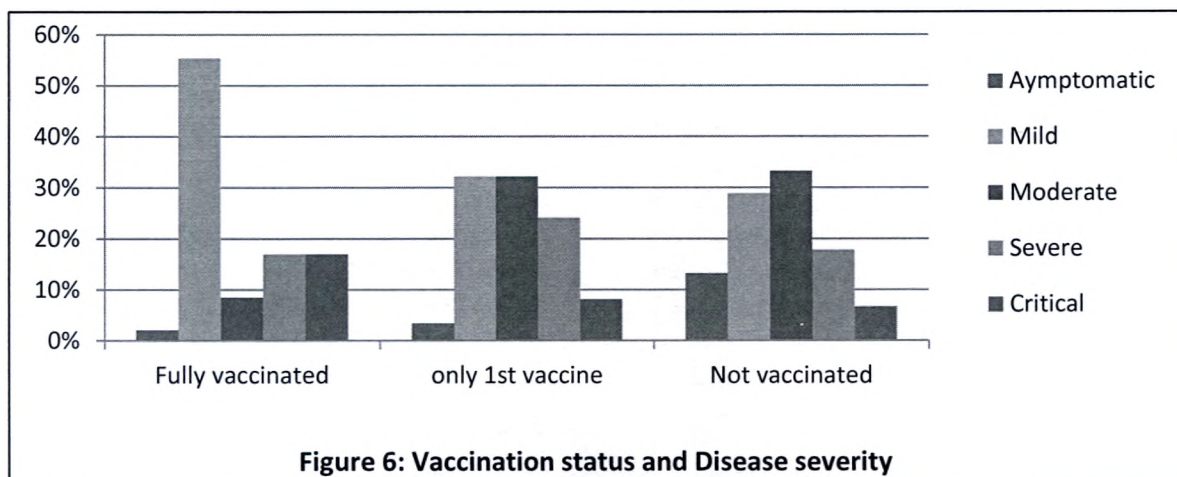
When mortality and outcome were cross tabulated against the presence of co-morbidities, most of the deaths 75.9% (22) were from co-morbid group, in compared to 24.1% (7) deaths, of which there were no other

chronic illnesses. Similarly, none co-morbid group showed 89.9% (62) recoveries, compared to the 80% (88) recoveries when associated with other illnesses. (Figure 5)



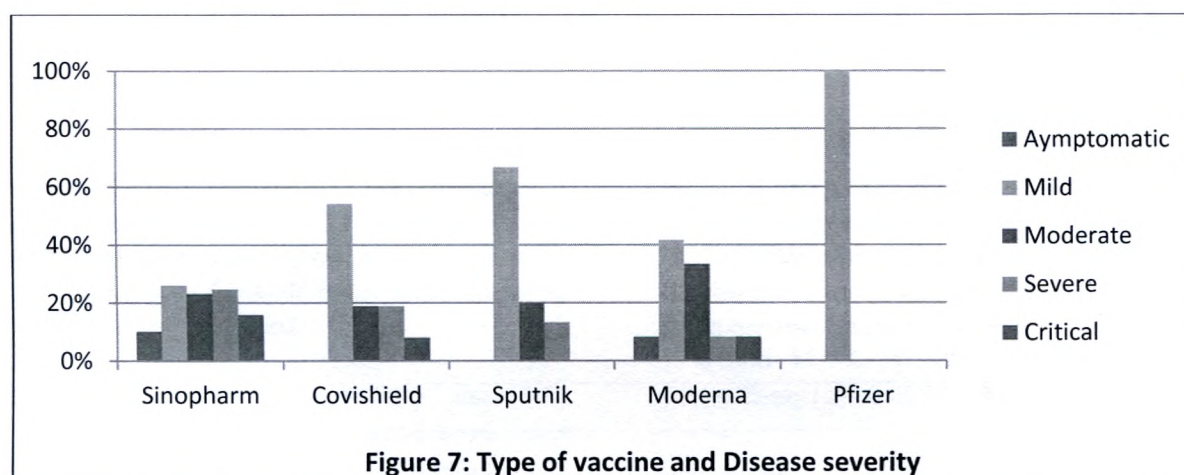
Disease severity showed a noteworthy variation with the vaccination status. When fully vaccinated, most (55.4%) were mildly symptomatic and when not vaccinated most (33.3%) were moderately symptomatic.

Partially vaccinated group showed highest proportions equally in both mild and moderate disease forms (32.2%)(Chi-squared 23.8693, p-value - .00241, significant at $p < .05$). (Figure 6)



Further, the severity of the disease exhibited a difference with the type of the vaccine received. Most of the critically ill have taken Sinopharm. Pfizer, Sputnik, Covishield and Moderna showed in decreasing order (100%, 66.7%, 54.2% and 41.7% respectively), more

mild form of the COVID illness. Plus, the disease severity did not show a significant difference with the Sinopharm vaccine; having 10.2% asymptomatic, 26.1% mild, 23.2% moderate, 24.6% severe and 15.9% critically ill patients. (Figure 7)



Discussion

During the research period, most of the admitted COVID-19 positive patients were vaccinated either two doses or a single dose, majority having given Sinopharm vaccine. COVID-19 infection has a clinical spectrum of disease from asymptomatic to critically ill, however, the greatest proportion presented with mild infection. In many, respiratory rate was slightly higher than normal (20-25/min), though, most could maintain normal oxygen saturation on air (more than 94%) without the need of oxygen therapy. More than half of patients fully recovered, about a fourth recovered, but follows up after discharge was required, whilst 16.20% died of COVID-19.

Vaccination status i.e.; fully or partially vaccinated or not vaccinated, and the type of the vaccine showed a noteworthy influence on the disease severity and outcome. About 70% fully vaccinated patients recovered completely. Most fully vaccinated patients were mildly symptomatic when most of the not vaccinated group was moderately symptomatic. Of vaccinated group, highest number of deaths and critically ill were the patients who have taken Sinopharm. Moreover, complete recovery was seen in more than half of the patients with all (Covishield, Moderna, Sputnik and Pfizer) except Sinopharm vaccine. Having notable variance in the outcome with different vaccines, study results raise the question

behind the rationality of the expression 'the best vaccine is what one can get first' which was used when rolling out the vaccination program.

Our study further confirmed that the presence of co-morbidities augment the severity and mortality in COVID-19.

A major drawback of our study was the small sample size, given the limitations of planned study duration and the number of hospital admissions during the period; we could not reach the estimated sample size.

Many of the described apparent associations have yet to be repeated and validated using robust statistical methods. Now the vaccination has been extended further with booster doses. Undoubtedly the outcome can vary with this advancement. On that account, it is vital to address knowledge gaps in the field and identify factors that will be helpful in overcoming this health burden.

Conclusions and Recommendations

In COVID-19, the majority shows mild symptoms, but the number of deaths and critically ill cannot be simply neglected. Vaccination effectively lowers the disease severity as well as mortality. The results show that most of those who vaccinated with two doses recovered completely compared to the partially vaccinated and not vaccinated patients. We further observed a notable variance in the outcome with different types of vaccines. A significant reduction in mortality is seen with Pfizer, Covishield and sputnik vaccines. On the other hand, most of the deaths and critically ill among vaccinated groups are seen with Sinopharm vaccine. Furthermore, the study confirmed the prevailing finding that the presence of co-morbidities augments disease severity and mortality in COVID-19. Our findings strengthen the fact that the vaccination is the sustainer in COVID-19 pandemic control, also gives an insight to the future vaccination schedules.

There are still a great many uncertainties about COVID-19 disease and vaccination. As a case in point, the duration of protection of the vaccines is not yet known. On the other hand, clinical studies are still ongoing to answer these ambiguities such as the efficacy, effectiveness, side effects, impacts of vaccines, the necessity of booster doses etc. In furtherance of improving health outcomes, it is vital to identify and validate these untested areas.

Conflict of interest

None declared

References

- COVID-19 Public Health Emergency of International Concern (PHEIC) Global research and innovation forum (retrieved on 21/09/2021) [https://www.who.int/publications/m/item/COVID-19-public-health-emergency-of-international-concern-\(pheic\)-global-research-and-innovation-forum#:~:text=On%2030%20January%202020%20following,of%20International%20Concern%20\(PHEIC\)](https://www.who.int/publications/m/item/COVID-19-public-health-emergency-of-international-concern-(pheic)-global-research-and-innovation-forum#:~:text=On%2030%20January%202020%20following,of%20International%20Concern%20(PHEIC))
- COVID-19 Corona virus Pandemic (retrieved on 21/09/2021) <https://www.worldometers.info/coronavirus/>
- Guidance for Intermediate care centers on management of COVID-19 positive individuals https://www.epid.gov.lk/web/images/pdf/Circulars/Corona_virus/Guidance_for_intermediate_care_centers_on_management.pdf (referred on 20/09/2021)
- Sri Lanka Vaccinates 50 percent of total population, covering over 10 million with both doses <https://www.who.int/srilanka/news/detail/18-09-2021-sri-lanka-vaccinates-50-per-cent-of-total-population> (referred on 21/09/2021)
- The Great Lockdown: Worst Economic Downturn Since the Great Depression. "The Great Lockdown: Worst Economic Downturn Since the Great Depression". IMF Blog. Retrieved 23 April 2020
- Updated discharge criteria from treatment facilities for COVID_19 patients (10th August 2021) http://epid.gov.lk/web/images/pdf/Circulars/Corona_virus/discharge_criteria_COVID_19_updated.pdf (referred on 21/09/2021)

Predictive Policing: Sweeping the Nation, Promising the Holy Grail of Policing, Preventing Crime before It Happens

Ariyadasa, A.

Abstract

This essay is a review of the literature on the negative impacts on predictive policing in the algorithmic era while suggesting the curbing mechanisms. It could be concluded that, apart from the environmental, polytypical and social damages, predictive policing violates privacy of the individuals. It could be concluded that the present emphasis of predictive policing research is based on persuasive arguments and anecdotal evidence rather than comprehensive scientific study. Future research could be conducted of both positive and negative expectations in order to build an evidence foundation for predictive policing.

Keywords: Predictive policing, predictive algorithms, big data, literature review

Introduction

What is this story about?

Predictive policing is the use of algorithms to evaluate huge quantities of data in order to forecast and prevent probable future crimes. The most extensively used technique, place-based predictive policing, often analyzes pre-existing crime data to identify areas and periods with a high probability of crime. Some suggest that predictive policing may save police agencies money by boosting the effectiveness of crime-reduction initiatives.

This is just a glimpse of predictive policing, its issues, describing what essence of the problems, who caused them, and the curbing mechanism with opinions and suggestions. Background of Predictive policing.

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The first law enforcement agency that used predictive policing is the Santa Cruz police. In the previous years, a cumulative amount of police forces around the world have adopted predictive policing that uses statistical data to guide their decision-making. (Meijer, 2019). High powers computers and predictive analytics are used for predicting burglaries, car thefts, property crimes, etc. Predictive policing thus raises some profound questions about the nature of prediction in an era influenced by data collection and analysis. (Ferguson, 2017).

What is the problem with Predictive policing?

Against this backdrop, predictive policing has various susceptibilities in the social, environmental, and political arena. Therefore, the following questions have arisen with regard to the prior prediction of crimes. This article will scrutinize the environmental, social, and political damages of predictive policing, cases of the same, and the parties trying to resolve the problem.

Since data-driven decision systems are taking over, no organization or culture seems insusceptible from the impact of automated decision-making. Police departments are progressively positioning data mining techniques to predict, prevent and investigate crime. Therefore, predictive policing will badly impact the environment, society as well as politics.



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Damages Caused by Predictive Policing on the Environment, Society, and Politics.

Predictive capacities have been implemented in various contexts and have a significant impact on applications ranging from “business, communication systems and politics to health monitoring and environmental protection” (Mader, 2013)

The major social issue in predictive policing is Racial Biasness. Algorithms are capable of racially biased criminal justice systems. (Ordonelle, 2019). Predictive policing algorithms encourage directed police patrols to target minority communities with discriminatory consequences for minority individuals (Brantingham, 2018). Therefore, Predictive policing reduces the accountability of law enforcement. As most processes in data analytics are automated, it might undermine the ability of officers and departments to explain and justify their decisions in a meaningful way.

Transparency is paramount in predictive policing which is a highly challenging area in predictive policing. Police departments should tell the public which predictive policing software is used.

Environmental effects on the formation of co-offense links and accordingly our approach in defining offenders' spatial closeness is different from those in location-based social networks is caused by predictive policing because the social environments.

The political impact evident in the rise of predictive policing in Germany is above all a political phenomenon, involving the discursive shaping of domestic burglary as a security problem. These new prediction tools facilitate rhetorical links for politicians and police authorities in legitimizing their ambitions to fight crime.

Who is responsible for this problem?

USA Police departments using predictive technologies hope they will improve their departments' effectiveness and lead to this agony constructing the issues mentioned above. Apart from that, the Software companies

who drag the police for Predictive policing solutions are also culprits for this issue. Therefore, different stakeholders are trying to solve the impacts of predictive policing.

Who is going to solve it?

Among several organizations, NIJ has launched a demonstration initiative to develop, test, and evaluate predictive policing in a real-world, real-time context (Pearsall, 2019). Apart from that, Researchers, policymakers, and funding organizations are trying to solve this problem at the national level.

Predictive Policing and the Influence Caused on the Society

The most advanced version of predictive policing can now offer real-time crime reports, generated by computer models, led to racial and community profiling, and an increase in unnecessary searches on law-abiding citizens (false positive). Bad data and information contribute to a debacle every step of the way. Therefore, every person needs to care about this problem.

Why should readers care about this Problem?

Predictive policing has the potential to make policing fairer. By promoting decision-making based on objective evidence, predictive policing could potentially alleviate certain discrepancies in the enforcement of the law. Therefore, this is of the utmost importance to public maintenance of the rule of law and good governance along with ethics.

How does predictive policing influence the well-being of people, society, or the environment?

Predictive policing is part of the broader development of a pre-crime society (Zedner, 2007). According to the criminologist Garland, this has led to a ‘culture of control’, within which criminal law is seen as an instrument to control the risk of crime (Garland, 2001)

A high level of usage of predictive policing must be treated with a high level of caution and mechanism for the public to know, assess and reject such systems.

Curbing the Issues Caused by Predictive Policing and Actions against Bad Data Predictions

How could we fix this?

Proposed solutions for curbing issues in predictive policing

- Using predictive policing for corporate sustainability

Core issues such as data, methodology, social science, transparency, accountability, practical implementation, administration, vision, and security must be addressed before adopting any predictive policing technology. (Ferguson A.G., 2017). Transferring big data algorithms which are developed for 'predictive policing' to the field of corporate sustainability to curb major corporate scandals with disastrous environmental (BP Oil spill) or social (Rana Plaza building collapse) consequences, or global warming and floods could be prevented if big data-driven predictive algorithms were in place (Seele, 2016).

- Transparency is Paramount

Racial biases could be prevented by having proper guidelines to enhance transparency to the public. Using randomizing software such as HunchLab over-policing areas that appear high risk because of biased crime data in order to have a balanced crime map. The appeal of predictive policing has in large measure been that it offers a "black box" solution to crime. (Andrew G, 2017). Therefore, the principle of transparency should be drawn by the organizations by way of regulations that could be duly enforced by the law.

- Risk assessment and monitoring mechanisms

Assessing the "risk" associated with an individual—whether of committing future crimes or of being a suspect in past crimes—is highly contentious and fraught with personal privacy concerns (McInnis, 2013)

- Ensure fairness

Continued empirical scrutiny along with careful policy development will be needed to guard

against bias in predictive policing and ensure fairness in outcomes.

- Actions against Bad data predictions

Some "data ethics" issues are the result of building bad products. For example, Microsoft released a chatbot named Tay. therefore, regulations and law enforcement mechanisms are needed for bad data predictions.

Feasibility of the curbing mechanisms

Private actors' involvement complicates the hazards of predictive policing. Unscrambling expansion from execution is shielding the algorithm from public review, which amplifies concerns about noisy data, improper biases, and flawed algorithms. (Bakke, 2018). Intellectual property rights and trade secret Laws safeguard companies from the disclosure of algorithms and add a layer of secrecy to predictive policing. Private developers who do not wish to surrender information to the public can hide behind proprietary rights, which raises accountability concerns. Correctness of the models and liability of the predictive algorithms will create an accountability gap. The amalgamation of high-tech surveillance and private progress requirements increases transparency issues. Therefore, the feasibility of the curbing mechanisms seems to be challenging in the scenario.

Suggestions and Opinions about the Situation Described in the Story.

- Vendors of predictive software should disclose the source code to the public. For example, journalists should be given free access, and parts of algorithms could be open source so that software developers and crime analysts can test alternatives.
- Public forums and pressure groups are needed for lobbying purposes to analyze which criminological theories are being modeled, and their limitations. As an example, HunchLab addresses civil-rights concerns with its clients through webinars, and participates in public panel discussions alongside critics and activists. (Shapiro, 2017).
- Researchers and data journalists have to draw public attention to these types of issues and identify limitations in predictive policing. Blog

posts, Facebook campaigns, and Youtube channels could be used as tools for drawing public attention to this. For example, a 2016 ProPublica investigation demonstrated that offender-based modeling algorithms were likely to misidentify low-risk black defendants as high risk and high-risk white defendants as low risk. (Angwin, 2016)

- Funding organizations should fund studies of the possible inequitable effects of predictive policing — not just its accuracy. They should also publish and disseminate principles and policies on predictive policing that consider civil-rights concerns. These documents are crucial because, in the absence of legislation, a court injunction, or a consent decree, there is no federal mandate for municipal and state police oversight in the United States. As an example, last year the American Civil Liberties Union, together with 16 civil-rights, privacy, and racial-justice organizations and technology companies, published a joint statement of concern about predictive policing (see go.nature.com/2ih4sko).
- Using this as a model, reports should detail the kinds of data that can and cannot be used to train algorithms, the shortcomings of predictive systems, and their potential to amplify bias.

References

- Angwin, J., (2016). Machine Bias. [Online] Available at: <https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing> [Accessed 26 January 2022].
- Bakke, E., (2018). Predictive Policing: The Argument for Public Transparency, NYU Annual Survey of American Law, 74(131), pp. 132-171. (<https://annualsurveyofamericanlaw.org/wp-content/uploads/2019/08/74-1-Predictive-Policing-The-Argument-for-Public-Transparency.pdf>)
- Brantingham, P.J. (2018). Does Predictive Policing Lead to Biased Arrests? Results From a Randomized Controlled Trial. *Statistics and Public Policy*, 5(1), pp. 1-6. (<https://doi.org/10.1080/2330443X.2018.1438940>)
- Ferguson A.G., (2017). Policing Predictive Policing. *Washington University Law review*, 94(5), pp. 1109-1189. (<https://openscholarship.wustl.edu/>
- [cgi/viewcontent.cgi?article=6306&context=law_lawreview](https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing))
- Garland, D., (2001). *The Culture of Control. Crime and Social Order in Contemporary Society*. Oxford: Oxford UP. (<https://www.jstor.org/stable/24497904>)
- Mader, C., (2013). Sustainability process assessment on transformative potentials: the Graz Model for Integrative Development. *Journal of Cleaner Production*, Volume 49, pp. 54-63. (<https://www.sciencedirect.com/science/article/pii/S0959652612004507?via%3Dihub>)
- McInnis, B., (2013). *Predictive Policing The Role of Crime Forecasting in Law Enforcement Operations* Santa Monica
- Meijer, A., (2019). Predictive Policing: Review of Benefits and Drawbacks. *International Journal for Public Administration*, 42(12), pp. 1031-1039. (<https://doi.org/10.1080/01900692.2019.1575664>)
- Ordonelle, R. M., (2019). Challenging Racist Predictive Policing Algorithms Under the Equal Protection Clause. *NYU Law review*, 544(4). (<https://www.nyulawreview.org/wp-content/uploads/2019/06/NYULawReview-94-3-ODonnell.pdf>)
- Pearsall, B., (2019). Predictive Policing: The Future of Law Enforcement?. *NIJ Journal*, Issue 266, pp. 16-19. (<https://nij.ojp.gov/topics/articles/predictive-policing-future-law-enforcement>)
- Seele, P., (2016). Predictive Sustainability Control: A review assessing the potential to transfer big data-driven 'predictive policing' to corporate sustainability management. *Journal of Cleaner Production*, 29 October, Volume 153, pp. 673-686. (<https://doi.org/10.1016/j.jclepro.2016.10.175>)
- Shapiro, A., (2017). Reform Predictive Policing. *Nature*, 541(26), pp. 458-460. (<https://www.nature.com/articles/541458a>)
- Zedner, (2007). Pre-crime and post-criminology. *Theoretical Criminology*. 11(2) ed. s.l.:s.n. (<https://doi.org/10.1177%2F1362480607075851>)

Electronic Governance: What, Why, and How?

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Introduction

The key concepts of e-governance and practices around the world encapsulate the expectations of citizens and virtues of government service delivery to achieve good governance. The key focus of governments should be to enhance the efficiency by adapting to modern technology. Internet-based advanced ICTs have broadened the focus of such intervention to add all good governance features, where e-Governance considered as the main tool for good governance. (GOSL, 2013).

What is e-Governance?

The concept of e-Governance is as "Transformation of Government to Provide Efficient, Convenient, and Transparent Services to the Citizens & Business Through Information & Communication Technologies." There is a common misconception that "e-Government is always based on the internet and its components", where telephone, fax, mobile, CCTV, tracking systems, RFID, biometrics, smartcards, non-online e-voting, TV, and radio-based delivery of public services etc. are part of e-Government. The difference between e-Government and e-Governance is that e-Government is a system where citizens are recipients with a one-way protocol while e-Governance is a functionality where citizens are participants with a both-way protocol i.e., government to citizen and vice versa.

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Any e-Governance project should align with four key pillars namely people, process, technology and resources. The failure or success of a project will depend on how best the above pillars are managed within a project implementation. (Dissanayake & Dissanayake, 2013)

The e-Governance nomenclature

The e-Governance nomenclature highlights the service deliver from Government to Citizens (G2C), Government to Business (G2B) and Government-to-Government (G2G). The different levels of e-Gov services in each country ranges from the basic presence, enhanced presence, interactional, transactional, integration, and inclusion. The explanation also emphasized the importance of striking the balance between backend systems and front-end interfaces in any eGov system.

The global best practices

The global best practices for implementing e-Governance can be identified by analyzing success and failure factors in e-Government and statistics of global success rates of e-Government projects. There are many success stories from top countries in the e-Gov indexes such as Denmark, Netherlands, Australia, and Sweden. The success rates are changing at the national level, the organizational level, and the project level. The e-Government design reality gap, is mostly identified in government projects. Many countries have derived e-Government or Digital Government strategies from the national development policies or specific digital policies. Further, leading countries have given a very high policy priority to the data aspects such as open data and open government giving a very high emphasis to the openness of the governments. Many countries have begun to provide guidelines in the use of Cloud Hosting, Artificial



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Intelligence and Block Chain. (Weerakkody *et al.*, 2013; Withanage, 2022).

Sri Lankan experience

On success story in Sri Lanka context is integrating University Grants Commission (UGC), Department of Examination (DoE), in which all universities enroll students through GCE A/L Z-score marks. This project has enabled efficient validation of student applications in real-time and to release university selection information to potential students in a timely manner.

Conclusion

In the current context, e-Governance is important to provide faster and transparent services to the citizens with the help of technology, which need to be implemented with clear national policies.

References

- Dissanayake, S. and Dissanayake, L. (2013) Digital Public Administration and E-Government in Developing Nations: Policy and Practice, IGI Global, USA, DOI:10.4018/978-1-4666-3691-0.ch016
- GoSL (2003) Policy on E-Government, Government of Sri Lanka, May 2003
- Weerakkody, V., Dwivedi, Y.K. and Kurunananda, A. (2009), Implementing e-government in Sri Lanka: Lessons from the UK. *Inform. Techno. Dev.*, 15: 171-192. <https://doi.org/10.1002/itdj.20122>
- Withanage, U P A, Gunawardene, L. & Endagamage, DM (2022) Why the Utilization of E-Government Services is Poor? – A study with the Citizens in Colombo Municipal Council Area in Sri Lanka. *Integrated Journal for Research in Arts and Humanities* 2:4, pages7-13.

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