

INTERDISCIPLINARY RESEARCH FOR SUSTAINABLE DEVELOPMENT

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FOREWORD

Environment is the perdurable medium to create the best cultural modification, which is an unstoppable spirit for a fabulous fusion to enrich the elevating attainments of multifarious research in deed. With the multiple changes in the global scenario, Interdisciplinary Research for Sustainable Development (IRSD) now-a-days has its own significance. This book series will bring in research ideas of various people from different countries in a single forum and which certainly will be a fabulous opportunity for uniting the research fraternity. IRSD Book Series provide a fertile platform to exchange, deliberate and innovate, ideas resulting in possible future collaborations in pursuit of the United Nation's Sustainable Development Goals: The Global Goals, which will contribute to new research initiatives in the domain of Social & Environmental Sustainability for sustainable development of mankind. SDGs are adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. The first edition of the Book series is going to be truly thought provoking at all not to highlight the captivating research brilliance but to have the world-wide educational recognition in a very stimulating manner. It is one of the spellbinding Research alliances in all over the globe for the evergreen global actuality for creating an extensive hope of research eminence in deed.

**Dr S Negi
Chief Editor
I2OR, India**

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A Comprehensive survey on Scalability in software defined networking

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Abstract - Software-defined networking decouples the control plane from data plane, and this ultimately advances the planes' independent evolution thus making the network becomes more programmable, flexible and centralized without losing its vendor-agnostic property. SDN can scale vertically or horizontally; the former involves the addition control functionalities to the data plane while in horizontal scalability, multiple controllers are deployed to control the whole network. OpenFlow protocol, which features switches managed by series of controllers, has become the most widely used (framework) for centralizing functionalities in the control plane in SDN. Despite these advantages and edge that SDN has the traditional network, there exist a host of scalability challenges which have thus far evoked the proposition of various solutions. Notable among these concerns are the trade-offs between cost and efficiency, controller overload and delay processing time. This paper presents a review on the scalability of software-defined networking; shedding light on some of these challenges and also exploring literature to see [and highlight] some of the solutions that have been proposed.

Keywords: *SDN, scalability, API, Openflow, Devoflow.*

I. INTRODUCTION

Considering the enormous complexity revolving around cloud computing in the face of ever-rising demands, the need for a scalable and flexible network like the software-defined networking [1] is fast overtaking the computing world. The fundamental objective of a software-defined network is to decouple the control plane from data plane, and this ultimately advances the planes' independent evolution [2]. As a result of this, the network becomes more programmable, flexible and centralized property [2]. To make the most of the advantage offered by SDN, it is important that network designers understand conceptual limitation surrounding the practical usage of the network and also have an initial estimation of the requirement of SDN [3]. Apart from existing in a centralized architecture, software-defined networking controllers can also be implemented as a multilayer structure or a distributed structure [4].

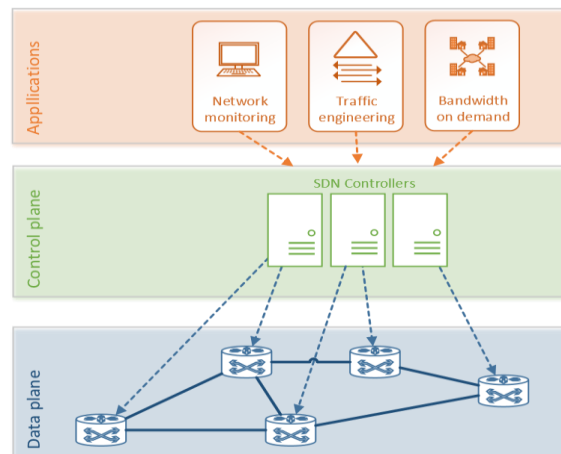


Figure1 Software-Defined Network Architecture

Source: Vizarreta et al.

An offshoot of SDN's flexibility is that it provides an avenue through which network developers can experiment and implement new ideas with great precision [5, 6]. Beyond this, however, SDN enhances configuration - as the control plane gets unified over every other network device [7] and also brings about improved performance; this is made possible through feedback control and global visibility attainable through the network's centrality [1]. Despite these advantages, there exist a host of challenges - hovering round processing speed, trade-offs, memory size to mention but a few - that are connected with software-defined networking, and it is to this end that improvements have been proposed [8-11].

II. RESEARCH PAPERS REVIEW

As an alternative to the common practice of overdependence of centralized controller on a flow's first packet for the installation of rules, the DIFANE solution was proposed by **Minlan Yu, Jennifer Rexford, Michael J. Freedman and Jia Wang** [18] This is based on the partitioning wildcard rules over multiple switches, meaning decisions can be initiated in the data plane. In DIFANE, rules are generated and allocated to authority switches by the controller, and packets that match cached rules are forwarded to egress switch while packets that do not match cached rules are redirected, on the basis of the partitioning information, to the right authority switch. The result showed that DIFANE recovers quickly from authority switch failure and also keeps packets in the fast path - meaning that the delay is relatively small - even as it was shown to deliver a higher throughput than NOX. Though DIFANE evolves as a scalable solution that appreciably takes care of the overhead issue, it does have its pitfall which borders on the concern over the visibility of the states and statistics of flows.

In addressing the problem of overhead that arises from the use of the OpenFlow protocol, **Andrew R. Curtis, Jeffrey C. Mogul, Jean Tourrilhes, Praveen Yalagandula and Puneet Sharma, Sujata Banerjee** [17] proposed the application of DevoFlow which is centered around having mechanisms in place to devolve control and collect statistics. Rule cloning and local actions are the mechanisms used in devolving control. A simulation method was employed to evaluate the functioning of DevoFlow on a large-scale network with the behaviour of the OpenFlow protocol being stimulated through the modelling of the switch flow tables and the limited data plane-control plane bandwidth. A fluid model was used in capturing the overheads that evolved from each flow. The modification of OpenFlow with DevoFlow could go a long way in addressing the flow initiation overhead issue, and as such improve scalability. By the way, DevoFlow, larger flows are pushed to the controller in order to ease the scalability issue while short-lived flows are handled in the data path. As a matter of fact, [17] reported that flow rate did not drop when the data plane-control plane queue on the switch held 1000 packets - which were delivered at a speed of 17Mbps, and less than 0.01% flow rate was dropped when the packet limit was set at 100. More notably, no latency was observed as the flow-table entries were installed upon the re-routing of a flow by the OpenFlow controller. The proposal discussed here is cost-effective as it cuts down the switch-internal communication that takes place between the two planes in the network, and this can be of immeasurable benefits in building a scalable architecture.

Siamak Azodolmolky, Philipp Wieder and Ramin Yahyapour [3] defined a mathematical model that is derived from network calculus to evaluate the behaviour of a scalable SDN architecture. The network calculus, which functions to determine metrics such as queue length, throughput and delay, is based on mini-plus algebra. Network performance is evaluated through bounds that are also valuable in the characterization of the arrival and service processes while the flows were defined through arrival curves. The upper bound of the queue reported in this research present a good ground for evaluating the performance of root software-defined network controllers and aid (network) designers to derive an accurate estimation - upon factoring flow control of the controllers and the cumulative arrival processes - of the buffer requirement needed for the evolution of the controllers. On the other hand, the the upper bound of two local controllers' event delay was of importance in deriving the worst case estimation which was useful to designers in arriving at the needed buffer space. The researchers then went on to emphasize that both the deterministic network calculus and stochastic network calculus present promising analytical frameworks for SDN deployment.

Soheil Hassas Yeganeh, Amin Tootoonchian, and Yashar Ganjali [2] contended that the issues surrounding the scalability of software-defined networks are not specific as other network settings like data centers, service providers and so on also exhibit some of these challenges. However, they emphasized that unlike traditional networks, SDN gives room for the scalability of network management and programming, and makes available building blocks for the testing and verification of networks. It was said that the decoupling process involved in SDN is usually faced by signaling overheads - which could arise as functionality shift from a local controller to a remote controller as well as the implementation of an appropriate API to sustain the vendor-agnostic feature of the network. Besides,

the authors highlighted a couple of other issues connected to software-defined networks, and also stated the approaches taken to resolve them. Among the concerns listed are: i.) Controller overload: this is due to functionality being pushed to the centralized setup and this could cause the slowing down of a network. This can be addressed by using distributed systems like Onix and Hyperflow to take care of certain control functions to the end of preserving scalability. ii.) Flow initiation overhead: this, more or less, persists in cases whereby actual flows are initiated prior to providing entries unto the forwarding table. This amounts to a delay in the flow setup which is reflected in the update time of the forwarding information base (FIB). In proffering a solution for the delay, they suggested that the remote controllers be put in proximal distance to the switches. Nevertheless, they posited that a solution like DIFANE will be greatly valuable for taking care of the flow initiation bottleneck. iii.) Failure resilience: the performance of the network as link failure notifications are directed to the centralized setup therefore causing a delay in the propagation of information to the forwarding tables. The authors proposed that an out-of-band control network, along with the local fast fail-over mechanisms featured on the switches, can be effective in addressing this particular issue. Furthermore, they stressed that with increasing scalability, there will be a need for the modification of API making it more expressive to support the new/unfamiliar protocols that will emerge. Overall, the authors conclude that, though software-defined networking is far from being perfect, it still has an edge over the traditional networks as it regards flexibility.

Xinjie Guan, Baek-Young Choi and Sejun Song [16] conducted a research to examine how scalable the software-defined networking would be under disaster situations using a GENI test-bed. The OpenFlow switch was injected with new flows to the end of resulting in saturation. Each of the four hosts and two controllers employed in this research generated a single packet flow - at 46 bytes - with the speed being between 250 flows/sec to 2000 flows/sec. It was observed that CPU utilization dropped with increasing flows with the injection of 250 new flows leading to a 20% packet loss. This, in effect, caused an overload on the controller, and also hamper the functionality of the FlowVisor on the switches. On the whole, the result from this research revealed that scalability of software-defined networking is not determined by the controller alone. The authors proposed that having the Network Embedded On-line Disaster management system positioned in proximity with the source of failure should serve to boost the reliability and scalability of the controllers.

Zuo Qingyun, Chen Ming, DingKe, and Xu Bo[12] proposed two approaches to address the issue that accompany the addition of functionalities to the control plane. But for this to be successfully improve scalability, they pointed out that three principles must be fulfilled. The principles are stated thus: I.) All control functionalities, except the ones promoting the processing efficiency and adaptation of hardware and software requirement, be reserved in the control plane; II) Control functionalities should not change the basic process of the data plane; III) Collection of statistics from the data plane should neither cause high load in the control plane nor affect accuracy and validity. For the purpose of reducing control messages, the researchers integrated statistics server in the OpenFlow network, and flow processing functionality was also added to this server. With the elimination of redundant packet-in messages, the researchers reported the alleviation of controller overload and reduced processing delay.

III. SCALABILITY METHODS

Dwelling more on the scalability of the network; SDN can scale vertically or horizontally [12]. In network that scales vertically, control functionalities are added to the data plane with a root controller ensuring global view as attainable with Kandoo [13]. On the hand; for horizontal scalability, multiple controllers are deployed to control the whole network [12]. Horizontal scalability is, however, limited in that the root controller is only capable of maintaining infrequent global events [12]. According to Tootoonchian[14], the two profound questions that hang over the scalability of the control plane are: “i.) how fast can the controller respond to data path requests? AND ii.) how many data path requests can it handle per second?” Research studies on the scalability of SDN are often undertaken to answer these questions and also address some salient issues.

OpenFlow Architecture

OpenFlow was initially designed for experimental in campus networks [12]. It gives access to the flow tables to the end of directing traffic through switches and routers [15]. The basic architecture of the OpenFlow features switches that are managed by a series of controllers.

Though other SDN frameworks exist [1], the OpenFlow protocol remains the most widely used (framework) for centralizing functionalities in the control plane [16]. With an OpenFlow modeled centralized network, the need to use switch-by-switch configurations in constructing global policies is eliminated, even as a near-optimal traffic management becomes realistic [17].

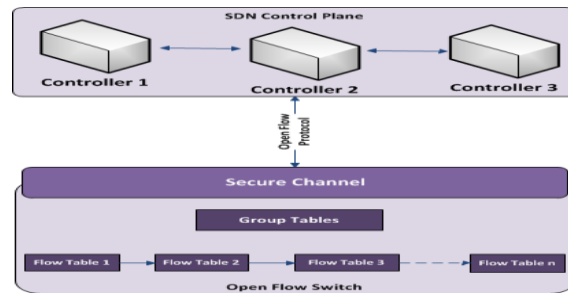


Figure2 Basic architecture of OpenFlow

Source: Jammal et al.

Nevertheless, the OpenFlow protocol yet exhibits some weaknesses; one is the significant latency that arises from the ratio of its aggregate forwarding rate to its data plane-control plane bandwidth, and another (weakness) is the scaling difficulty that results from attempting to make the controller have complete visibility over all flows [17]. The scalability issues that emanate with deployment of additional network and computational resources for every OpenFlow event may yet subject the network to disaster.

IV. METHOD COMPARISON

The research papers have focused on the frontiers concerning opportunities and successful implementation with respect to the architecture. The Microservice architecture is costlier to develop upfront but there are many advantages to it. In Microservice architecture, the application is broken down into a series of modules. Each module of the architecture is associated with specific business objectives. Specific architectural changes have to be made in order to keep the security and privacy of the infrastructure within the networking area. Many solutions have been referred by the experts keeping in mind the usage of cloud computing services by most of the companies in recent times.

V. CONCLUSION

The best method for the companies who have been working on networking infrastructure with cloud platforms for computing purposes could be Cloud Edge. It will allow the device to compute and make decisions locally. The device could do so at high speed without affecting the efficiency. The time to send the query from the device to the network and getting back the reply is reduced. The Cloud Edge collects a lot of information but it only sends the processed data to the cloud. It lowers the quantity of data that might be at risk in the cloud. There is no risk of network failure or slow connection with Cloud Edge. It is especially great for operations in remote locations where getting a reliable network connection is not possible.

Software-defined networking has been shown to have some edge over traditional networks, especially with the growing demands that evolve with cloud computing mobile devices and some other programming applications. While the solutions for this network architecture currently available offer some improvements, they are still lacking in one or the other. Therefore, future research focus should not solely be directed towards resolving these issues but also preparing the network to efficiently accommodate the projected trend in computing. These scalability concerns must be adequately addressed, with the performance metrics considered, in order to fully maximize the potentials that SDN presents.

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WOMEN EDUCATION AND SUSTAINABLE DEVELOPMENT IN INDIA

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ABSTRACT - Women play a vital role in the progression of our nation and improvement. Inequalities exist in socio economic culture. Women are the game changers and are needed to address the world's toughest challenges so empowering them through education is the priority. When women are educated, the generation would get educated. This will lead to the development of our country. Educating women is the powerful tool to bring change in the society and in the Nation. This paper is an attempt to throw lights on origin, importance and initiatives taken for women education and proposed few suggestions to educate women as it's the need for sustainable development to make the future of remain bright for future generations.

Key Words: *Sustainable Development, Women Education and Initiatives*

I. INTRODUCTION

Education for sustainable development is primary to all other agendas and on the World Agenda. It provides equal opportunity to everyone to get empowered through quality education required for a sustainable future through values, behaviour and lifestyles and bring positive societal transformation. Education empowers people and benefits a country's economy. It is a key contributor to economic growth in developing countries. Better and higher education leads to better health, income, human capital and empowerment and it therefore plays a significant role.

Women play a vital role in the development of the family, society and country. Globally it is recognized that education is one of the indicators for women empowerment in matters of building citizens character, reconstruction of economic and social reforms and is an integral part of national development. Education enables women to respond to the challenges, to confront their traditional role and change their life-style.

In India, in the fight against poverty, women's education is often overlooked. Upper caste males had fear that women may become too modern and independent because of which they created lot of difficulties for women in the form of oppression and opposition to continue their education. It has come a long way to be what it is today with a big gap to be filled under the fast-changing conditions in the country. Women education plays a very important role in the overall development of the nation. To improve the role of women in the society the government should mainly concentrate on their education and increase their employment opportunities.

II. WOMEN EDUCATION

The journey of women's education can be divided in two periods viz., before 200 BCE and from 200 BCE

A. Before 200BCE

Before 200 BCE, Vedas, Upanishads etc., were studied in Vedic Education and it held great importance in Ancient India.

WOMEN PERFORMING VEDIC SACRIFICES

In this period studying of Vedas and performing Vedic sacrifices were performed by women. There are evidences that some of the hymns of the Rigveda such as Sikataa, Romasa, Lopamudra, Urvashi etc., are compositions of poetesses.

UPANAYANAM

In the Vedic age women had access to upanayana samskara. To begin learning and reciting Vedic literature every student has to undergo a special initiation process as a part of Upanayana ritual. Girl students were permitted to continue their education till they get married. It is believed that there used to be two classes of girl students viz., Sadyovadhus and Brahmavadinis based on their age of marriage.

Sadyavodhus are the girls who used to get married at the age of 16 or 17. They were taught only some important Vedic hymes, music and dance which are necessary for usual prayers and sacrifices. Also, music and dancing were taught to them.

Brahmavadinis used to continue their education even after the age of 16-17 and would get married only after the completion of their education.

B. From 200 BCE

Due to religious status of women, there was a setback in women's education from 200 BCE. It was assumed that for correct transmission of the Vedic literature women had to be barred from this education. As soon as the girl attains puberty, they were forced to get married. It hindered women from getting educated and flourishing.

Even though there was a decline in the female education as a whole in society, in well-cultured rich families' girls and women received a fairly good literary education by hiring special tutors and made contributions to literature. In this period there were a meagre number of literate women in society. The condition got even worse during the 19th century (from 1000 AD to 1900 AD) until some reforms were made by people like Raja Ram Mohan Roy and many more.

In 1818, Robert May of London Missionary Society (LMS) in Bengal region of Chinsurah, opened school exclusively for girls after which various schools were opened for girls by various pioneers. To promote women education under the Church Missionary Society, Mary Ann Cooke opened a school staffed with Brahmin Pandits and received patronage of respectable Hindu men. In 1821, with the initiative of CMS in Tirnevelveli, the first boarding school for girls was opened. Mostly, Christian girls or girls who belonged to lower caste used to attend those schools.

In 1851, Jyotiba Phule established school in Poona for girls by realizing the importance of their education. Everyone who realized the importance of women education demanded it. There was slow or no progress in the expansion of women education after the revolution of 1857.

After realizing the need of women's education, based on the recommendations of Education Commission in 1882, Government of India gave grants to Women's Educational Institutions. With this many new schools came into existence. With this, women's literacy rate rose to 0.2%.

After the country got independence in 1947, women's education got a fillip and Government has taken initiatives to provide education to all Indian Women. Women literacy rate in 1947 rose to 6% and in the year 1971, 22% of Indian women were literate.

By the beginning of 20th century, women's institutions rose by 6,107 institutions and girl students rose to 47,470. By the end of 2001, there were 54.7% female literates. As per the census 2011, literacy rate of female in India is 64.6% an increase about 14.387%. The total enrolment of women in higher education in the year 2014 has been estimated to be 13301 (Source: Educational Statistics at a Glance 2014). According to NSO, the female literacy rate in India is 70.3% in the year 2021.

III. IMPORTANCE OF WOMEN EDUCATION**1. Social development**

With the help of educated women many of the issues faced by the society can be solved.

2. Gender equality

Education will help to close a gender gap in society and bring gender equality in all aspects and in all sectors.

3. Economic productivity

Women's education improves economic empowerment which in turn increases productivity and encourages economic diversification and raises GDP of a nation.

4. Reduction in infant mortality

A well-educated woman will have more chances of making better decisions for her family's health and will have more knowledge about the leading causes of death in children and concentrate more on parental care, hygiene and immunization.

5. Improved living standard

Education will improve chances of employability and pave way for better standard of living.

6. Inclusive growth

India is a developing nation striving for growth in each sector. Education is a way to achieve this goal and the power of women's education on economic growth is undeniable.

7. Woman empowerment

Women have been deprived of their rights. Education is a powerful tool for woman emancipation and empowerment to achieve a place in society and can equally participate

8. Strengthening of democracy

Education will create awareness among women which will cause increased participation in politics that leads to strengthening of democracy.

IV. HINDERANCES IN WOMEN EDUCATION

Female literacy in India is hindered by many factors such as

- Financial background,
- Health issues,
- Gender-based inequality,
- Discrimination and exploitation,
- Domestic chores, no interest in studies, marriage,

- Family support, lack of educational institutions in the surrounding areas,
- Lack of safe means of travel,
- Irregular transport,
- Sexual harassment,
- Lack of toilets etc.,

V. INITIATIVES TAKEN BY GOVERNMENT FOR ENCOURAGING WOMEN EDUCATION

A. SCHEMES TO ENCOURAGE WOMEN EDUCATION

The following welfare schemes has been established by Government of India for motivating women education in India.

1. **Sakshar Bharat**

This scheme was launched in 2008 and under which Lok Shiksha Kendras were set up for promoting education among woman.

2. **SABLA-Rajiv Gandhi Scheme**

This scheme aims at providing nutrition for growing adolescent girls by provision of food grains.

3. **Right To Education**

Right to Education considers education as a fundamental right which provides free and compulsory education to every child aged between 6 to 14.

4. **National Programme for Education of Girls**

This scheme was introduced by Government of India in July 2003 to reduce the dropout rates in the schools by giving special attention to weak girls by forming women's group to follow up and supervision on girl's enrolment, attendance etc. This programme was an incentive to reach out to the girls. who the Sarva Shiksha Abhiyan was not able to reach through other schemes.

5. **Mahila Sangha**

Under this scheme women's forums (Mahila Sangha) were created for rural women to provide to meet, discuss issues, ask questions, make informed choices and it was implemented in ten states.

6. **Rahstriya Madhyamik Shiksha Abhiyan**

It was launched with the vision of making quality secondary education accessible to everyone between 15 and 16 years old by having prescribed norms. The main aim of this scheme was to provide infrastructure for girls' hostel.

7. **Dhanlakshmi Scheme**

Conditional money transfer scheme for Girl Child following 3 conditions.

- At birth and Registration of Birth.
- Progress of Immunization and Completion of Immunization.
- Enrolments and Retention in School.

8. **Kasturba Gandhi Balika Vidyalaya**

This scheme was launched in July, 2004, to provide education to girls of underprivileged and rural areas at primary level with a reservation of 75% for backward class and 25% for BPL (below Poverty line).

9. **Beti Bachao, Beti Padhao**

On 22nd January, 2015 social campaign was launched for this newly announced Scheme for enhancing girls' education in India by Government of India. This is famous for empowering women and aims to exterminate female foeticide and access them with an appropriate education.

10. **Working Women Hostels**

The scheme was established to provide a working environment with accommodation facilities to every place where women may get employment opportunities.

11. **The Support to Training and Employment Programme (STEP)**

These schemes are open for women above 16 years to supports them to be self-employed or uplift them to be entrepreneurs with adequate education in various sectors.

12. **Nari Shakti Puraskar**

This initiative is taken by the Ministry of Women and Child Development to empower women by acknowledging their excellent contribution towards society and awarding them.

13. **UDAAN - Giving wings to Girl Students**

This scheme is dedicated to enhance the enrolment of girl students in prestigious technical education institutions through incentives & academic support promote admission in the educational institutions and preparing them for engineering entrance examinations.

14. **Mahila Samakhya- Mahila Samakhya (MS)**

Mahila Samyakhya is an ongoing scheme for women's empowerment initiated in 1989 for the education and empowerment of women for socially and economically marginalized groups in rural areas.

15. Saakshar Bharat

A new variant of The National Literacy Mission, Saakshar Bharat launched in 2009 with an aim to accelerate adult education, especially for women's who have no access to formal education.

16. Mid-Day Meal Scheme

Mid-Day Meal Scheme provides a useful source of employment for women and helps liberate working women from the burden of cooking at home during the day.

B. HIGHER EDUCATION

1. Higher education of women through Open and Distance Learning (ODL) Mode
2. Post School Diploma (Polytechnics etc.) to provide financial assistance for the construction of women hostel.
3. Many numbers of schemes were launched by The University Grants Commission (UGC) to encourage the enrolment and promote Higher Education among women.
4. Day Care Centres in Universities and Colleges
5. For single child in family Government has introduced Post Graduate Indira Gandhi Scholarship for encouraging higher education.
6. Construction of Women's Hostels for Colleges
7. Development of Women's Studies in Universities and Colleges
8. Scheme of Capacity Building of Women Managers in Higher Education
9. Post-Doctoral Fellowships for Women

VI. BENEFITS OF WOMEN EDUCATION

Many reforms can be manifested by educating women. Few benefits are listed below.

1. Women's education will give power to more equality.
2. Many social discrepancies will be exlaimed, and a powerful system might be established.
3. Women's education would help them voice their opinions.
4. Women will be able to earn and raise standard of living.
5. Rear their children in a better way and provide good health and other facilities.

VII. SUGGESTIONS

Globally Covid-19 pandemic has worsened the gender inequality and women are hard hit by losses, school closures, poverty and domestic violence. Educating women is the one way of giving them power and enable them great choices and lead their life as they wish. Government is providing many schemes for the empowerment of women through education but as an individual we too should have our contribution in empowering women for sustainable development of our nation.

1. **Focus:** Focus on basic education as it has its own intrinsic value.
2. **Support:** Protect the Girls and Women from getting subjected to abuse, child labour, trafficking, Child marriages, domestic violence by offering counselling, training and educating.
3. **Volunteer:** Volunteer as a tutor or mentor throughout reach programme and influence the life of a girl child living in your community.
4. **Voice:** give counselling to the parents of girl child and make them to understand the importance of education for girls and use your voice to the girl continue her studies.
5. **Build:** Build the technical, cognitive and behavioural skills of girls by emphasizing on nutrition, stimulation and cognitive skills which may be conducive to high productivity in their future life.
6. **Environment:** Create an environment that encourages investments in knowledge and creativity.
7. **Tell:** Tell the women in your life that how much you appreciate and care for them and empower them to take decisions. Give them necessary education and train them with necessary life skills.

VIII. CONCLUSION

World's population is constituted with approximately 50% of women. Gender equality still exists in the form of discrimination, suppression and violence. Development cannot be achieved without the participation of women in a nation or Society. Every Government foremost importance for women education in order to develop. For sustainable development, India needs to concentrate on women education as there is inequality in literacy rate even after 75 years of Independence. A very serious concern is needed for women education. To Empower nation, educate the women.

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Basics of ADR and Pharmacovigilance

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DEFINITION^{1,2}

The WHO defines an “Adverse drug reactions “**any response to a drug which is noxious and unintended and which occurs or doses normally used in man of prophylaxis diagnosis or therapy of disease or for the modification of physiologic function**”.

Pharmacovigilance has been defined by the WHO as ‘The science and activities relating to the “**detection, assessment, understanding and prevention of adverse effects or any other drug-related problems**”.

Adverse drug reactions (ADRs) are types of adverse drug events (ADEs). ADEs include ADRs, medication errors and other drug-related problems. ADEs are the negative consequences of drug misadventures. Henri Manasse defined drug misadventure as the iatrogenic hazard that is an inherent risk when drug therapy is indicated.

The American Society of Health- System Pharmacists (ASHP) defines significant ADRs as any unexpected, unintended, undesired, or excessive response to a drug that includes the following.^{3,4,5}

- ❖ Requires discontinuing the drug
- ❖ Requires changing the drug therapy
- ❖ Requires modifying the dose
- ❖ Necessitates admission to the hospital
- ❖ Prolongs stay in a health care facility
- ❖ Necessitates supportive treatment
- ❖ Significantly complicates diagnosis
- ❖ Negatively affects prognosis or results in temporary or permanent harm, disability or death.

Consistent with this definition, an allergic reaction (an immunologic hypersensitivity, occurring as the result of unusual sensitivity to a drug) and an idiosyncratic reaction (an abnormal susceptibility to a drug that is peculiar to the individual) are also considered as ADR.

The Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) defines an adverse drug reaction (ADR) as an undesired effect of a medication that increases toxicity, decreases desired therapeutic effect or both.

Mechanisms of adverse drug reactions:

An ADR can be defined as an unpleasant and harmful reaction resulting from an intervention after receiving the medication. The mechanism of adverse reactions can be divided into direct toxicity studies and hypersensitivity reactions that occur due to the pharmacokinetic and pharmacodynamic alterations of the drug products.⁶ Direct toxicity reactions may be attributed to the toxic effects of a compound or its metabolites which are apparent in various organ systems, inducing noxious chemical reactions, physiological dysfunction, DNA damage or injury to cellular structures and tissues^{10,11}. On the other hand, hypersensitivity reactions can be determined after the immune system of the individual shows an exaggerated response to a drug or its metabolites, which include allergy and anaphylactic reactions¹². It has been suggested that the results of direct cytotoxicity and excessive immune reaction are noticeable in various organs like skin, liver, lungs, bone marrow and kidneys^{13,14}.

Types of adverse drug reactions based on Rawlins and Thompson classification:

In this classification, the ADRs are categorized into two classes viz type A and type B reactions.

1. **Type A reactions:** These include the reactions that are predictable from the drug’s known pharmacology and are usually dose dependent. Their incidence and morbidity are generally high while mortality is usually, but not invariably low. Examples are bradycardia with β adrenoceptor blockers, hemorrhage with anticoagulants, hypoglycemia with sulphonylureas, etc. Some type A reactions have a long latency, like teratogenicity, chloroquine retinopathy, delayed effects like vaginal adenocarcinoma in daughters of women who received diethylstilbestrol during pregnancy, etc.

2. **Type B reactions:** These are aberrant or bizarre effects that cannot be predicted on the basis of the drug's pharmacology. These reactions are generally unrelated to dosage and though comparatively rare, they often cause serious illness and death. These reactions are often not observed during conventional pharmacological and toxicological screening programmes and consequently account for many drug withdrawals from the market. Some examples are: malignant hyperthermia of anesthesia, anaphylaxis due to penicillin, and many immunological reactions.

Types of adverse drug reactions based on Brown's Classification:

The types of adverse reaction can be studied in two main headings, i.e., more common ADRs including type A and B reactions; and less common ADRs which include type C, D and E reactions (Table 1)^{6,9}.

TYPE A REACTION: Augmented

Type A adverse reactions have been commonly related to dose which enhance the normal therapeutic effect of drug. Moreover, the pharmacokinetic or pharmacodynamic factors of the drugs have been found to be responsible for type A ADRs. The pharmacokinetic causes of type A reactions may be attributed to the genetic variations in order to cause ADRs¹⁵. Moreover, hepatic diseases have been noted to cause pharmacokinetic variations that induce subsequent changes in the distribution and metabolism of drugs resulting in ADR⁶⁻⁹. The raised half-life of the drugs along with reduced glomerular filtration rates (GFR) has been suggested to cause pharmacokinetic variations. Moreover, the adverse effects have been detected with drugs extensively rejected by the kidney. In addition, the diseases have been noted to cause ADRs due to impaired absorption due to mucosal oedema, poor renal perfusion, or changes in apparent volume of distribution⁹. Also, in conditions like hypothyroidism and thyroid disease, the hepatic metabolism of the drugs get reduced which further have been suggested to lead pharmacokinetic variations ultimately causing type A adverse reactions.

The pharmacodynamic causes of type A reactions include hepatic disease, altered fluid and electrolyte balance, altered sensitivity, and long-term effects¹⁶. The hepatic disease has been shown to affect pharmacodynamic response of a drug and cause ADR due to production of clotting factor. Also, the drug must be escaped which impairs clotting or affects bleeding by causing ulceration. Hypokalaemia and hypercalcaemia, the consequences of cardiac glycoside, have been noted to get potentiated, causing pharmacodynamic variations ultimately causing type A adverse reactions. In addition, type A adverse effects have been documented to be related to the pharmacological effects of the drug. However, type A effects can usually be replicated and studied experimentally. Also, type A adverse reactions have been detected by spontaneous reporting during the original clinical trials^{19,20}. Hence, marketing the quantitative and controlled determination is needed in order to certify the relationship and major persistence with type A effects of low specificity.

TYPE B REACTION: Bizarre

Type B adverse effects have been noted in a marginal number of patients and are often sensitive or idiosyncratic reactions¹⁹. Moreover, type B adverse reactions have been suggested to be unforeseen and unpredictable; showing less or no relationship with the dosage. However, the relationship with time and low background frequency are generally the chief reasons to suspect the drug in type B effects. Furthermore, type B ADRs can be classified as non-immunological ADR's, that are further categorized as predictable and unpredictable reactions which are due to over dose, collective effects, slow toxicity, drug interaction, metabolic modification, teratogenicity, aggravation of disease, drug induced chromosomal disturbance, and intolerance; and immunological ADR's, which are unpredictable and occur due to immunoglobulin (Ig) E-dependent drug reactions, immune complex dependent drug reactions, cytotoxic drug-induced reactions, and cell mediated reactions^{9,16}.

The pharmacokinetic causes of type-B ADRs remain scarce, that can be an aspect to bizarreness of absorption or distribution, which suggests that the bio-activation of drugs yield reactive species responsible for a significant preparation of type-B adverse effects. Also, the direct or immune mediated toxicity has been noted to result in binding of such reactive metabolites. The type-B reactions propose to occur as a result of bio-activation of reactive metabolites includes hepatotoxicity, agranulocytosis, and hypersensitivity reactions^{6,20}. Moreover, the pharmacodynamic causes affecting type B reactions depend on response of individual patients to specific drugs. There has been a variation between individuals even after allowance has been made for patient's age, gender, body weight, disease state and concurrent drug regimens. The genetic, immunological, neoplastic, and teratogenic have been considered in qualitative difference in the target organ response to drugs. Also, the idiosyncratic reactions have been labelled in genetic causes for abnormal response for many type-B adverse reactions²¹.

TYPE C REACTION: Continuous drug use

The type C adverse reactions have been attributed to both serious and common effects having notable outcomes on public health from chronic disease toxicities. Moreover, type C reactions have been regarded as the reactions with chronic effects related to long-term drug use, such as analgesic nephropathy or extrapyramidal effects. These reactions

have been found to relate to the cumulative toxic effects of a drug used over time, in which the adverse effects increase gradually. In addition, the type C reactions have been suggested as the long-term drug effects including adaptive changes and withdrawal effects⁶. Type C adverse reactions have been known to be chronic in nature associated with long-term drug therapy, which can be evidenced by the fact that the induction of iatrogenic hyperadrenocorticism occurs with chronic use of prednisolone or other corticosteroids. In addition, studies have reported the adaptation on discontinuation of the drug, commonly referred to as abstinence syndrome²².

TYPE D REACTION: Delayed

Type D reactions, also termed as delayed ADRs, are the reactions that have been found to be apparent after sometime of the treatment. The development of secondary cancers in patients treated with alkylating agents like cyclophosphamide is the best example of type D adverse reactions.

TYPE E REACTION: End of Dose

Type E ADRs have been known to occur when drug treatment has been terminated suddenly, the examples of which include withdrawal seizures on terminating anticonvulsant therapy and adrenocortical insufficiency subsequent to glucocorticoids termination^{6,9,16}.

TYPE F: Familial Reaction

Certain adverse drug reactions occur only in susceptible individuals with genetically determined, inherited metabolic disorders. Some of the more common familial disorders include phenyl ketonuria, glucose 6-phosphate dehydrogenase deficiency; esterase inhibitor deficiency, porphyria and sickle cell anemia.

These reactions must not be confused with those that occur because of the normal variation in ability to metabolize a drug among the population. For example, up to 10% of the population of the western world are deficient in CYP 2D6. However, this does not make them liable to suffer unique adverse effects compared with the rest of the population.

TYPE G: GENOTOXICITY REACTIONS

Several drugs can produce genetic damage in humans. Notably, some are potentially carcinogenic or genotoxic. Some, but not all, teratogenic agents damage genetic material within the foetus.

TYPE H: HYPERSENSITIVITY REACTIONS

These are side-effects caused by allergy or hypersensitivity. They are probably the most common adverse reactions after Type A reactions. There are many different types, but all involve activation of an immune response. They are not pharmacologically predictable and neither are they dose related according to the definition of 'dose dependent' given above (although very small doses can sometimes be used for desensitization). Accordingly, reducing the dose does not usually lead to amelioration of symptoms; the drug must be stopped. Some examples are anaphylaxis, allergic skin rashes, Stevens–Johnson syndrome,

photoallergy, acute angioedema, hypersensitivity, cholestasis and hypersensitivity mediated blood dyscrasias.

TYPE U: UNCLASSIFIED REACTIONS

Some ADRs have a mechanism that is not understood and these must remain unclassified until more is known about them. This may necessitate the introduction of new adverse reaction categories in the future. Examples include drug induced taste disturbance, muscular adverse effects of Simvastatin, and nausea and vomiting after a gaseous general anesthetic. The severity of the reaction was determined according to Hartwig et al. as given below²³

Mild reactions which were self-limiting and able to resolve over time without treatment and did not contribute to prolongation of length of stay.

Moderate ADRs were defined as those that required therapeutic intervention and hospitalization prolonged by 1 day but resolved in <24 h or change in drug therapy or specific treatment to prevent a further outcome.

Severe ADRs were those that were life threatening, producing disability and those that prolonged hospital stay or led to hospitalization, required intensive medical care or led to the death of the patient.^{23,24}

Classification based on the reaction time:

Reaction time is defined as the time between the last drug exposure and the appearance of the first symptoms.²⁵

- **Acute:** 0-6min. Thus include 4.3% of the reaction.

- **Sub-acute:** 1-24hrs. This include 86.5% of reaction.
- **Latent:** 1 day. This include 3.5% of reaction.

Patient outcomes were reported as:

- Fatal
- Fully recovered (Patient fully recovered during hospitalization)
- Recovering (Patient recovering, but not fully recovered during hospitalization)
- Unknown (not documented)

PREDISPOSING FACTORS ²

There are many factors that can predispose to the occurrence of adverse drug reactions in a patient. Patients who have one or more of the following predisposing factors are at high risk of developing ADR. The proportion of all patients developing ADR is still very small.

POLYPHARMACY

Patients with multiple drug therapy are prone to develop an adverse drug reaction either due to alteration or drugs effects through an interaction mechanism or by synergistic effects. The amount of risk associated with multiple drug therapy increases in direct proportion of the number of drugs administered.

MULTIPLE AND INTERCURRENT DISEASES

Patients with multiple diseases are at increased risk of developing and ADR due to multiple drug use for their multiple diseases. Similarly, patients with impaired hepatic or renal status are also at a high risk of developing an ADR to drugs which are eliminated by these organs. For example, a patient with decreased renal function who is treated with amino glycosides is at an increased risk of developing nephrotoxicity unless appropriate dosage adjustment is made.

AGE

Elderly and pediatric patients are more vulnerable to develop ADRs. Elderly patients are more susceptible to ADRs due to the physiological (pharmacokinetic and pharmacodynamic) which accompany aging, and because they are often taking many drugs for chronic and multiple diseases. Nitrate and ACE inhibitor induced postural hypotension in an elderly patient is an example of this kind, where the reaction may be exacerbated age-related impaired bar receptor responses to a change in posture. Pediatric patients may develop serious adverse drug reactions to some drugs since all children, especially Neonates; differ in their drug handling capacity compared to adults. An example of such of such serious reaction is the gray baby syndrome with Chloramphenicol.

DRUG CHARACTERISTICS

Some drugs are highly toxic in nature and patients who are treated with these are at an increased risk of ADRs. For example, nausea and vomiting is a common adverse drug reaction seen in patients treated with anticancer drugs. Also, patients who are treated with drugs, which have a narrow therapeutic index such as Digoxin and Gentamicin, are more susceptible to develop ADRs.

GENDER

It has been repeated that women are more susceptible to develop an ADR for unknown reasons. Chloramphenicol induced aplastic anemia and Phenylbutazone induced agranulo- cytosis is twice and thrice as common respectively in women patients.

RACE AND GENETICS

It is evident that ADRs are more common in genetically predisposed individual (G-6PD) enzyme are at higher risk of developing hemolysis due to Primaquine than those who are not.

Race and genetic polymorphism may account for alteration in handling of drugs and their end organ effects.

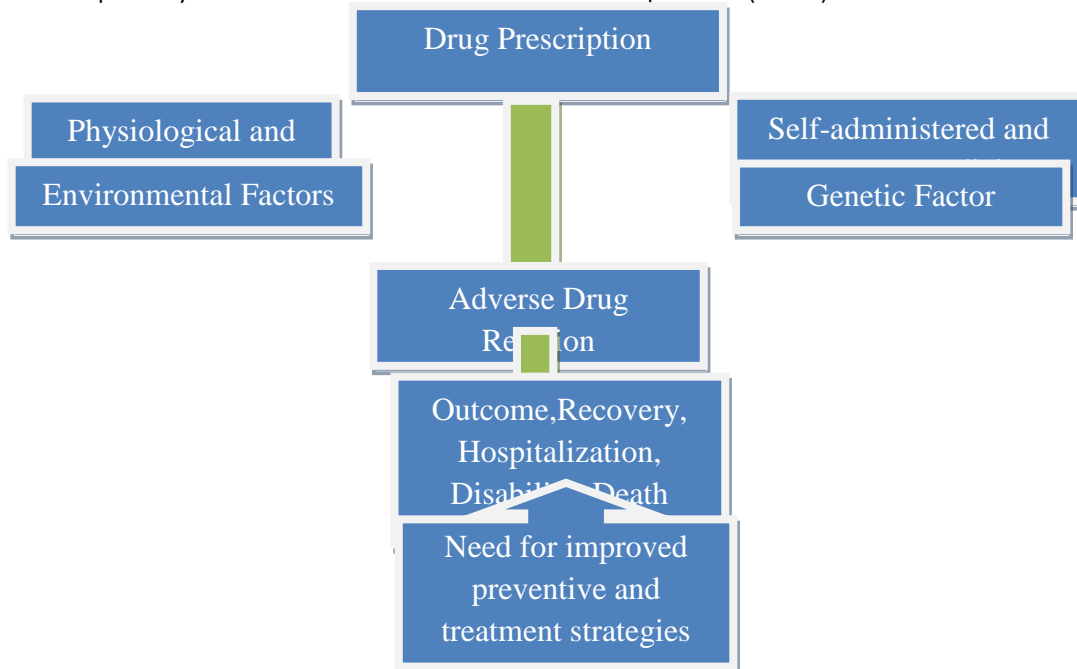


Figure 1.1 predisposing factors of ADRs

Pharmacovigilance (abbreviated as PV or PhV) also known as drug safety, is the pharmacological science relating to the detection, assessment, understanding and prevention of adverse effects, particularly long term and short term side effects of medicines. Science of collecting, monitoring researching, assessing and evaluating information from healthcare providers and patients on the adverse effects of medications, biological, herbalism and traditional medicines with a view to:⁶

- Preventing harm from adverse reactions in humans arising from the use of authorised medicinal products within or outside the terms of marketing authorization or from occupational exposure.
- Promoting the safe and effective use of medicinal products, in particular providing timely information about the safety of medicinal products to patients, healthcare professionals and the public.
- Identifying new information about hazards associated with medicines.

HISTORY OF PHARMACOVIGILANCE:

The safety of drug was not the early concern in the history of drug. The thalidomide tragedy of 1960's opened the eyes of drug regulators as well as other concern healthcare professionals to establish a way to ensure drug safety^{27,28}. The milestone in the drug safety was the publication of chloroform related death on The Lancet journal for the first time in 1893.²⁷ Onwards, safety of drug became the global concern and different initiatives were taken by different country to safeguard the public health safety. The US Federal, Food and Drug (US FDA) act was passed in 1906 for the first time, but it was amended to control misbranding of ingredients and false advertising claims after the deaths associated with sulphanilamide elixir.²⁷ There were 107 deaths due to the use of diethylene glycol as a solvent for sulphanilamide elixir. There were radical changes in the drug safety issues after the worldwide thalidomide tragedy which was first reported by an Australian obstetrician, William McBride in 1961.²⁷ He reported thalidomide associated "seal limbs" in the baby, used in pregnancy. This drug had not been adequately screened for teratogenic effects, but similar malformations were subsequently shown in the rabbit and (at high dose) in the rat. In West Germany 4000 individuals were affected. The tragedy made the world to be more concern about the drug safety, as efficacy was only the parameter to see the effect of drugs. Immediately after the tragedy the US FDA act was amended to compulsory premarketing submission of both efficacy and safety data in 1962.²⁷ The UK Medicines act was enforced in 1968, however, safety monitoring via "yellow card system" was introduced in 1964.²⁷ The drug safety issues were globalized, strengthen and systematized after the establishment of World Health Organization (WHO) Programme for International Drug Monitoring in 1968.^{27,28} The Uppsala Monitoring Centre (UMC) located at Uppsala, Sweden co-ordinates the International Drug Monitoring program. Till now there are 104 official member countries and 33 associate members throughout the world, including developed, developing and under-developed country²⁷

HISTORY OF PHARMACOVIGILANCE IN INDIA:

It was not until 1986 that a formal adverse drug reaction (ADR) monitoring system consisting of 12 regional centers, each covering a population of 50 million, was proposed for India²⁹. In 1997, India joined hands with the World Health Organization (WHO) Adverse Drug Reaction Monitoring Programme based in Uppsala, Sweden. Three centers for ADR monitoring were identified, mainly based in teaching hospitals A National Pharmacovigilance Centre located in the Department of Pharmacology, All India Institute of Medical Sciences(AIIMS),New Delhi and two WHO special center's in Mumbai (KEM Hospital) and Aligarh (JLN Hospital,Aligarh Muslim University). These centers were to report ADRs to the drug regulatory authority of India. The major role of these centers was to monitor ADRs to medicines which are marketed in India. However, they hardly functioned as information about the need to report ADRs and about the functions of these monitoring centers were yet to reach the prescribers and there was lack of funding from the government. This attempt was unsuccessful and hence, again from the 1st of January 2005, the WHO- sponsored and World Bank-funded National Pharmacovigilance Program for India was made operational.³⁰

The National Pharmacovigilance Program established in January 2005, was to be overseen by the National Pharmacovigilance Advisory Committee based in the Central Drug Standard Control Organization (CDSCO), New Delhi. Two zonal centers-the South-West zonal center (located in the Department of Clinical Pharmacology, Seth GS Medical College and KEM Hospital, Mumbai) and the North-East zonal center (located in the Department of Pharmacology, AIIMS, New Delhi), were to collate information from all over the country and send it to the Committee as well as to the Uppsala Monitoring center in Sweden. Three regional centers would report to the Mumbai Centre and two to the New Delhi Center. Each regional Centre in turn would have several peripheral centers reporting to it. Presently there are 24 peripheral centers.

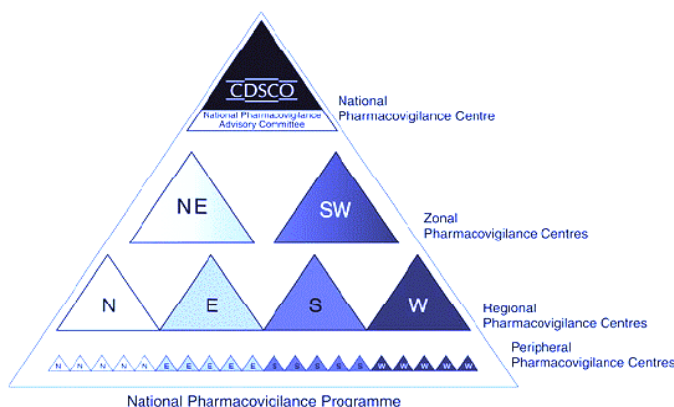


Fig.1.2 NPP

Objectives

The program has three broad objectives:

- ✚ The short-term objective is to foster a reporting culture,
- ✚ The intermediate objective is to involve large number of healthcare professionals in the systems for information provision (reporting) and in information dissemination.
- ✚ The long-term objective is for the program to be a benchmark for global drug monitoring.

The Enormity of the Problem of ADRs

Several studies conducted throughout the world have demonstrated that ADRs significantly decrease the quality of life, increase hospitalizations, prolong hospital stay and increase mortality. A landmark study by Lazarou in 1998 described ADRs to be the 4th-6th leading cause of death in the US and ADRs are estimated to cause 3-7% of all hospital admissions¹¹. More than half of these ADRs are not recognized by the physicians on admission and ADRs may be responsible for death of 15 of 1000 patient's admitted³². To worsen the situation further, the financial cost of ADRs to the healthcare system is also huge. With more new medicines being approved for marketing more quickly without long-term safety studies by the regulatory authorities and switching of prescription-only medicines (POM) to over-the-counter (OTC) to be used more widely by patients for self-medication, the general public is at risk of exposing itself to ADRs. The scenario will further be uglier in our country where poverty, illiteracy, corruption and practicing by quacks is very rampant. In past, India's regulatory agencies and drug companies based their safety assessments on experiences

derived from long-term drug use in the Western markets and there was no real urgency for the government to establish a strong Pharmacovigilance system of its own. In past few decades, however, the lag between when a drug is placed on the market and its subsequent availability in India has decreased considerably so that the much needed long-term safety data is no longer available. In addition, India-based drug companies have increased their capacity to develop and launch new drugs through their own R&D units and this has heightened the importance of developing adequate internal Pharmacovigilance standards to detect adverse drug events³⁵.

However, what needs to be more important along with the funding is a focused vision and effective strategy for developing the Pharmacovigilance systems, especially in the DCGI Office, which is lacking. Traditionally, Pharmacovigilance was never done in India in Pharmaceutical companies, be it Indian or MNCs, so there is an immense shortage of knowledgeable people who will be able to advice the DCGI on this matter, as Pharmacovigilance is a very complex subject, intertwined with regulations and complex systems. The need is therefore to engage a completely independent adviser who has an extensive and practical knowledge on Pharmacovigilance, who can act as a Pharmacovigilance Advisor to the Government of India to effectively implement the systems and policies on Pharmacovigilance. This will help the DCGI to spearhead the activities and implementation of Pharmacovigilance.

A Curriculum Design and Instructional Planning Model for a Project-Based Learning for Sustaining Engineering Education

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Abstract - Engineering graduates should possess outstanding attributes to undertake various tasks in real life from entry-level jobs to chief level. However, most of the curriculum design and instructional planning models don't lead to the ultimate graduates' attributes to meet the challenges of fast-growing disruptive digital technologies and the knowledge-based global economy. The current research has focused on three stages of curriculum design: I. Basic Courses, II. Core Courses, and III. Advanced Courses. In addition, the three-stage curriculum design model has been linked to three-stage instructional planning. In the first stage, the basic courses have to focus on the skills and abilities needed to analyze engineering problems. Needed contextual knowledge of materials, their physical and chemical properties, cost, quality, taxes, transport cost, and availability are to be introduced in the first stage. For this stage, both applied scientists and design engineers are needed to develop a curriculum. In the second stage, through core courses, the links between the basics and their application have to be focused on. The advances in the design software and digital tools are to be incorporated. For this stage, both shop floor engineers and senior engineers are needed. In the third stage, advanced courses, the professionals' skills, and competencies/ attributes needed for Problem Analysis, Design Thinking, Realistic Design, Product/Prototype Development, Testing, Improving, Planning for Mass Production at various Production Centers, Marketing, Maintenance, Scrap Management, and Recycling are to be considered. For this stage, the managers, executives, and senior faculty members in engineering education are needed for planning. The current technologies and emerging technologies in design and manufacturing have to be introduced in the third stage. The whole student-specific instruction will be a mega project-based learning model which will ensure an innovative and ultimate instructional planning model which will help instructors in preparing and delivering. The graduates would learn the managerial competencies to work from the junior level to chief level in a corporate. The three stages have been validated in many field situations and checking the utility by the senior executives of various companies. Such a sustaining development model finds implementation in all professional programs and all areas with needed modifications.

Keywords: Three Stage Curriculum Design Model, Three Stage Instructional Planning Model, Aims of basic, core, and advanced courses, Sustainable Curriculum Design, and Instructional Planning Model.

I. INTRODUCTION

Many curriculum designs and instructional planning models are being used in engineering education in bits and pieces and leaving a large gap in developing industry-specific attributes of the graduates. These models have been developed for a small task and leaving a big gap to achieve ultimate attributes in the engineering graduates. To solve this task in Engineering Education more efforts are required to identify the knowledge needed in every stage. Most of the faculty members neither possess industrial training nor work in key critical areas for problem analysis, realistic design, product/prototype development, non-destructive testing, and performance testing and improving the product, value analysis for effecting moderate cost, planning for mass production with improved production process through well-trained employees, and marketing the innovative product in the global market. Most of the time, there is a need for planning appropriate courses for training the executives, maintenance engineers, and skilled employees in all global outlets. Finally, one has to plan for safe scrapping and retrieving the re-useable components without polluting the environment with toxic materials. Graduate students have to develop skills in sustainability in all stages of their professional careers.

II. LITERATURE SURVEY

Review the most significant curriculum design models in engineering, identify their utilities, drawbacks, and suggestion for improvement for engineering programs are required. A comparison of various curriculum design models is presented in Table.1.

Table-1 Comparison of Various Curriculum Design Models for Engineering Education

Models of Curriculum Design	Utility	Drawbacks	Suggestions for Improvement
Integrated Engineering Curricula (Jefyfrey E. Froyd & Mathew W. Ohland, 2005)	Helps learners to build interdisciplinary links and social links within the community. Provides concrete assessment data on retention and student performance.	Programs implemented to date are not sufficiently well defined to guide the design and implementation of programs at other institutions.	The cost of maintenance is high. Needs external funding from NSF. Institutions can also fund.
Discipline-based curriculum (Geraldine O'Neil, 2010)	Centered on the conceptual structures of the discipline and reform the work of the people in the discipline.	Ignores knowledge that lies between disciplines.	Create clusters of institutions and companies.
Problem-based curriculum	The learning that results from the process of working towards the understanding of a resolution of a problem.	Considers a limited problem encountered in the learning process.	Needs to integrate professional skills and real-life projects.
Faculty wide curriculum reform: the integrated engineering program (John E. Mitchell, Abel Nyamapfene, Kate Roach, & Emanuela Tilley, 2018)	Integrates existing discipline-specific content with threads of professional skills and design through a backbone of problem-based learning experiences.	Yet to integrate professional attributes for total career development.	Needs to integrate professional project management abilities (engineering practices).
Conceptual framework (National Academy of Sciences)	Emphasizes discrete facts with a focus on breadth over depth.	Do not provide students with engaging opportunities to experience how science is done.	Unify the study of science and engineering through their common applications across fields.
Affiliation process (Cornell University)	Nurtures innovative spirits in students' pursuit of careers that benefit human health and quality of life, increasing their knowledge of ways to apply physical laws to solve human problems.	Does not consider industry projects in their career.	Should incorporate industry-relevant attributes for innovative design and production.
Industry Relevant and Interdisciplinary Postgraduate Programs in Engineering and Technology (Thanikachalam. V, 2015)	Basic courses feed mathematic skills for analyses and design. Advanced courses are industry-specific.	Industry-specific field activities like manufacturing, testing, improving are to be added concerning the industry.	Institutions have to create collaborate with the industries for internships and dissertation works.
Planning and Developing Outcome-based Engineering Curricula to Meet the Needs of Fast-growing Indian Industries (Thanikachalam. V)	PEOs and Course outcomes are linked to industry. More industry-specific electives are provided. Job Training is a must. Cooperative programs are essential.	Most of the institutions are not have required collaboration with the industries, hence, implementation has become difficult.	Adjunct faculty can be added for a short time. Part-time faculty can also be added.
Partnerships in Outcome-based Education (Daziell and Gourvanec, 2003)	Course outcomes are identified. Partnerships with the companies are emphasized.	Could be implemented in industrial hubs, if, the companies agreed.	The governments can provide additional norms for grants.

The Essential Skills of an Engineer: A Comparative Study of Academics, Industry Personnel and Engineering Students (Duyen Q. Nguyen, 1998)	Needed cognitive skills, attitudes, and competencies have been identified.	Further courses have to be developed. Job shifts are not considered.	The given scenario can be utilized for planning and implementation
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2.1 Synthesis

These research works focus on the need for considering various skills, competencies, attitudes, exposure to real-life projects, undertaking the industry-specific analysis, design, development, testing, improvement, and mass production. Considering the needs of industries, it will be important to develop a three-stage planning, such as basic level, core level, and advanced level for any engineering program.

2.2 Instructional planning

It is an integral part of the whole curriculum design and development. If the faculty members fail to develop appropriate instructional planning, prepare instructional packages, and adequate exposure to the current manufacturing process, the curriculum will remain as a paper tiger.

Table-2 Models on Instructional Planning for Engineering Programs

Models of Instructional Planning	Utility	Drawbacks	Suggestion for Improvement for Engineering Programs
1. Merrill's Principles of Instruction Task centered on: Activation, Demonstration, Allocation, and Integration	Classroom instruction	Doesn't provide autonomous planning skills followed by total performance.	The needs of engineering graduates from project analysis to maintenance have to be included.
2. Dick and Carey Model: This model focuses on the interrelationship between context, content, instruction, and learning.	Classroom instruction	Don't focus on independent abilities to complete a complex project.	Could include the skills and competencies for task performance.
3. Kemp Design Model Centers on Identifying learning goals, researching the audience, identifying the content, clarifying the instructional objectives, structuring sequence, designing instructional strategies, planning instructional messages, developing evaluation instruments, and selecting learning resources.	Generally used for instructional design of arts and science courses.	Can't provide needed total attributes for independent practice.	The skills and competencies for independent performance in real life have to be added.
3. Bloom's Revised Taxonomy: Centers on Knowledge, Understand, Apply, Analyze, Evaluate, and Create.	Primarily used for school program evaluation.	Steps are not focused on engineering attributes.	Need for total planning and executing skills are to be added.
5. Gagne's Nine Events of Instruction Directs to: Gain Attention, Inform Learner of Objectives, Stimulate Recall of Prior Learning, Present Stimulus Material, Provide Learner Guidance, Elicit Performance, Provide Feedback, Assess Performance, Enhance Retention and Transfer.	Primarily used for classroom instruction. Doesn't focus on andragogy.	It is far from the skills and competencies needed to execute a mega project	Andragogy needs are also to be added.

6. ADDIE Model Consists of: Analysis, Design, Development, Implementation, and Evaluation	Provides guidelines to create effective training modules	It is not focused on the development of needed graduate's attributes	Complete with value analysis, testing, improving, and maintenance skills
7. Action Mapping by Cathy Moore: Provides a visual path to instructional design.	Used in the context of business	Does not meet the challenges of the industry.	Needs to focus more on higher-order cognitive skills.
8. Backward Design/ Understanding by Design: Based on the research on cognitive psychology. An interactive process that promotes constant reflection and improvement of curriculum.	Rightly included long-term performance. Preparation of learning activities based on the goals.	Still short of total self-contained approach.	Should include the steps from analysis to product release and scrapping.
9. Design Thinking Model: Solution-based approach. Components: Empathize, Define, Ideate, Prototype, and Test	Fairly good model.	Fails to create innovation after scrapping the old prototype	Incorporate needed innovations after the half-life value is reached.
10. Fink's Significant Learning Model: Consists of six steps of learning: Fundamental-Knowledge, Application, Integration, Human dimensions, Caring, and Learning how to learn.	Basis of the model: learning to occur, there must be a change in the learner.	Fails to integrate the attributes required for an engineering graduate who has to contribute to different stages of tasks.	The needed skills, aptitudes, motor skills, and human relations are to be incorporated.
11. ARCS Model: Based on the problem-solving approach. Components of the model: Attention, Relevance, Confidence, and Satisfaction.	Incorporates analyzing, sparking, and sustaining learner motivation.	The performing skills are missing.	Need for revising the model by focusing on the professional tasks.

2.3 Discussion

All the instructional design models consider a part of the expected graduates' attributes and do not fully consider the overall skills, competencies, attitudes, analysis, design, prototype development/ assembly, testing, value analysis and costing, manufacturing, maintenance, scrapping, and utilizing. Engineers have to develop instructions based on the professional needs of the work place which are not ensured. Improving manufacturing skills, the engineers have to perform procedural analysis, quality checks, and safety analysis. They have to ensure job aids, ergonomics, tools, and operational manuals. Hence, there is a need for a model which will ensure professional skills and attributes.

III. OBJECTIVES OF RESEARCH

- Develop a three-stage curriculum design and instructional planning model by incorporating the needed cognitive abilities, analytical skills, design abilities, product/prototype development competencies, testing skills, value analysis, improving manufacturing, marketing, maintenance, and scrapping, and utilizing the components or safe disposal of the wastes for sustaining engineering education.
- Adopt sustainable project-based learning in the planned instructional planning for engineering education.
- Validate the model in selected branches of Engineering.

3.1 Research Methodology

It is based on Lincoln and Guba's evaluative criteria. It further, incorporated job analysis, job specification, systematic shadowing of the best field practices, identifying the needed cognitive abilities, motor skills, attitudes, and human relations. The prior knowledge earned, critical problem-solving skills, and interdisciplinary research skills will be identified. Development of ***“Analysis-Design-Prototype-Testing- Refining-Costing-Valuation-Mass Production-Marketing-Maintenance-Safe-Scraping”*** for improving the attributes of the engineering graduates.

3.2 Needs of the Corporate Senior Executives

The senior executives of auto ancillary manufacturing companies, cement manufacturing companies, electrical, and electronic product manufacturing companies, pharmacy companies, software companies, and supply chain companies desired the following graduate attributes:

- Engineering graduates should possess advanced expertise in analytical skills, product planning and development skills, use of software in design, knowledge of human resource management, interpersonal skills, excellent character, and behavior, readiness to learn, managerial skills,
- Design skills, testing abilities, and improving the products,
- Estimation and value analysis, prototype development skills,
- Total quality, modular manufacturing principles, productivity, cost reduction, problem-solving, and critical thinking skills.
- Trends in advances in manufacturing, and
- Potential leaders and Innovators.

3.3 Recruitment Process adopted by Corporates

Most of the corporates prepare job descriptions and plan the recruitment of fresh graduates through the following process:

- Campus recruitment
- Advertising in the mass media
- Online recruitment through job portals
- Retaining the trainees based on their performance
- Selection through direct applications
- Entrance examinations
- One Qualified candidate per one senior employee just before his retirement
- Job fairs
- Special recruitment and selection of outstanding candidates

3.4 Macro Job Analysis

The following macro job analysis is based on the macro analysis of prevailing jobs in substantial Indian companies:

Table-3

Entry Level	Junior Level	Middle Level	Senior Level	Chief
In-house training Exposure to various departments for knowing the technical activities, equipment, product lines, and managers. After training, posting to various departments like Market and Product Analysis, Design, Product Development, Testing, Costing, Estimating, Value Analysis, Manufacturing, Marketing and Maintenance.	Working as a junior officer/ junior engineer/ assistant manager. Coaching and mentoring by senior officers. Training under Corporate's Executive Development Center. Acquiring plant specific cognitive skills, and problem-solving abilities. Focusing on quality, productivity, and value analysis. Improving communication skills.	Taking charge of a unit. Fully responsible for productivity, safety, quality and preventive maintenance, and breakdown maintenance. Undergoes advanced training in the Executive Development Center. Should be capable of conflict resolution. Should coordinate with purchase department, maintenance department whenever required.	Planning level tasks in collaboration with Chief, Ancillary component suppliers. Planning for expansion of the production center. Planning to start new production units in various parts of the country based on the state government incentives, tax concessions, environmental policies, and labor policies. Meeting the officials of the State Industry Development Corporations for getting approval for new units, power supply, roads, etc.	Overall leadership, growth, getting market share, export, government incentives, focus on the bottom line, diversification, adding promising products,

Desired Key performing Skills/ Attributes of Graduates	Gaining needed cognitive, motor skills and attitudes	Department Specific Skills	Industry-Specific Skills	Outstanding Skills
Analytical skills, Expertise in Design, Use of software packages, product development, testing, improving, Productivity, Knowledge of Indian standards, Total Quality Management, Knowledge of global industrial growth, attitude for excellence, lifelong learning. good character and conduct.	Gaining expertise in interdisciplinary research, product design in consultation with the marketing department, work-place environment, prototype development, testing, identification of defects, redesign, improvement, supervising the employees, assuring safe work practices, creating job aids, and improving manufacturing tools.	Checking the cleanliness, safe deposit of tools, systematic storage of ancillary components, checking the lighting, ventilation, and right disposal of waste. Recording the production schedules. Training the employees in preventive maintenance and rectifying the machines.	Overall focus on the trends in the planning and production of components, new global standards, innovation. Focus on environmental safety.	Planning cost-effective components, assuring total quality, high productivity, getting the patents for innovations.

IV. CURRICULUM DESIGN MODEL

It has been considered in three stages as follows:

4.1 Stage I of Curriculum Design: Content development for Basic Courses (Applied Mathematics, Applied Physics, and Applied Chemistry, Communication, Economics, Industrial Psychology, etc.) Constitute a team of engineers, engineering faculty members, science and mathematics faculty, industrial psychologists, economists, and communication specialists. Provided the feedback and suggestions got from the tracer study. For each stage conduct formative evaluation. The following are some of the suggestions:

- State the needs of the topic for engineering
- Identify the problems if this approach is not available
- Relate the cognitive skills to analyze an engineering product
- Relate higher cognitive skills to design an engineering product
- Give examples using these basic courses
- Give assignments
- Motivate the students

4.2 Stage I. Instructional Material Planning for the Basic Courses

Constitute a committee of trained faculty members in the instructional planning and develop needed new textbooks, lab manuals, drawing manuals, case studies, assignments, and model test papers. Download needed video programs, MMPLs. Add suitable seminars and industrial exposures. Edit and publish them.

4.3 Stage II. Development of Curriculum for Core Courses

Constitute a group of outstanding engineering faculty members, design engineers from the industry, senior engineers of manufacturing units, and human resource developers. They have to check the PEOs, courses outcomes, current technology application in the industries. They have to identify the advances in software related to designing, costing, testing, and prototype development. Introduce digital technology in design, testing, and product development. Add needed advances in various branches of engineering. The following are some of the suggestions:

- Relate the core courses to Project-based learning
- Use case studies
- Display the video programs related to the topic

- Relate high order cognitive abilities to design, alternate design, composite materials, easy fabrication by using 3D printing, etc.
- Relate material testing and error reduction to engineering product testing
- Discuss needed lithium materials for manufacturing car batteries
- Identify alternate sources for electricity (wind, solar, geothermal, hydro, etc.)
- Provide examples for recycling paper, steel, zinc, etc.
- Provide case studies on the growth of companies, products, linkages with foreign companies, costing, quality management, etc.
- Provide challenging problems
- Provide assignment to check the current research papers on these issues
- Appreciate the best solutions
- Remove the fear of failure

4.4 Stage II: Instructional Planning for Core Courses

Constitute a committee of expert faculty members and a small group of senior engineers from the industry. Develop suitable textbooks, manuals, case studies, and courses in research methodology. Introduce industry- relevant product planning, design, drawing, value analysis, and estimation. Compare the course materials in various global universities.

4.5 State III: Developing Curriculum for Preparing Industry-Specific Courses with Built-in Attributes and Developing Skills to Plan and Develop Quality Products/ Structures.

Constitute a committee of experienced senior faculty members who have undertaken many consultancy projects, published papers in many international conferences and journals, and who obtained patents. Also, invite suitable representatives of companies. Some of the suggestions are:

Introduce industrial exposure. In this stage, try to add more analysis, design, drawing, estimation, model making, checking the performance, testing, validation, and plan for trial production. Introduce just-in-time learning. Involve representatives of well-established companies in the state and region. Introduce a set of courses on industrial psychology and international growth in technology. Possible courses:

- Analysis of the needs of users
- Knowledge of trends
- Impact of disruptive technologies
- Impact of Industry.4.0
- Innovation in planning and product development
- Advances in various subjects
- Export and global competition
- Global economy
- Advances in research and development
- Advances in quality product development
- Costing and valuing
- Environmental impact assessment
- Alternate product improvement
- Trends in global manufacturing
- Human resources management
- Alternate sources of energy

4.6 Stage III: Instructional Planning Model for Industry-Specific Advanced Courses

Constitute a team of high-performing faculty members, and faculty members who completed outstanding consultancy projects for industries, published innovative papers in various international conferences and journals, faculty who obtained patents. Include design engineers, heads of manufacturing, representatives of research and development units, chief learning officers from various companies for in-depth discussion and development of the advanced courses. Introduce capstone projects and internships in the companies. The following are some suggestions:

1. Analytical skills: These are based on the outcome of basic and core courses like communication, drawing, applied mathematics, applied physics and chemistry, material science, and computer utilities.

2. Product design and prototype development: These are based on design thinking, advanced courses, workshop and manufacturing practices, the right use of tools, following approved practices, and global standards.
3. Checking the cost and conducting value analysis and ensuring the optimum cost in a competitive global market.
4. Testing the prototypes by conducting performance tests and non-destructive tests and collaborating with the shop floor engineers.
5. Checking the real-life performance by identifying the efficiency, identifying defective components, circuits, lubrication, switches, etc.
6. Improving performance by fitting the good quality components and running the product as per specification.
7. Planning mass production by utilizing quality machines with safety, and employing trained workers.
8. Testing the products and certifying the quality, energy consumption, and pollution.
9. Developing a cognitive instructional process to train the junior executives and prepare new products. The graduates need to know the total product manufacturing, choosing the site based on the availability of needed area, electric power, roads, tax concessions, nearness to ports, availability of skilled workers, and conducive environment.
10. Developing a skill-specific instructional design process for improving psychomotor skills to train the employees in developing, manufacturing new products, tools, safe maintenance, and safe scrapping.
11. Conduct value analysis to manage the scrap by isolating toxic components for safe disposal.
12. Go to the first step and create an innovative product based on the feedback from the users and advances in cutting edge technologies.

Design the curriculum with needed learning packages, case studies, and videos on industrial practices. Provide mini-projects related to the branch of study. Get the feedback. Get the industry experts to review the projects and indicate the innovations.

4.7 Faculty Development for Implementing the New Curriculum

Identify the learning needs for implementing basic, core, and advanced courses. For applied science faculty members, provide exposure to various engineering labs, design problems, and testing methods. Conduct a short-seminars on the growth of new products based on the advances in basic courses. Plan in-house faculty development programs based on the needs.

For implementing core courses, provide needed industrial exposure, action research projects, and internships. Introduce advanced courses in various content-based subjects. Encourage to undergo MOOCS under Coursera/EDX.

For implementing advanced courses, provide sufficient opportunities for undergoing needed courses, and industrial internships. Introduce research cluster. Encourage industrial consultancy and interdisciplinary research.

4.8 Validation of the 12 Steps Model

This 12 steps Project-Based Model has been tested as follows:

1. Planning auto ancillary components, product planning, design, estimation, testing, and marketing through the Auto Ancillary Component Manufacturing Companies.
2. Reinforced Concrete Bridges Planning, Design, Estimation, Construction, Testing, and Maintenance in State Highways Engineering Department.
3. Irrigation Structures Planning, Design, Estimation, Construction, Testing, and Maintenance in State Irrigation Engineering Department.
4. Waste Water Treatment Plants, Design, Estimation, Construction, Testing, and Maintenance in Chennai Metropolitan Water Supply and Sewerage Board.
5. Foundations Planning, Design, Estimation, Construction, Testing, and Maintenance of State Public Works Department (Building Division).
6. Highways Pavements Design, Estimation, Construction, Testing, and Maintenance of Payment Design Unit of State Highways.
7. Housing Complex Planning, Designing Layout, Estimating, and Marketing of State Housing Board.

All have been validated. The graduates are market- ready.

V. CONCLUSION

12 Steps model of instructional design for mega project-based learning in engineering education is composed of 1. Analytical Skills, 2. Product Design and Prototype Development, 3. Value Analysis, 4. Testing the Prototype, 5. Checking the Performance of the Product in real-life conditions, 6. Improving the Performance by changing the faulty components, 7. Planning Mass Production, 8. Testing the Product and Certifying, 9. Train the Marketing Executives, 10. Train the Maintenance Employees, 11. Manage Scrap by isolating the Toxic Components for Safe Disposal, and 12. Go to the First Step and Create an Innovative Product.

Design the curriculum with needed learning packages and videos on the industrial packages. Provide mini- projects related to the branch of study. Arrange to review the projects through industry experts and indicate the innovation. This 12 Steps Model has been validated in the undergraduate program of Civil Engineering and Postgraduate Program on Human Resource Development.

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THE ACTIONS ON ZERO HUNGER

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According to the database, the world population projection is 7.7 billion presently. That means yearly it has been changing by nearly 1.05% and As per world population clock the current crude birth rate of the world is 18.9 per 1000 population and death rate is 7.5 per 1000 population then just imagine how rapidly our pollution is growing and How much food we need to survive a family called Earth!

And the questions begin here only about how many acres of fertile lands we need to do for agriculture? And how much we already ruined for different aspects like for industries ,deforestation ,infrastructure etc ...

Among these all other sides we should calculate what kind of food we are consuming . Is it chemical mixed or organic? If not ,then what are the health conditions ? What about immunity? And how can human beings be living in an imbalanced and unconditional situation by ruining their own prime actions from the base of fundamental living rights ? And finally it will create a huge cycling problem for everyone to solve .If it will go in continuity. That is why this one became a great part of SDG work. So it needs many expertise ,manageable and successful persons and more to more need real thinkers ,kind personality propels to discuss this and to take the actions at community level .and this is the one point

And on the other hand, as a youth we have a ton of capabilities ,abilities and many sorts of skills to reach any giant steps in life .But without a mentor it might be quite difficult to reach a probable destination in which way we would like to reach .

So that UN general assembly were set up this 17 SDG activities on 2015 with interlinked of whatever human basic related fundamental rights with having mottos ,agendas and perfection action plans with subordinate different bodies .Under this UN, many sub body commuturs are working like food security committee, security council ,Economic and Social Council, the Trusteeship Council, the International Court of Justice, and the UN Secretariat. Donations for food ,child care by UNESCO and other than these across the universe, an uncountable number of ,educationists ,environmentalists, institutes are connecting to do something to make changes on the earth to make free from all the 17 SDG issues as well .

Then why delay , take the oath as a volunteer and promise yourself that as much as possible we can act towards it and will do that as best as our knowledge with joining each one's hands to make it a successful mission .

With inviting you all to join hands for the SDG theme of the action on zero hunger, I am going to present a few of my own Actions in front of you which are running in my mind circle.

And my first action is :Prior to making Null of poverty and zero hunger actions - institutions , colleges, NGO'S ,schools along with teaching staff should provide as a special knowledge to the students instead of making them GS /class secretary / leadership by giving a little bit of assignments , projects regarding to extract their skills in the tender age about SDG activities it will really helpful to take basic level acts in academic level. As well, it will kindly build their mind power and they also come to know what is happening around us and where the real problems are .Even fundraising box / donation box keeping at school premises and making helping hand actions weekly activities will make students perform well standardly in young age only . Including cultural activities will help them know how to interact with society and what we can do as a reasonable person for this nation and a few of them may be ready to be for society's well being in the future career .

And the second step is ;across the nation many cultural and social organizations ,corporate companies , societal institutions ,rich colonial group builders ,business background people's ,and so called parties ,events will go to conduct as per their wishes with bulk of crackers ,lighting arrangements and many times food wasting will be happens .So have to change the thought on this and better to stop to do these all and instead that we can donate that amount some charity or we can serve food to who really needs .And especially whenever we making birthday celebration at home better to sponsor something as we can from our children hands to orphans children's either we can celebrate with them .It will sticky in their hearts and indirectly one of our step will b go in toot level for the making of better society in food level .

By this we can avoid sound populations ,power wastage ,water pollution ,peaceless activities and the great morality ,humanity will stand out to make everyone's life peaceful and happy . upcoming generations also will follow these steps as a ritual . One small step can create a big historical day on the earth .

Third actions : and in the home, Parents always buying an expensive gifts to the childrens and completely I agree that's their wish but along this please keep some better habits like if you do one good work for neighbours / society / needy people I will buy for you a doll ,will take to you picnic as well parents should carry with them in social activities ,charity functions ,cultural activities ,practicing to them activities in how to deal with problems under the child leadership. For example, what is hunger ,and how hungry children will cry for food on the road, what type of clothes they wore , food served by the child hand , sharing baby collecting saving box to such a child education charity like so many activities we can take from the child hand and the

Fourth actions : tag the board in every hotel , restaurants, street food shops. Respect your food .“Don’t waste the food ,for wasting it will be a penalty for dish washing .As we have seen at many places but in rare points free food survivors are in the midst of us ,no charge for soldiers and for the old aged people in personal and private levels and in the gvt levels 3 meal for 15 rupees in Amma canteen in tamilnadu and indira canteen we can see for 10 ,15 rupees and 5 for snacks .Like In this system have to take charge for double who are wasted food in the hotel ,street food and restaurants in various level strictly prohibited with penalty . When it will become, then only people will become mentally ready to do it .

Fifth and final one action : it’s very light and simple .Everyday before to eat and serving the plate ,in front of the meal pray for everyone near god like “God i am praying to you please provide the same food or whatever you can for every hungry person” keep your blessings on every poverty person” .as per the myths praying system ways will work from the inbuilt of soul connects and such a true heart pray never will lose it will be beneficial to need person by grasping positive energy through a wish .So make it a habit from today onwards .

Conclusion :No one thought will go as failure .It will be an identity on remarkable actions if we do not take any actions ,hard work with each other. That's all .And nothing we can see changes in the world .

Hence ,being a human being ,an educated person ,being a sophisticated civilized ,keep your best steps on No poverty and try to turn it into Zero hunger .

“When we come to know the possibilities we will make it in reality by resolving .if not all, at least in percentage wise. And always remember this by only talking and thinking never will do anything .Only taking actions can show better results .

Use of Biological Sensitive Field Effect Transistor (BioFET) Based Integrated Platforms to Detect *E.coli* Bacteria

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Abstract --- Foodborne illnesses have been correlated with the existence of infectious pathogens such as bacteria in food and drinking water. Furthermore, they have been determined as the major causes of childhood illnesses and deaths in developing countries. Compounding this issue is that many detection methods are expensive, requires training and time to provide a result. This places a constraint in ensuring that water being intake is safe. To ensure the freeness of pathogens, it is required that routine analysis be made especially with the exponential climate change, population increase and rapid pollution due to more industries to meet the demand of the population size. For this reason, it is imperative that rapid forms to detect pathogens be made readily available while ensuring that the methods are all inexpensive, portable and ultrasensitive at the same time. In this study, various biosensors to detect *E.coli* bacteria have been reviewed. Emphasis has been made on field-effect transistors with their detection abilities due to carrier mobility and conductivity. Finally, current BioFET platforms have been investigated and their performance compared to other field-effect transistors.

Keywords: Biosensor, *E.coli* detection, field-effect transistors, nano-biosensors, microfluidics

I. INTRODUCTION

A variety of biosensors, both optical and electrochemical, have been developed for the detection of pathogenic bacteria over the past decade. In the past, detection of the bacteria involved evaluating the infected organism and seeing if there is a growth in the bacteria. However, this process was time consuming. As such, advanced systems have been developed with both signal transduction and pathogen coupling recognition to allow for rapid detection and portability. Requirements for an ideal detector include high specificity and high sensitivity using a protocol that can be completed in a relatively short time. For purpose of this report, the focus is on BioFET based integrated platforms used to detect the *E.coli* bacteria.

The bacteria in study, the *Escherichia coli* (*E.coli*) is a gram-negative rod shaped bacterium with more than 150 serotypes. The bacteria normally live in the intestines of people and animals. For the most part, they can be harmless. However, there are several strains such as *E.coli* O157:H7 that is known for causing severe abdominal cramps, vomiting bloody diarrhea and even death. It was reported that between 2003 and 2012, the Centers for Disease Control and Prevention (CDC) traced 391 O157:H7 outbreaks. These included 4,930 cases of illness, 1,274 hospitalizations, 300 cases of Hemolytic-uremic syndrome and 34 deaths. Other strains such as O104:H4, O121, O26, O103, O111, O145, VTEC O157, and O104:H21 are known to cause other common infections such as urine infections and gastroenteritis [1,2].

As already mentioned, there are many strains of the *E.coli* bacteria. Depending on the strain, we have various symptoms. This becomes important in the design of the biosensor as we need to particularly be aware of the symptoms to determine which strain we are looking at. The strains are called pathotypes. With respect to the various symptoms, a common example is the diarrhea induced *E.coli*.

Enteropathogenic *E.coli* (EPEC) do not produce any toxins. They involve the formation of A/E lesions followed by the interference of host cell signal transduction. When they are ingested, they cling to the epithelial cells of the intestine resulting in bloody diarrhea. Enteraggregative *E. coli* (EAEC), another strain resulting in watery, mucoid diarrhea, are characterized by the strains being able to tissue culture cells in a distinctive brick-like manner. Another strain Enteroinvasive *E. coli* (EIEC) is known to be transmitted through fecal matter and ingested with only a slight contact needed for transmission. When these strains are ingested, invasion of the epithelial cells take place, resulting in a mild form of dysentery. Most common strain in the Enterotoxigenic *E. coli* (ETEC) which leads to watery diarrhea. When present, the strain adheres to the epithelium of the small intestine through colonization antigens. They tend to adapt into various forms to deal with internal body conditions. Finally, a more dangerous strain is the Verocytotoxin producing *E.coli* (VTEC). They are characterized by the production of verotoxins that creates microvascular changes in vivo that can cause paralysis. Most outbreaks are a result of this strain [3,4].

BioFETs are field-effect transistor-based biosensor that is gated by changes in the surface potential induced by the binding of molecules. The use of biological field effect transistors (for the detection of biochemical events have provided possibilities of new sensing systems that are smaller, less expensive, faster, and capable of multiplexing. A BioFET contains the following parts: a semiconductor transducer, a dielectric layer, a biofunctionalized surface, the analyte and a reference electrode. The biofunctionalized surface contains immobilized biomolecule receptors while the analyte contains the dissolved sample molecules. When the target molecules bind to the receptors, there is a change in the surface charge density. As a result, the potential in the semiconductor changes and conductivity in the channel of the field effect transducer occurs. To initiate a response, a bias voltage is applied. The charge flows from the source to the drain electrode creating the drain source current. This flow is controlled by applying an electrical field to form a gate [5]. As a result, the field effect transistor is able to be turned on and off. The gate source voltage in turns generates an electrical field in the transistor channel and influences the channel conductance. In summary, a BioFET is any field-effect transistor that uses biomolecules for either operation or sensing properties in the functionality of the FET.

With this brief summary of both factors for design, various bioFET based integrated platforms have been tested. They have been improved through the use of other field effect transistor materials such as the Graphene field effect transistor (G-FET).

II. TYPES OF BIOSENSORS AND THEIR RESPECTIVE MECHANISMS TO DETECT *E. COLI* BACTERIA

Before continuing, it is important to first discuss what a biosensor is. As reviewed in this course, a biosensor is a sensor that can translate the biological information into the data we can measure, analyze and process. As such it is any device that uses biological components to not only indicate the amount of biomaterial but also assist in providing the information about the biological information. This analytical device is composed of biological receptor and a physical or chemical transducer. Here, the transducer can directly recognize and capture the target analyte and convert the biological and chemical components into quantifiable and analyzable signals [6].

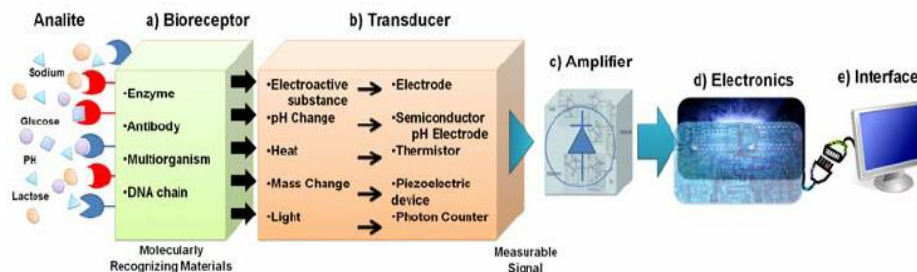


Figure 1: Components of a Biosensor and Associated Mechanisms for Signal Processing [7].

In light of the transduction component, biosensors are arranged into four noteworthy sorts.

A. Optical Based

As the name suggests, these include Optical-including light retention/reflection, Surface Plasmon Resonance (SPR), fluorescence, iridescence, and optical fiber. Over the past decade, optical fiber sensors have developed rapidly due to its superior capabilities as compared with traditional electron sensors because of its small size, light weight, instant response, anti-electromagnetic interference, capabilities of being chemically inert and long distance transmission [8]. Surface Plasmon Resonance (SPR) optical fiber sensors have pulled in much consideration for quite a long time, because of their preferences of high affectability, high sensitivity, capability of being a straightforward or diverse structure, and low cost. They have been applied for refractive index detection of chemical and biological analytes which occurs when plane-polarized light hits a thin metal film under total internal reflection conditions. SPR fiber sensors have more excellent performances such as ultrahigh sensitivity up to several microns per refractive index unit [9].

B. Piezoelectric

These include quartz crystal stone microbalance (QCM), surface acoustic wave, magnetoelastic, and cantilever. Quartz crystal microbalance (QCM) biosensors have been employed for the detection of a range of analytes such as proteins like lysozymes as well as pathogens like *E.coli.* and *Cryptosporidium parvum* [10]. QCM can be utilized to gauge changes in mass and viscoelastic properties of adsorbed and immobilized proteins as an element of time. It primarily depends on the piezoelectric impact. At the point when a voltage is connected to a piezoelectric quartz crystal, the material starts to oscillates. The recurrence of the oscillations will change contingent upon the measure of material stored onto the quartz crystal. The scattering is dictated by estimating the signal once the voltage to the quartz crystal is turned off. Viscoelasticity, or the inflexibility of the kept layer, will make the voltage decay at various speeds.

Magnetoelastic sensors work due to the utilization of a magnetic field that causes them to oscillate. These sensors are manufactured from amorphous ferromagnetic ribbon and offer the likelihood of remote, remote question detecting, in this way making them perfect for joining into computerized frameworks. The sensor wavers with a trademark recurrence that relies on the properties, shape, physical measurements and mass of the material that the sensor is made of in time varying magnetic fields [11].

Piezoelectric-excited millimeter-sized cantilever (PEMC) sensors have been applied for the recognition of a few poisons, proteins, biomaterials, and pathogens such as *E.coli* (strand: *E. coli* O157:H7) and *Cryptosporidium parvum*. This sensor is mass sensitive and has two-layered system with different and various capacities for each layer. The piezoelectric layer is normally made of lead zirconate titanate which acts as an actuator and a sensor. For activation, an alternating current (AC) is passed through the layer of the lead zirconate titanate [12].

C. Electrochemical

Electrochemical biosensors transform biochemical information like analyte concentrations into useful signals that can be analyzed. That is, a current or voltage or ionic and conductance carried out by bioelectrodes. They depend on the enzymatic catalysis reaction between immobilized biomolecules and the targeted analyte which either produces or consumes electrons or ions [13]. As such, the electrical properties of the solution is affected. These include amperometric/voltammetric, potentiometric, impedimetric, and conductometric. Electrochemical reactions in biosensors function by drawing out a measurable current, referred to as amperometric, a measurable charge accumulation or potential, referred to as potentiometric, measuring resistance and reactance which combines to form impedance, referred to as impedimetric or by modifying conductive properties of a medium, referred to as conductometric [14]. These biosensors that use electrochemical transduction primarily need a working electrode, a counter electrode and a reference electrode. The latter mentioned is maintained at a distance from the site of the biological recognition element and analyte interaction providing a known and stable potential. The transduction component is achieved by the working electrode when the interaction occurs. Finally, the counter electrode measures current and facilitates delivery of electrolytic solution to allow current transfer to the working electrode. Both two electrodes previously mentioned are conductive and chemically stable. In addition, they are either made of inert metals or carbon, while the reference electrode is either silver or silver chloride.

D. Calorimetric & Colorimetric

These include ordinary thermistors, compound thermistors and thermopile sensors which works by being dependent on the recognition of warmth delivered from natural responses brought about by enthalpy changes. These temperature changes are determined by the use of thermistors at the entrance and exit of small packed bed columns containing immobilised enzymes within a constant temperature environment [15]. The thermistors, used to detect the temperature change, function by changing their electrical resistance with the temperature. This resistance change is converted to a proportional voltage change with the use of a Wheatstone. For these type of biosensors, they can be referred to as calorimetric where the primary difference is one used to measure heat while the other to measure the concentration of the solution. Nevertheless, they can be used in relation to each other.

Most colorimetric methods provide great potential as they are inexpensive for daily applications while also being low cost and simple to use. As the name suggests, colorimetry is a technique used to determine the concentration of colored compounds in solution. The color change substrates can be easily observed by the naked eye. A very common colorimetric biosensors is the gold-nanoparticle based one. Previous research indicated that a novel biosensor was developed using gold-nanoparticles (AuNPs) for indicating different concentrations of *E. coli* O157:H7. In this proposed research, the magnetic nanoparticles were modified with the captured antibodies while the detection antibodies were used to modify the polystyrene microspheres. They both underwent a reaction with the *E.coli* strand along with the catalysts. The gold-nanoparticles and the crosslinking agents (hydrogen peroxide injected magnetic nanoparticles) were then injected into a catalyst in a mixing channel and heat was applied. This led to a color change of the gold-nanoparticles from blue to red. The color was then measured providing the amount of bacteria present, primarily the concentration in the solution. Here, we see the use of both calorimetric and colorimetric biosensors [16].

Using the various arrangements of biosensors mentioned above, they can be applied for use of identifying *E.coli* bacteria. The ideal conditions for operation and detection of *E.coli* pathogenic strands are derived and summarized in the table below.

TABLE 1: IDEAL CONDITIONS FOR BIOSENSORS DERIVED FOR *E.COLI* DETECTION FROM THE FOUR TYPES MENTIONED [17]

Properties	Value or quality
Sensitivity	Ideally less than 10 cfu/mL
Specificity	It must be able to identify the particular strand of <i>E.coli</i> . versus that of other strands and bacteria. In addition, it should be able to isolate background noises or anomalies in the mixes.

Properties	Value or quality
Detection time	Real-time
Size	Should be compact and portable. Furthermore, it should be able to be carried in travel cases and free from materials that is not allowed in travel.
Consistency	The test should provide results that is in constant range with the results that would be obtained with several testing. Furthermore, the results should not be significantly different than that in the lab.
Stability	The biorecognition elements or biochemicals should have a reasonable shelf life.
Sample processing	The testing should be simple with no pre-treatment needed for the sample.
Operator requirements	It should be able to be use by any person fairly simple.

III. FIELD-EFFECT TRANSISTORS OPERATION AND PERFORMANCE FOR *E. COLI* BACTERIA DETECTION WITH USE OF BIOMOLECULES FOR SENSING

A. Graphene Field-Effect Transistor (G-FET) Biosensors

Graphene has gained interest in biosensors due to its extraordinary electrical properties primarily because of its high carrier mobility and conductivity. For the G-FET based biosensors, two primary conditions have been established. Firstly, there must be an aqueous solution present to provide the liquid condition for the biosensor to operate. Secondly, the graphene surface must be functionalized or programmed to induce the sensing probe needed for biosensing. This is achieved by functionalizing it with antibodies, aptamers or nanoparticles. These aforementioned substances act as the sensing probe for the G-FET biosensors because of its high selective ability and sensitivity [18,19]

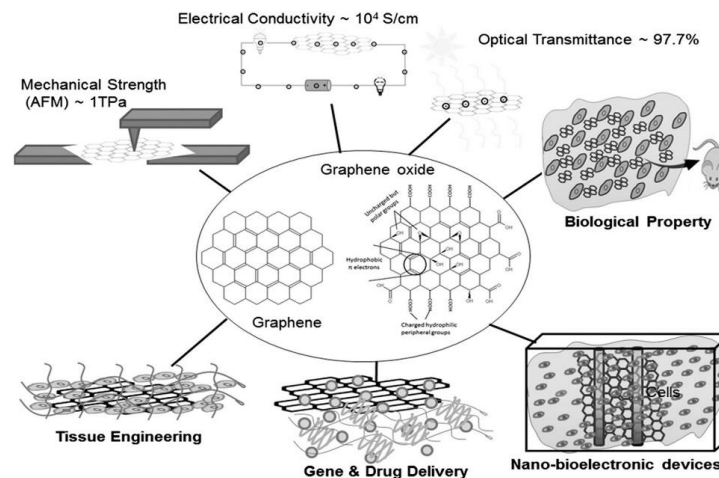


Figure 2: Representation of GN-based electrochemical sensors in DNA, protein and cancer cell detection with GN's excellent mechanical, electrical and optical properties [18].

For detection of *E.coli*, the G-FET biosensor uses an antibody or aptamer as sensing probes. Upon activation, the probe show *E.coli* concentration dependent electrical response, detection of bacteria cells within 120s and motion of the cells when the surface of the graphene is induced with a charge. The efficiency of the biosensor is dependent on the size of the sensing probe. A smaller sized probe allows for charges to be introduced on the surfaces more efficiently. Furthermore, higher bacterial concentrations gives rise to larger electrical response this providing a relationship between the concentration of the bacteria and electrical current. Based on the operation, the performance is therefore a result of the saturation correlation between the active sensing size of the graphene and the size of the bacteria. For the G-FET biosensor, there are three terminals. These are the source, drain and gate electrodes. Both the source and drain electrode, in the study reviewed, was a Silicon wafer with a 300nm oxide layer. The Si chip was then laced with 15nm of Chromium and 90nm of Gold creating the contact pads for the graphene. The active sensing area was design to be as small as possible with the final dimensions being 100 μ m by 100 μ m. It was observed that the motion of *E.coli* in the electrolyte was affected by the gravitational force, Brownian force, drag force from the liquid, the binding force generated from the sensing prove and the force of swimming as a result of the movement of the *E.coli* bacteria [20].

B. Application of Metal Oxide Semiconductor Field Effect Transistor (MOSFET) in *E.coli* Detection

In this section, the use of MOSFETs for detection of *E.coli* bacteria is discussed. Previous research has suggest that a MOSFET based power supply can go beyond detection of *E.coli* and deactivate the bacteria as well as further destroy it. This is achieved through the use of high voltage on the said pathogenic microorganism. The primary objective is to open the pores in the cell membrane which then facilitates delivery of foreign materials in the cell, thus ultimately killing it [21]. As such, two parts of this experiment was deduced: detection of *E.coli* bacteria and deactivation of the cells. The testing solution was comprised of *E.coli* O157:H7 inoculated into 10mL of Luria Bertani (LB) broth which was allowed to grow overnight at room temperature while simultaneously rotating at 200 rpm. Two millimeters of the overnight culture was then transferred and placed in a 500mL flask of fresh LB broth and was allowed to grow under the same conditions. The growth continued until it was ensured that the optical density reached 0.5 to 0.7. For detection purposes, 3.3 kb pGF Puv plasmid DNA was used and once an electric field was induced it developed across the parallel plate electrodes. The pGF Puv plasmid contains the pMB1 origin of replications from PUC 19. PUC 19 is a mutant gene from the marine jellyfish *Aequora Victoria*, and a *bla* gene for ampicillin resistance. Both replication and ampicillin resistance facilitates the selection and confirmation of not only the initial level of *E.coli* bacteria present but also how much and fast the pathogenic cells become deactivated. The MOSFET based pulsed power supply was capable of supplying square pulse of up to 3000V. It was noted that when using low field (1.30 MV/m) microsecond pulse as well as high field (2.15 MV/m) microsecond pulses. There was not enough energy to make the cell membrane permeable. However, when switching to a millisecond time period, the number of cells in the initial population that were transformed increased from 1 in 642,857 to 1 in 34,305. It was seen that an increase in the electric field strength resulted in a decrease in the survival ratio. As such, it is was concluded that for MOSFET based systems, when the field strength increase in the range of 1.2 – 2MV/m for 1ms pulses, thus decreasing the survival ratio. Similarly, for G-FETs, it can be proposed to further design for BioFET or integrate them with MOSFETS to not only detect *E.coli* but eradicate the bacteria [22, 23].

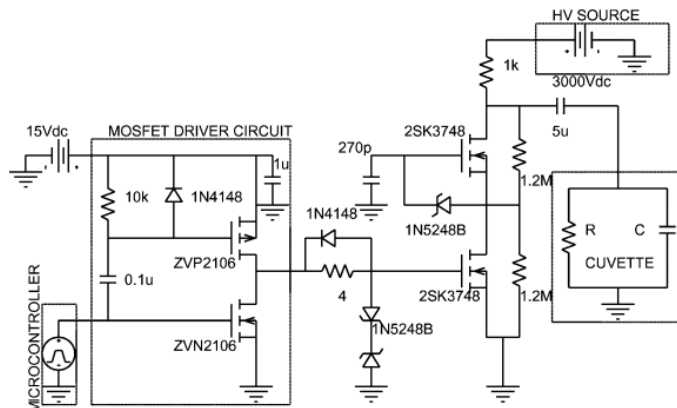


Figure 3: Circuit diagram of the series-MOSFET pulsed power supply [22].

C. Carbon Nanotube Field-Effect Transistor (CNT-FET) Biosensors

Single walled carbon nanotubes have been known for its extensive and outstanding properties such as biocompatibility, size compatibility and sensitivity towards minute electrical perturbations. Furthermore, they are capable of operating at room temperature and reagentless which becomes significant in being portable, easy to use and readily available. Carbon nanotubes field effect transistors (CNT-FET) have been used to detect biological molecules such as viruses, bacteria, DNA and enzymes through two mechanisms: charge transfer mechanism (electrostatic gating) or by the Schottky – Barrier modulation effect. Electrostatic gating is a very common approach to alter the properties of a thin film material [24]. Because, in field effect transistors, controlled and reversible changes in the carrier concentration of the channel material are induced by applied electric fields, this principle can be utilized. As such, it facilitates the development of novel devices that can be used to test basic properties of materials faster and simpler versus typical chemical doping.

The CNT-FET was prepared by separating metallic from semiconducting nanotubes either using sulphuric acid or nitric acid. It was then immerse in a 6mM solution of methyl formamide solution at room temperature and left overnight. The CNT-FET was washed with de-ionized water and blown dried with nitrogen. It was then submerged with 4.7mg/mL solution of *E. coli* O157: H7 antibody in phosphate buffer solution (PBS) overnight. Finally, it was then re-rinsed with de-ionized water removing any remaining unreacted antibodies and dried under nitrogen.

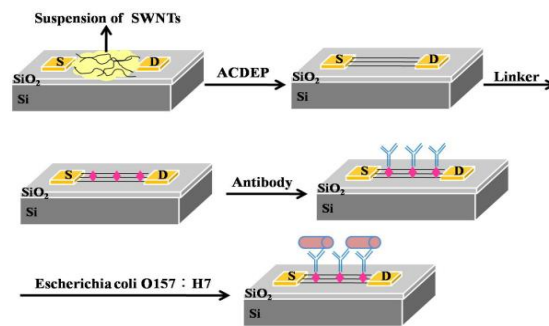


Figure 4: Schematic illustration for fabrication of CNTFET immune biosensor [25].

The nanotubes were functionalized using corresponding receptor molecules as recognition layer to realize specific detection of biomolecules. The CNT-FET channels were modified with the antibody. Linker bifunctional molecules can attach with the nanotube as well as to the antibody, creating a bridge medium. As a result, it was seen that the antibody on the CNT-FET caused a significant decrease in the source-drain resistance. This is summarized as the capturing of the antibody which then results in the change of the resistance. Upon obtaining, these electrical properties, the biosensors was washed with de-ionized water and dried under nitrogen again. With use of a scanning electron microscope, it was possible to see if the *E.coli* bacteria were attached to the channels. It was concluded that real time analysis was possible and the CNT-FET biosensor were indeed sensitive to change of concentration with a short response time [25,26].

IV. CONCLUSION

As already mentioned, it is very important that rapid forms to detect pathogens be made readily available while ensuring that the methods are inexpensive, portable and ultrasensitive all at the same time. As clearly seen in this discussion, nanotechnology has broadened the horizon in advancing current tools to diagnose and combat health problems globally. When establishing a biosensor, it is obvious that sensitivity, specificity, non-toxicity, small molecule detection and cost effectiveness is pivotal in the design process. For G-FETs, it was seen that the graphene bacteria distance, which is defined by the size of the sensing probe, is major in improving sensing performances of biosensors as surface charges are induced more efficiently providing a larger electrical response. Moreover, there is a relationship between the source-drain current, the graphene bacteria distance and the concentration of the bacteria. This relationship is summarized as both high bacteria concentrations and smaller graphene bacteria distance results in larger changes of source-drain current. Using this relationship, the performance and design of G-FET biosensors can be optimized continually. Likewise, the CNT-FET provided a label free rapid and sensitive detection of *E.coli* pathogens. As proposed, the use of single walls provided improved sensing response as well as using carbon nanotubes provided an increase in the sensing surface area for molecular recognition while also acting as sensing elements that responds to surface modification. The major advantage was seen as the CNT-FET can exhibit sensitivity and specificity in a five (5) minute detection time thus achieving one of the primary goals for rapid detection. As such, nanomaterials and carbon based FETs have proven to provide suitable bio-sensing abilities for detection of *E.coli* pathogens that can also be can be further integrated into portable multiplexed devices for use in food safety industries, agricultural areas, border protection, bioterrorism combating and, of course, inside households.

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Emerging Therapeutic modalities against COVID 19

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Abstract - The coronavirus disease 19 (COVID-19) is an extremely pathogenic, contagious infection originated by SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2), which come out from China and transmit throughout the world. Due to high dissemination rate of SARS-CoV-2 infection in the people, the adequate evidences in context to potent treatments for this disease are required. Till now, there is no effective medicines available against this virus. The detailed structure of SARS-CoV-2 gives a significant options of potential drug targets which can be used for the elimination of this fatal infection. Remdesivir has shown potent potential against SARS-CoV-2 in *in vitro* investigations, however it is not authenticated by US Food and Drug Administration and is being examined in ongoing clinical randomized studies. The usage of Cytokine inhibitors like Tocilizumab, elsilimomab are in clinical trials for their protective efficacy against COVID-19 infection. Moreover, corticosteroids are currently not recommended due to their negligible effect on clearance of viral load and it makes a patient more susceptible to secondary infections. In addition to it, many plants and their secondary metabolites have also proven to be effective in the inhibition of virus invasion, its replication and assembly. The speed and number of clinical studies highlight the hope that soon we will get the effective medications which will make COVID-19 less life-threatening infection.

I. INTRODUCTION

Several seasonal epidemic and occasional pandemic outbreaks in humans, bird and animals are caused by viruses. The world has endured many respiratory infections due to various classes of influenza virus and pigs serve the huge carrier of these viruses. The H1N1 (Spanish flu) and Asian flu (H2N2) caused the mortality rate approximately 50 million and 4 million people globally. Likewise, 1 million people has been annihilated due to Hong Kong flu (H3N2). Other deadly coronavirus SARS-CoV and Middle East respiratory syndrome coronavirus (MERS-CoV) has been originated from Coronaviridae family which leads to two regional outbreaks- MERS (middle east respiratory syndrome) and SARS (severe acute respiratory syndrome). These pathogenic viruses induce an acute respiratory distress syndrome (ARDS) and acute injury in lungs that ultimately result in failure of the lungs (Zhong *et al.*, 2003; Centers for Disease Control & Prevention, 2005; Wang *et al.*, 2013). These viruses are 65-125 nm in size, consist of single-stranded RNA (26 to 32kbs). The coronaviridae family is further divided into alpha (α), β beta), delta (δ) and gamma (γ) subgroups. Latestly Wuhan, a business hub of China accustomed an outburst of a novel highly contagious β group coronavirus (SARS-CoV-2) which cause more than 1800 mortality and spread the infection over 70,000 individuals in the first two months of the outbreak (Shereen *et al.*, 2020).

II. STRUCTURE OF SARS-COV-2

SARS-CoV-2 consist of a thirty thousand base pairs, positive-sense, single-stranded RNA which is surrounded by the envelope membrane (Saikatendu *et al.*, 2005; Lu *et al.*, 2020). The genome of SARS-CoV-2 encode several structural and non-structural proteins. Structural proteins are membrane envelope (E), spike (S), and nucleo-capsid (N) proteins at 3' terminal region and two viral replicase polyproteins namely pp1a and pp1b at the 5' terminal end. These two viral replicase polyproteins produce non-structural proteins (nsp) like helicase, papain-like protease, 3-chymotrypsin-like protease, and RNA-dependent RNA polymerase (RdRp) upon proteolysis and assist in the life cycle of virus (Angeletti *et al.*, ;Zumla *et al.*, 2016). All these viral proteins might be potential targets for the drug discovery in future and till now E protein, Spike protein, N protein and RdRp are under investigation for targeting against SARS-CoV 2 (41, 42, Su *et al.*, 2020)

The glycoprotein through which coronavirus enters into the mammalian host is the spike protein (Chen *et al.*, 2020; Khailany *et al.*, 2020; Letko *et al.*, 2020). This protein encodes three domains a single-pass transmembrane anchor, a large ectodomain and a short C-terminal intracellular tail (RCSB, 2020). The ectodomain contain a receptor-binding unit S1 which binds to a specific cell surface receptor angiotensin-converting enzyme 2 (ACE2) and a membrane-fusion S2 stalk assist in the binding of viral membranes to host cell and ultimately viral genomes enter into the host cells (Yuan *et al.*, 2020; Shang *et al.*, 2020; Lan *et al.*, 2020). ACE2 is present throughout the animal kingdom with conserved primary structures. ACE2 from fishes to mammals can fuse with the RBD (receptor binding domain) of COVID 19 and plays a crucial role in the infection rate of virus (RCSB, 2020). Thus, thwarting of the binding between the RBD and ACE2 interaction is a significant treatment option to cure the SARS-CoV2 infection. Specific molecular blockers and antibodies can hamper the interaction of receptor binding domain with ACE2.

N-protein is attached to the RNA strand of virus which assist the virus to transform human cells into viral factories. This protein might be a critical drug target as the blocking of the attachment between RNA strand and N-protein can hinder the replication and transcription of virus (Boopathi *et al.*, 2020).) The pyrimidone and theophylline drugs are the probable blockers of contact between the N protein to RNA genome of coronavirus, therefore it reveals novel outlets for *in vitro* affirmations. The M-protein

is present on the surface of virus in a huge amount and it is supposed to be act as the facilitator for the aggregation of viral particles. The small membrane protein E contain 76 -109 amino-acid and it exhibits major part in assembly of viral particles, permeability of the cell membrane of host and interactions among the virus and host cell (Sarma *et al.*, 2020 ; Gupta *et al.*, 2020).

Among the non-structural proteins, nsp5 has important part in the multiplication as well as maturation of COVID 19. As a main constituent, the nsp5 is named as the main protease (Mpro). Similar with other pathogenic agents, the functional importance of chymotrypsin-like protease (3CLpro) or Mpro of COVID 19 provide a potent drug target for the finding of effective antiviral therapeutics. Like other coronaviruses Mpro encodes three domains. The domain I and II are arranged as an antiparallel β -barrels similar with the chymotrypsin and consisting of 8–101 and 102–184 amino acids respectively. In addition to it, the domain III made up of 5 α -helices which align into a antiparallel globular cluster and 201–306 amino acids. Intriguingly, a expanded loop region is present between the domain II and III and it comprised of 185–200 residues. The substrate-binding pocket of COVID 19 Mpro has Cys-His catalytic dyad and it is found in a depression among the domain I and II (Jin *et al.*, 2020).

The nsp12 of COVID 19 encompassed RdRp which assist in the replication of the RNA genome. The active domain of the polymerase is comprised of A-G conserved motifs and two consecutive aspartate residues (Xu *et al.*, 2003; Gao *et al.*, 2020). Multiple sequence alignment (MSA) of SARS-CoV-2 demonstrated that the SARS-CoV RdRp possess close proximity to the RdRp of SARS-CoV-2 (Elfiky *et al.*, 2020). This data may provide a platform for the development of novel agents against SARS-CoV-2.

III. CLINICAL MANIFESTATIONS OF COVID-19

COVID-19 is mainly transmitted by the respiratory secretions, by droplets and direct contact. Moreover, this virus is also present in fecal swabs and blood which indicate its multiple routes transmission (Li *et al.*, 2020; Zhang *et al.*, 2020). According to the recent epidemiological studies, the signs of this infection present after 14 days (incubation period), around 3–7 days (Jin *et al.*, 2020). It is based on the age and immune status of the patient. It is seen mostly in the age group of >70-years old in comparison to those who are under the age of 70 (Wang *et al.*, 2020a). Mostly patients show fever, tiredness, cough, headache, diarrhoea, difficult or laboured breathing, haemoptysis and decrease in lymphocyte count (Ren *et al.*, 2020; Huang *et al.*, 2020; Wang *et al.*, 2020; Carlos *et al.*, 2020). Some patients in severe condition develop clinical symptoms like pneumonia, ARDS, RNAemia, respiratory failure, acute heart injury, organ failure and even death.

Therapeutic Modalities

Currently, no specific vaccine and effective drug is available for the cure of COVID-19 infection. At this time, many therapeutics are under search for the cure of this viral infection (Liu *et al.*, 2020; Lu, 2020). The requirement of a competent drug for the management of COVID-19 compel us for the evaluation of the already present antiviral medications which are in common use for other viral diseases. Especially, in consideration of the analogy among the SARS-CoV-2 and remaining Beta coronaviruses related with earlier outbreaks as SARS-CoV and MERS-Cov, the similar medicines tested with dubious outcomes against COVID-19 (Zumla *et al.*, 2016; Lim *et al.*, 2020).

Vaccines:

All the vaccines trials are in the preclinical phase. Out of the various vaccine candidates, DNA or RNA based vaccines and viral vectored vaccine has been investigated. INO-4800 is one of the DNA plasmid vaccine and formulated by INOVIO Pharmaceuticals (IP) and Beijing Advaccine Biotechnology (Carlson, 2020). Clover Biopharmaceuticals is designing a recombinant vaccine by using trimeric Spike protein (Duddu, 2020). In addition to it, the lipid nanoparticle encapsulated mRNA vaccine (mRNA-1273) designed by NIAID (National Institute of Allergy Infectious Diseases) in collaboration with Moderna, Inc Cambridge, Massachusetts has checked on 45 healthy adult volunteers for 42 days. The trial has been promoted to Phase 1 (Park, 2020). ChAdOx1 nCoV-19 is comprised of a non-replicating adenovirus vector and the genetic sequence of the S protein of SARS-CoV-2. This vaccine is in phase III trial and innocuous for people due to the non-replicating behavior of adenovirus vector.

Antiviral Agents

Lopinavir-ritonavir

Ritonavir-boosted lopinavir has been approved (2000) in HIV-patients by the U.S. Food and Drugs Administration. Some investigators demonstrate the potential of combination of lopinavir/ritonavir against MERS-CoV and SARS-CoV infections. Metabolism of lopinavir occurs in the liver by CYP3A (cytochrome P4503A) isoenzyme. Lopinavir is always use in combination with ritonavir to lower the concentration of lopinavir and enhance the amount of lopinavir as ritonavir hinder CYP3A isoenzyme. Ritonavir-boosted lopinavir are antiretroviral protease inhibitors, used as a second-line drug against HIV infection with negligible toxicity (Huang *et al.*, 2015). The target for finding an effective drug against Corona infection is viral protease which has crucial role in the synthesis of polyproteins that are essential for multiplication of Corona virus. Out of many anti-HIV-1 protease inhibitors,

these drugs have been exhibited the maximum inhibitory potential against COVID-19 (Dayer *et al.*, 2017). On the basis of previous studies on protective efficacy of lopinavir/ritonavir against MERS and SARS CoV infection, the ICMR (Indian Council of Medical Research) has recommended the use of this drug combination (200 mg/50 mg - 2 tablets every 12 h for two weeks) for symptomatic severe ill patients. Other therapeutic options such as IFN- β 1b and ribavirin was not advised because of their adverse effects. Fortunately, after administration of lopinavir/ritonavir, it resulted the significant reduction in viral load of β -coronavirus viral loads and negligible concentration of this virus were found. It might be possible that this clearance of viral load is associated with natural healing process rather than the effect of lopinavir/ritonavir. Thus more studies are required to be done to validate the protective effect of this combination (Bhatnagar *et al.*, 2020, Lim *et al.*, 2020).

Remdesivir

Remdesivir is a nucleoside analog with huge antiviral potential and proficient cure of different viral infections such as Ebola and Nipah related infectious diseases (Lo *et al.*, 2019). It is RNA-dependent RNA polymerase (RdRp) blocker and it has the ability to hamper the multiplication of several coronaviruses in respiratory cells. This drug has revealed therapeutic and prophylactic potential in nonclinical models of coronaviruses (de Wit *et al.*, 2020; Sheahan *et al.*, 2017; Wang *et al.*, 2020). Remdesivir administration after two days of infection in murine model of SARS remarkably caused reduction in viral load in lungs but did not decline severity or mortality of infection (Sheahan *et al.*, 2017). It has revealed protective efficacy against SARS-CoV-2 in Vero E6 cells and revealed 50% effective concentration (EC50) and EC90 of 0.46 μ g/mL and 1.06 μ g/mL respectively (Wang *et al.*, 2020). Coronaviruses showed moderately resistance to remdesivir in *in vitro* analysis, however it remain vulnerable to more concentrations of remdesivir (Agostini *et al.*, 2018). This drug has marked safety index clinically on the basis of earlier studies in patients for acute Ebola virus infection (Mulangu *et al.*, 2019, European Medicines Agency, 2020). Grein *et al.*, 2020 described the compassionate use of remdesivir (two hundred mg iv on one day, followed by hundred mg for nine days) to COVID-19 infected individuals and it leads to 68% clinical improvement. In another randomised, placebo-controlled multicentre trial in China demonstrated that remdesivir did not cause a marked decline in viral load or presence in upper respiratory tract. It also presents some side effects such as anorexia, nausea, vomiting, higher levels of bilirubin, and impaired cardiopulmonary status. The limitation of the ongoing investigations is the small sample size, therefore more studies should be carried out with larger sample size to confirm the efficacy of remdesivir against COVID-19. Moreover, we can also check and enhance the potency of remdesivir in combination with other therapeutic agents against SARS-CoV-2 which also reduce the host immunopathological responses related with COVID-19 severity (Wang *et al.*, 2020).

Antimalarial Agents

Chloroquine phosphate

Chloroquine phosphate is an antimalarial drug, have revealed protective efficacy with adequate safety profile against COVID-19 linked pneumonia in multicenter research trials run in China. It is advised to be part of the next version of the instructions for the prohibition, Diagnosis, and Cure of pneumonia induced by SARS-CoV2 announced by the National Health Commission of China against COVID-19 infection (Gao *et al.*, 2020). The mode of action of chloroquine is to halt the glycosylation of the Ace-2 receptor, endosomal endocytosis and TLR's (toll-like receptor) activity (Vincent *et al.*, 2005; Savarino *et al.*, 2006; Devaux *et al.*, 2020). It limits the binding of virus to receptors, leads to a favourable effect of the drug on entry and after-entry stages of the corona virus infection. Moreover, recently chloroquine has been checked in approximately ten random research trials in China against COVID-19 in different combination with the anti-viral medications (Chinese Clinical Trial Registry, 2020). It is found that chloroquine is better than control treatment in the improvement of lung imaging, reducing the aggravation of pneumonia which ultimately limits the disease severity (Gao *et al.*, 2020). In another *in vitro* investigation, hydroxychloroquine found to be thrice times more superior than chloroquine (Yao *et al.*, 2020).

Anti-Cytokine therapy

Some COVID-19 patients showed multiple organ failure in the later stage due to induction of cytokine storm (CRS) (Zhang *et al.*, 2020). Cytokine storm (CRS) is a type of hyper-immune mechanism which produces a rapid secretion of cytokines in response to external stimulus that will results in systemic inflammation (Ferrara *et al.*, 1993). It is found that approximately 25% of COVID-19 patients faced severe complications such as acute respiratory distress syndrome (ARDS) (Fu *et al.*, 2020) and is induced by the huge secretion of cytokines linked with viral replication and lung injury (Mehta *et al.*, 2020). Additionally the higher concentration of these cytokines are inversely proportional to the absolute lymphocytes count (Diao *et al.*, 2020). The enhanced titre of IL-10, TNF alpha, IL-6 and IFN- γ have been seen in several cases of ICU COVID-19 patients (Huang *et al.*, 2020; Li *et al.*, 2020. Zhou *et al.*, 2020, Yang *et al.*, 2020, Gong *et al.*, 2020). From all of these cytokines, IL-6 has allured more attention and therapeutic agents that inhibit the IL-6 receptor (tocilizumab and sarilumab) are in phase 2/3 clinical trials for the effective cure of COVID-19 (Zhang *et al.*, 2020).

IL-6 Inhibitors

Tocilizumab, an anti-IL-6R humanized monoclonal antibody which can adhere to membrane-bound and soluble form of IL-6R and it might be an effectual mode for the cure of cytokine storm in SARS-CoV2 infection. In the phase one, COVID-19 patients showed disseminated lungs abrasion and consistent pyrexia before treatment. When we administered tocilizumab with conventional therapeutics, the pyrexia of 11 patients had normalized within one day. In the meantime, the respiratory function and horowitz index were bettered and CT scan indicated remarkable recovery of lungs injury in four infected individuals. Thus, tocilizumab can be a worth choice drug for those patients who are severe ill with COVID-19. Moreover, Genentech declared that the US FDA has endorsed a random, placebo-controlled Phase III trial (double-blind) for tocilizumab to cure severe pneumonia in covid-19 patients. This study aims to determine the safety index and potential of tocilizumab (intravenous) in severe COVID-19 patients (Zhang et al., 2020a, Genentech, 2020).

Ruxolitinib is a Janus kinase (JAK) inhibitor and effective in the cure of myeloid neoplasm (Verstovsek *et al.*, 2010; Vannucchi *et al.*, 2017). It reveals potential against isoforms of JAK which has a crucial part in the signalling of inflammatory chemokines (Mesa, 2010). When IL-6 bind to IL-6R and sgp130, it initiate intracellular signalling by the JAK/STAT (Janus-kinase/Signal transducer and activator of transcription) (Zegeye *et al.*, 2018, Johnson *et al.*, 2018; Villarino *et al.*, 2017) and mitogen-activated protein kinase (MAPK) (Wolf *et al.*, 2014, Heinrich *et al.*, 2003). Thus by inhibiting IL-6 intracellular transduction pathway, we might halt the IL-6 action. Moreover it is demonstrated that ruxolitinib caused the significant decrease in the titre of several inflammatory chemokines like TNF- α and IL-6 in inflammatory human macrophages (Bjorn and Hasselbalch, 2015). Further in another study, the levels of IL-6 and TNF- α , were found to be declined by the treatment of ruxolitinib at mRNA and protein level (Febvre-James *et al.*, 2018). Therefore, Ruxolitinib can be used as an ideal agent in the later stages of COVID19 infection and currently this drug is being checked in few infected individuals in Italy.

Baricitinib is effective and potent inhibitor against JAK-STAT signaling, therefore it is not only reducing the concentration of IL-6 (Choi *et al.*, 2018), but it is also effective to hinder the clathrin-mediated endocytosis and viral load of cells. This agent reduces viral infection *in vitro* by targeting factors of the numb-associated kinase (NAK) family (Bekerman *et al.*, 2017). It can be given orally and has acceptable adverse effects, only show small interaction with drug transporters and CYP enzymes (Stebbing *et al.*, 2020). In addition to it, other monoclonal antibodies targets IL-6 are elsilimomab (BE-8), sirukumab, clazakizumab (BMS945429) and olokizumab which are in various ongoing phase trials to reveal their potential and safe profile in different pathogenic conditions (Sieper *et al.*, 2015, Smolen *et al.*, 2014, Rovin *et al.*, 2016, Weinblatt *et al.*, 2015, Danese *et al.*, 2019). The protective efficacy of sirukumab has been examined in a phase trial against SARS-CoV2 infection. Moreover, another therapeutic glatiramer acetate also revealed efficacy to hinder the JAK/ STAT pathway which ultimately reduced the levels of IL-17 and IL-6 in an autoimmune encephalitis (Begum-Haque *et al.*, 2008).

TNF inhibitors

Additionally, the S proteins of virus produce a TNF- α -converting enzyme which is important for the binding potential of the virus and production of TNF α (Haga *et al.*, 2008). It can be possible that the TNF inhibitors might be a good option in decreasing viral load and organ damage in SARS-CoV2 infection (Wang *et al.*, 2007). Therefore, a research investigating adalimumab in SARS-CoV2 infection has currently been certified in the Chinese Clinical Trial Registry. Many TNF- α blocking antibodies like etanercept, and golimumab are successfully used to cure inflammatory infections and these treatments have been suggested for the severe COVID-19 patients (Feldmann *et al.*, 2020).

Other Cytokine inhibition

Moreover, IL-10 is increased to lower the severity of COVID 19 infection, but it also cause the infiltration of inflammatory cells and lung fibrosis (Sun *et al.*, 2011). Thus IL-10 blocking is worthwhile for rejuvenating exhausted T cells and also limit the pathogenesis during COVID-19 (Saeidi *et al.*, 2018, Sun *et al.*, 2011). However, there are some lacunas of cytokine therapy like the development of chronic inflammatory disorders, therefore more investigations should be carried out to confirm whether hyperactivation or blocking of cytokines like IL-10 can be assist in the control of COVID-19 infection (Kodaz, 2020).

Convalescent plasma therapy

Another treatment option for the prevention of SARS-Cov 2 infection is the usage of Convalescent plasma which is the transfusion of plasma loaded with antibodies from recovered individuals from a disease (Chen *et al.*, 2020; Luke *et al.*, 2006). The significance of this therapy is that it provides immediate immunity for individuals. It can be used therapeutically and prophylactically to reduce the severity of the disease (Casadevall and Scharff, 1994; Casadevall and Pirofski, 2003). Its mode of action is the first transfused antibodies bind to the pathogen which leads to phagocytosis, cellular cytotoxicity and neutralization of the pathogen (van Erp *et al.*, 2019; Gunn *et al.*, 2018). This therapy was already tested in other corona viruses, SARS-CoV and MERS (Zhang *et al.*, 2005). A meta-analysis review of eight speculative investigations with 714 individuals with either severe influenza or SARS demonstrated that treatment with convalescent plasma caused the significant decline in mortality with negligible side effects (Mair-Jenkins *et al.*, 2015). Infact, the first case report of five severe COVID-19 patients in China administered with convalescent plasma showed the

decreased viral burden and improved chest imaging and fever (Shen *et al.*, 2020). Moreover, a case report of treatment of three COVID-19 patients in China with immunoglobulin intravenously at the concentration of 0.3-0.5 g/kg/d for five days was also reported (Cao *et al.*, 2020). Duan *et al.*, 2020 also demonstrated the efficacy of plasma therapy clinically in terms of improvement in fever, breathing, cough and chest congestion with no adverse effects.

Corticosteroids

The usage of corticosteroids is to reduce the inflammation in the lungs of the host, which may result in some complications like acute lung injury and ARDS. However, this advantage may be predominated by side effects like usage of these steroids cause a patient to more prone to secondary infections and delay in viral clearance (Russell *et al.*, 2020). Currently, several Scientist suggested that corticosteroids, importantly methylprednisolone can reform the impaired immune response induced by sepsis in COVID-19 infection and elevate the low blood pressure (Lamontagne *et al.*, 2018). Precisely, a retrospective cohort analysis including 201 COVID-19 individuals with ARDS were administered with methylprednisolone (1–2 mg/kg intravenously daily for 4–7 days) demonstrated that methylprednisolone might be useful in the decline of the mortality. In Brief, of those individuals with ARDS who administered methylprednisolone treatment which results in 46% mortality, whereas 61.8% mortality occur in those patients who did not administer methylprednisolone (Wu *et al.*, 2020). Moreover in another investigation, treatment of methylprednisolone showed improvement in hypoxia and fever in 46 ICU COVID-19 patients who developed respiratory failure (Wang *et al.*, 2020). However, the role of corticosteroids is still contradictory as Huang *et al.*, 2020 indicated the corticosteroids possess negligible effect on clearance of viral load. In addition to it, the IDSA (Infectious Diseases Society of America) advocates against the usage of corticosteroids daily in COVID-19. However, they endorse the utility of corticosteroids in the patients with ARDS in the view of a clinical trial (Bhimraj *et al.*, 2020). Therefore, the clinical usage of corticosteroids should be based on the severity of infection in patient and it is still required to be established.

Potentially effective natural compounds

Natural compounds derived from plants hamper the multiplication of virus and also decrease the cytokine storm by regulating the immune response. Citrus fruits contain a flavonoid Hesperetin which have the potential to decline the protease cleavage action of virus. It was observed that hesperetin has the ability to hinder the ACE2 receptors and stop the SARS-CoV-2 infection (Li *et al.*, 2019). In another investigation, efficacy of *Camellia sinensis* against coronavirus reported that Epigallocatechin gallate exhibited more binding energy with Mpro of SARS-CoV-2 as compared to chloroquine and remdesivir (Sharma and Deep, 2020). Moreover, docking studies at molecular level showed that active phytoconstituents of *Camellia sinensis* like epigallocatechin 3-gallate, genistein, caffeoylquinic acid, theaflavin, and ethyl transcaffeate presented affinity against protease of SARS-CoV-2 (Kanbarkar and Mishra, 2020). In addition to it, a silico study displayed that flavonoid mainly luteolin and chlorogenic acid, displays the capacity to covalently attach to the main protease of SARS-CoV-2 and leads to irretrievable inhibition of viral enzyme (Mohapatra *et al.*, 2020). In another investigation, it was observed that the phytoconstituents of Neem leaves caused the reduction in the activity of Mpro of SARS-CoV-2 (Subramanian, 2020). Lately, research on *M. oleifera* demonstrated that this plant contains the active components like pterygospermin, quercetin, morphine and kaempferol and has the ability to hamper the RNA dependent RNA polymerase of COVID-19 (Shaji, 2020). Moreover, piperolactam isolated from *P. longum* displayed more affinity for ACE2 receptor and Mpro. It was found that due to inhibition of these proteins, piperolactam A hinders the multiplication and access of virus into the host cells (Joshi *et al.*, 2020).

IV. CONCLUSION

Therefore, COVID-19 pandemic is a potentially fatal disease which cause public health crisis globally. There are many researches and clinical trials are going on to find competent treatment against COVID-19 but no therapies have been revealed effective so far.

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Sustainable Development Goals (SDGs): Challenges for India

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Abstract: The Sustainable Development Goals, or SDGs, are a set of 17 global goals that all 193 United Nations member nations have agreed to meet by 2030. The Sustainable Development Goals (SDGs) provide a framework and blueprint for achieving long-term global prosperity, and they commit participating countries to taking individual and collective action for the greater welfare of all people in the world. The Sustainable Development Goals (SDGs) are a follow-up to the Millennium Development Goals (MDGs), which ran from 2000 to 2015. The United nation proposed 17 SDGs to transform the world. These aim to improve lives and spread prosperity throughout a healthy planet. At its heart, these SDGs are an urgent call for action by all countries, developed or developing in a global partnership. There is a need for changes in environment and policies to make the best planet for survival. In this paper, we are explained 17 SDGs along with Indian government initiative to achieve this goal. We also described challenges faced by India for the development and implementation Agenda 2030 as well as described the need of finance and Gap of finance to complete SDGs.

Keywords: SDGs (Sustainable Development Goals), MDGs (Millennium Development Goals), etc.

I. INTRODUCTION

The term "sustainability" has become a buzzword in international society. The struggle for expansion and excellence has caused an imbalance in economic development across countries, depleted some natural resources, and thrown the ecological balance off. Because this poses a threat to human life on Earth, a path of action that ensures a safe environment for future generations has become imperative. Sustainable development is a concept coined to describe how development is carried out in such a way that natural resources are preserved and handed on to future generations in a healthy state. 17 Sustainable Development Goals (SDGs) have been devised by the United Nations to help achieve a more wealthy, egalitarian, and secure world by the year 2030. Current study attempts to comprehend the problems that India faces in fulfilling the Sustainable Development Goals at this time.

II. SUSTAINABLE DEVELOPMENT GOALS

The Sustainable Development Goals (SDGs) are a collection of 17 goals with 169 targets that span a wide variety of concerns related to sustainable development. As it is a challenging goal which not only aims for zero hunger and poverty but also a major emphasis on clean and green energy. These goals range from poverty eradication to the preservation and restoration of life on land and sea. Sustainable development, according to the Brundtland Report, is defined as development that meets present demands without jeopardising future generations' ability to meet their own. The United Nations adopted the SDGs in September 2015, and they will expire in 15 years. While the 193 countries have goals to achieve, obstacles and challenges frequently arise along the process of achieving those goals.

Table 1: 17 Sustainable Development Goals

Goal no.	17 SDG Goals	Description
1	SDG 1 – No Poverty	Zero poverty all over the world.
2	SDG 2 – Zero Hunger	Promote sustainable agriculture to end hunger and improve nutrition.
3	SDG 3 – Good health and well-being	Aiming for healthy lives and well being for everyone for all the ages.

4	SDG 4- Quality Education	Aims to provide inclusion and quality education to all as well as promote the education
5	SDG 5 – Gender Equality	Empowering girls and women. Aiming for many things like child marriages and child education , physical and sexual abuse, representation in
6	SDG 6-Clean Water and Sanitation	Aims to provide clean drinking water and improve sanitation
7	SDG 7-Affordable and Clean Energy	Affordable , renewable , safe energy sources for all.
8	SDG 8-Decent Work and Economic Growth	Aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9	SDG 9- Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10	SDG 10-Reduced Inequality	Aims to Reduce inequality within and among countries
11	SDG 11-Sustainable Cities and Communities	Aims to develop safe,resilient and sustainable cities and human settlements
12	SDG12-Responsible Consumption and Production	Reduce consumption of the resources and recycling to improve production
13	SDG 13-Climate Action	Reverse climate action and reduce greenhouse emissions to reduce 1.5 degree Celsius.
14	SDG 14-Life Below Water	Sustainable development of water sources and life under water.
15	SDG 15-Life on Land	Aims many challenging prospects like reducing deforestation , reverse desertification and protecting endangered species on land.
16	SDG 16-Peace and Justice Strong Institutions	Aims to long-term development, foster peaceful and inclusive societies, ensure universal access to justice, and construct effective, responsible, and inclusive institutions at all levels.
17	SDG 17-Partnerships to achieve the Goal	Justice for all and accountability for the offenders.

III. INITIATIVE BY INDIAN GOVERNMENT

India, which is home to one-sixth of the world's population, is pivotal to the 2030 Agenda's success. With the Government of India partnering sub-national and local governments, civil society organisations, local communities, persons in vulnerable situations, and the commercial sector in its second VNR, India has undertaken a paradigm change to a "whole-of-society" approach. The newly-formed NITI (National Institution for Transforming India) Aayog, which replaced India's 65-year-old Planning Commission, is in charge of organising SDGs across the country. States should do the same mapping for state-sponsored schemes that are being implemented to meet the SDGs, including visioning, planning, budgeting, and building implementation and monitoring systems.

In addition, the Ministry of Statistics and Programme Implementation is working on developing important indicators to track the progress of the SDGs. The Indian government has introduced numerous major programmes that are at the heart of the SDGs since 2015 (when the United Nations, along with other countries, adopted the SDGs). Swachh Bharat Mission, Skill India, Make In India, Digital India, and others are among them. Below Table 2 shows the Indian Government Initiative.

Table 2: Indian Government Initiative with description

Indian Government Initiative	Description
The Namami Gange Mission	A important policy goal toward attaining SDG 6 was the establishment of a priority programme with a budget investment of Rs.20,000 crores for the period 2015-2020. Among the primary components are sewerage project management, urban and rural sanitation, industrial pollution, water use efficiency and quality enhancement, ecosystem conservation, and the Clean Ganga Fund.
Sashakt Bharat - Sabal Bharat (Empowered and Resilient India)	Through economic progress and empowerment, India has successfully pulled more than 271 million people out of multidimensional poverty. Reduced inequalities have resulted from improved access to nutrition, child health, education, sanitation, drinking water, power, and housing, particularly among those in disadvantaged situations.
Swachh Bharat - Swasth Bharat (Clean and Healthy India)	India achieved 100 percent rural sanitation and substantial reductions in stunting and child and maternal mortality rates thanks to a nationwide initiative sparked by the Clean India Campaign and the National Nutrition Mission. India is leading the charge for global cooperation to combat the COVID-19 pandemic. The nation has provided medical aid to a number of countries and has launched the SAARC COVID-19 Emergency Fund with a USD 10 million initial contribution. India's domestic reaction to the COVID-19 pandemic includes a USD 22.5 billion economic stimulus package, full health coverage for front-line employees, and direct financial transfers to the poorest citizens.
Samagra Bharat - Saksham Bharat (Inclusive and Entrepreneurial India)	“Universalizing access to nutrition, health, education, and social protection, as well as promoting entrepreneurship and employment skills, are all ways to promote social inclusion. The Jan Dhan-Aadhaar-Mobile (JAM) trinity – nearly universal access to bank accounts aided by the Jan Dhan Yojana (National Financial Inclusion Scheme); Aadhaar card (National unique identity number) for over 90% of the population; and widespread access to mobile phones – has opened up new avenues of credit, insurance, and Direct Benefit Transfers (DBT) to the poor, including over 200 million women, accelerating their economic empowerment.”
Sampanna Bharat-Samriddh Bharat (Prosperous and Vibrant India)	“With a young population and a thriving innovation and business ecosystem, India is one of the fastest growing emerging market economies. With a GDP of USD 2.72 trillion in 2018-19, India aims to expand to a USD 5 trillion economy by 2025 and pursue an equitable and sustainable economic path by growing manufacturing, creating infrastructure, spurring investments, supporting technological innovation, and encouraging entrepreneurship.”
Satāt Bharat – Sanatan	India's climate action plans include clean and efficient energy systems, disaster-resistant infrastructure, and

<p>Bharat (Sustainable India)</p>	<p>planned eco-restoration. As a result of its nationally determined contributions, India has electrified 100 percent of its villages, reduced 38 million tons of CO2 emissions annually through energy efficient appliances, provided clean cooking fuel to 80 million poor households, and set a target to install 450GW of renewable energy and restore 26 million hectares of degraded land by 2030. India is the world's third-largest producer of renewable energy, fourth-largest producer of wind energy, and fifth-largest producer of solar energy. India launched the Coalition for Disaster Resilient Infrastructure and the International Solar Alliance to leverage global partnerships for climate change and disaster resilience.</p>
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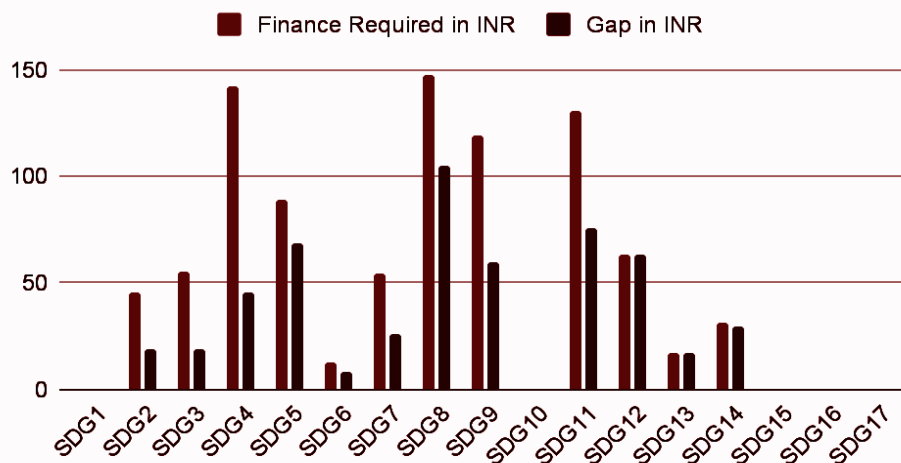
The Government of India will continue to work collaboratively with all domestic and global stakeholders to accelerate efforts for a sustainable planet for future generations.

IV. NEED OF FINANCE TO ACHIEVE SDGS

The financial requirement for India to meet its costs for food security i.e.SDG 2 is around INR 46 lakh crores (USD 729 billion) from 2015-24. This cost includes the financial requirements for providing access to safe and nutritious food for all. It also includes investments in irrigation, soil and water conservation, wasteland regeneration and rain-fed farming.To meet SDG 3, India's Health Index, which takes into account the population's health, the quality of healthcare facilities, and financial instruments for healthcare access, must reach a value of roughly 0.9. (insurance, etc.). To obtain this Index value, India will need roughly INR 55 lakh crores (USD 880 billion) till 2030. The availability of funds for public health in India is expected to be around INR 19 lakh crores (USD 305 billion).In order to achieve all the targets of Goal 4; the total financial requirement for India is of the order of INR 142 lakhs crores (USD 2258 billion).Comparing to the per capita spending requirement of these countries to ensure gender equality, India requires a sum of INR 89 lakh crores (USD 1408 billion) to ensure gender equality by 2030. For access to and availability of water and sanitation for all, India is estimated to require a sum of INR 13 lakh crores (USD 199 billion) till 2030.For ensuring access to energy in the Business As Usual (BAU) scenario, that is, a fossil fuel dominant energy mix, India would require finances of the order of INR 28 lakh crores for enhancing production capacity alone, and not including other related costs.For a sustained, inclusive and sustainable economic growth, India will

require to enhance its MSME sector and other labour intensive sectors.For making cities inclusive, safe, resilient and sustainable, India will require a sum of INR 131 lakh crores (USD 2067 billion). This includes housing for all, development and planning of cities, efficient transport systems, public spaces and other components of urban infrastructure costs.The cumulative costs of low carbon strategies have been estimated to be around INR 62.5 lakh crores (USD 992 billion), between 2011 and 2030. The total finance required for climate adaptation alone from 2015 to 2030 is INR 17 lakh crores or USD 267 billion. The below chart shows the Requirement of finance to achieve the target and gap of finance. Yet we are not calculating the need of finance for SDG 1,10, 15,16 and 17 .Because all these depend on other SDGs.

SDGs Finance Report



V. CHALLENGES

India has played a significant role in the development and implementation of Agenda 2030. Our National Development Goals (NDGs) must mirror the SDGs (Sustainable Development Goals). Even before the SDGs were fully operational, India's commitment to them was clear and effective. The cornerstone of India's Development Agenda is Prime Minister Narendra Modi's concept of "Collective Effort, Inclusive Growth." In order to accelerate the implementation of Agenda 2030, the government has produced a draught of a "Three Years Action Agenda" for the years 2017–18, 2018–19, and 2019–20. The government is nearing the end of a 15-year vision that will include a seven-year strategy. As India is a great believer in 'Cooperative Federalism,' the entire document is being written in conjunction with state governments. The Indian Parliament held various forums, notably the South Asian Speakers' Summit in February 2017, to demonstrate India's commitment to the SDG Agenda at the highest levels of government. The following are the four primary problems that India has in achieving the SDGs:

- **Defining Key Indicators:** Developing appropriate indicators to adequately measure the development of the SDGs is one of India's biggest difficulties. In order to effectively execute the SDGs, fundamental definitions for sectors such as poverty, hunger, safe drinking water, and education must be changed.[1] Central Asia indicators availability 41%, South and west Asia indicators availability 45%, East Asia indicators availability 46% and Pacific indicators availability 43%.
- **Goals for Sustainable Development:** How to find them despite India's best efforts and prioritization on poverty alleviation since the Fourth Five-Year Plan, the country has the biggest number of people living in poverty. There is a significant financing gap that is impeding progress toward the SDGs at the current level of spending.
- **Monitoring and Ownership of the Implementation Process:** While the NITI Aayog is expected to play an important role in taking ownership of the implementation process, members of the Aayog have expressed concerns about the limited manpower they have to handle such a Herculean task on numerous occasions.
- **Progress Evaluation:** The Indian government has acknowledged the lack of statistics, particularly from sub-national territories. Another obstacle that has complicated progress measurement for even the Millennium Development Goals (MDGs), which were the precursors to SDGs, is the lack of adequate administrative data coverage.

VI. CONCLUSION

India is the world's second-largest country by population. To the rest of the world, India's efforts to attain the SDGs are extremely important. If India achieves the SDGs, it will signify that a larger portion of the world has done so. As a result, India must create efficient mechanisms for implementing, monitoring, and measuring the SDGs' progress. The establishment of appropriate indicators appears to be India's largest issue. In short, the SDGs' ultimate purpose is to create a new worldview and lay the groundwork for a strategy to end poverty without putting considerable strain on the planet's life support systems.

VII. FUTURE SUGGESTIONS:

India takes a comprehensive approach to achieving its 2030 Sustainable Development Goals (SDGs) by introducing a variety of programmes. The SDG Index Score for India varies from 42 to 69 for States and 57 to 68 for UTs. According to the survey, Kerala and Himachal Pradesh are the front runners among all states with a score of 69, while Chandigarh and Puducherry are the front runners among the UTs with scores of 68 and 65, respectively. There is a need for global, comprehensive, and scientifically based information on SD, as well as an assessment of the SDGs' accomplishment using targets and indicators. It also emphasizes the need of SDGs being action-oriented, simple, and easy to explain, restricted in number, aspirational, global in scope, and universally applicable.

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“SCREENING OF PHENOLIC ACID COMPOUNDS OF *MUSSAENDA FRONDOSA* L. VAR. *LAXA* HOOK. F. AGAINST COVID-19 PROTEINS USING IN SILICO STUDIES”

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ABSTRACT - *Mussaenda frondosa*. Linn is a medicinal plant, belongs to Rubiaceae family. In traditional medicine, dried flowers, roots, leaves of *M. frondosa* are used as anti-dyspeptic, antispasmodic, anti-inflammatory and anti-oxidant. To evaluate the phytochemical profile (Phenolic acids) and to present an *in silico* approach about antioxidant and anti COVID potential of *M. frondosa* plant was selected. Phytochemical profile of methanol leaf extract was analyzed by high-performance liquid chromatography (HPLC) technique. Predictions of activity spectra for substances and *in silico* evaluation (Antioxidant and Anti-COVID) from major phytoconstituents were performed via computer simulation. Chromatographic data indicated the presence of 21 (4-Hydroxybenzaldehyde, 6-Methoxy luteolin, Asiatic acid, Cauloside-C, Chlorogenic acid, Conifery aldehyde, Diosmin, Esculetin, Ferulic acid, Genistin, Hesperidin, Luteolin-7,3-di-o-glucoside, Medicagenic acid, Polydatin, Protocatechuic acid, Protocatechuic aldehyde, Resveratrol, Sinapic alcohol, Soyasaponin I, Spiraeoside, Syringaldehyde) as the main compounds in leaf extract. Computer simulations pointed some potent antioxidant and anti-COVID activities in agreement with traditional use. Out of 21 compounds 6 compounds (6-Methoxy luteolin, Asiatic acid, Chlorogenic acid, Genistin, Medicagenic acid, Protocatechuic acid) were found to possess significant antioxidant and anti- COVID activity. Moreover, *in silico* toxic predictions showed that the *M. frondosa* major compounds had low probability for toxic risk. Our results indicate that the *M. frondosa* infusion possesses low toxicological potential and an effective antioxidant activity and anti COVID activity. These findings confirm the traditional use of this plant in the folk medicine.

Keywords: *Mussaenda frondosa*, Antioxidant activity, Anti-COVID activity, 6-Methoxy luteolin, Protocatechuic aldehyde.

I. INTRODUCTION

Novel corona virus disease (COVID-19) has become a pandemic threat to the public health. It is a respiratory malady causing fever, fatigue, dry cough, muscle aches, shortness of breath and some instances lead to pneumonia [1]. This outbreak was declared a Public Health Emergency of international concern on 30th January 2020 by WHO owing to its quick transmission with an estimated reproductive number of 2.2. It has spread to nearly 187 countries worldwide with over 2,66,073 confirmed cases and over 11,184 confirmed deaths with a recorded case fatality rate (CFT) of 4.4 as of March 20, 2020 [2] The causative agent for COVID-19 is SARS-CoV-2 (Severe acute respiratory syndrome coronavirus 2). This SARS family contains 14 binding residues out of which 8 amino acids are specifically conserved for SARS-CoV-2. Importantly, the binding residues of this family interact with the ACE-2 (Angiotensin converting enzyme-2) directly [3].

As of now there have been two challenges in management of SARS-CoV-2, one is curbing the infection rate from the infection/transmission and the second is how to reduce the rate of disease severity after infection. The existing literature explicates only on the structure predictions, functions and inhibition of SARS-CoV-2 proteins/ enzymes utilizing the accessible drugs. The bioinformatics reports are gaining more attention in discovery of non-toxic and appropriate drugs in the management of SARS-CoV-2. The researchers have reported the role of many phytochemicals in medicating SARS-CoV-2 employing molecular docking studies [4].

Most of the scientists investigated the role of important proteins or enzymes which are very essential for SARS-CoV-2 replication and infection utilizing *in silico* studies. The present study was aimed to explore numerous antiviral compounds based on the existing literature. The identified antiviral compounds were analysed for non-toxicity and drug likeliness properties. Further, the compounds would be subjected for molecular docking to study the interaction studies and to determine the interacting amino acids of these compounds against 12 different SARS-CoV-2 specific enzymes/ proteins, which are very critical for viral replication and infection. The main principle interest of the present research is to identify appropriate non-toxic plant based bioactive compounds by comparing with the available synthetic drugs. For this study we have selected highly medicinal plant *Mussaenda frondosa*. Linn (Fig 1) which belongs to the family Rubiaceae.

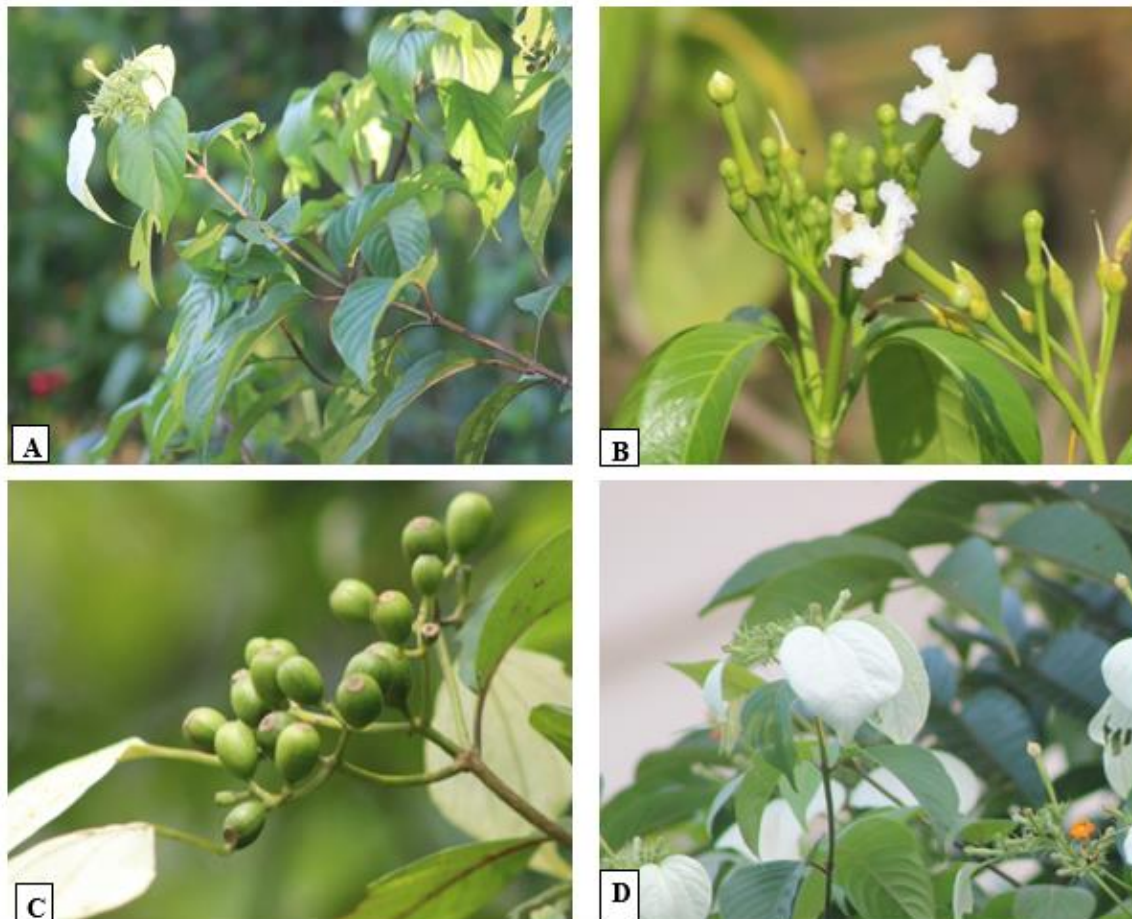


Fig 1: Habit of *Mussaenda frondosa* L. var. *laxa* Hook. F. A) Climbing shrub; B) Inflorescence-Terminal cymes; C) Fruit-A berry; D) Petaloid sepal.

Investigations about chemical composition found the ferulic acid, flavonoids quercetin, 3-O-methylquercetin, and luteolin as the main compounds in *M. frondosa* extracts [5]. These isolated compounds have demonstrated *in vitro* some pharmacological activities, such as scavenging of reactive oxygen species (ROS) [6]. Surely, this antioxidant property is very important considering that ROS and other reactive species have been implicated in the pathology of over 100 human diseases.

Considering the potential of *M. frondosa* as a medicinal plant, this study aimed to identify phenolic content and to evaluate, *in silico* antioxidant and anti-COVID potential of identified phenolic compounds.

II. MATERIALS AND METHODS

A. Selection of plant based plants secondary metabolites

After the extensive literature review we have selected a potential therapeutically important medicinal plant i.e., *Mussaenda frondosa* rich in secondary metabolites. The plant secondary metabolites were identified by HPLC and LC-MS analysis [7] and compounds tabulated in Table 1 with their possible pharmaceutical implications. Remedesevir, Ivermectin, and quercetin compounds were selected as standard drugs which are effective in declining the replication of Corona virus. Three

standard antioxidant drugs (Quercetin, ascorbic acid, gallic acid) were selected for insilico antioxidant screening of plant metabolites. Altogether 21 compounds were selected for in silico screening (Table 1)

Table 1. List of selected bioactive compounds from *Mussaenda frondosa* and their possible pharmaceutical activity.

Sl. No	Phenolic acid compounds	Possible Pharmaceutical activity
1.	4-Hydroxybenzaldehyde	Anti-Inflammatory, Anti-angiogenic, Anti-nociceptive.
2.	6-Methoxy luteolin	Anti-viral, Anti-inflammatory, Cardio protective, Anti-diabetic, Anti-cancer, Anti-aging.
3.	Asiatic acid	Anti-diabetic, Anti-hyperlipidemic
4.	Cauloside-C	Anti-bacterial, Anti-inflammatory, Analgesic
5.	Chlorogenic acid	Antiviral activity, Anti-ulcerogenic activity, Anti-inflammatory, Anti-diabetic, Antitumor
6	Conifery aldehyde	Anti-fungal
7	Diosmin	Anti-inflammatory
8	Esculetin	Anti-inflammatory Anti-oxidant
9	Ferulic acid	Anti-oxidant
10	Genistin	Anti-tumour activity, Anti-inflammatory
11	Hesperidin	Anti-inflammatory
12	Luteolin-7,3-di-o-glucoside	Antihyperglycaemic, Anti-proliferative activity
13	Medicagenic acid	Anti-fungal activity
14	Polydatin	Anti-oxidant activity
15	Protocatechuic acid	Chemopreventive activity, Anti-inflammatory Analgesic activity
16	Protocatechuic aldehyde	Antioxidant activity
17	Resveratrol	Anti-oxidant activity
18	Sinapic alcohol	Scavenging activity Antioxidant activity
19	Soyasaponin I	Anticarcinogenic activity, Scavenging activity
20	Spiraeoside	Antioxidant, Anti-inflammatory, Gastro-protective activity
21	Syringaldehyde	Antioxidant property.

All the identified 21 plants secondary metabolites were subjected to online software tools like admetSAR (adsorption, dissolution, metabolism, excretion and toxicity) (<http://lmmd.ecust.edu.cn/admetSar1/>) and Molsoft (https://www.mn-am.com/online_demos/corina_demo) to perceive their toxicity and drug likeliness properties [8]. Following the analysis 6 plant secondary metabolites (6-methoxy luteolin, Asiatic acid, Chlorogenic acid, Genistin, Medicagenic acid, Protocatechuic acid) were found to be non-toxic, non-carcinogens and proved to exhibit drug likeliness property which were further selected for docking studies. Canonical smiles were collected for all 21 secondary metabolites in the Pubchem website. The PDB formats for all the 21 metabolites have been elucidated using online Corina software.

B. Selection, preparation and retrieval of antioxidant and COVID-19 viral proteins

From the available literature, 15 different antioxidant proteins (1CB4, 1DGH, 1DNU, 1K4U, 1KHB, 1XAN, 2CAG, 2P31, 3EMW, 3MNG, 3S7S, 4COX, 4KZC, 4LYN, 5H5Q) (Table 2) and 12 different SARS-CoV-2 viral replicating proteins/ enzymes (2CJR, 2AJF, 3E9S, 5RE4, 5RFK, 6ACK, 6LU7, 6LAZ, 6NUR, 6W41, 6W46, 6Y84) are selected for the docking study viz., nucleocapsid proteins, protease, ACE2 receptor binding proteins, Nsp12 polymerase bound to nsp7 and nsp8 co-factors, Nsp9 were selected for present study (Table 3). The proteins/ enzymes were prepared by removing the water molecules within 3Å of het groups.

Table 2. List of COVID proteins and their names selected for insilico screening

Sl. No	PDB Name	Name of the protein
1.	2CJR	Crystal structure of oligomerization domain of SARS coronavirus nucleocapsid protein
2.	2AJF	Structure of SARS coronavirus spike receptor-binding domain complexed with its receptor
3.	3E9S	A new class of papain-like protease/deubiquitinase inhibitors blocks SARS virus replication
4.	5RE4	PanDDA analysis group deposition – crystal structure of SARS-CoV-2 main protease in complex with Z1129283193
5.	5RFK	PanDDA analysis group deposition -- Crystal Structure of SARS-CoV-2 main protease in complex with PCM-0102575
6.	6ACK	Trypsin-cleaved and low pH-treated SARS-CoV spike glycoprotein and ACE2 complex, ACE2-bound conformation 3
7.	6LU7	The crystal structure of COVID-19 main protease in complex with an inhibitor N3
8.	6LZG	Structure of novel coronavirus spike receptor-binding domain complexed with its receptor ACE2
9.	6NUR	SARS-Coronavirus NSP12 bound to NSP7 and NSP8 co-factors
10.	6W41	Crystal structure of SARS-CoV-2 receptor binding domain in complex with human antibody CR3022
11.	6W4b	The crystal structure of Nsp9 RNA binding protein of SARS CoV-2
12.	6Y84	SARS-CoV-2 main protease with unliganded active site (2019-nCoV, coronavirus disease 2019, COVID-19)

Table 3. List of

Antioxidant proteins and their names selected for in silico screening

Sl. No	PDB Name	Name of the protein
1.	1CB4	Crystal structure of copper, zinc superoxide dismutase
2.	1DGH	Human erythrocyte catalase 3-amino-1,2,4-triazole complex
3.	1DNU	Structural analyses of human myeloperoxidase-thiocyanate complex
4.	1K4U	Solution structure of the C-terminal SH3 domain of p67phox complexed with the C-terminal tail region of p47phox
5.	1KHB	PEPCK complex with non-hydrolyzable GTP analog, native data
6.	1XAN	Human glutathione reductase in complex with a xanthene inhibitor
7.	2CAG	Catalase compound
8.	2P31	Crystal structure of human glutathione peroxidase 7
9.	3EMW	Crystal Structure of human splA/ryanodine receptor domain and SOCS box containing 2 (SPSB2) in complex with a 20-residue VASA peptide
10.	3MNG	wild type human PrxV with DTT bound as a competitive inhibitor
11.	3S7S	Crystal structure of human placental aromatase complexed with breast cancer drug exemestan
12.	4COX	Cyclooxygenase-2 (prostaglandin synthase-2) complexed with a non-selective inhibitor, indomethacin
13.	4KZC	Structure of PI3K gamma with Imidazopyridine inhibitors
14.	4LYN	Crystal structure of cyclin-dependent kinase 2 (cdk2-wt) complex with (2s)-n-(5-(((5-tert-butyl-1,3-oxazol-2-yl) methyl)sulfanyl)-1,3-thiazol-2-yl)-2-phenylpropanamide
15.	5H5Q	Crystal structure of human GPX4 in complex with GXpep-

C. Molecular docking studies of selected plant secondary metabolites with Corona viral proteins

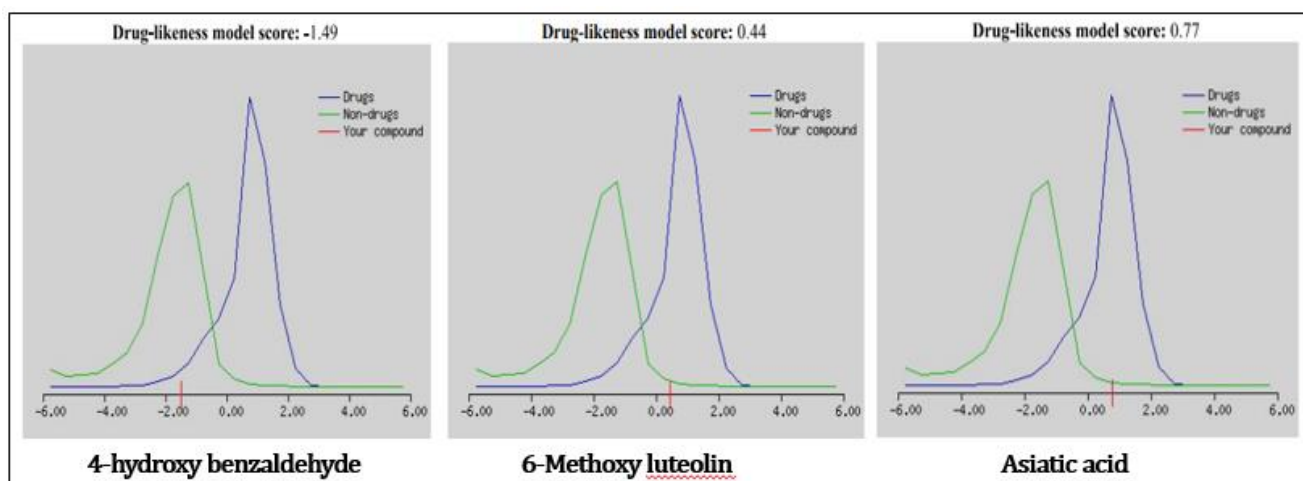
Interaction studies with population size of 200, generations of 70 and total 2 number of solutions was set for docking individually between all 15 antioxidant and 12 selected viral replicating enzymes/ proteins against 21 promised plants bioactive compounds using iGEMdockv2.1. To compare the effectiveness of plants bioactive compounds, different standard drugs (COVID- Remdesivir, Ivermectin, Quercetin, Antioxidant- Ascorbic acid, Quercetin, Gallic acid) were selected.

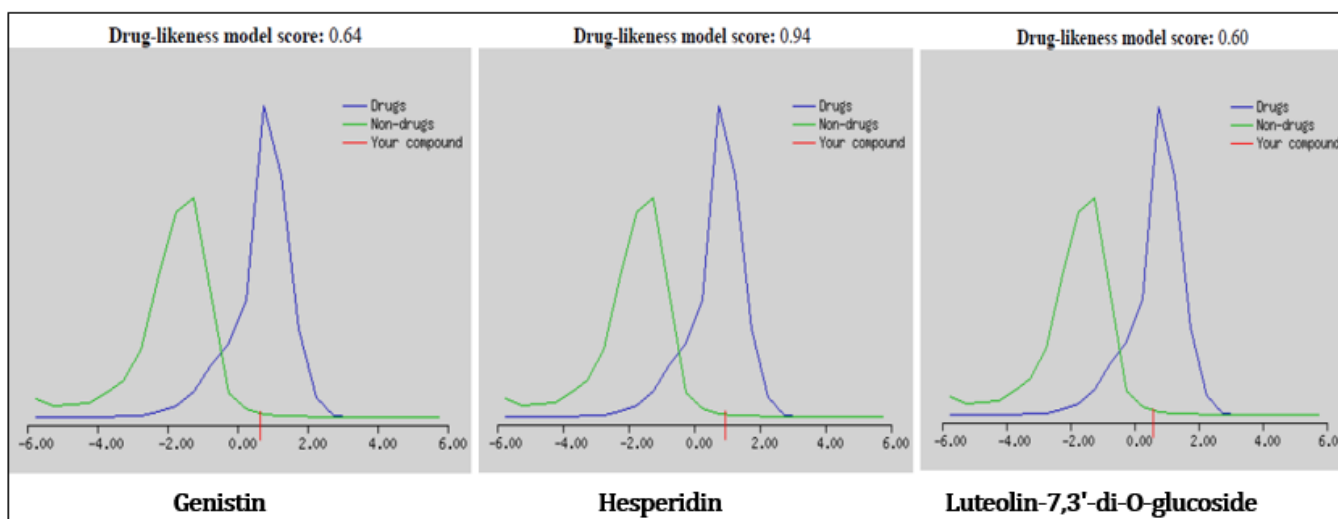
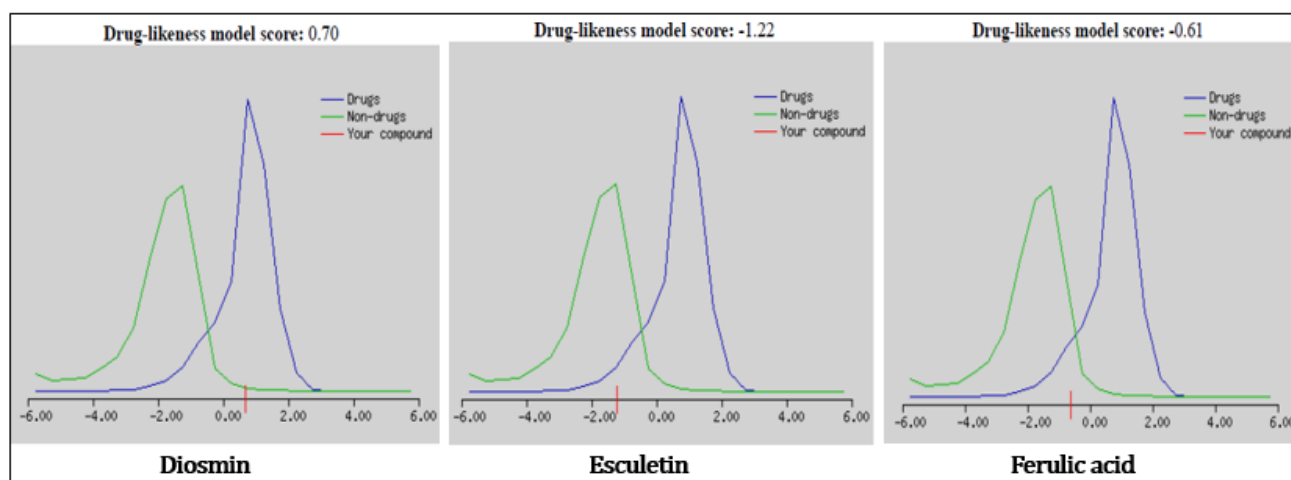
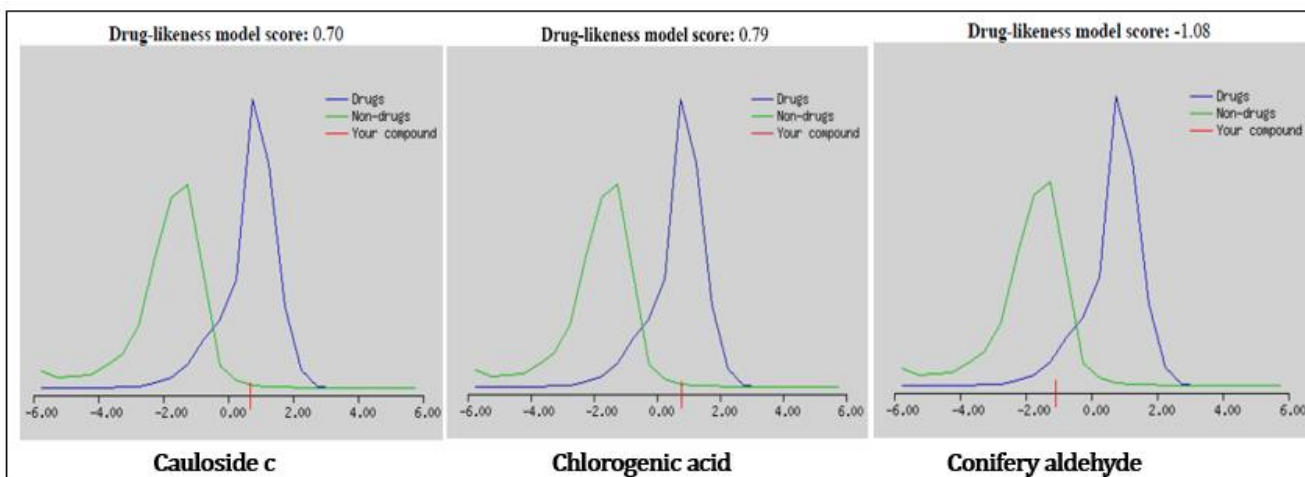
D. Interaction studies and identification of interacting amino acids

iGEMdockv2.1 was used to study interaction studies and post docking analyses. Interaction studies were carried out for plant bioactive compounds against antioxidant and COVID-19 proteins/ enzymes using structure based drug design approach of molecular docking system. The investigation was resumed to interpret the interacting amino acids with low binding energy. Four rounds of docking interaction studies was performed to get acquire the accuracy of interaction studies between the same protein/ enzymes and ligands. Brief energy, van der Waals force and hydrogen bonding values were obtained from the output of docked analyses and confirmation was obtained with pymol viewer [9]

III. RESULTS

Canonical smiles of 21 plant based bioactive compounds were collected from Pubchem. The particulars (toxicity, non-carcinogen and drug likeliness properties) of 21 bioactive compounds is enumerated in Table 4. Among 21 compounds 19 compounds were non AMES toxic which are not supposed to be mutagenic and could not trigger any tumorigenic effects in the test organism [10] whereas Genistin and spiraeoside molecules are found to be AMES toxic [11]. Table 5 predicts the physiochemical analysis of promised selected plant secondary metabolites. Figure 5 explains the drug likeliness property of the selected promised plants bioactive compounds. Druglikeness score of the secondary metabolites appear in the following order with respect to their druglikeness property (Fig 2) viz., Hesperidin (0.94) > Chlorogenic acid (0.79) > Asiatic acid (0.77) > Cauloside – C (0.70) > Diosmin (0.70) > Soyasaponin (0.68) > Luteolin-7,3-di-o-glucoside (0.60) > Medicagenic acid (0.59) > 6-Methoxy luteolin (0.47) > Protocetachuic acid (0.23). Rest of the phenolic acids are showing negative to druglikeness property (Table 4). With respect to the molecular weight (Table 5) of the compounds all the phenolic acids exhibit less than 500 KD which are admissible to act as a drug but 5 compounds [Soyasaponin I (MW: 942.52) Cauloside-C (MW: 766.45), Luteolin-7,3-di-o-glucoside (MW: 610.15), Diosmin (MW: 608.12), Medicagenic acid (MW: 502.33)] were found to be bulky molecules whose MW is more than 500 KD [12]. The compounds which were found to possess good druglikeness score were selected to study the their interaction against antioxidant and COVID proteins. All together 7 compounds were screened out to test further for docking studies. Table 9 shows the binding energy of the plant bioactive principles against COVID proteins. The binding energies of the plant metabolites with the antioxidant proteins are elucidated in Table 8. 6- methoxy luteolin and Genistin showed significant interaction against all the tested COVID proteins (Table 9). Medicagenic acid [2ajf (-103.1), 5re4 (-108.54), 6lzg (-105.76)] and chlorogenic acid [5rfk, 6ack, 6lzg]) exhibited good interaction with few number of COVID proteins. (Table 9 and 13). Based on the significant binding energies with which the metabolites has interacted with proteins further study was continued for design figuring of the docking images. The list of the interacting aminoacids of the significant interactions is shown in Table 9 and 10.





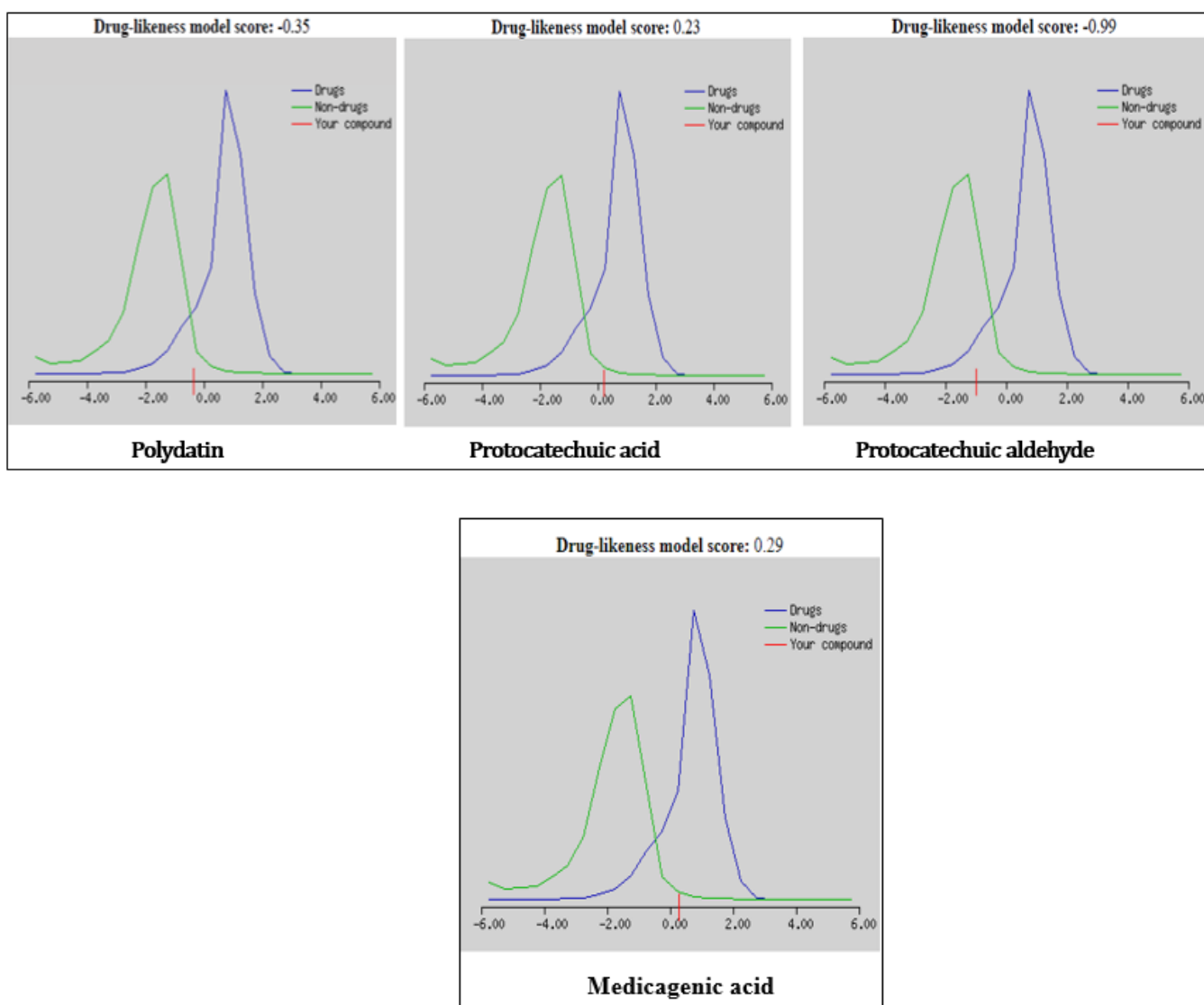


Fig 2: Drug likeness properties of promised phenolic compounds of *mussaenda frondosa* Linn

A. Interaction of plant metabolites with COVID proteins and their interacting aminoacids

The 6-Methoxy luteolin has shown firm interaction with 6w4b COVID protein at THR-75, ALA-69, GLU-78 by exhibiting high binding energy (-110.32 kcal/mol) followed with 6ack (-107.96) and 3e9s (-106.44) (Fig 3.1). Among, the standard COVID drugs [Quercitin (-107.29 kcal/mol), Remdesivir (-81.51 kcal/mol), Ivermactin (-96.78 kcal/mol)] tested none of the standard compounds possess good activity than the plant metabolite 6-Methoxy luteolin.

Asiatic acid has exhibited firm interaction with 6lzg COVID protein at (GLN 102, TRP 566, GLU 564, ALA 396, LYS 562) with a binding energy of -103.64kcal/mol (Fig 3.2). Among, the standard COVID drugs tested both Quercitin (-110.96kcal/mol), and Ivermectin (-128.54kcal/mol) possessed highest activity than the plant bioactive principles.

Chlorogenic acid has shown good interactions with 6lzg COVID protein at (ALA-387, GLN-388, ARG-393, ASN-33, GLU-37, ARG-403, SER-494, GLY-496) by exhibiting high binding energy (-117.31kcal/mol) followed with 5RFK (-103.77) and 6ACK (-101.52). Among, the standard COVID drugs; ivermectin showed better activity than the plant metabolite [Quercitin (-110.96kcal/mol), Remdesivir (-92.17kcal/mol), Ivermectin (-128.54kcal/mol)] (Fig 3.3)

Genestin has shown firm interactions with 2CJR COVID protein at (ASP-344, LYS-343, LYS-257, LVS-258, ARG-263, ARG-260, ALA-337) by exhibiting high binding energy (-132.03kcal/mol) followed with 6W4B (-120.15), and 6LZG (-

113.29). Among, the standard COVID drugs {Quercitin (-101.23kcal/mol) , Remedesivir (-93.37kcal/mol), Ivermectin (-112.36kcal/mol) tested none of the standard compounds possess good activity then the plant metabolite Genestin. (Fig 3.4)

Medicagenic acid has shown firm interactions with 5RE4, COVID protein at (TYR-239, ASP-289, ARG-131) by exhibiting high binding energy (-105.54 Kcal/mol) followed with 6LZG (-105.54) and 2AJF (-103.31). Among, the standard COVID drugs Quercitin [Quercitin (-113.72kcal/mol), Remedesivir (-93.02kcal/mol), Ivermectin (- 95.39kcal/mol)] possess higher activity against 5RE4 than the plant metabolite Medicagenic acid (Fig 3.5).

Protocatechuic acid has shown firm interactions with 3E9S COVID protein at (GLY-288, SER-116, SER-115, TRP-107, PYR-274, HIS-273, TYR-113) by exhibiting high binding energy (-91.8Kcal/mol) which is found to be less potential than the all the standard COVID drugs [Quercitin (-118.61kcal/mol), Remedesivir (-100.46kcal/mol), Ivermectin (-99.29kcal/mol)] (Fig 3.6).

Fig 3: Figures showing the interaction of COVID proteins with plant metabolites

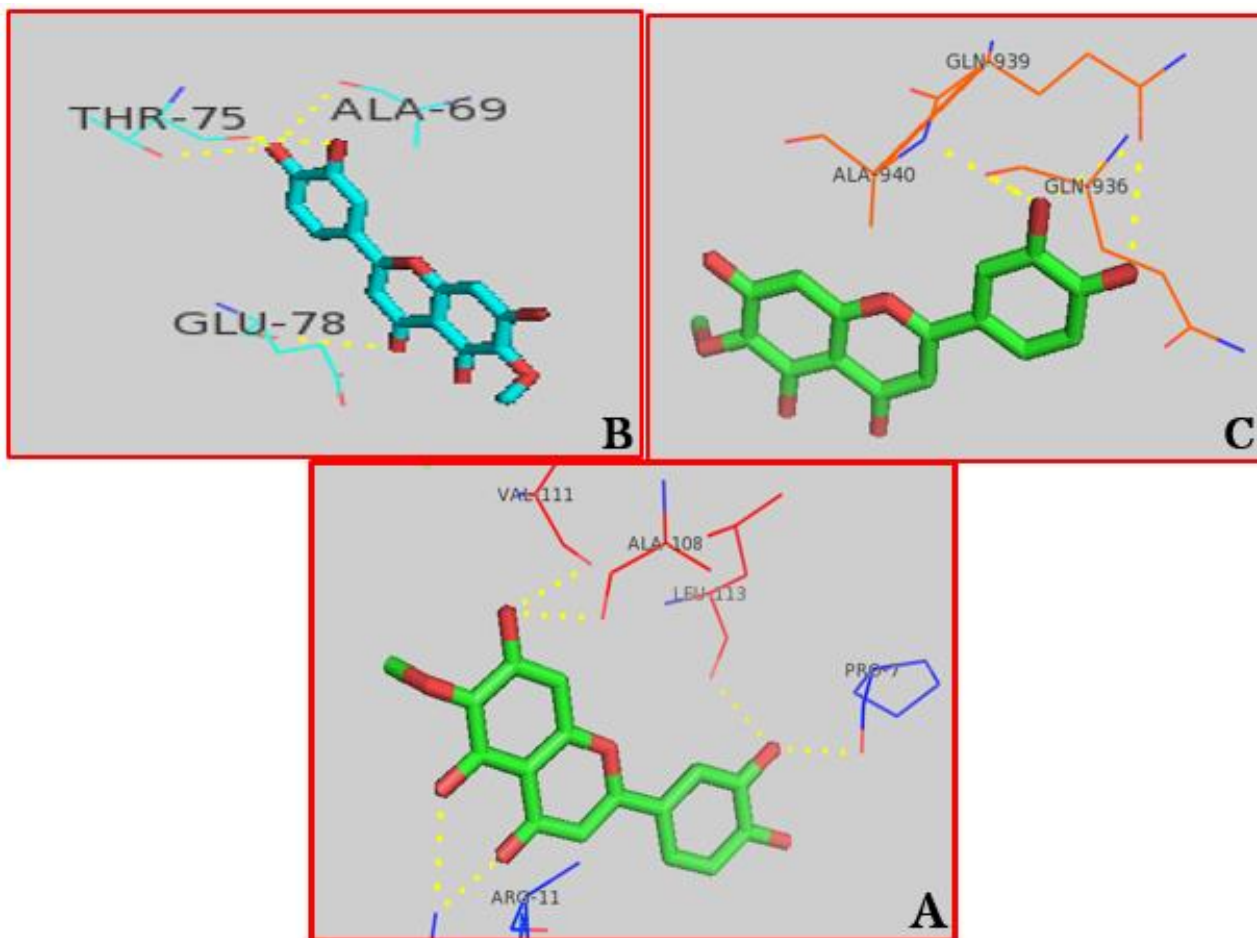


Fig 3.1 : 6-Methoxy luteolin with (A) 6W4B (-110.32) by binding at (VAL-111, ALA-108, LEU-113, PRO-7 ARG- 11) significantly followed by (B) 6ACK (-107.96 kcal/mol), (C) 3E9S (-106.44 kcal/mol).

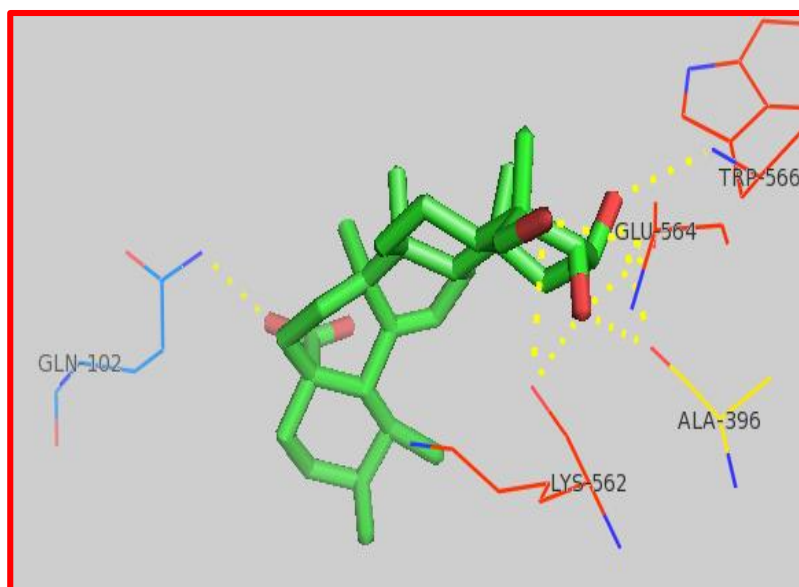


Fig 3.2 : Asiatic acid with 6LZG (-103.64) by binding at (GLN-102, TRP- 566, GLU-564, ALA-396, LYS-562)

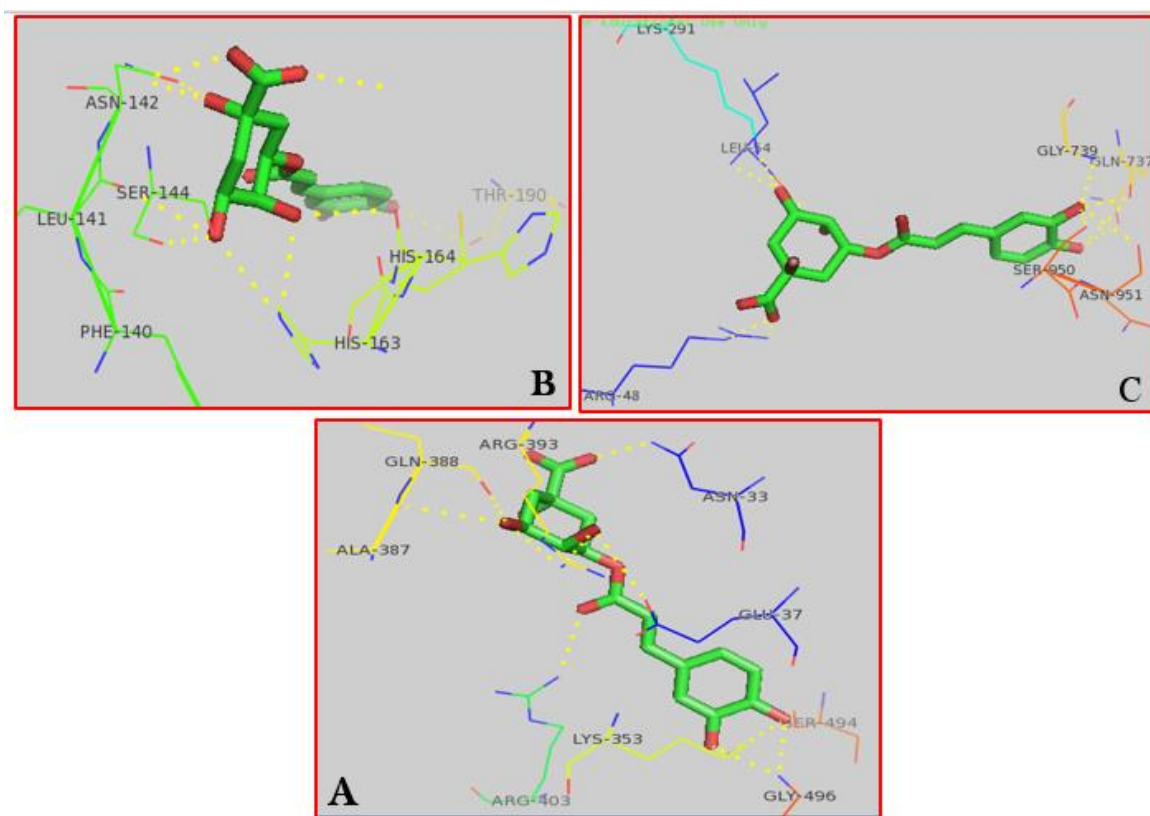


Fig 3.3 : Chlorogenic acid with (A) 6LZG(-117.31) by binding at (ALA-387, GLN-388 ARG-393, ASN-33, GLU-37, LYS-353, ARG-403, SER-494, GLY-496) significantly followed by (B)5RFK (-103.77 kal/mol), (C)6ACK(-101.52kal/mol)

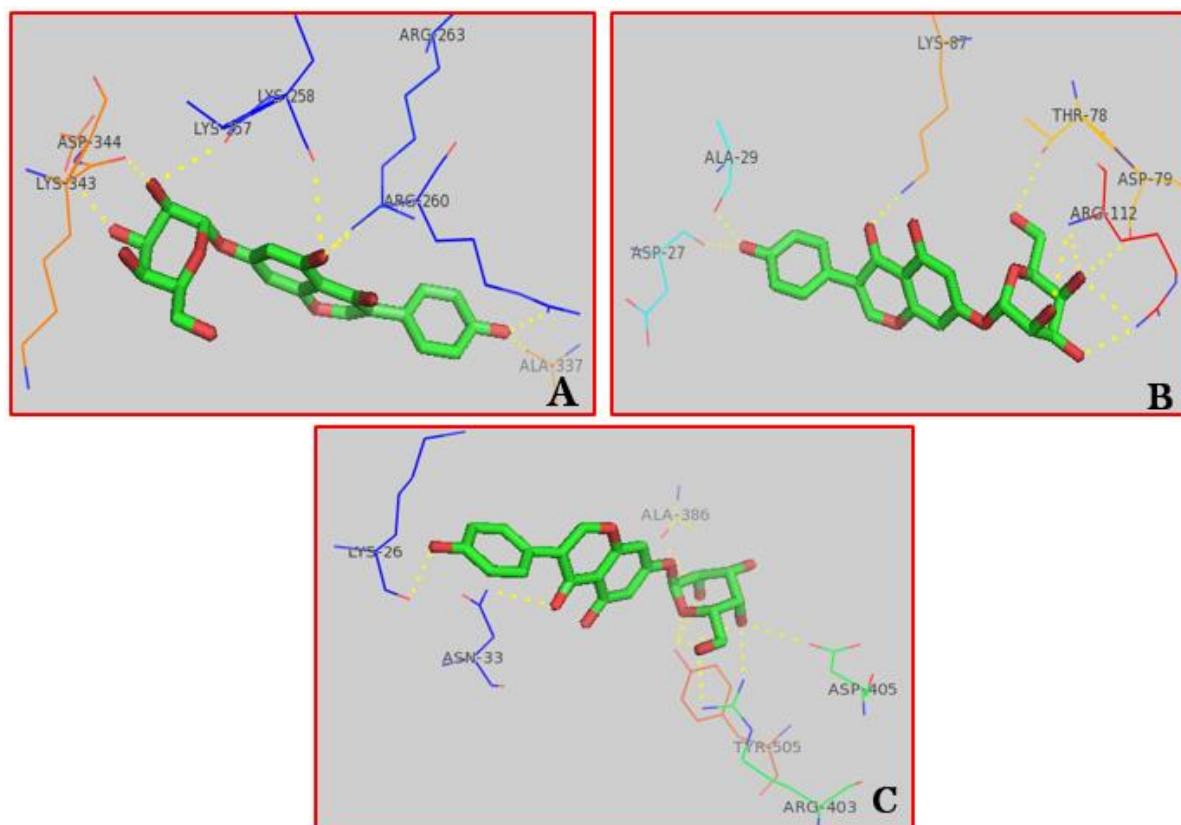


Fig 3.4 : Genistin with (A)2CGR(-132.03) By binding at (ASP - 344, LYS-343, LYS-257, LYS-258, ARG-263, ARG-20, ALA-337) significantly followed by (B)6W4B(-120.15Kcal/mol), (C)6LZG(-113.29kcal/mol)

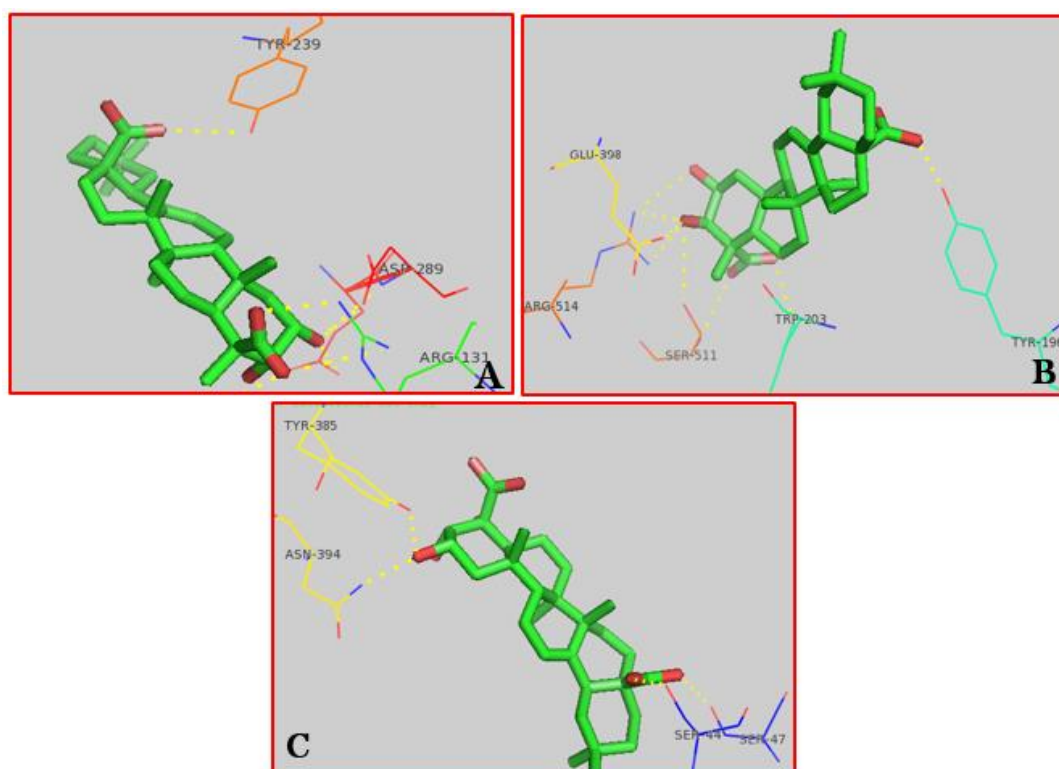


Fig 3.5: Medicagenic acid with (A) 5RE4(-105.54) by binding at (TYR-239, ASP-289, ARG-131) significantly followed by (B)6LZC(-105.54mol/kal) (C)2AJF(-103.1 kal/mol)

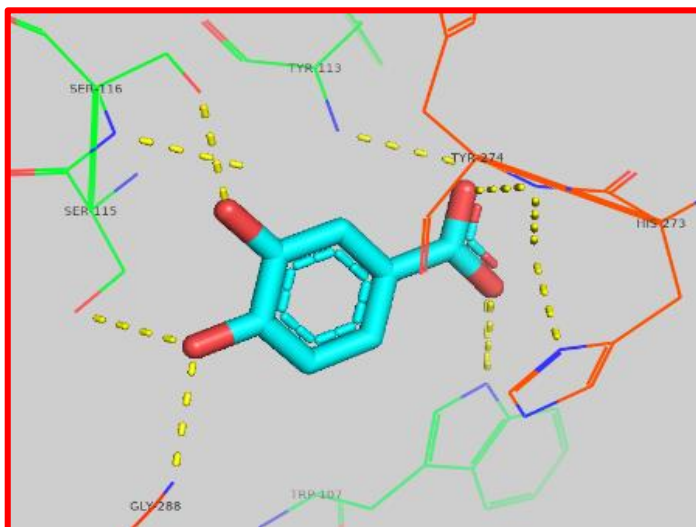


Fig 3.6 : Protocatechuic acid with (A) 3E9S(-91.8) by binding at (GLY-288, SER-116, SER 115, TRP-107, TYR-274, HIS-273, TYR – 113)

B. Interaction of plant metabolites with antioxidant proteins and their interacting aminoacids

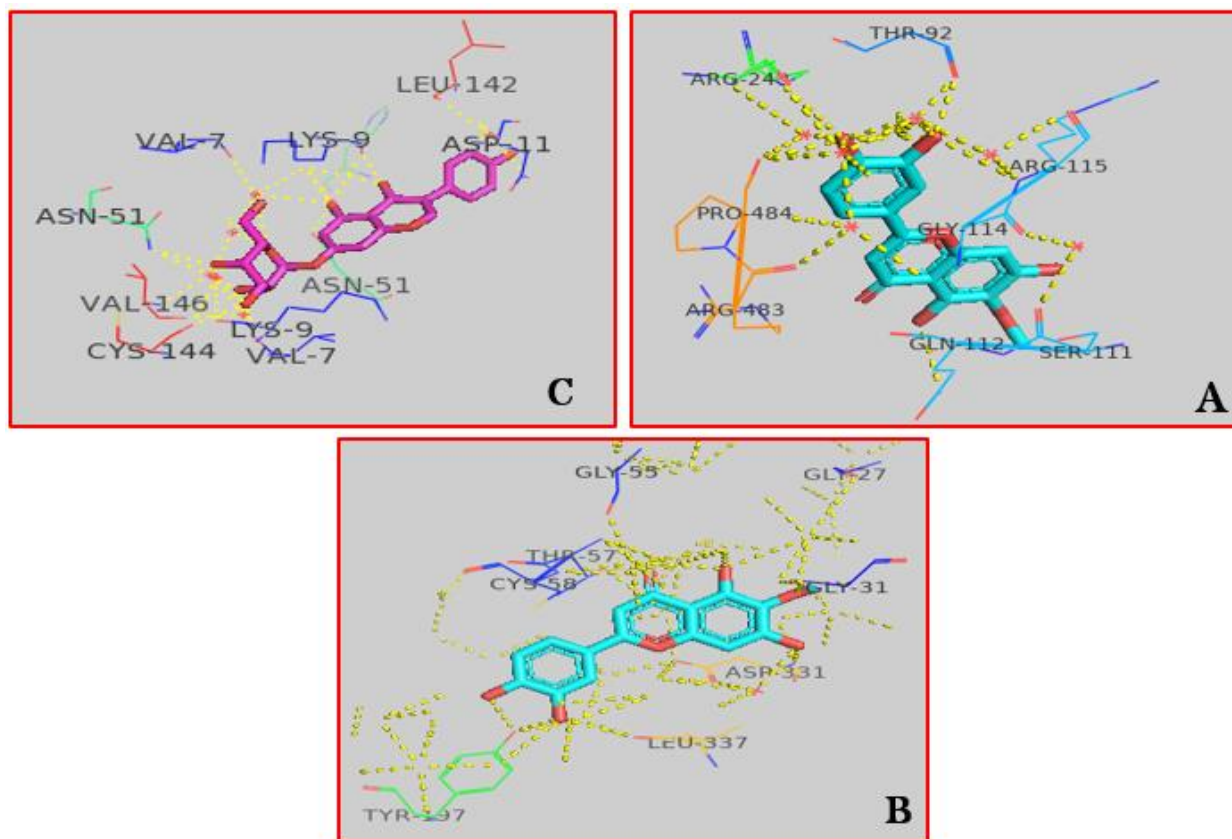
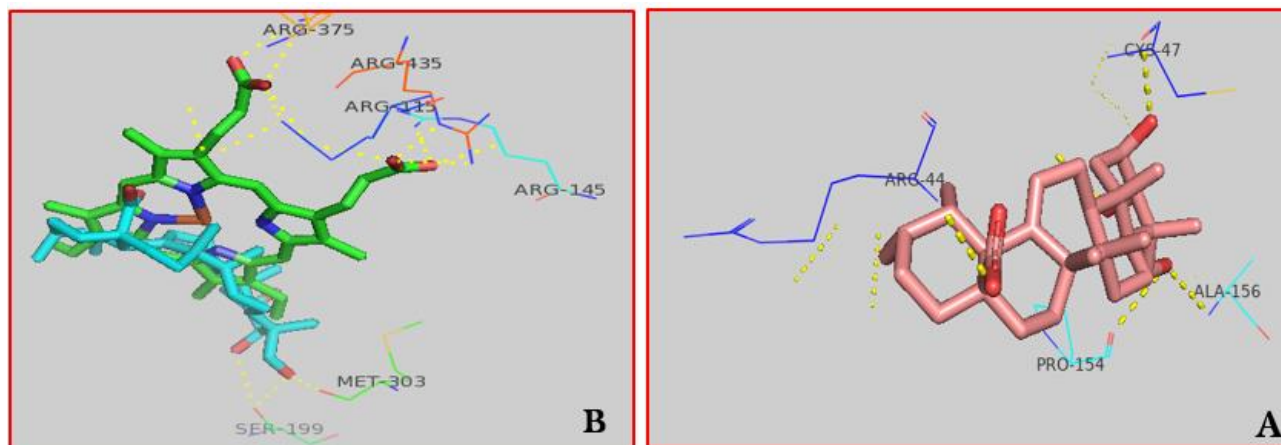
6-methoxy luteolin has shown firm interaction with 1khh antioxidant protein at (THR 92, ARG 24, ARG 115, GLY 114, GLN 484) by exhibiting the high binding energy (-120.45kcal/mol) followed with laxn (-112.89) and 1dgh (-107.29) among the standard antioxidant proteins Quercitin [ascorbic acid (-105.87kcal/mol), gallic acid (-101.99kcal/mol), Quercitin (120.8kcal/mol)] possess more antioxidant potential than the our test compounds(Fig 4.1)

Asiatic acid has shown firm interaction with 4COX antioxidant protein at ARG 44, PRO 154, ALA 156, CYS 47 by exhibiting the high binding energy (-122.53kcal/mol) followed with 1DGH (-113.79) and 3S7S (-109.84). Among the standard antioxidant drugs tested none of the standard compounds possesses good activity than the plant metabolite Asiatic acid (Fig 4.2)

Chlorogenic acid has found to be potent compound against 3S7S antioxidant protein at THR 310, CYS 437, ARG 435, ARG 375, ARG 115, ALA 438 by exhibiting the high binding energy (-132.85kcal/mol) followed by 1khh (-125.48) and 1CB4. Among the standard antioxidant proteins [ascorbic acid (-108.11kcal/mol), Gallic acid (-89.73kcal/mol), Quercitin (-103.22kcal/mol)] tested none of the standard compounds possesses good activity than the plant metabolite chlorogenic acid. (Fig 4.3).

Genistin has shown firm interaction with 1CB4 by exhibiting the high binding energy (-121.48kcal/mol) at VAL 7, LYS 9, ASP 11, LEU 142, ASN 51, VAL 146, CYS 144 interacting aminoacids followed with 1KHB (-116.1). Among the standard antioxidant proteins {ascorbic acid (-111.07kcal/mol), Gallic acid (-89.42kcal/mol), Quercitin (-103.27kcal/mol)} tested none of the standard compounds possesses good activity than the plant metabolite genistin(Fig 4.4)

Medicagenic acid posses highest activity against 3MNG protein (THR-150, ASP-145, THR-147, ARG-127, THR-44) by exhibiting high binding energy (-132.85Kcal/mol). Among, the standard antioxidant drugs {Ascorbic acid (-103.47 Kcal/mol), Gallic acid (-110.08 Kcal/mol), Quercitin (-98.12 Kcal/mol) tested none of the standard compounds possess good activity then the plant metabolite Medicagenic acid (Fig 4.5)

Fig 4: Figure depicting the interaction of antioxidant proteins with plant metabolites**Fig 4.1 :** 6-Methoxy luteolin with (A)1KHB(-120.45) by binding at(THR 92, ARG 24, ARG 115, GLY 114, GLN 112, SER 111, ARG 483, PRO 484) significantly by (B)1XAN(-112.89kal/mol)(C)1DGH(-107.29kal/mol)**Fig 4.2 :** Asiatic acid with (A)4COX(-112.53) by binding at (ARG 44, PRO 154, ALA 156, CYS 47) significantly by (B)3s7s(-109.84kal/mol)

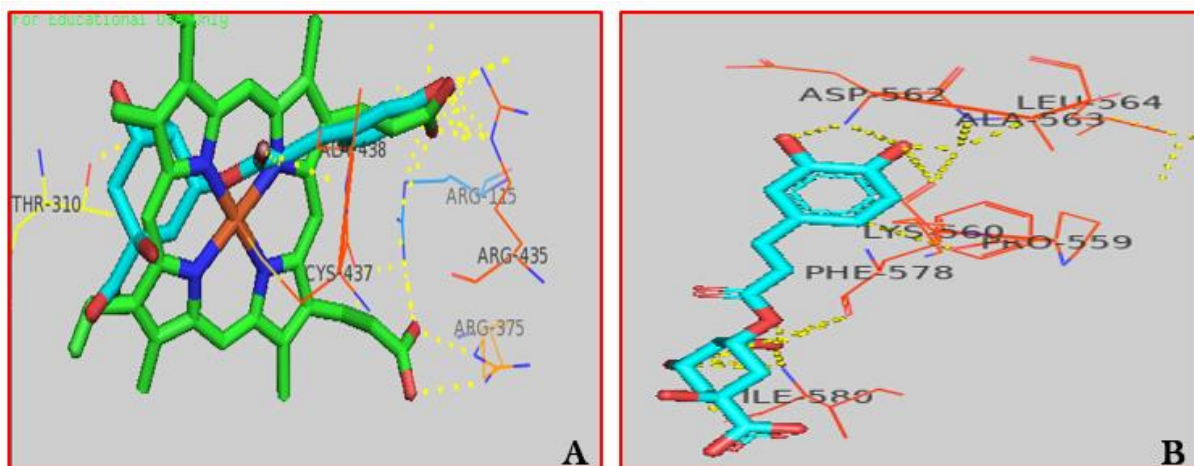


Fig 4.3 : Chlorogenic acid with (A)3S7S (-132.85) by binding at (THR 310, CYS 437, ARG 435, ARG 375, ARG 115, ALA 438.) significantly followed by (B)1KHB(-125.48kal/mol)

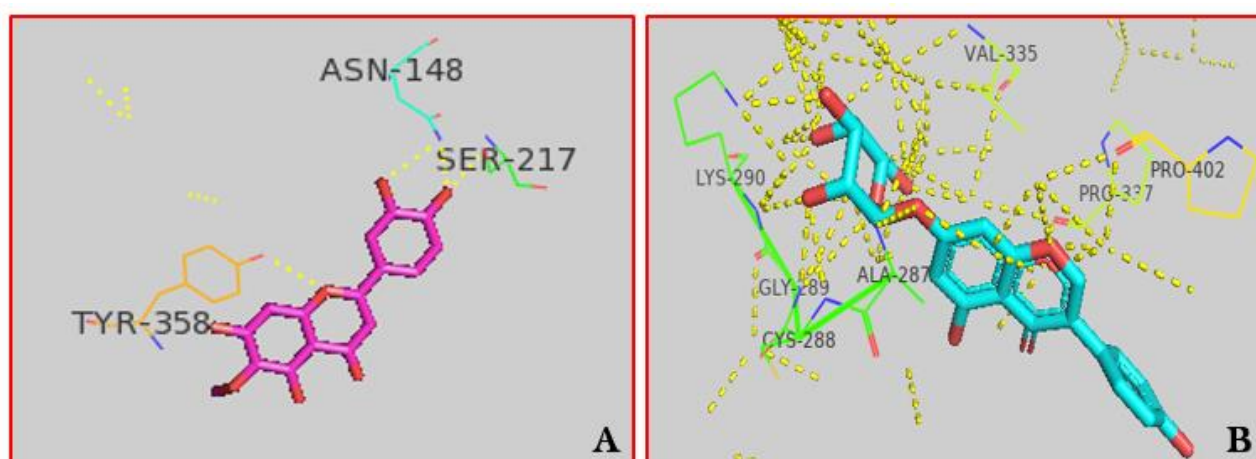


Fig 4.4 : Genistin with (A)1CB4(-121.48) by binding at (VAL 7, LYS 9, ASP 11, LEU 142, ASN 51, VAL 146, CYS 144.) significantly followed by (B)1KHB(-116.17kal/mol)

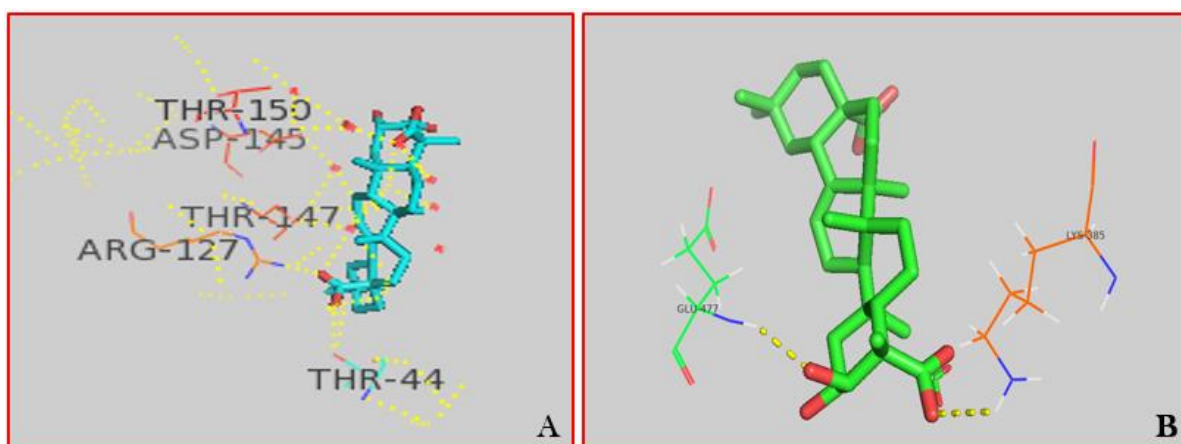


Fig 4.5 : Medicagenic acid with (A)3MNG(-132.85) by binding at (THR 150, ASP 145, THR 147 ARG 127, THR 44.) significantly followed by(B)1k4u(-125.48kal/mol)

IV. DISCUSSION

Coronaviruses have a long history of infecting humans and animals and causing respiratory, digestive, liver and central nervous system diseases in them [13]. A novel newly emerged SARS-CoV-2 is presenting major threats to human health nowadays. Currently, no specific clinical therapeutics are available for the treatment of SARS-CoV-2-mediated infections [14]. Thus, the need of the hour is to identify and characterize novel drug candidate to overcome the health losses caused by SARS-CoV-2. In this context, natural products have gained importance as potent anti-viral agents during recent years [15]. Considering the immediate need of therapeutics against COVID-19 and services of natural products in drug discovery, we have screened flavonoids against novel drug target, Mpro, of SARS-CoV-2 for the identification of Mpro inhibitors to provide natural scaffolds for drug development.

Antiviral effects of flavonoids have been the subject matter of several reports. It has been previously reported that flavonoids exert their antiviral effects via blockage of cellular receptors, inhibiting viral antigenic determinants, loss of enzymatic functions, and/or inhibition of particle biosynthesis which is consistent with our findings [16]. Furthermore, the antiviral activity of specific flavonoid subclass groups, such as catechins, flavanones, flavonols has been reported previously against various viral strains. Song et al. [17] reported reduced viral infectivity by catechins. Antiviral natural product-based medicines have also been used for two previous coronavirus outbreaks of SARS-CoV and MERS-CoV which suggests that nature has tremendous potential to provide treatment for the ongoing epidemic of COVID-19.

Previous reports also suggest anti-influenza virus potential of hesperidin and apiiin, the anti-DENV activity of rutin while the anti-rotavirus potential of diosmin which further affirm the potential of these compounds against COVID-19 [18]. Hesperidin and diosmin are flavanone glycoside which is richly found in the citrus including lemons, grapefruits and sweet oranges [19]. Rutin is a vital nutritional component and abundant flavonol found in tea, and apples [20]. Interestingly, all the compounds possessing binding energies more than Nelfinavir are nutraceuticals and important nutritional components of fruits and vegetables, thus, we anticipate that consumption of citrus fruits, cherries and apples has the potential to boost immunity to fight against COVID-19 infections.

Phytochemicals like flavonoids and polyphenols related in this work are compounds with strong antioxidant capacity that offers protection against oxidative deterioration and its consequences [21]. In the current study out of the 6 listed compounds except 6-methoxy luteolin all the other 5 metabolites are found to be potent drug against antioxidant activity. In case of interaction of plant metabolites with COVID proteins 6-Methoxy luteolin and Genestin possess highest activity than the standard drugs against 6W4B and 2CJR proteins respectively. Other research also states that Citrus sp can be developed for the discovery of anti-SARS-CoV-2 drugs because it is able to inhibit S-glycoprotein and proteases [22].

V. CONCLUSION

To combat the life-threatening corona virus infection, several studies are ongoing using antiviral drug therapies. In this work, docking studies were performed on 6 molecules out of 21 identified phenolic acids known to possess antiviral activities. 6-methoxy luteolin and Genestin were found to bind to the active sites of all the 12 different SARS-CoV-2 replicating enzymes/proteins. Out of 6 shortlisted bioactive principles except 6-methoxy luteolin all the other anti-viral compounds were found to possess significant antioxidant activity compared to standard drugs. The results suggests that, the promised plant bioactive compounds are non-toxic possessing druglikeness properties which could be used for treatment of SARS-CoV-2 after *in vitro* and *in vivo* experiments. Many natural products and herbal ingredients are observed to possess robust antiviral activity and their discoveries can further aid in the development of derivatives and therapeutic leads and also examine the possibility of combination therapies with other natural agents, as a multi-target therapy which may help to reduce the risk of generating drug-resistant viruses.

Table 4. Results of admetSAR and drug likeliness properties of the plant bioactive principles:

Non-toxic with drug likeliness plant secondary metabolites	Toxic with drug likeliness plant secondary metabolites with high molecular differences	Druglikeness (+ve)	Druglikeness (-ve)
4-Hydroxybenzaldehyde	Genistin (AMES toxic) (0.64)		-1.49
6-Methoxy luteolin	Spiraeoside (AMES toxic) (0.47)	0.44	
Asiatic acid	Soyasaponin I (MW: 942.52) (0.68)	0.77	
Chlorogenic acid	Cauloside-C (MW: 766.45) (0.70)	0.79	
Conifery aldehyde	Luteolin-7,3-di-o-glucoside (MW: 610.15) (0.60)		-1.08
Esculetin	Diosmin (MW: 608.12) (0.70)		-1.22
Ferulic acid	Medicagenic acid (MW: 502.33) (0.59)		-0.61
Hesperidin		0.94	
Polydatin			-0.35
Protocatechuic acid		0.23	
Protocatechuic aldehyde			-0.99
Resveratrol			-1.00
Sinapic alcohol			-1.09
Syringaldehyde			-1.73

Table 5. Physiochemical analysis of all the identified plant secondary metabolites in Molsoft

Sl. No	Phytochemicals	MF	MW (<500)	HBA (>10)	HBD (<5)	LogP	LogS (moles/L)	PSA (Å ²)	MV (Å ³)	B/A group	BBB (max6)	NSC
1	4-hydroxy benzaldehyde	C7H6O2	122.04	2	1	1.07	-0.97	32.01	114.63	<0./7.49	3.87	0
2	6-Methoxy luteolin	C16H12O7	316.06	7	4	2.62	-3.14	94.63	304.6	<0./6.66	2.65	0
3	Asiatic acid	C30H48O5	488.35	5	4	3.63	-4.10	76.76	588.29	<0./5.73	1.79	12
4	Coniferyaldehyde	C10H10O3	178.06	3	1	1.48	1.72	38.52	187.24	<0./9.69	3.98	0
5	Esculetin	C9H6O4	178.03	4	2	0.73	-1.08	53.74	174.77	<0./8.28	2.91	0
6	Ferulic acid	C10H10O4	194.06	4	2	1.61	-1.90	52.80	194.88	<0./4.54	2.97	0
7	Protocatechuic acid	C7H6O4	154.03	4	3	1.05	-1.66	6.74	132.27	<0./5.18	2.67	0
8	Protocatechuic aldehyde	C7H6O3	138.03	3	2	0.63	-1.18	47.49	127.35	<0./7.31	3.97	0
9	Resveratrol	C14H12O3	228.08	3	3	2.8	-2.42	52.82	224.35	<0./8.71	3.71	0
10	Sinapic alcohol	C11H14O4	210.09	4	2	0.69	-0.97	47.63	219.06	<0./9.65	3.71	0
11	Cauloside-C	C 41 H 66 O 13	766.959	13	8	2.01	-2.36	172.22	828.09	<0./5.73	0.34	18

12	Chlorogenic acid	C ₁₆ H ₁₈ O ₉	354.31	9	6	-0.20	-1.40	127.41	338.61	<0./4.67	1.74	4
13	Diosmin	C ₂₈ H ₃₂ O ₁₅	608.549	15	8	-0.04	-1.49	188.28	543.30	<0./9.27	1.21	10
14	Genistin	C ₁₂ H ₂₀ O ₁₀	432.37	10	6	-0.39	-1.77	134.88	392.38	<0./9.74	1.70	5
15	Hesperidin	C ₂₈ H ₃₄ O ₁₅	610.57	15	8	-0.81	-1.55	186.70	534.27	<0./9.80	1.21	11
16	Luteolin-7,3-di-o-glucoside	C ₂₇ H ₃₀ O ₁₆	610.57	16	10	-1.71	-1.54	214.69	534.95	<0./9.77	1.21	10
17	Medicagenic acid	C ₃₀ H ₄₆ O ₆	502.692	6	4	2.68	-2.84	43.83	262.08	-3.04	4.25	0
18	Polydatin	C ₂₀ H ₂₂ O ₈	390.4	8	6	0.53	-1.13	115.06	356.05	<0./9.28	2.22	5
19	Soyasaponin I	C ₄₈ H ₇₈ O ₁₈	943.134	18	11	1.56	-2.38	233.40	974.00	<0./4.35	0.34	25
20	Spiraeoside	C ₂₁ H ₂₀ O ₁₂	464.379	12	8	-0.76	-1.77	166.01	412.11	<0./6.70	1.61	5
21	Syringaldehyde	C ₉ H ₁₀ O ₄	182.17	4	1	0.71	-0.89	45.14	178.02	<0./7.42	3.49	0

MF-Molecular Formula; MW-Molecular Weight; HBA-Hydrogen Bond Acceptor; HBD-Hydrogen Bond Donor; MolLog, MolLogS, MolPSA-MolVol, BBB-Blood Brain Barrier, NSC-Number of Stereo Centers

Table 6. Consolidated binding energy of the plant bioactive compounds with COVID proteins

Sl. No		Binding energy of the plant bioactive compounds with COVID proteins											
		2cjr	2ajf	3e9s	5re4	5rfk	6ack	6lu7	6lzg	6nur	6w4l	6w4b	6y84
1.	4-Hydroxybenzaldehyde	-61.48	-56.22	-68.88	-62.04	-63.19	-61.67	67.11	-59.36	-62.7	-71.67	-53.53	-62.68
2.	6-Methoxy luteolin	-98.49	-86.14	-106.44	-100.16	-95.09	-107.96	-90.2	-99.33	-103.89	-110.32	-78.61	-100.29
3.	Asiatic acid	-94.92	-93.46	-88.26	-96.77	-90.3	-96.98	-82.55	-103.64	-90.76	--94.71	-81.88	-99.93
4.	Chlorogenic acid	-88.94	-93.39	-93.3	-86.63	-103.77	-101.52	-91.72	-117.31	-97.64	-103.68	-82.67	-98.36
5.	Genistin	-132.03	-91.93	-110.03	-108.54	-103.98	-113.29	-98.07	-100.53	-103.27	-120.15	-91.21	-112.55
6.	Medicagenic acid	-98.74	-103.1	-75.98	-105.54	-92.18	-89.66	-94.27	-105.76	-91.11	-97.25	-72.84	-92.95
7.	Protocatechuic acid	-82.32	-71.04	-91.82	-77.19	-76.74	-77.75	-50.94	-76.67	-84.4	-85.9	-67.75	-75.53

Table 7. Consolidated binding energy of the plant bioactive compounds with antioxidant proteins

Compounds	Binding energy Plants Bioactive Compounds with antioxidant proteins											
	2P31	3EMW	3MNG	3S7S	1CB4	1DGH	1DNU	1K4U	4COX	4KZC	4LYN	5H5Q
4-Hydroxybenzaldehyde	-67.33	-71.33	-51.78	-67.19	-60.76	-56.73	-52.73	-63.8	-64.71	-55.74	-57.51	-62.82
6-Methoxy luteolin	-105.81	-85.24	-82.17	-114.94	-91.2	-107.29	-73.29	-94.75	-107.71	-99.82	-92.72	-92.24

Asiatic acid	-82.07	-92.05	-74.42	-109.84	-100.33	-113.79	-69.39	-89.87	-122.53	-103.39	-81.65	
Chlorogenic acid	-93.43	-96.32	-79.62	-132.85	-114.78	-103.91	-70.17	-89.8	-63.77	-96.06	-90.5	-91.27
Genistin	-94.8	-94.77	-80.05	-110.42	-121.48	-95.91	-86.01	-95.24	-97.3	-91.91	-104.97	-106.36
Medicagenic acid	-91.94	-92.06	-86.95	-111.89		-108.82	-67.88	-86.7	-71.02	-75.13	-96.72	-83.74
Protocatechuic acid	-79.29	-74.3	-59.44	-88.2	-81.86	-67.2	-61.26	-66.64	-75.33	-75.94	-68.72	-76.21

Table 8. Consolidated binding energy of the standard drugs with antioxidant and COVID proteins.

	COVID standard Drugs				Standard Antioxidant drugs		
	Quercitin	Remdesivir	Ivermectin		Ascorbic acid	Gallic acid	Quercitin
2cjr	-101.23	-93.37	-112.36	2p31	-104.87	-100.99	-110.8
2ajf	-91.25	-105.29	-109.19	3emw	-111.96	-111.97	-99.8
3e9s	-118.61	-100.46	-99.29	3mng	-103.47	-110.08	-98.12
5re4	-113.72	-93.02	-95.39	3s7s	-108.11	-89.73	-103.22
5rfk	-92.78	-98.13	-95.65	1cb4	-111.07	-89.42	-103.27
6ack	-91.87	-103.17	-105.45	1dgh	-97.6	-94.08	-99.17
6lu7	-89.38	-84.13	-96.47	1dnu	-88.93	-88.06	-91.88
6lzg	-110.96	-92.17	-128.54	1k4u	-117.28	-109.55	-90.33
6nur	-97.51	-105.95	-112.95	4cox	-102.31	-86.19	-90.61
6w41	-113.85	-102.39	-126.31	4kzc	-105.8	-105.3	-93.68
6w4b	-83.47	-81.51	-96.78	4lyn	-100.94	-84.2	-91.38
6y84	-104.61	-100.75	-108.52	5h5q	-96.08	-101.71	-100.95
				1khh	-105.87	-101.99	-120.8
				1xan	-101.96	-110.97	-119.8

Table 9. Interaction studies of the identified phenolic compounds with different coronavirus-2 proteins.**I**

4-Hydroxybenzaldehyde			
PDB	Binding Energy	VDW	H-Bond
2CJR	-61.48	-41.68	-19.8
2AJF	-56.22	-41.81	-14.41
3E9S	-68.88	-59.38	-9.5
5RE4	-62.04	-53.98	-8.06
5RFK	-73.62	-59.38	-19.8
6ACK	-77.75	-48.49	-27.48
6LU7	-68.88	-59.38	-9.5
6LZG	-68.88	-59.38	-9.5
6NUR	-94.92	-80.15	-12.47
6W41	-93.46	-80.77	-12.68
6W4b	-88.26	-72.5	-13.59
6Y84	-68.88	-59.38	-9.5

II

6-Methoxy luteolin			
PDB	Binding Energy	VDW	H-Bond
2CJR	-98.49	-59.16	-39.33
2AJF	-86.14	-72.64	-13.51
3E9S	-106.44	-88.65	-17.8
5RE4	-100.16	-85.58	-14.58
5RFK	-95.09	-69.03	-26.06
6ACK	-107.96	-94.22	-13.74
6LU7	-90.2	-68.26	-21.95
6LZG	-99.33	-72.61	-26.72
6NUR	-103.89	-81.32	-22.58
6W41	-78.61	-53.02	-25.59
6W4b	-110.32	-84.16	-26.16
6Y84	-68.88	-59.38	-9.5

Asiatic acid			
PDB	Binding Energy	VDW	H-Bond
2CJR	-94.92	-80.15	-12.47
2AJF	-93.46	-80.77	-12.68
3E9S	-88.26	-72.5	-13.59
5RE4	-96.77	-82.18	-12.56
5RFK	-90.3	-82.9	-7.4
6ACK	-96.98	-86.52	-10.46
6LU7	-82.55	-63.67	-17.56
6LZG	-103.64	-80.86	-23.12
6NUR	-90.76	-73.65	-17.69
6W41	-81.88	-59.69	-22.19
6W4b	-94.71	-75.31	-15.74
6Y84	-99.93	-78.93	-20.99

Chlorogenic acid			
PDB	Binding Energy	VDW	H-Bond
2CJR	-88.94	-60.5	-28.44
2AJF	-93.39	-66.03	-27.35
3E9S	-93.3	-79.45	-13.84
5RE4	-86.63	-57.3	-29.34
5RFK	-103.77	-71.75	-30.47
6ACK	-101.52	-62.72	-37.01
6LU7	-91.72	-64.28	-27.45
6LZG	-117.31	-87.9	-30.08
6NUR	-97.64	-66.81	-27.65
6W41	-82.67	-57.09	-27.51
6W4b	-103.68	-77.9	-25.78
6Y84	-98.36	-70.33	-28.77

Genistin			
PDB	Binding Energy	VDW	H-Bond
2CJR	-132.03	-100.66	-31.37
2AJF	-91.93	-64.13	-27.8
3E9S	-110.03	-86.94	-23.08
5RE4	-108.54	-72.03	-36.51
5RFK	-103.98	-60.24	-43.74
6ACK	-98.07	-56.21	-41.86
6LU7	-100.53	-75.76	-24.77
6LZG	-113.29	-94.91	-18.37
6NUR	-103.27	-76.99	-26.29
6W41	-91.21	-60.92	-30.29
6W4b	-120.15	-82.1	-38.05
6Y84	-112.55	-85.14	-27.41

Medicagenic acid			
PDB	Binding Energy	VDW	H-Bond
2CJR	-98.74	-82.52	-13.3
2AJF	-103.1	-80.45	-9.21
3E9S	-75.98	-62.62	-9.72
5RE4	-105.54	-79.61	-25.05
5RFK	-92.18	-75.68	-15.09
6ACK	-89.66	-80.45	-9.21
6LU7	-94.27	-66.6	-26.19
6LZG	-105.76	-75.28	-29.84
6NUR	-91.11	-67.07	-21.76
6W41	-72.84	-61.28	-11.56
6W4b	-97.25	83.22	-13.82
6Y84	-92.95	-63.95	-25.36

Protocatechuic acid			
PDB	Binding Energy	VDW	H-Bond
2CJR	-82.32	-51.05	-28.07
2AJF	-71.04	-38.89	-29.42
3E9S	-91.8	-64.23	-25.84
5RE4	-77.19	-55.18	-21.51
5RFK	-76.74	-50.5	-25.64
6ACK	-77.75	-48.49	-27.48
6LU7	-50.94	-39.94	-11
6LZG	-76.67	-55.69	-20.87
6NUR	-84.4	-54.91	-29.36
6W41	-67.75	-53.29	-14.46
6W4b	-85.9	-56.52	-29.37
6Y84	-75.53	-61.26	-13.71

Table 10. Interaction studies of different plants bioactive compounds with different antioxidant proteins and their interacting amino acids:**I****II**

4-Hydroxybenzaldehyde			
PDB	Binding Energy	VDW	H-Bond
1CB4	-60.76	-38.08	-22.68
1DGH	-56.73	-44.73	-12
1DNU	-52.73	-44.26	-8.47
1K4U	-63.8	-49.42	-14.38
1KHB	-67.97	-55.97	-12
1MV5	-58.98	-46.86	-12.12
1XAN	-65.53	-48.08	-15.45
2CAG	-64.8	-51.64	-13.16
2P31	-67.33	-59.07	-8.26
3EMW	-71.33	-56.83	-14.5
3MNG	-51.78	-36.28	-15.5
3S7S	-67.19	-47.46	-19.73
4COX	64.71	-58.24	-6.47
4KZC	-55.74	-43.74	-12
4LYN	-57.51	-46.17	-11.37
5H5Q	-62.82	-49.84	-12.99

6-Methoxy luteolin			
PDB	Binding Energy	VDW	H-Bond
1CB4	-91.2	-64.28	-26.92
1DGH	-107.29	-91.58	-15.71
1DNU	-73.29	-50.37	-22.92
1K4U	-94.75	-74.5	-20.26
1KHB	-120.45	-74.51	-45.94
1MV5	-106.42	-81.18	-25.25
1XAN	-112.89	-85.41	-27.49
2CAG	-99.4	-86.83	-12.58
2P31	-105.81	-86.49	-19.32
3EMW	-85.24	-67.28	-17.97
3MNG	-82.17	-61.59	-20.58
3S7S	-114.94	-75.76	-39.18
4COX	-107.71	-95.04	-12.67
4KZC	-99.82	-78.34	-21.48
4LYN	-92.72	-65.89	-26.89
5H5Q	-92.24	-77.18	-15.06

III

Asiatic acid			
PDB	Binding Energy	VDW	H-Bond
1CB4	-100.33	-87.52	-12.81
1DGH	-113.79	-92.12	-20.59
1DNU	-69.39	-60.89	-8.5
1K4U	-89.87	-82.92	-8.26
1KHB	-91.47	-73.66	-17.7
1MV5	-100.91	-86.37	-14.54
1XAN	-94.08	-74.23	-15.87
2CAG	-81.69	-77.23	-4.46
2P31	-82.07	-64.15	-17.41
3EMW	-92.05	-71.85	-18.25
3MNG	-74.42	-54.22	-20.2
3S7S	-109.84	-85.08	-24.76
4COX	-122.53	-106.57	-16.2
4KZC	-103.39	-84.45	-18.93
4LYN	-81.65	-58.61	-23.04
5H5Q	-86.87	-69.37	-17.5

IV

Chlorogenic acid			
PDB	Binding Energy	VDW	H-Bond
1CB4	-114.78	-78.89	-36.4
1DGH	-103.91	-81.06	-22.85
1DNU	-70.17	-52.37	-17.8
1K4U	-89.8	-67.26	-22.54
1KHB	-125.48	-89.33	-30.08
1MV5	-94.94	-74.78	-21.18
1XAN	-100.84	-73.27	-29.07
2CAG	-103.89	-63.64	-34.98
2P31	-93.43	-58.04	-33.21
3EMW	-96.32	-67.88	-26.74
3MNG	-79.62	-59.65	-19.97
3S7S	-132.85	-89.73	-43.12
4COX	-63.77	-48.28	-15.49
4KZC	-96.06	-63.31	-30.78
4LYN	-90.5	-58.18	-29.88
5H5Q	-91.27	-70.65	-19.56

V

Genistin			
PDB	Binding Energy	VDW	H-Bond
1CB4	-121.48	-94.02	-27.46
1DGH	-95.91	-80.76	-15.15
1DNU	-86.01	-62.7	-23.31
1K4U	-95.24	-84.33	-10.91
1KHB	-116.17	-80.04	-36.13
1MV5	-109.96	-90.46	-19.51
1XAN	-139.88	-108.35	-31.53
2CAG	-107.33	-77.35	-29.98
2P31	-94.8	-70.33	-24.47
3EMW	-94.77	-72.87	-21.9
3MNG	-80.05	-46.99	-33.06
3S7S	-110.42	-83.1	-27.32
4KZC	-91.91	-72.3	-19
4LYN	-104.97	-57.02	-47.96
5H5Q	-106.36	-90.4	-15.96

VI

Medicagenic acid			
PDB	Binding Energy	VDW	H-Bond
1CB4	-108.82	-75.16	-30.36
1DGH	-67.88	-59.94	-7.94
1DNU	-86.7	-74.49	-10.7
1K4U	-125.48	-89.33	-30.08
1KHB	-94.94	-74.78	-21.18
1MV5	-100.84	-73.27	-29.07
1XAN	-103.89	-63.64	-34.98
2CAG	-93.43	-58.04	-33.21
2P31	-96.32	-67.88	-26.74
3EMW	-79.62	-59.65	-19.97
3MNG	-132.85	-89.73	-43.12
3S7S	71.02	-53.4	-17.63
4COX	-75.13	-60.68	-15.09
4KZC	-96.77	-80.55	-12.42
4LYN	--83.74	-63.15	-20.84
5H5Q	-108.82	-75.16	-30.36

VII

Protocatechuic acid			
PDB	Binding Energy	VDW	H-Bond
1CB4	-81.86	-40.17	-30.77
1DGH	-67.2	-46.88	-18.28
1DNU	-61.26	-42.61	-16.5
1K4U	-66.64	-46.11	-19.93
1KHB	-86.52	-44.53	-38.38
1MV5	-71.99	-48.99	-22.99
1XAN	-78.32	-49.18	-29.39
2CAG	-85.27	-54.27	-26.93
2P31	-79.29	-58.83	-19.83
3EMW	-74.3	-39.08	-29.78
3MNG	-59.44	-35.45	-23.99
3S7S	-88.2	-51.78	-31.04
4COX	-75.33	-51.25	-21.37
4KZC	-75.94	-58.33	-17.61
4LYN	-68.72	-47.63	-21.66
5H5Q	-71.59	-52.01	-19.58

Table 11: Interaction studies of different plants bioactive compounds with different COVID proteins and their interacting amino acids

PDB	Binding Energy	VDW	H-Bond	Interacting amino acids
6-Methoxy luteolin				
3E9S	-106.44	-88.65	-17.8	THR-75, ALA-69, GLU-78
6ACK	-107.96	-94.22	-13.74	ALA-940, GLN-939, GLN-936
6W4B	-110.32	-84.16	-26.16	VAL-111, ALA-108, LEU 113, PRO-7 ARG- 11
Asiatic acid				
6LZG	-103.64	-80.86	-23.12	GLN-102, TRP- 566 GLU-564, ALA - 396 Lys-562
Chlorogenic acid				
5RFK	-103.77	-71.75	-30.47	ASN-142 SER - 144 LEU-141, DHE-140 HIS - 163, HIS-164, THR – 190
6ACK	-101.52	-62.72	-37.01	LYS-291, LEU-SH, ARG-H8, GLY-739 GLN-737 SER-950 ASN-951
6LZG	-117.31	-87.9	-30.08	ALA-387, GLN-388 ARG-393, ASN -33 GLU-37, LYS-353, ARG-403, SER - 494, GLY-496
Genistin				
2CJR	-132.03	-100.66	-31.37	Asp - 344, LYS-343, LYS-257, LVS-258, ARG-263, ARG - 260 ALA – 337
6LZG	-113.29	-94.91	-18.37	ASP-34H LYS-343, LYS-357, LYS -258 ARG-263, ARG - 260, ALA – 337
6W4B	-120.15	-82.1	-38.05	ASP-27 ALA-29, LYS -87, ASP-79, ARG-112 THR-78
Medicagenic acid				
2AJF	-103.1	-80.45	-9.21	TYR-385 ASN -394 SER-44, SER-47
5RE4	-105.54	-79.61	-25.05	TYR-239 ASP-289, ARG – 131
6LZG	-105.76	-75.28	-29.84	GLU-398, ARG-514, SER-SI), TRP-203 TYR – 196
Protocatechuic acid				
3E9S	-91.8	-64.23	-25.84	GLY-288, SER-116 SER 115, TRP-107, TYR-274, HIS-273, TYR – 113

Table 12: Interaction studies of different plants bioactive compounds with different antioxidant proteins and their interacting amino acids:

PDB	Binding Energy	VDW	H-Bond	Interacting amino acids
6-Methoxy luteolin				
1DGH	-107.29	-91.58	-15.71	ASN 148, TYR 358, SER 217.
1KHB	-120.45	-74.51	-45.94	THR 92, ARG 24, ARG 115, GLY 114, GLN 112, SER 111, ARG 483, PRO 484,
1XAN	-112.89	-85.41	-27.49	GLY 55, GLY 27, GLY 31, ASP 331, LEU 337, TYR 197, CYS 58, THR 57.
Asiatic acid				
1DGH	-113.79	-92.12	-20.59	
3S7S	-109.84	-85.08	-24.76	ARG 375, ARG 115, MET 374, TRP 141, ARG 435, ARG 145, SER 199.
4COX	-122.53	-106.57	-16.2	ARG 44, PRO 154, ALA 156, CYS 47
Chlorogenic acid				
1CB4	-114.78	-78.89	-36.4	
1KHB	-125.48	-89.33	-30.08	ASP 562, LEU 564, ALA 563, PRO 559, PHE 578, LYS 560.
3S7S	-132.85	-89.73	-43.12	THR 310, CYS 437, ARG 435, ARG 375, ARG 115, ALA 438.
Genistin				
1CB4	-121.48	-94.02	-27.46	VAL 7, LYS 9, ASP 11, LEU 142, ASN 51, VAL 146, CYS 144.
1KHB	-116.17	-80.04	-36.13	VAL 335, PRO 402, ALA 287, GLY 289, CYS 288, LYS 290
Medicagenic acid				
1K4U	-125.48	-89.33	-30.08	LYS 385, GLU 477.
3MNG	-132.85	-89.73	-43.12	THR 150, ASP 145, THR 147 ARG 127, THR 44.

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The Vibrancy of Leader's Paradigm is Truly Exalted for Protean Enhancement

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ABSTRACT - The term "Management and Leadership" are the very prime focus for any of the very enriching occupational steps to deal with most significant progress. Most importantly, both education and occupation are largely dependent upon the same because the term "Management" shall be navigating the most legitimate avenues to accomplish the task with the finest objectives. Leaders do search for such omnipotent roots to walk upon where they are in a position to instigate some unique commercial dealings along with their operational eventualities. In this regard, new hypothesis, riveting mind set and the most dynamic team building and their imposing execution and most notably their collective educational vertex are absolutely very imperative for the entire team to take off. On the other hand, the term "Leadership" shall be focusing upon the methodology and best future consequences respectively. It is quite evident that both academic leaders and organizational leaders shall have to focus for the vivid progressions along with the radiant dimension of success in terms of best financial outputs, occupational vibrancy, global appreciations and undeniable good will at all. This is the primary need of those leaders to refine both education and organization in a befitting manner. This is how they may enrich the best occupational goal with momentous dexterity, where economical solidity is one of the significant measures consequently. Therefore, leaders are those very eminent personalities, who are here to execute their best through the stature of prime competency for leading the hierarchy of an organization without any second thought because their elite motive to ensure the comprehensive organizational success and the most rapid celerity with best available resources, indeed. That is how leaders do empower their followers who shall have to be well trained not only for the self enrichment within the stipulated time frame but to contribute a lot for the unbeaten occupational culmination in a conforming manner. In this regard, their all-round preparation is very important for procuring the emphatic occupational maturation from each worker who should be really very trained, efficient and exclusively pertinent to make the vision absolutely successful.

KEYWORDS: a. Educational magnificence, b. Leadership approaches, c. Organizational furtherance and d. Leaders' contributions.

I. INTRODUCTION

Leaders do take the noteworthy initiatives to excel their absolute integrities, to achieve the largest organizational goals very shortly, which shall be really very stimulating for both leaders and followers to inculcate some exceptional experiences, to ensure the best commercial dealing and the impressive financial outputs as per their most prestigious strategy. That is why they need the exclusive trainings and the sound exposures not only to enhance the best commercial profit margin but to expand the streamlined inclinations of that very organization and their first-rated multifaceted developments as well. This process does evaluate the utmost participation of their followers to be involved in that organization. It is quite needless to state that the concept of "Participative Leadership Approach" shall have to be instigated as soon as possible for the overall evaluation for both leaders and followers. Otherwise, leaders will not be able to discover the strengths and weaknesses from their immediate subordinates and followers. So, how shall it be possible to win the spirited occupational attainments right from the beginning? It is a process of establishing a family, where the entire official aspirations and the administrative challenges shall have to be consummated as a whole. Most importantly, followers from entire hierarchy shall have to raise their voices and valid points for their collective refinements right from knowledge to their felicitous executions at the end of the day. That is how, the great leadership transformation is possible by the most dynamic leaders because skillful organizational actualizations need the high-end educational competency and it is one of the most pivotal issues in all the regards. That is the reason why leaders are really desirous to bring out the real parity in between their standing of education and ardent knowledge and on the other hand, they must have the heartfelt realizations for the organizational spirit and need as well. Both the perspectives would be comprehensively evaluated by the leaders and they shall disclose the final outcomes about their collective strengths of team right from the proper detection and the executions of elite class indeed. This is how, the leadership transformation is correctly directed and entrenched by the leaders to ensure the high-end vertex, where educational competency

and organizational purifications are undoubtedly possible and that is possible just within the stipulated time frame. According to the legitimate protocol of leaders, they should transform their followers to enhance the best skillful potentials not only to adopt the best leadership qualities but to convert their qualities in enriching the supreme performances in connection with the destined regulatory mission in a very equitable dimension for successful tomorrow. So these are the possible profit making avenues to generate unique occupational propositions at all. That is the reason why leaders are solely responsible to implement their unequivocal plans to explore and they do play the sheet anchor role as eye-openers for all the associate followers with intensified encouragements at the end. According to their sustainable objectives this is the finest root of segregated work force, where both leaders and followers shall have the equal opportunities to refine their exposed thoughts and the untold introspections as well.

Zakeer Ahmed Khan, Dr. Allah Nawaz and Irfanullah Khan have expressed their most invaluable views in one of the published articles entitled: Leadership Theories and Styles: A Literature Review(2016) that, various explanations, classifications and definitions may enrich our contemporary literature in deed. If all the leadership styles are properly clarified then both organizational and social research will be equally considered.

In the same light, the versatile contributions of transformational leaders will be really impactful from the perspectives of both education and an organization not only in terms of glorious economical growth but for the imperative celerity to hold the profession in a legitimate style because each leader is really goal oriented and they do invariably focus upon performance and various evaluations. Therefore, followers of entire hierarchy are absolutely very conscious for the self assessments. Otherwise, the perfection of them will not be possible and on the contrary, the compact professional structure will be beyond the reach. In this regard, professional initiatives will have to be really enlarged for the most aristocratic benchmark and that will be really impactful for all the sustainable goals to achieve through the best cognizance of financial enhancement, educational merriment and the organizational achievement at the same point of time.

II. RESEARCH ILLUSTRATIONS

This is the illustrious concept and the best authoritative headway, where both leaders and followers and on the other hand, all the students and the teachers should equally be confined to enact for the forthcoming enterprises to focus upon and to set the significant instances in the history.

Therefore, leaders are such well wishers and great path influencers, who are aiming for the very specific avenues to deal with. The following points are very crucial in this regard.

- They should have the specific intention for the collective professional solace, where financial strength, their communal existence and the unparallel value of positivity are absolutely stunning to move to. That is why leaders do need the empirical study, which signifies both transformational and transactional approaches of leadership for their comprehensive automation of competent milestones to reach lawfully.
- Leaders need the worthwhile accession to enhance their thoughts and envisions in a global platform because their irreplaceable global efforts and initiatives will be definitely very attractive to adopt the root of professional exhilarations, where each follower and employee shall have the exclusive charm and they will be able to satisfy their respective discipline not only for the societal entrance but for the optimistic outcomes also. Leaders do prefer the flawless globalization. As a result, they will be able to cope up the best global paradigm and the active occupational diligence respectively. This is the refining business procurement to the well deserved professional community. So the captivating bonding between leaders and followers for reinforcing each and other to win this magnificent battle of team work and culture of inhabitable learning.
- Apart from the same, another most exemplary attention should be the network. As a reflection it would be both education and occupation which will definitely be in an indispensable focus of proficient culmination. So leaders do have the enduring responsibility to clarify the florid desire of our learners from the end of both education and organization. It is really endless in nature and in case of rapid refinements the entire global net work will be truly supporting to those leaders to utilize all the needful opportunities as a hole. In this regard leaders should be communicating with all the other overseas leaders to collaborate and to ensure the best commercial assignments at the end of the day. Therefore, all the learners will be really courageous not only to develop their collective learning but to

generate the highest occupational perceptions through the effect of flawless communication throughout the year. The key idea is all the scholar students are having some inextinguishable scopes to study abroad and they are trying to accomplish their great educational height from there and they are being invariably involved to deal with the international business of absolute elite class. So I think they shall fulfill both the avenues of education and profession under the sublime guidelines of global leaders to reach at the pick soon.

- In the same light, leaders do concentrate upon the operation as well. Because any successful operational flow is invariably necessitous not only to extract the best performance from the employees but to pay the decisive courage to the students. Leaders are trying to pay the real equality to the entire society between all the mentors and mentees and in other words, all the leaders and their well deserved subordinates as well. So it is a real balance and it may reform the most unequivocal future consequences very minutely.

Therefore, leaders are prepared and trained very magnificently to find two masterly boulevards of both education and occupation simultaneously.

Rose Ngozi Amanchukwu, Gloria Jones Stanley and Nwachukwu Prince Ololube have deciphered their collective thoughts in one of the published articles entitled: A Review of Leadership Theories, Principles and Styles and their relevance of Educational Management(2015) that, nation cannot be grown up without the influence of educational leaders. The prime focus of this research manuscript is to determine the wider concept of leadership and the impacts of school management.

III. METHODOLOGY

It is an exclusive research abstract, which has already been composed through self-cognitive practice based upon the pure research focus of exclusive theory, where leaders and followers are always in the same platform to frame the most mutually exclusive bonding to make sure that, they are undoubtedly participative in nature to understand about their forthcoming communal responsibilities in terms of educational acceleration and the organizational inventiveness. Both the chapters are invariably interconnected with each and other to find out the avenue of common victory of sustainability in enriching their real economical growth, communal magnificence and the brand value reach of academic and organizational leaders in deed. It comprises pre-training method, learning and post learning consequently.

That is why, they have entrenched their considerable focus upon the following:

PRE-TRAINING METHOD:

- a. **Rigorous Training:** Leaders are liable to pay the needful training for the rapid growth according to their all-round parameters. So that it is absolutely possible to take all the mentees and followers to enhance their collective determinations. In this respect, they will be able to generate the additional trust upon themselves to work hard for our genuine stimulations. They shall be reflecting their depth of education and learning for the competent shape of an organization without any second thought. This is how both education and the implementation of learning may influence upon the best organizational greatness along with the magical consequence of our national legacy and the vigilant summery of success.
- b. **All-round Motivation:** According to my analytical perception we need the motivation at every individual stage of our lives at all. So that our overall competency will be functioning proper for the wide-ranging accuracy. Both competency and accuracy are very indispensable for an organization. As a matter of the fact is leaders are solely responsible to motivate their students, subordinates and followers to fulfill their utmost professional target within the stipulated time frame. It is an interesting initiative which is allotted to the leaders to adopt the process and to devote for the discreet professional mission through the best educational core.
- c. **Context of Goal:** Leaders do wish to reach the target along with their great team members who are not only ambitious but to display the best all-round performance to enrich the goal. So leaders are very adoptive for assignments and multifarious tasks to focus upon. They firmly believe that, bright organizational ease means the invaluable reflection of education. So educational values are the prime focus from the point of view of leaders in enriching their self erudition which is accordingly reflective for professional enlightenment. They do train their followers as per the concept of advocacy leadership approaches and they do expect for the diligent occupational glory.

IV. LEARNING

It is a real time to move for the pre-scheduled betterment upon the past experiences. So leaders do think about the future and that is the reason why they do ensure the comfortable presence on the basis of past for sustaining in the highly competitive future. So it is a big deal for both leaders and followers to participate in connection with the delightful occupational discovery, where the commercial benefits are just a matter of time.

- a. **Publicity:** It is indeed very crucial in this methodology. Most importantly, I have invented the most profit-making discovery, where people shall have the rousing opportunities to publicize their collective vision and the exemplary hard works at the end. On the other hand, it should bring out the inhabitable parity between the desire and the flow of execution consecutively. It is very helpful to ensure the balance between bodies and minds as well. So that, it is quite evident for the leaders to secure the psychological harmony for themselves. It is a promising step to prepare the followers who may come in front with never-ending professional dynamism from all the undesirable resilience.
- b. **Implementation of Scopes:** Leaders do search for the variety of scopes all the time because it is highly demanding for all of our followers to cherish the most glistening objectives with positivity. Therefore, it is undoubtedly very magnetic and compelling for the leaders to stimulate their mentees and followers to walk upon the same track to crack the historic visionary because without scopes hopes will not be coming in front. As a result, both leaders and followers will not be able to explore the thoughts at all. Therefore, the methodology says that, all the leaders shall have to be absolutely perceptual to bring out their best occupational manpower for accomplishing the said implemented scopes without any fail.
- c. **Cognitive Competence:** Leaders do need the same to regulate the real organizational paradigm along with the exclusive brilliance in deed. This cognition might be the unavoidable medium to think upon the all-round developments so that both education and organization might be in the same track to be evaluated. Most notably the prime importance is to have the sound education. It shall be undoubtedly proactive to join in an organization through the most impressive occupational perspicacity. That is why, both cognition and competence shall have to be under consideration to change the shape of our overall system and every individual leader and follower shall have to abide by the same. Then only this entire global academic uncertainty will be not here over the coming years and leaders shall have to remember that, without knowledge, education and the commendable conception organization cannot run and it is never possible for them to accomplish the best organizational goal indeed.
- d. **Scrutiny of Need:** It has the exclusive occupational essence because each leader and follower shall have to understand the nature and the absolute impulse of an organization. It is very important for him/her to be involved in an organization to match their most constructive perceptions with the same. That is how they are absolutely keen to direct the entire organization from the perspective of its fascinating occupational transparency to its congratulatory brilliance at the same point of time.

V. POST LEARNING

It is another very important aspect, where past experiences and the presently available resources are equally very important for the leaders to estimate the future. In this concept, they have decided to specify certain parameters for certifying the forthcoming assignments certainly.

- a. **Qualitative Measure:** Each individual is incepted in this earth with qualities and those shall have to be really enriched through their significant refinements in deed. Without the aforesaid measure they will not be able to jump in these most prestigious occupational ventures along with their sound participations and learning as well. It is quite evident to share that the organizational practices are really very delicate and it is not so easy. Hence, it is indeed very essential for them to speculate about the best possible educational opportunities, which shall be undoubtedly very purposeful to grab the needful learning and that shall have to be implemented in their profession as well.
- b. **Exclusive Insights:** Each leader is very worried about their conceptual insights because the entire development of an organization needs the utmost support of the leaders' right from the beginning. That is why, they must remember about the best reflection of education for the great professional zeal to ensure. Now they should be

thinking about the thought process to drive the same for organizational prosperity through the unbeaten benefaction of learning and educational excellence at all. That is why, both leaders and followers should have the same intensity of mind not only to proceed further in terms of money and best financial outcome but it shall be the sound proposition of emphatic organizational virtuoso invariably.

- c. **Future Estimation:** It means the best conceptual assessment and it is the inhabitable responsibility of our leaders to do the best analysis about the mentioned estimation. It is absolutely preferable to have the assumption in connection with the possible future consequences. Thus, they shall be arranging their required finance, best and competent manpower, significant professional planning, scopes of great decision making and so on. Therefore, it shall be undoubtedly mesmerizing for both leaders and followers to understand the market research and it is absolutely much needed to judge the situation for upcoming possibilities to enrich the superior organizational trend indeed. That is why, trained and experienced leaders should immediately be evaluated and appointed for this exclusive research to accomplish for the consequential future goals which are definitely desirable for them to sustain with anticipated occupational profit and best resource of financial outputs at the same point of time.
- d. **Predilection of Knowledge:** It is absolutely very riveting and it has the far-reaching impacts for the sparkling occupational speed of movements. That is why the foremost stage is to impart knowledge with exhilarating education at all. That is the spirited avenue to participate for combative occupational floor. So it will be really meticulous for them to tackle various occupational uncertainties and those will be explicitly verified by the leaders for proceeding in the next step shortly. It is invariably true that education can bring out the strong metamorphosis with the profanities and positive propensities to project the classic vision of any organization.

The fact is that I have highlighted self explanatory methodology from the perspective of leaders to enrich both the discipline of education and organization in terms of acceptance, accelerations and superiority. Most notably, leaders should be concentrating upon both the said disciplines to bring out the hope and scope to explore. This is what I have expounded in my research thesis along with the said form of knowledge from my heart-felt perception and belief.

Furthermore, I really feel very crucial that they who are today's managers they are tomorrow's leaders. So effective leadership skills are vastly depending upon the self vision and the upright estimation as well. Therefore, I have incorporated below some of the valid contexts to highlight my research focus which are as follows:

- i. **Positive vision:** Leaders' brains are small but significant and far-reaching. Leaders do have the invariable vision that how far they will be able to run and how far an organization is able to grow through attaining profits and competent business goodwill. Leaders do frame the requisite channel accordingly. It is quite true that this noble vision is unquestionably instigated from substantial education, confidence and self desire respectively.
- ii. **Mutual Stimulation:** It is really very expensive in our human life. As a result leaders do need the same throughout their best professional life to prosper in a very befitting manner. That is why leaders and followers do stimulate themselves with each and other. So they do expect everybody to be under the sublime guidelines not only for collective learning with sound education but to grip the fundamental equation of their respective organizations as a hole. Stimulation means an additional zeal to store and the scope of rapid execution without any hesitation indeed. That means the leaders do intend for accomplishing thoughts to prevail in all over the globe. It indicates the alluring knowledge and learning which is undoubtedly required to entrench their best professional contemplations without any second thought. So leaders are the great motivators through their convincing style already. That is the reason why all the followers are in a very prior position to enhance the spirit for hard works and noticeable dedications. It is very natural for the leaders to extract the best output at the end. This is how the concept of "Stimulation" is established and it is really enriching for both the leaders and followers to excel their mutual stimulation.
- iii. **Mentoring:** The open-eyed fact is that leaders are the best path finders in all over the globe. They do nourish their deployed employees in such a manner that, employees do gain the enormous knowledge regarding their allotted fields and they are in a commendable position to implement the same for well

deserved economical revenue.

Jyoti and Dr. Farhat Mohsin have contributed their high-end cognitive reflections in one of the published articles entitled: Current Practices and Challenges of Performance Management System in Higher Education Institutions(2020), that according to the present day scenario most of the organizations have adopted the most valuable “Performance Management System”. The objective is to refine the concept of “Human Resource”. It is one of the noticeable organizational steps for the entire managerial hierarchy to concentrate upon their organizational and individual advancements indeed.

Therefore, according to my research thesis I should be including three very expensive conditions for the leaders to certify my research focus.

1. Leaders have to train their employee: It means the concept of “Advocacy Leadership Approach” which is definitely very impressive in this regard because all the employees do join in an organization after the completion of learning. Nevertheless, learning does not have specific end at all. Once the theoretical learning is finished the occupational learning is instigated. Apart from the bookish knowledge the efforts for occupational learning will be in vein. All the bookish conceptions should reflect about the strength of their objectivity. So both the academic learning and occupational learning must match with each and other. It shall be really prevailing for the leaders to include the utmost strengths of their followers. It is quite evident that, academic learning helps and stimulates to participate in occupational learning. It means that, the primary learning is the base of secondary learning indeed. So leaders are trying to enrich their both the notable vision and base of learning for multifaceted outputs to enhance the global flow of economy.
2. Leaders have to take the proper decision: Decision making is one of the elite procedures to have the best options out of various alternatives. We, the rational human being do take a number of decisions in our day-to-day life but business decisions are always very specific and goal oriented. That is why, leaders do have the same in connection with the inhabitable progression of their organizations indeed. Therefore, it is a very important step for the leaders to search the best alternatives for solving any particular problem within the blink of an eye. It is absolutely very supportive to reach the best organizational goal with the utmost professional clarity. It means a lot for the followers to have the great vicinity of learning and prosperity along with their significant promotions and best financial sustainability. Therefore, this fascinating concept makes the exclusive bonding between leaders and followers and to accelerate their prevalent occupational goal to achieve and they shall definitely be able to motivate their next generations to maintain the same prestigious tradition for enabling the effective managerial performance with spirits.
3. Leaders have to reach the organizational goal: It is the ultimate factor and that is the reason why both leaders and followers are emphasizing the same. The fact is that they do place their collective decisions in a very conforming manner so that each individual can have the positive scope to participate and they can convert their decisions to productive actions indeed. It shall be really worth while once they will be well groomed, matured and prospective in nature so that it shall be very easier for them to feel the need of organizational goal, which is equally very important for them to learn the process of enrichment and it shall definitely in their favor to develop their course of actions and on the other hand detection of problems alongside the perceptual analysis. It is needless to convey that organizational goal needs the all-round eminence and meticulous paradigm and these are conceptually regulated by the leaders as well. So it is very essential for the leaders to secure their advantageous educational core and mutual understanding. I believe, leaders shall have to take the invaluable initiatives to make it happen and it will be a grand occupational benchmark for all of us to earn our bread and butter at the end.

VI. FINDINGS

My research focus reflects the satisfying objectives of professional attainments where both leaders and followers are the best eye-openers to channelize the divine occupational vision, while they are very introspective, impactful and demonstrative towards their trained professional shape for all. So according to my most candid perception, leaders are the most imperial personalities who have found the solutions through the five tenets of life and it is really influential for them not only to maintain their impetus fortitude but to glitter their omnipotent professional majesty in a very conforming manner. These five tenets are presented below:

- a. **Self Objectivity:** It is one of the illustrious factors, where each leader shall possess for both learning of students and exploration of employees. It is a price less dimension for them to abide by the noble instructions of leaders but to make it realistic according to their progressive dynamism at all. It increases spirit and devotion to complete the assigned tasks very smartly. That is the reason why both leaders and followers shall have to have this studentship for refining their untold learning with momentous elevation of life indeed.
- b. **Self Practicability:** It is highly spirited and thoroughly distinctive to enhance the desire of moral contributions. It is highly effective for our leaders to enrich their psychological dreams for both education and profession. Most importantly, it is very costly for self discovery and to know about the self strengths and weaknesses. Therefore, leaders do generate their actual self for their ardent knowledge and to disseminate the collective learning at the end. Without educational richness it is not possible and leaders are the genuine generator for the explosive boulevard of knowledge for elevating their speed and it is simply the magnificent journey for real organizational goal.
- c. **Self Celerity:** It creates the hope to reach the destiny. It is the ultimatum to snatch the best occupational victory as well. Leaders do generate the confidence and they aspire for their consequential milestone accordingly. Therefore, they need to have the unavoidable education and it is perceptually very effective for leaders and followers not only to run a successful organization but to preserve this exceptional momentum in the better consequential life. So it is very important for students, who are going to be the most prestigious leaders across the globe with phenomenal exorbitance.
- d. **Self Originality:** It signifies the present standing in a befitting manner. Academic leaders do guide their students to analyze the best qualitative measure of a student. Most importantly, it is really very costly for them to focus upon this throughout the year so that it shall be as advanced as it is really expected not only to find the best academic excellence but it shall be undoubtedly praiseworthy to convert the same in enriching their professional endeavor.
- e. **Self Viability:** It is already accustomed by the leaders and that is the reason why leaders do include their followers who have already been proficient through their first-rated educational grandeur. It shall be very easier for them to demand for the noticeable occupational inventiveness and it will be absolutely favorable for them to drag the organization for the fabulous global interpretations. So it shall be the dashing intentional core and it is perpetually regulated by the leaders with gorgeous perspicacity of learning.

Busse Ronald has expounded his significant perceptions in one of the renowned published articles entitled: *Comprehensive Leadership Review, Literature, Theories and Research* (2014), that leadership has been comprehensively perceived in this manuscript. Most importantly author has described about the historical foundation of leadership after that modern leadership approaches in a most conforming manner.

Therefore, all the leaders must be having the said propensities to research for an organizational glory where both educational dream and occupational zeal will be contributing together not only for their grand sustainability in all over the globe but to set the refulgent example for the both histrionic and scientific discoveries in terms of imperishable financial affluence, immortal gesture of collective professional fame and most notably communal victory with graceful visionary.

VII. THE ROBUST THOUGHTS

The key ideology is leaders are the exclusive waves of an ocean and that are why they are in a position to think very broadly in the end. On the other hand, I have introspected the very expensive concept of "LEADER" from the core of my gleeful significance of global benefaction which is as follows:

1. **L- Lucrative Insights:** It is a great concept which each and every individual leader should have because of their best cognitive reflection. As a result they will be able to assimilate those collective introspections and sort it out for the best occupational enrichment within a very short while. So that every individual leader shall be able to participate in that glistening paradigm of an organization and their thoughts will be undoubtedly implemented. Each leader shall have this most pivotal learning and they will be able to reach the destiny through their collective efforts and initiatives.

2. E-Emerging Ideologies: It is indeed very imperative from the perspective of innovation and the most needful occupational implementation at the same point of time. In this regard each leader and follower shall be appeared with their new and justified ideologies which may refine their best professional strategies within a very short while. Now the thought is this inventive nature will be really motivating them and that shall work for the drastic refinements of an organization indeed. On the other hand, all the ideologies will be minutely monitored by the leaders and all the fair and significant ideologies will be properly discussed in their common meeting and it will be accepted accordingly.
3. A-Ambitious Core: Both the leaders and followers shall have to have the utmost ambitious core so that it shall be really worthwhile for them to work hard and to concentrate upon the organizational strategies at the same time. This ambitious nature will be absolutely very conducive to refine their devotions and to restyle their organizational paradigm where every leader and follower shall be able to do their extensive research about their present professional standing and on the other hand, their needful towards the stable occupational benchmark.
4. D-Destined Planning: It has the far-reaching mileage already. Both the planning of leaders and followers shall have to be truly matched. Because constructive planning may make the entire occupational journey absolutely amicable. In other words, all the constructive planning shall have to have the appropriate directions and the dimensions which would definitely be the finest path for them not only to ensure the best learning but to entrench the same in terms of commercial revenue, global acceptance and business goodwill.
5. E- Empowerment of Skillful Employees: Each organization should have the same because the entire managerial hierarchy shall have to be absolutely very skillful manpower to accomplish the multifarious works very smoothly and each follower shall have to be well trained. So that it shall be really easier for them to understand the organizational need and they will be able to analyze the same. That is why skill is very important which brings out the confidence and the indomitable spirits in connection with the gradual progress of an organization which is absolutely desirable at all times.
6. R- Revolution: The entire organization should have the propensity to ensure their best revolution in the end. It should be from the perspective of commerce, organizational management, cohesive stance of an organization, communal harmony, organizational research and collective occupational victory. Therefore the entire organizational hierarchy shall have to be concerned about the same and this spirited direction will undoubtedly be successful once both the planning and its impactful implementation are at the same track.

VIII. CONCLUSION

This research focus is having the booming concept of multifaceted acquirements where both the concept of education and profession are really well bonded to fabricate an enduring professional avenue with infinite hope to prosper in the near future. Most importantly each leader is having his or her legitimate root of advancement where they do focus to place their pre-thought hypothesis and communal planning. It is not an experiment but it is an exclusive paradigm to select the requisite dimension of occupational goal in terms of sound financial strengths, strengthen occupational synergies, communal glory and the destined consequential future as well.

Therefore, I have penetrated the concept of “Leader” through the following:

1. L-Learning as per your best: It ensures the passionate magnificence of learning for entrenching their florid betterments to survive in this highly competitive globe.
2. E-Emerging originations: It shall be conducive for both leaders and their desired beginners to reach their occupational goals collectively with the extensive expansions of knowledge and spirited accelerations of quality.
3. A-Aspired demonstrations: An organization gives the incomparable stand of scopes to flourish. So leaders would be truly sensitized to adopt the education and evolve the profession at the same point of time so that the equality of transformation will definitely be reflected.
4. D-Destined magnitude: Leaders shall be emphasizing upon the same not only to

showcase their occupational fame but to embrace their global omnipotence in terms of best commercial decree, global reformations and unblemished communal eminence.

5. E-Enduring solidity: The entire organization does incorporate this unique conception to draw the best attention because it is the enlightening spark for their all-round manifestation in connection with global revenue generation.
6. R- Realignment of stand: It is definitely possible for all the leaders and followers through their united cultural synthesis where the collective notion of learning will be invested and inquisitive professional goal will definitely be innovated since both educational zeal and occupational deal are perpetually interconnected for the reactive success forever.

“Leadership is to realize the need and to visualize the success”The accumulation of communal leaders:

- a. They are always upright to maintain their philanthropic occupational boulevard where they will be stimulating their followers to define their learning and to embark their exclusive introspections.
- b. Leaders should have the elite professional visionary. So that both leaders and followers shall definitely on a same platform to bring out the exceptional discovery.
- c. Leaders should have an elaborated mission to reach the sound organizational goal with overdrawn integrity.
- d. Both leaders and followers are well trained, well equipped and vastly exposed to regulate the best occupational paradigm.
- e. They do have the phenomenal adjustment with each and other to work hard in any of the positive and negative situations along with their invaluable commitments.

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Analyzing SDGs through a Gender Lens

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Broader overview

Only 10 years remain to achieve all Sustainable Development Goals (SDGs) globally, so there is a growing need to increase the effectiveness and efficiency of action by targeting multiple SDGs. The SDGs were conceived as an ‘indivisible whole’, but interactions between SDGs need to be better understood. There is a need to explore interactions including synergies and possible conflicts between the SDGs and differ widely in their conclusions. Assessing interactions between SDGs, and the influence of gender issues on them can make an important contribution to informing decisions in 2020 and beyond.

It is estimated that roughly 1/4 of all SDG targets implicitly or explicitly address gender equality and about 32% of indicators are gender relevant.¹ As such, gender equality is not just the focus of Sustainable Development Goal 5; it is also integrated throughout the Sustainable Development Goals. This reflects the growing body of evidence that gender equality has multiplier effects across the spectrum of development. Empowering women and reducing gender gaps in health, education, labour markets and other areas results in lower poverty, higher economic growth, greater agricultural productivity, more resilient communities, better nutrition and better education of children. Conversely, failing to address gender inequalities and discrimination against women will hinder, if not derail, achievement of the Sustainable Development Goals. In short, there can be no sustainable development if the tangible and intangible barriers that hold back half the population are not addressed.²

- Recognizing and reducing women’s unpaid work is essential both for reducing poverty (Goal 1) and for promoting inclusive and sustainable economic growth (Goal 8).
- Evidence shows that ensuring women’s equal access to agricultural resources would contribute substantially toward ending hunger and achieving food security and improved nutrition (Goal 2).
- Ensuring that girls and women have access to clean water and sanitation facilities (Goal 6) also has multiplier effects given the significant impacts of poor sanitation on the safety, well-being and educational prospects of women.

Among the 230 unique global SDG indicators, 53 explicitly reference women, girls, gender, or sex, including the 14 SDG 5 indicators.

The Sustainable Development Goals (SDGs) seek to change the course of the twenty-first century, addressing key challenges such as eradicating poverty and hunger, eliminating inequalities and violence against women and girls and combating climate change. Gender equality and women’s empowerment are prerequisites for achieving these and other global goals. Thus, achieving gender equality and women’s empowerment is a stand-alone goal—SDG 5—and integrated across the other goals, with many targets specifically recognizing gender equality and women’s empowerment as both an objective and part of the solution.

Progress on SDG 5: Progress on the 2030 Agenda

The HLPF Thematic Review stresses the numerous reinforcing linkages between SDG 5 and other SDGs, many of which UN Women also highlighted in a report on SDG monitoring and gender equality. Some examples include:

- **Ending all forms of discrimination:** Ending discrimination against women and girls is critical to ensuring equal access to quality and affordable education (SDG 4), access to the labor market (SDG 8), and political participation (SDG 10). Ending discrimination will also empower women and girls to contribute to promoting peaceful and inclusive societies (SDG 16) and to pursue opportunities for decent work and employment (SDG 8), therefore also contributing to poverty reduction (SDG 1).

¹ <https://eeca.unfpa.org/sites/default/files/pub-pdf/UNFPA-EECARO-SDGs-GENDER-15-NOV-WEB.pdf>

² https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

- **Eliminating violence and harmful practices:** Ending all forms of violence against women and girls will contribute to achieving peace and security and human rights (SDG 16). Other synergies include providing safe public spaces and transport (SDG 11).
- **Promoting economic empowerment and financing:** Promoting women's economic empowerment and ensuring women's economic rights will support efforts on poverty eradication (SDG 1), full and productive employment and decent work (SDG 8 and 9) and peaceful and inclusive societies (SDG 16) and promotion of sustainable industrial development (SDG 9), among other synergies.
- **Ensuring participation and leadership in decision-making:** Women's full and effective participation in leadership and decision-making is an enabler for other SDG targets, including on water and sanitation (SDG 6), inequalities (SDG 10) and peaceful and inclusive societies (SDG 16). Women's participation can also enhance agricultural productivity (SDG 2), strengthen women's voice in decisions about their health and rights (SDG 3 and SDG 5), contribute to climate change planning and management (SDG 13) and sustainable use and management of ocean (SDG 14) and terrestrial (SDG 15) resources.
- **Ensuring healthy lives:** Women's access to sexual and reproductive health and rights and services are directly linked to reductions in maternal mortality (SDG 3) and ending communicable diseases like HIV and AIDS (SDG 3). Women and girl's lack of autonomy over their health can limit their outcomes on education (SDG 4), sanitation and hygiene (SDG 6) and employment (SDG 8), among others.³

Table: Gendered perspective on the SDGs

SDGs	Relevant Estimates
SDG 1: No Poverty	Women and girls around the world are 4 percent more likely than men and boys to live in extreme poverty and the risk rises to 25 percent for women aged between 25 to 34.
SDG 2: Zero Hunger	Globally, women have a 10 percent higher risk of experiencing food insecurity than men.
SDG 3: Good Health and Well-Being	Nearly 300,000 women die from complications related to pregnancy and childbirth in a year.
SDG 4: Quality Education	Nearly 15 million girls relative to 10 million boys of primary school age are out of school.
SDG 5: Gender Equality	Worldwide only 1 in 4 parliamentary seats are held by women.
SDG 6: Clean Water and Sanitation	Women and girls spend nearly a total of 200 million hours every day collecting water.
SDG 7: Affordable and Clean Energy	Globally, nearly 3 billion people lack access to clean fuel. Women and children are adversely impacted since they are the main procurers and users of household energy.

³ <http://sdg.iisd.org/commentary/policy-briefs/achieve-gender-equality-to-deliver-the-sdgs/>

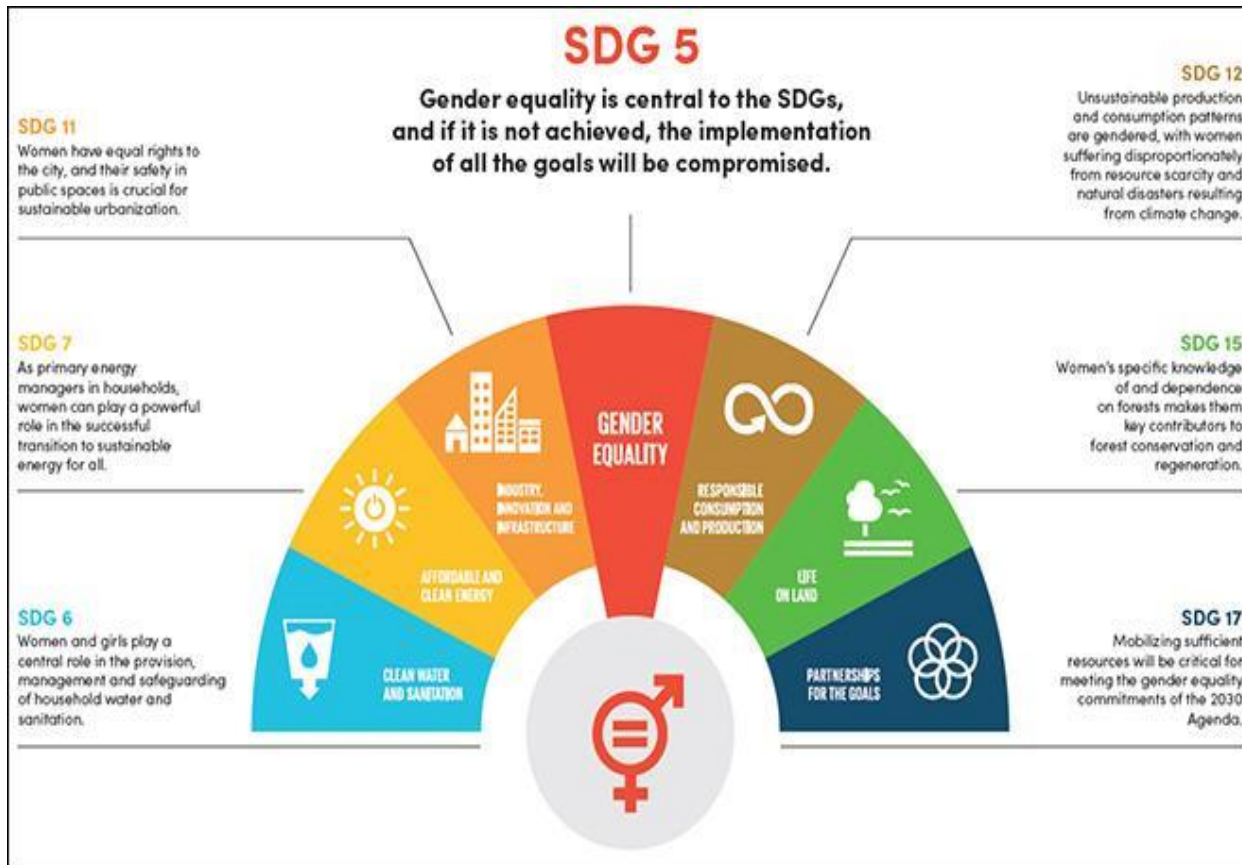
SDG 8: Decent Work and Economic Growth	Labour force participation rate of women aged 25 to 54 is 55 percent while it is 94 percent for men in the same age group.
SDG 9: Industry, Innovation and Infrastructure	On average, only 28.8 percent of the world's researchers are women.
SDG 10: Reduced Inequalities	Assessment of migration policies indicated that 71 percent of countries impose restrictions on spouses and partners (mostly women) joining migrants.
SDG 11: Sustainable Cities and Communities	Women are overrepresented in slums in 70 percent of countries where data is available.
SDG 12: Responsible Consumption and Production; SDG 13: Climate Action; SDG 14: Life Below Water; SDG 15: Life on Land	38.7 percent of employed women are in agriculture, forestry and fisheries but only 13.8 percent of landholders are women.
SDG 16: Peace, Justice and Strong Institutions	3 in 4 human trafficking victims are women and girls.
SDG 17: Partnerships for Goals	Out of the US\$ 117 billion in Overseas Development Assistance (ODA) commitments received by developing nations in the previous years, only 38 percent targeted gender equality or women's equality as a primary or secondary objective.

Source: ⁴from 'The Gender Snapshot 2019' by UN Women.

In the Indian context, although India has an overall improved SDG score of 61.92 (out of 100) and ranks 117 out of 193 UN member states in terms of SDGs achievement in the [Sustainable Development Report 2020](#) — 'major challenges remain' for the country in achieving SDG 5.

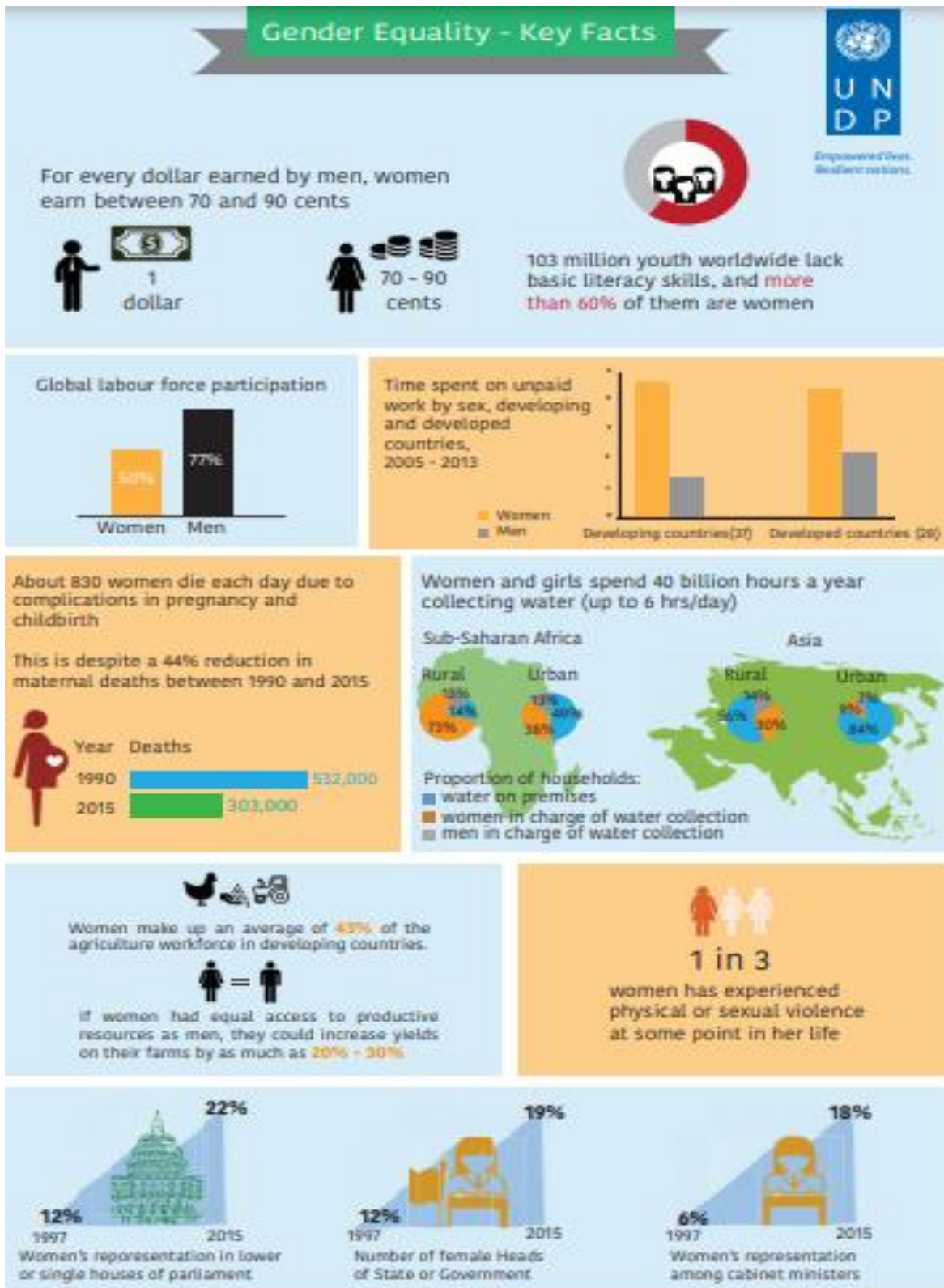
⁴ <https://www.orfonline.org/expert-speak/covid19-need-overarching-gender-agenda-sdgs/>

Figure: SDG 5 Inter-linkages



Source: UN Women⁵

⁵ <https://www.orfonline.org/expert-speak/covid19-need-overarching-gender-agenda-sdgs/>



SDG 5: Achieve gender equality and empower all women and girls

The sustainable development goals seek to change the course of the 21st century, addressing key challenges such as poverty, inequality, and violence against women. Women's empowerment is a pre-condition for this. Women have a critical role to play in all of the SDGs, with many targets specifically recognizing women's equality and empowerment as both the objective, and as part of the solution. Goal 5 is known as the stand-alone gender goal because it is dedicated to achieving these ends. Deep legal and legislative changes are needed to ensure women's rights around the world. While a record 143 countries guaranteed equality between men and women in their Constitutions by 2014, another 52 had not taken this step. In many nations, gender discrimination is still woven through legal and social norms. Stark gender disparities remain in economic and political realms. While there has been some progress over the decades, on average women in the labour market still earn 24 per cent less than men globally. As of August 2015, only 22 percent of all national parliamentarians were female, a slow rise from 11.3 per cent in 1995. Meanwhile, violence against women is a pandemic affecting all countries, even those that have made laudable progress in other areas.

Worldwide, 35 per cent of women have experienced either physical and/or sexual intimate partner violence or non - partner sexual violence. Women have a right to equality in all areas. It must be embedded across legal systems, upheld in both laws and legal practices, including proactive measures such as quotas. Since all areas of life relate to gender equality, efforts must be made to cut the roots of gender discrimination wherever they appear. UN Women works to empower women and girls in all its programmes. Advancing women's political participation and leadership and economic empowerment are two of the entity's central goals. Women should get on ballots, attain political office, and go to polls to vote. There is a need for women to secure decent jobs, accumulate assets, and influence institutions and public policies, while underlining the need to recognize, reduce and redistribute the burden on women for unpaid care. Efforts should be encouraged to end violence, raise awareness of its causes and consequences and boost efforts to prevent and respond, including ensuring the rights of women living with HIV. Governments need to reflect the needs of women and girls in their planning and budgeting, and engage men and boys, urging them to become champions of gender equality.⁷

SDG 5 (Achieve gender equality and empower all women and girls) and SDG 1 (End poverty in all its forms everywhere)**Target**

5.a

Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws

Linked to SDG 1**Target**

1.4

By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance

Target

5.4

Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate

Linked to SDG 1**Target**

1.3

⁶ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

⁷ <https://sustainabledevelopment.un.org/content/documents/2322UN%20Women%20Analysis%20on%20Women%20and%20SDGs.pdf>

Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable

Indicators

1.3.1
Proportion of population covered by social protection floors/systems, by sex, distinguishing children, unemployed persons, older persons, persons with disabilities, pregnant women, newborns, work-injury victims and the poor and the vulnerable

The end of poverty can only be achieved with the end of gender-based discrimination. All over the world, gender inequality makes and keeps women poor, depriving them of basic rights and opportunities for well-being. Women make significant contributions every day from bringing an income to her household as an employed wage earner, to creating jobs as an entrepreneur, to taking care of her family and elders. However, a woman farmer, for instance, may not be able to make her crops thrive like a man can because she doesn't have the same access to seeds, credit, technology and extension services. She is very unlikely to own her land—only 20 per cent of landowners globally are women. If she hopes to someday inherit family property, the law may deprive her of an equal share, or social convention may simply favor her male relatives. Poverty comes with many risks; discrimination leaves women less resilient to these. In an economic downturn, poor women are less likely to have savings and abilities to make up for lost income. Poor girls are more than twice as likely to marry in childhood as those who are wealthy. They then face potentially life-threatening risks from early pregnancy, and often lost hopes for an education and a better income. Women have a right to equal access to all avenues to end poverty, from social protection safety nets to use of the latest technology. Fully realizing that right will be key to achieving the first SDG. There is a requirement for Programmes to provide training, loans and practical skills to empower poor women economically, give them a voice, strengthen social services and increase awareness of women's rights. Ensuring women's access to basic services, control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services is another step towards achieving gender equality.



8

**SDG 5 (Achieve gender equality and empower all women and girls) and
SDG 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture)**

⁸ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

Women prepare up to 90 per cent of meals in households around the world, yet when times are tough, women and girls may be the first to eat less. Households headed by women may not eat enough simply because women earn at lower levels and are less prepared to cope with sudden crisis. Nourishment is not just about the quantity of food, but its quality. In poor households, women can be less likely to get the nutrients they need, including to manage the physical demands of pregnancy and breastfeeding. Gender inequality intersects with inadequate health care, insufficient education and limited income to drive these deprivations. Inequities in food consumption stand in contrast to women's significant role in agricultural production. They comprise on average 43 per cent of the agricultural labour force in developing countries, and over 50 per cent in parts of Asia and Africa. Yet their potential contribution to food security remains constrained by unequal access to land and other productive assets. Ending hunger means that all women can consume enough food with adequate nutrients. All women working in agriculture, if unshackled from discrimination, can contribute to greater global food security. Efforts are required to stop hunger by supporting women's role in food security, as the cornerstones of food production and utilization. Training for women farmers and access to information and technology, to help women achieve higher agricultural productivity, legal changes to allow more equitable distribution of assets, such as land and credit are important steps towards gender equality.

While women account for an average of 50 percent of the agricultural workforce in East and Southeast Asia and sub-Saharan Africa, and much more in some individual countries, women have less access than men to productive resources, such as seeds and tools, and opportunities. According to the Food and Agriculture Organization, with the same access to productive resources, such as fertilizers, seeds and tools as men, rural women could increase yields on their farms by 20 to 30 percent. This could increase agricultural output in developing countries by between 2.5 and 4 percent, which could in turn reduce the number of undernourished people in the world by 12–17 percent.⁹

Efforts to overcome and tackle these challenges will lead to gains not only in gender equality, but in related issues. For instance, eliminating the gender gap in agriculture could increase national production by 2.5 to 4% and contribute to associated gains in undernourishment from 12 to 17 %, therefore ensuring progress on SDG 5 as well as on SDG 2 (zero hunger).

**SDG 5 (Achieve gender equality and empower all women and girls) and
SDG 3 (Ensure healthy lives and promote well-being for all at all ages)**

The highest attainable standard of health is a fundamental right of every person. Gender-based discrimination, however, undercuts this right. It can render women more susceptible to sickness and less likely to obtain care, for reasons ranging from affordability to social conventions keeping them at home. Among women of reproductive age worldwide, AIDS is now the leading cause of death. Not only are women biologically more susceptible to HIV transmission, but their unequal social and economic status undercuts abilities to protect themselves and make empowered choices. Countries have committed to universal access to sexual and reproductive health care services, but many gaps have slowed progress so far. More than 225 million women have an unmet need for contraceptive methods. In developing regions, where maternal mortality rates are 14 times higher than in developed ones, only half of pregnant women receive the minimum standard for antenatal care. Fulfilling the right to health requires health systems to become fully responsive to women and girls, offering higher quality, more comprehensive and readily accessible services. Societies at large must end practices that critically endanger women's health and well-being—among them, all forms of gender-based violence. Nations need to work towards advancing women's well-being and health through improvement of the provision of health services for women and girls, including survivors of violence, and backing nongovernmental partners in filling gaps. It is important to end practices that endanger women and girls, such as child marriage, female genital cutting, dietary restrictions and others. There is a requirement for programmes to help meet women's health needs during medical humanitarian crises, restoring confidence in maternal and child health services.

**SDG 5 (Achieve gender equality and empower all women and girls) and
SDG 4 (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all)**

All developing regions of the world have achieved — or almost achieved — equal enrolment of boys and girls in primary school. This is an historic accomplishment, but far from complete. In sub-Saharan Africa, only 23 percent of poor rural girls finish primary school. Gender gaps widen significantly in many countries in secondary and tertiary schools. Education is a right. It empowers individuals to increase their well-being and contributes to broader social and economic gains. Improved education accounts for about 50 per cent of economic growth in Organization of Economic Co-operation and Development countries over the past five decades. About half is due

⁹ The State of Food and Agriculture: 2010-2011 Women in Agriculture, Closing the Gender Gap for Development; FAO. <http://www.fao.org/3/i2050e/i2050e.pdf>

to more women entering higher levels of education, and greater equality as to the years men and women spend in school. For education to deliver, it must be inclusive and high-quality. Active efforts to end gender stereotypes must tackle those that limit schooling or channel women and girls into ‘acceptable’ areas of study or work. For all girls and boys, men and women, education must be available across their lifetimes. Pre-primary education establishes a foundation on which all later schooling can build. Ongoing learning for adults broadens choices for productive and fulfilling lives. Organisations need to promote education — a core pre-requisite for gender equality and women’s rights – through the revision of school curricula and policies to counteract gender discrimination, improving access to information technologies, and training for teachers, students and parents. Along with the World Association of Girl Guides and Girl Scouts, UN Women has developed a non-formal educational curriculum to prevent violence against women and girls, which educators and youth leaders are being trained to deliver in more than a dozen countries.

**SDG 5 (Achieve gender equality and empower all women and girls) and
SDG 6 (Ensure availability and sustainable management of water and sanitation for all)**

While gender equality and the right to water and sanitation are intrinsically linked, we are far from achieving either of these goals. Water, sanitation and hygiene (WASH) are deeply relevant for women’s and girls’ empowerment, affecting their education, health, income and safety. The 1992 Dublin Statement on Water and Sustainable Development stated: ‘Women play a central part in the provision, management and safeguarding of water’ and policies should ‘address women’s specific needs’ and ‘empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them’. The 1995 Beijing Declaration also referenced gender equality in relation to water, stating ‘inadequate access to safe water, sanitation facilities ... all overburden women and their families and have a negative effect on their health’. The Declaration calls for ensuring that ‘women’s priorities are included in public investment programmes for economic infrastructure, such as water and sanitation’.

We know that women and girls – especially those living in poverty – are disproportionately affected by a lack of water and sanitation services, making SDG 5 and 6 fundamentally interdependent. Inadequate sanitation and hygiene put women’s health and survival at risk during pregnancy and childbirth. Girls may drop out of school or suffer psychological stress because of the lack of adequate sanitation and hygiene facilities in their communities. In 8 out of 10 households without a water source on the premises, women and girls are responsible for water collection. Globally, they spend an estimated 200 million hours collecting water every day. In addition to placing them at risk of violence and harassment, spending time on water collection can prevent girls from attending school and limits women’s ability to engage in other productive activities. Furthermore, despite being responsible for household water needs, women are often under-represented in water governance, including water user committees. As a result, development policies fail to recognize women as key stakeholders in water management and perpetuate cycles of gender inequality.

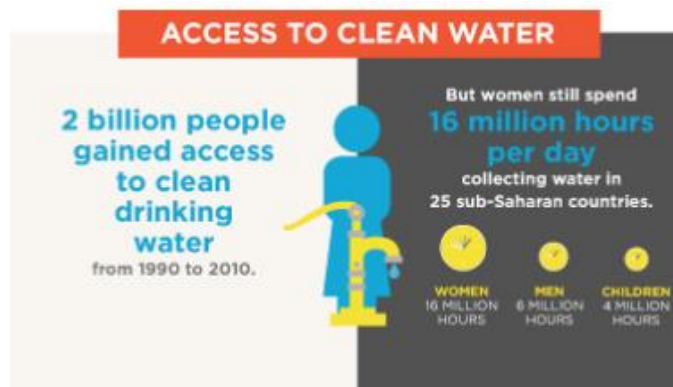
A drink of water sustains human life, but only if it is safe and affordable. From 1990 to 2015, 2.6 billion people gained access to improved drinking water, but 663 million still rely on unimproved sources like unprotected wells and springs. Water quality has deteriorated through pollution, and worsening scarcity pressures over 40 per cent of the global population. For women, inadequate water supplies pose additional burdens. In a single day in 25 sub-Saharan African countries, women spend 16 million hours collecting water, often to the detriment of schooling or paid work, and with potential health risks from repeatedly carrying heavy burdens over long distances. Poor quality sanitation—including open defecation— can pollute water and spread disease. Sanitation has improved for 2.1 billion people between 1990 and 2015, and open defecation has fallen by nearly half, yet 2.4 billion people still rely on unimproved sanitation facilities. In schools, a lack of separate facilities for girls can be a major reason for parents keeping them at home. Ensuring water and sanitation for all is the goal; achieving it must take all dimensions specific to women and girls on board and involve them directly in the process. Gender-responsive budgeting, for instance, can channel funds towards measures to improve easy access to safe drinking water so that women have more time to earn an income, girls are more likely to attend school, and family health and hygiene improve.

Women and girls often bear the primary responsibility for gathering water. In sub-Saharan Africa, for example, women and girls cumulatively spend 40 billion hours a year (up to six hours every day) collecting water, which deprives them of time for earning money, learning new skills, getting an education and participating in public life.³ Safe and convenient access to water and sanitation facilities also increases privacy and reduces risk to women and girls of sexual harassment/assault while gathering water. Recent data shows that, in 2011, only 45 percent of schools in least developed and low-income countries had adequate sanitation facilities.⁴ The lack of such facilities often keeps girls out of school, which has a long-term impact on their future prospects.

The only explicit reference to women and girls under SDG 6 relates to sanitation and hygiene (Target 6.2) – but not to water access and management. Of the Voluntary National Reports submitted for the 2018 High-Level Political Forum, only five countries mentioned the interlinkages between water and women as priorities for achieving the SDGs. The SDGs do not highlight the role of women in water beyond Targets 6.1 and 6.2, which only relate to water access, sanitation, and hygiene – and not, for example, to water governance. Indicators under SDG 6 mostly rely on data from water utilities and institutional records, which do not necessarily reflect quality or equity of services, or informal service delivery. In sum, the theoretical recognition that women and girls are key water and sanitation stakeholders has not translated to best practices on the ground. As Miletto et al. (2019) note: ‘Despite the countless number of gender and inclusion strategies within the water management sector, a clear gap remains evident between policies and practice and, most importantly, on the ground, where progress remains limited.’

Gender equality and access to water are basic human rights and are thus foundational for achieving the other SDGs. If we are to achieve these ambitious goals by 2030, leaving no one behind, we must promote more gender-transformative water and sanitation programmes. In particular, we must address the hidden causes of gender inequality, transforming power dynamics. This briefing note sets out three key policy recommendations to do so:

1. Increase the availability and quality of sex-disaggregated data on water, sanitation, and hygiene, including water governance.
2. Increase women’s leadership and meaningful participation in water governance and integrated water resources management (IWRM) at all levels (household, community, national, and transboundary);
3. Challenge social norms around unpaid care work, women’s leadership, and gender-based violence.¹⁰



SDG 5 (Achieve gender equality and empower all women and girls) and SDG 7 (Ensure access to affordable, reliable, sustainable and modern energy for all)

Sustainable modern energy fuels development, from the light that allows a child to do her homework to streetlamps allowing women to travel safely home at night. Universal access requires energy to be affordable and reliable. Generating it must not irreversibly harm the environment. In households, women are often the primary energy managers. When modern sources are not available, they spend hours each day collecting fuel to cook and heat their homes. Many suffer poor health through indoor air pollution generated, for example, by a rudimentary stove that smokes heavily as it burns wood or animal dung. Some indications suggest that women are more likely than men to conserve energy—using up to 22 per cent less, including through a greater willingness to alter everyday behaviours. However, women are largely absent in the industries that produce modern sources of renewable energy, comprising only 20 per cent of the workforce. As primary energy managers in households, women could play powerful roles in extending sustainable modern energy. All elements of energy planning and policymaking need to factor in gender dimensions and actively advance women’s leadership. Within the energy industry itself, barriers to women executives, entrepreneurs and employees must fall and their representation on national and global energy council must grow. Efforts have been made by UN Women in this direction. In Ghana, UN Women’s Fund for Gender Equality has introduced green cook stoves. And since 2011, UN Women has sponsored the Gender Equality Award granted by the

¹⁰<https://reliefweb.int/report/world/achieving-sustainable-development-goals-5-and-6-case-gender-transformative-water>

SEED Initiative, a global partnership for action on sustainable development and the green economy, which has prized many clean energy initiatives involving women. And new green energy programmes are in the pipeline.¹¹

Significant among these are SDG 7, which seeks to “ensure access to affordable, reliable, sustainable and modern energy for all” by 2030, and SDG 5, which aims to “achieve gender equality and empower all women and girls”, and these are inextricably linked. Integration of gender and energy issues can help reap benefits at multiple levels, contributing to most SDGs through improving the quality of services provided for maternal health, food security, clean water, entrepreneurship, agriculture and education. At the same time, women’s participation can increase the project and policy effectiveness and efficiency of energy-sector interventions and the achievement of SDG 7. Focus is still needed on the multiple tiers of access to clean and affordable energy. Global electrification reached 86 per cent in 2016 and close to universal access was achieved in urban areas (96 per cent), while rural areas lagged behind at 73 per cent. (IEA and World Bank, 2017) This means that over 1 billion people still do not have access to electricity, particularly in sub-Saharan Africa and South Asia. Global access to clean fuels and technologies for cooking reached 62 per cent in 2015. (ibid) However, 2.8 billion people still lack access to clean cooking, mainly in rural sub-Saharan Africa and Asia-Pacific (IEA, 2017). Thirty-eight per cent of the global population and almost 50 per cent of the population in developing countries lack access to clean cooking, relying on solid biomass, coal, and kerosene (IEA, 2017; WHO, 2016). Polluting fuels are used for cooking in 75 per cent of households in rural communities across the world, 91 per cent of rural households in Africa, and 82 per cent of rural households in the Western Pacific. Women and children in many places spend on average 1.4 hours a day collecting solid fuels (i.e., wood, crop wastes, charcoal, coal or dung) and women spend several hours per day cooking with inefficient stoves, limiting time available for them to pursue other economic, family or leisure activities. Some evidence indicates that women and girls are at risk of sexual violence when they collect fuel and water or when they are outside after dark (Rewald, 2017), especially in the absence of community lighting.¹² Significantly, the policy commitment to clean cooking has lagged behind as well. In 2014, more than 140 countries had renewable energy targets and support policies in place, but almost all of these were for the power sector (ADB, 2015). Under current policies and trends, 2.3 billion people will still lack access to clean cooking facilities in 2030 (IEA, 2017). Women and children bear the greatest burden of energy poverty. In contrast, access to and use of clean energy brings interconnected, corollary benefits related to greater gender equality, economic productivity, educational opportunities, and more.¹³

Box 12.2

Key Gender Issues Across the Energy Sector

Energy Access <i>Household Energy and Rural Electrification</i>	Time poverty due to fuel collection and cooking; gender-based violence related to fuel collection; health impacts, as women and children are disproportionately affected by indoor air pollution; and lack of access to information and financing for energy services or technologies.
Electricity Infrastructure <i>Generation, Transmission, and Distribution</i>	Displacement, inequity in ownership or land titling during resettlement; inequitable access to new jobs in areas such as energy, engineering, tourism or services; inequitable benefit sharing due to lack of land titles or government identification; gender-based violence related to migration, new roadways and traffic patterns; and exposure (mostly affecting men) to hazardous work on energy infrastructure such as electrical wiring and chemical handling.
Clean Energy <i>Renewable Energy and Energy Efficiency</i>	Women and female-headed households having less information on new technologies that can create opportunities for employment and training; lack of access to financing and collateral to purchase such technologies or services; lack of voice in household decision-making about energy options and electricity use that can impact behavioural change or adoption of improved energy services.
Energy Policy <i>Subsidies, Tariffs and Reforms</i>	Female-headed households are often poorer and may suffer more from rapid tariff increases than male-headed households; men often have power over household budgets and decision-making; men may be more affected than women by direct job losses in heavy manufacturing; women may not be included in policy consultations and decision-making due to societal norms.

Source: ESMAP 2017

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¹¹ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

¹² <https://sustainabledevelopment.un.org/content/documents/17489PB12.pdf>

¹³ <https://sustainabledevelopment.un.org/content/documents/17489PB12.pdf>

¹⁴ <https://sustainabledevelopment.un.org/content/documents/17489PB12.pdf>

Gender and Energy Facts and Figures

- High reliance on biomass for cooking in many countries means that women and children without clean cooking access spend an average of 1.4 hours/day collecting fuel.
- Only 4 of 72 countries analysed (6 per cent) had women ministers overseeing national energy policies and programmes.
- A study of more than 1,500 companies found that having more women on boards of directors led to more investment in renewable energy.
- Thirty-five per cent of the workforce in renewable energy companies are women, compared with 20-25 per cent in the broader energy sector.
- Women accounted for less than one-third of those employed in scientific R&D across the world.

Sources: C3E/IEA Technology Collaboration Programme, "Women in Clean Energy: Knowledge, Gaps and Opportunities" (2017); IEA Energy Access Outlook 2017; IRENA Director-General

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Status of gender and energy and progress towards achieving SDGs

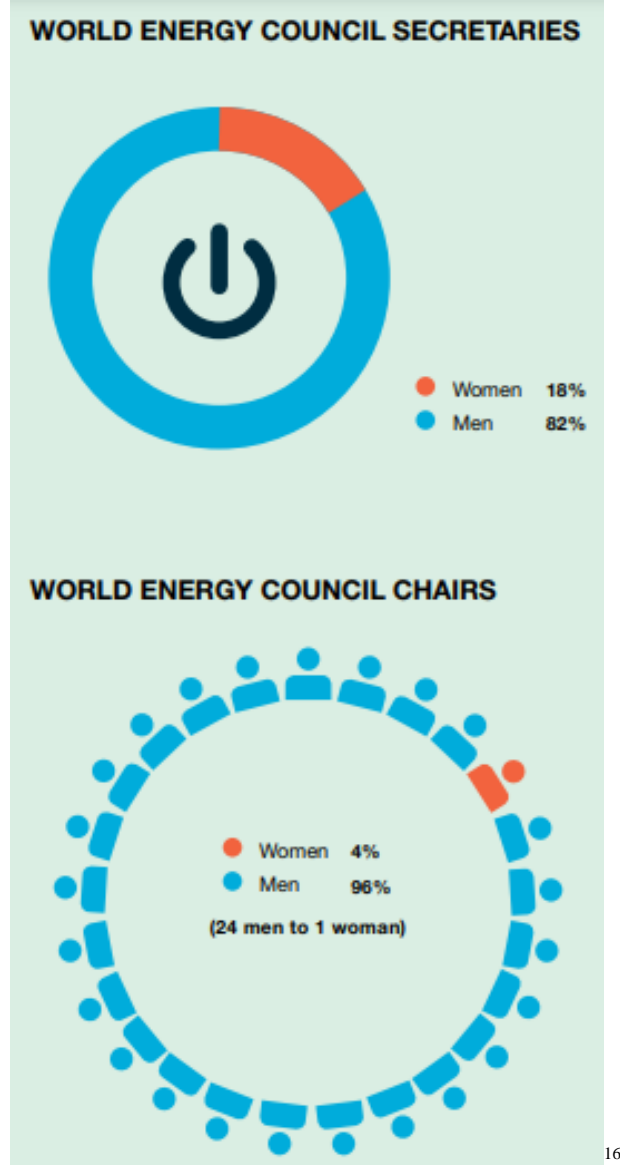
- Over 1 billion people in the world lack access to electricity, and close to 3 billion lack access to clean cooking.² Women bear the greatest burden of this energy poverty—it is their unpaid time and labour that is expended to gather biomass fuels for cooking, collect water or manually process grains and other foods. Household air pollution, linked to burning fuels such as wood, animal waste and charcoal, is responsible for about 2.8 million deaths every year, mostly among women and children.
- Greater access to energy services can improve women's health and well-being, free up their time and enable their economic empowerment, thereby supporting the achievement of SDG 5. • While some countries and regions are on track to achieve electricity for all, under current policies and trends, 2.3 billion people will still lack access to clean-cooking facilities in 2030. In recent years, going beyond their traditional role as "users" and "beneficiaries," women are playing a role in expanding energy access, thereby becoming part of the solution. A number of actors have started working on the intersection of gender, energy and sustainable development, and in advancing gender equality, social inclusion and women's empowerment in the energy sector.

Priority Actions

- Integrate gender and energy actions within all SDGs and establish gender-responsive global and national energy sector policies backed by evidence, such as sex-disaggregated data and analysis. Continue to build expertise and experience on gender issues across the energy value chain, from off-grid distribution and consumption to policy/pricing to generation and energy production. Energy sector institutions including energy ministries and utilities should be supported in developing gender-responsive programmes, monitoring systems and data collection methods.
- Promote and invest more in clean-cooking technologies and decentralized sustainable energy technologies that support gender equality and women's economic empowerment, involving women in the design and distribution of modern energy equipment and services. Within the energy industry itself, barriers to women executives, entrepreneurs and employees must fall, and their representation on national and global energy bodies grow.

¹⁵ <https://sustainabledevelopment.un.org/content/documents/17489PB12.pdf>

- Governments must raise their efforts to promote women-centric business models for expanding energy access to all, including at the last mile, through capacity-building, partnerships with local stakeholders, expanding women's access to finance and building a conducive enabling environment for women entrepreneurs.
- International and national energy and climate change programmes and mechanisms such as the Green Climate Fund and Nationally Determined Contributions must be supported to meaningfully integrate gender concerns in programming.



SDG 5 (Achieve gender equality and empower all women and girls) and SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all)

¹⁶ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

An inclusive, sustainable economy fosters growth with benefits for all. It does not harm the environment and uses resources judiciously so they will remain for generations to come. For many people, employment is the entry point for economic well-being. In an inclusive economy, decent work means a living wage, workplace safety and protection against discrimination. There has been some progress. Twenty years ago, 40 percent of women were engaged in wage and salaried employment; today 48 per cent of women are being paid wages. Yet, globally, women still work at lower rates than men. Gender stereotypes often define what ‘women’s work’ is and can channel women into some of the worst jobs. Among 143 countries, at least 90 per cent women’s rights and gender equality, the benefits, such as fairer societies and greater economic dynamism, accrue to everyone. Women must have equal access to decent work, productive resources and financial services, as well as an equal voice in economic decisions.¹⁷



Gender disparities in labour force participation must also be a key part of poverty reduction and growth strategies as they not only hinder human development, but also represent a substantial loss of economic potential. Many more women than men are in vulnerable and precarious forms of employment, which are characterized by inadequate earnings, low productivity and difficult conditions of work that undermine workers’ fundamental rights. Approximately 73 percent of the global jobs gap in 2014 was due to a shortfall in employment among women, who comprise only about 40 percent of the global workforce. In 2013, the estimated wages lost due to the global gap in female labour force participation stood at \$589 billion.¹⁸

Approximately 73 percent of the global jobs gap in 2014 was due to a shortfall in employment among women, who comprise only about 40 percent of the global workforce.

SDG 5 (Achieve gender equality and empower all women and girls) and SDG 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation)

Economic development builds on infrastructure — the roads, bridges and facilities that allow businesses to operate and people to obtain essential services. Infrastructure needs to be sustainable in its construction and use — including through environmentally sound technologies — and resilient to future risks. All elements of planning, building and financing must take gender dimensions into account, so that women have facilities and services essential to their needs and rights. For many countries, particularly those less developed, shifting from agriculture and towards industry is the route to better-paying jobs and higher standards of living. New and existing industries must pursue sustainable paths, including through innovation and upgraded technology. Investments in research and development will be key, but most researchers are still men — women account for only 25 per cent in more advanced Organization for Economic Co-operation and Development countries. Similarly, the construction, manufacturing and energy businesses, with few women

¹⁷ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

¹⁸ World Employment Social Outlook: The changing nature of jobs, International Labour Organization. 2015. https://www.spcr.cz/images/MO/wcms_368626.pdf

employees and decision-makers, fall far short of gender balance. From the factory floor to the high-tech lab, women must have equal opportunities in building a shared, sustainable future.



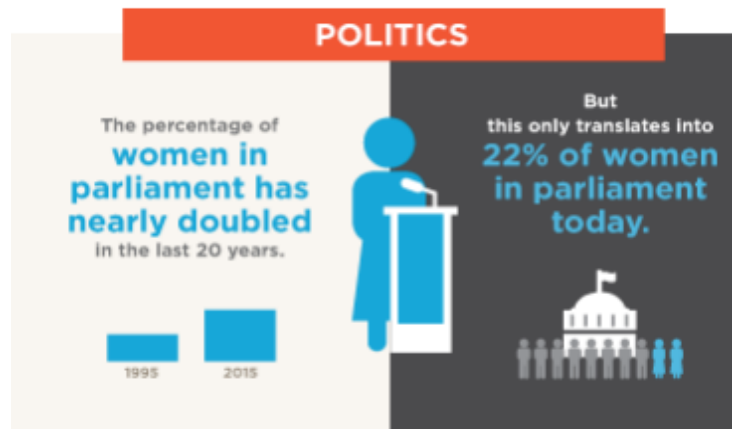
**SDG 5 (Achieve gender equality and empower all women and girls) and
SDG 10 (Reduce inequality within and among countries)**

Inequalities have widened across and within many countries, even amid high rates of economic growth. Disparities, caused by practices within countries and in the global economy, are unjust and weaken the social fabric. Today, more women are in the workforce, in politics, in leadership roles, breaking stereotypes and societal taboos. Yet, gender discrimination makes women prone to deeper disparities. Globally women earn 24 per cent less than men, with varied gaps between countries. They are also more likely than men to be in vulnerable employment, with up to 75 per cent of women's jobs being informal or unprotected in developing countries. Worldwide, 83 percent of domestic workers are women—most are not legally entitled to a minimum wage.

¹⁹ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf



Further, gender discrimination can intersect with other types, such as regarding age, disability ethnicity, economic status and so on, multiplying the burden of inequalities many times over. Social norms that treat women as second-class citizens in many cases translate into structural obstacles to progress, such as laws that fail to punish perpetrators of gender-based violence. Or budgets that do not fund the services women need most. Whether the issue is fiscal policy or safe migration or improved regulation of global financial markets, different and potentially unequal outcomes for women and men must be recognized. Only then can deliberate actions be taken to correct them, within and across countries.²¹



SDG 5 (Achieve gender equality and empower all women and girls) and SDG 11 (Make cities and human settlements inclusive, safe, resilient and sustainable)

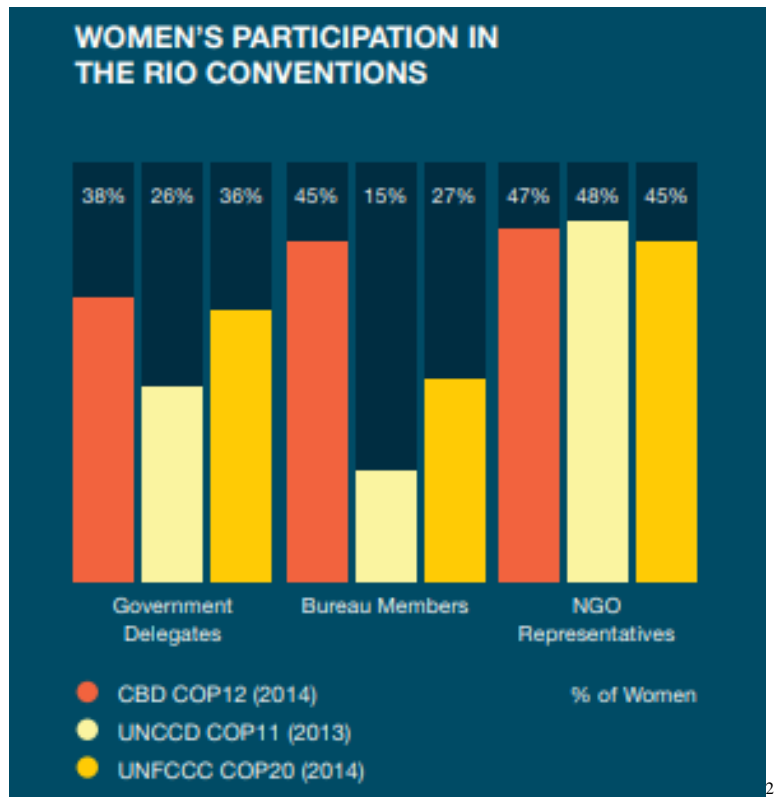
The world today is urbanizing at rates unprecedented in history. For many men and women, the chance to move to a city is a chance for a better life—a larger income, more interesting employment, a more comfortable residence and ready access to modern amenities. Yet cities are also placing of deep inequality and despair. New migrants, many of them women, can end up in overbuilt slums, poorly connected to public transport or essential services such as clean water. Life becomes dangerous and unhealthy, with many obstacles to gaining a secure foothold in the urban economy. For women, gender discrimination magnifies and adds to the risks. Not being able to

²⁰ <https://www.unwomen.org/en/news/in-focus/women-and-the-sdgs/sdg-10-reduced-inequalities>

²¹ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

**SDG 5 (Achieve gender equality and empower all women and girls) and
SDG 13 (Take urgent action to combat climate change and its impacts)**

Climate change poses growing risks. Catastrophic storms destroy lives and homes. Drought's pressure rural livelihoods. Sea level rise threatens low-lying areas. Slowing a dangerous rise in global temperatures depends on reducing greenhouse gas emissions. Since some level of climate change is now inexorable, other actions must help people adapt and become more resilient. Adequate education and employment, for example, help build safety nets against disaster. The most vulnerable people are most at risk from climate change, including many poor women. For them, the impacts are already a daily reality. Many spend increasingly long hours hunting for food, fuel and water, or struggling to grow crops. When disasters strike, women are far more likely to perish. Through their experiences and traditional knowledge as stewards of many natural resources, women can offer valuable insights into better managing the climate and its risks. They also have a right to all capacities needed to protect themselves, and to participate in decisions with profound implications for people and the planet.



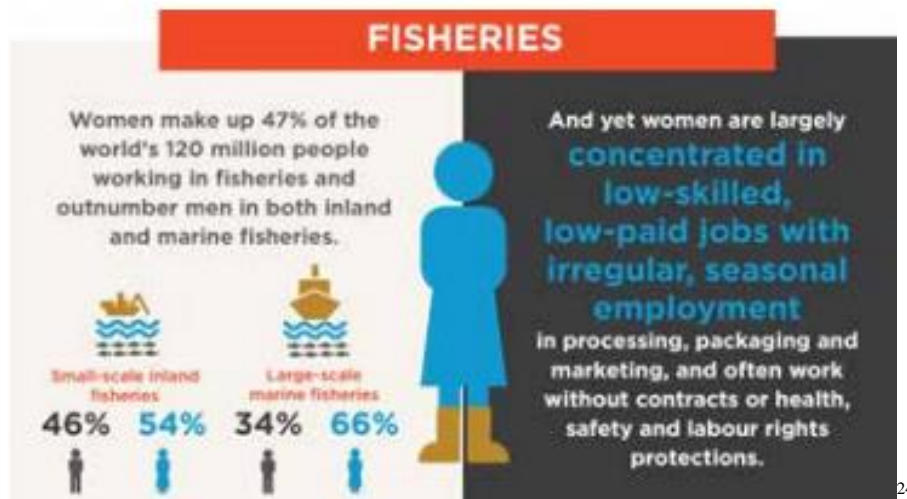
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**SDG 5 (Achieve gender equality and empower all women and girls) and
SDG 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development)**

The world's oceans—spreading over 70 per cent of the planet—are in crisis. Destructive fishing has decimated fish stocks and thrown marine ecosystems out of balance, as have pollution and ocean acidification. As temperatures warm from climate change, melting ice caps are raising sea levels, threatening homes everywhere. Over the longer term, oceanic changes can result in globally significant climate shifts. For now, the most immediate impacts are felt in coastal communities and among those who depend on oceans for

²³ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

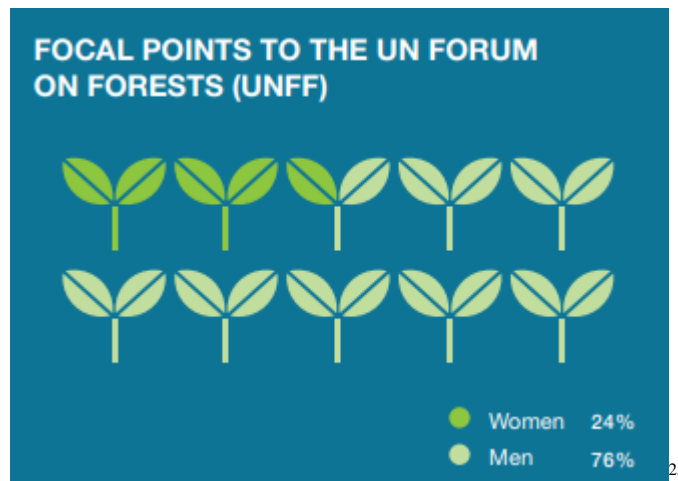
livelihoods. Women make up 47 per cent of the world's 120 million people working in fisheries and outnumber men in both large-scale marine fisheries (66 per cent) and small-scale inland fisheries (54 per cent). And yet, women are largely concentrated in low-skilled, low paid jobs with irregular, seasonal employment in processing, packaging and marketing. They often work without contracts or health, safety and labour rights protections. Women also earn approximately 64 percent of men's wages for the same work in aquaculture. Women face the risks of ocean degradation with fewer assets and alternatives for livelihoods, and less resilience against the loss of natural resources. All strategies for conservation and sustainable use need to respond to these vulnerabilities. Women's limited representation in marine science must be corrected towards tapping all perspectives for fair and durable solutions.



SDG 5 (Achieve gender equality and empower all women and girls) and SDG 15 (Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss)

Globally, forests have been cut at devastatingly fast rates, often for profits that bypass local communities. The felling of trees reduces carbon dioxide absorption and biodiversity, cutting links in the intricate web of life. Land use practices have led to land degradation and desertification, as have droughts, including those linked to climate change. All of these patterns undercut resources that sustain environmental health and human wellbeing. Women can be among the first and most affected, often charged with making up shortfalls in food and fuel. Their limited ownership of land reduces their capacity to adapt to losses or make decisions about how land is used—for the benefit of themselves and the environment. Despite these constraints, women play a critical role as stewards of the land, comprising much of the agricultural labour force in developing countries. They may be primary collectors of resources such as wood for fuel, as well as wild foods and herbs for medicines. Their knowledge about traditional practices that are inherently sustainable, however, is often excluded from decisions about sustainable ecosystems. This is a loss in terms of prospects for sustainable ecosystem use, which also depends on gender equality in all other dimensions—access to land, livelihoods and natural resources, and a say in how they are shared. Women, and indigenous women in particular, need to be included in decision-making on ecosystem use at all levels, as essential players in preserving our planet.

²⁴ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf



SDG 5 (Achieve gender equality and empower all women and girls) and SDG 16 (Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels)

Peaceful and inclusive societies uphold the rule of law and ensure equal access to justice. They protect people from all forms of violence, including gender-based violence, and control corruption and organized crime. Decision-making at all levels is inclusive and responsive, and fundamental freedoms are upheld. Laws and policies apply without discrimination. During wars or conflict, women often have fewer resources to protect themselves and, with children, frequently make up the majority of displaced and refugee populations. War tactics such as sexual violence specifically target them. Women have made strides in representation in decision-making, in some peace processes as well as governance more broadly. Still, the numbers reflect persistent inequality. From 1992 to 2011, only 9 percent of negotiators at peace tables were women, despite the landmark UN Security Council resolution 1325 in 2000, which recognized that women must play central roles. Only 22 percent of all national parliamentarians were female as of August 2015. For women in many societies, prospects for peace are undermined by gender-based violence. Women comprise 98 per cent of the estimated 4.5 million people forced into sexual exploitation, for instance. Gender discrimination in legal systems includes the failure to punish perpetrators of gender-based violence. By fully protecting all of women's rights, without exception, in all laws and practices, peaceful and inclusive societies will be within reach.

²⁵ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf



SDG 5 (Achieve gender equality and empower all women and girls) and SDG 17 (Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development)

The SDGs will mean little without the means to implement them. Finance, technology, capacities, partnerships and data are among the primary tools. Success also depends on a stable global economy and the ability of each country to make policy choices aimed at achieving all of the goals. Gender equality is central to all of the SDGs, but often, women end up on the short end of the means of implementation, in whatever form. While governments increasingly use gender-responsive budgeting to direct funds to programmes that benefit women, these exercises have revealed huge funding gaps in what women need—up to 90 per cent. Only 5 percent of foreign aid funds had gender equality as a principal objective in 2012-2013. Just around a third of countries have an office for gender statistics, even though data distinguished according to gender is critical to defining the best ways to achieve gender equality. Many countries simply do not know, for instance, how many women lack clean water or face abuse within their homes. Women have the right to equal access to and benefits from each of the means of implementation. They also need to lead decisions being made — whether in ministries of finance, companies that produce technologies, statistical offices or institutions charged with global economic oversight.



²⁶ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

²⁷ https://www.undp.org/content/dam/undp/library/SDGs/5_Gender_Equality_digital.pdf

Recommendations for Action

The HLPF Thematic Review identifies several areas where concerted efforts are needed to address existing implementation gaps:

Tackling structural barriers to gender equality: Governments should focus on policies that address structural, power and political dynamics that perpetuate discrimination against women and girls and represent barriers to gender equality, including removing discriminating legal frameworks, implementing policies that promote women's labor force participation, including through equal access to education at all levels, recognizing, reducing and redistributing unpaid care work and ensuring universal health coverage, including sexual and reproductive health.

- **Strengthening accountability mechanisms at the national level:** Governments and other stakeholders should build accountability mechanisms into interventions and strategies and monitor the effectiveness of these mechanisms, including taking action to ensure that such mechanisms are responsive to rights of women and girls.
- **Increasing investment and financing for gender equality:** Governments and other stakeholders can increase investments for gender equality and women and girls' empowerment by promoting investments not just in gender equality but across all sectors, including agriculture, education and culture, care services, social protection, health, infrastructure, justice, and water and sanitation.
- **Increasing data collection capacity:** Governments should strengthen national statistical systems to collect and produce high-quality, accessible, reliable, timely and disaggregated data to monitor SDG indicators and support evidence-based policy formulation.²⁸

Conclusion

The Thematic Review of SDG 5 notes achieving gender-responsive implementation of the 2030 Agenda presents “an enormous opportunity” to achieve not just gender equality, but to end poverty and hunger, combat inequalities within and among countries, build peace, just and inclusive societies, protect and promote human rights and ensure lasting protection of the planet and its natural resources. A comprehensive approach to SDG 5 that leverages synergies between SDG 5 and other Goals and promotes systematic mainstreaming of gender perspectives in implementing the 2030 Agenda will contribute both to realizing gender equality and the empowerment of women and girls as well as to ensure progress across all Goals and targets.

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²⁸ <http://sdg.iisd.org/commentary/policy-briefs/achieve-gender-equality-to-deliver-the-sdgs/>

A Retrospective and Prospective Research Approach on Student Engagement vs. Community Development: An Overview

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Abstract- This paper is designed to understand the relationship between student engagement and community development. The term community engagement in research can help a community address with its own health problems and disparities while ensuring the awareness of researcher's community goals. However, some researchers have a limited understanding of experience with the effective community engagement strategies. In this paper, we explore what we know about student engagement and speculate about the future holds for research in this field. We will onset by defining academics, and the outline of research student engagement. The retrospectives and future approaches to defining student engagement and community development are discussed in this content. Professional community development specialists identify and remove barriers to boost community engagement through igniting personal and emotional passions. This has ramifications for creating activities that pique each student's attention from the start, making discussion participation a really creative experience. The use of these frameworks is to train researchers to understand how to form and maintain genuine community-academic partnerships will boost accountability.

Keywords: *Community, Student, Engagement, Development, Approach.*

I. INTRODUCTION

Collection of mechanisms by which young people become active and constructively exercise their agency in their surrounding contexts, which is called community engagement. Participation in existing groups and government institutions, as well as the creation and leadership of new organisations, are all ways that young people might get involved. Youth involvement in the community is frequently cited as an effective means of fostering personal growth. Young people's involvement in their communities can have a good impact on the well-being of adults, their communities, and the functioning of civil society. This article argues the argument for the necessity of young community involvement from the perspectives of civil society, social justice, and intergenerational perspectives. There is a synthesis of recent research that includes Youth-adult partnerships, youth engagement in governance, and community organising with young people as participants are all instances of youth-adult collaborations. It concludes by making suggestions for future work in the fields of study, policy, and practise.

II. CONCEPTUAL FRAMEWORK OF COMMUNITY ENGAGEMENT

It is a method of study in which all members of a community are encouraged to participate and accept each other's views, tactics, and actions in order to form a genuine partnership to address challenges affecting the well-being of the community in question (**Minkler M, 2003**).

In any study project involving communities, community involvement is essential. Researchers and community members must work together to create an atmosphere that is conducive to learning and collaboration at all stages of the project. "Community engagement" honours the deeper levels of partnership and participation represented by the phrase "community involvement" in this work.

In higher education, primary and secondary education, public health, and social work, the principles of community participation have been established and refined over the course of time. Students in higher education, community partners, and K-12 students and schools have all benefited from community participation, according to researchers (**Belansky, 2020**). As a result, the relationship between the

school and the community is not considered as a one-way street, but rather as a two-way street with ramifications for both the school and the community as a whole. When community organisations and agencies work together with schools to provide health and learning resources for students and staff, schools can benefit as well as the community as a whole. This can be done through service-learning projects, facility sharing, and other ways to benefit the community at large. (**Lewallen TC, 2015**)

Given the documented benefits of community involvement for both schools and communities, it's not surprising that community participation has been regarded a catalyst for health promotion in school settings. Community participation in schools is still poorly understood, despite increased recognition of its value and ongoing lobbying for its inclusion across health-related fields. While **Bush et al. 2013** conducted a systematic evaluation of school-based health treatments for adolescents and found "good effects of integrating parents and the community in health interventions," their findings "were less certain about the importance of community participation". In light of the potential role that communities might play in promoting health equity, it is imperative that this issue be addressed. (**Grumbach K et al., 2015**) All in all, it's critical that community involvement in school-based health treatments and the community involvement that results from these efforts be better understood.

III. STUDENT ENGAGEMENT WITH COMMUNITY

Higher education students are active in the community in a variety of ways, from service-learning and community-based participatory research to internships and civic participation options for students like Madison. These various teaching approaches are all based on the same two tenets:

The capacity of students to apply what they've learned in the classroom to real-world settings is critical to their success. Students may take advantage of this opportunity in their communities. Students, faculty/staff, and community members, as well as community organisations and educational institutions, work together to achieve mutual goals in order to build the capacity of all partners; and critical reflection and assessment processes that are intentionally designed and intentionally implemented are common in well-designed community engagements." (**Felten and Clayton 2011**). Depending on the type of pedagogy used, instructors, staff, and students may have different goals for community engagement. If the student's major and future employment ambitions are intimately linked to the internship's aim, it serves a very different purpose than if the internship's purpose is simply to fulfil course objectives through serving the community. Students can gain experience through community-based participatory research, in which they work with a non-profit organisation to conduct an investigation, while civic engagement activities outside of the classroom frequently involve students working with political figures like albeit not necessarily in an activist or advocacy capacity, government officials. It is important to note that community involvement encompasses a wide range of approaches and motives for college students to get active in their local community.

As a rule, community engagement pedagogy is a high-risk, high-reward approach, regardless of the medium. The dangers are many. Because the community site is more dynamic and unpredictable than a traditional classroom, some students find it difficult to adjust, especially when unexpected events occur and behavioural standards are unclear. Learning in a group context can't always be broken down into "bite size chunks" or organised according to a syllabus. Although some students fail to live up to their community service commitments, students' behaviour is influenced by assumptions and biases about persons of different races, ethnicities, faiths, socioeconomic status and other aspects of personal or group identification (**Jones 2002; Catlett and Proweller 2011**). Students and community members alike might be negatively impacted by poorly executed student involvement programmes, which may also reinforce the unfavourable assumptions they already hold (**Jacoby 2015**).

Why would instructors and staff encourage students to get involved in their community when there are so many dangers? Engaging in a community reaps many benefits while also posing risks (**Fitch et al. 2013**). Work in the community has been shown to have a variety of good effects on students' cognitive, behavioural, and emotional well-being, as evidenced by the service-learning literature. (**Warren 2012**).

IV. SIGNIFICANCE OF PARTICIPATION AND DEVELOPMENT THEORY OF COMMUNITY: RETROSPECTIVE AND PROSPECTIVE

Teachers may feel aggrieved when students don't participate in online conversation because they believe it is a crucial part of building a community of learners. When the virtual classroom door swung wide at the beginning of each semester, I had always assumed that my students would rush in, but this hasn't always been the case for all pupils" (**Bender 2003**). When a student is present in a learning community, he or she must participate by offering a contribution to a discussion. People have the right to observe online debate without participating in order to get a sense of what is going on. According to a workshop held by Jacquie MacDonald and included Etienne Wenger, the founder of the concept of communities of practise, it was suggested that "lurking is a form of cognitive apprenticeship that may be seen as proper peripheral involvement in discussion-oriented CoPs." (**MacDonald et al. 2003**). In order to grow as a person and make a difference in their community, people need more than just being present in a group environment.

Participation is the only way for growth to take place. It's a shame that folks who don't have the necessary skills or confidence to participate in community involvement events can't participate in them. The goal is to get people to cross the threshold and then assist them in joining the community. People are hesitant to join a group for a variety of reasons, some of which are rooted in their own inadequacies or concerns. Studies have shown that people may lack the time, knowledge or interest to participate in community development efforts (**Dalziel, Hewitt, and Evans 2007**). They say that people may be fearful of the unknown or of alienating their peers if they use the wrong terms, according to a report written for the UK's Department for Communities and Local Government by Dalziel, Hewitt, and Evans (DHE). More than that, "inhospitable places where individuals felt intimidated" can be gathering places. The Joseph Rowntree Foundation's (2006) research revealed people in local government have a strong belief in the power of impassioned, well-connected, and unreachable insiders whose position is supported by that belief. This turns off a lot of people who might be interested in participating.

There are a number of issues to consider when it comes to the variety of meeting venues that some students may find intimidating. While teachers can be captivated by powerful pupils, they may be overtaken by their own concerns or feelings of inadequacy in relation to others in the class. It is just as important for a student to feel included in a classroom community as it is for a student to feel like a member of a community outside of the classroom (**Fraser 2005**). Note of caution is necessary. The principle of empowerment is undermined when values like "participation is good for you" are imposed. "Enticing lurkers into active engagement... feels a bit like the 'father knows best' school of homogenization," one participant said at the workshop on communities of practise. Additionally, (**Ferreday and Hodgson 2008**) discuss how "Participants might feel despotic if they are made to participate in an unreflective and normative manner by course designers, instructors, and eventually themselves," peeling aside the utopian picture of participation to discover its dark side". (**Malcom Moseley 2003**), a community development researcher, argues that the "squandering of a large resource" of human and social capital is a result of people not being involved in collective or community activity. Teachers planning online conversation have an unanticipated task because of these tensions. For this reason, even if some students are unable to participate in a learning community for a variety of personal reasons, the teacher has an obligation to design activities that are engaging and entertaining to the greatest number of students possible. With this in mind, the goal is to encourage engagement where it is lacking. Those who do not participate in community activities run the danger of compounding their disadvantages and missing out on valuable learning opportunities.

V. MAIN CHARACTERISTICS OF STUDENT ENGAGEMENT

Engagement Is Different from Motivation

A wide range of goal-directed behaviours, thoughts, and emotional states can be included in the concept of engagement (**Fredricks, Blumenfeld, & Paris, 2004**). Although definitions of engagement differ among studies, engagement is distinct from motivation. Although not universally accepted, the idea that motivation has an action or energy component known as "engagement" has become a popular one (**Appleton et al., 2008**). When it comes to energy, purpose, and endurance in activities, motivation has been described as the psychological processes that underpin these traits, while involvement is seen as a visible outward representation of the same motivation. Cognitive (e.g., self-regulated learning) and emotional (e.g., interest, pleasurable emotions about the task) and behavioural manifestations of engagement are also possible (**Christenson et al., 2008**). As a result, motivation to achieve a goal or succeed in academics is stimulated when it is put into action consciously.

There Are Several Levels of engagement

The concept of 'engagement' is one that has multiple levels, each with an increasing degree of hierarchical significance (**Eccles & Wang, 2012**). Students' engagement has been studied in at least three levels. (**Skinner & Pitzer, 2012**). Students' engagement in school activities (e.g., volunteering) is shown on the first level (e.g., involvement in school activities). In the second level, focus is shifted to the classroom or the subject matter at hand. (e.g., how students interact with math professors and material) (e.g., how students interact with math teachers and curriculum). Students' engagement in classroom learning activities is examined on a third level that emphasises changes in action and experience from one moment to the next.

The Dimensions of engagement

An agreement is scarce among academics on which components of student participation should be separated. (**Fredricks et al., 2004**). For the most part, models include both behavioural (such as active involvement in school) and emotional (such as affective responses to school experiences) components. Examples of these include: Cognitive engagement covers mental processes that enhance learning and performance, such as self-regulated planning and a propensity for challenge (**Wang, Willett, & Eccles, 2011**). There is another facet of engagement that is less well-known but as important: a student's direct and purposeful efforts to enhance the learning process by actively influencing the teacher's instruction. This is called agentic engagement (**Reeve & Tseng, 2011**). Researchers must specify the characteristics of involvement and guarantee that their measurements are compatible with a wide range of explanations of engagement in the field.

Engagement Can Be Shaped

Context influences student engagement, which makes it an ideal location for interventions (**Wang & Holcombe, 2010**). In order to keep students engaged in school, it is important that they have positive learning experiences, supportive connections with teachers and classmates, and reaffirmations of their developmental needs in the classrooms. Structures of schools, such as class size and location, are also thought to have a bearing on the educational climate, which in turn affects student motivation and engagement. Although structural elements may not directly affect student engagement, classroom practises may be altered, which in turn affect student engagement (**Benner, Graham, & Mistry, 2008**).

Student engagement in the classroom is dependent on a number of different facets of that process. For example, in classrooms where activities are hands-on, difficult, and real, students are more likely to be engaged. Teachers that provide their students clear goals and instructions, consistent guidance, and constructive feedback have more engaged students. According to **Spera, (2005)**, researchers have discovered a connection between strong parental expectations for their children's school engagement and their own tenacity and enthusiasm (as well as their own well-being) (**Wang & Sheikh-Khalil, 2014**). Student engagement can be thought of as a changeable construct that can be shaped by researchers in order to improve student engagement and learning.

VI. RELATION BETWEEN STUDENT ENGAGEMENT AND COMMUNITY DEVELOPMENT

Relationships and community are the foundation of student involvement. When students feel that they belong to the class and that their talents and interests are valued, they are more engaged in class. In order to encourage students to participate actively in the classroom, teachers should cultivate an atmosphere of trust and openness in the classroom. A classroom community may be built when students are able to share their knowledge and interests with one another. This allows you to formatively assess your students as well as contextualise the subject matter in a way that makes it meaningful to them. Making connections between what you want your students to learn and what they already know is all it takes to get them to study. Integrating the names and hobbies of your audience members may be as simple as including them into your examples. As a teacher, you'll need to listen to your students and find out what they know, how they think, and the things that are important to them.

You may further increase student engagement by providing organised opportunities for students to pick what they study and how they are rated. In order to guarantee that your students gain disciplinary-specific skills while selecting their own project, subject, or method of presenting what they know, it is not necessary to abandon your instructional goals when you allow your students to make their own choices.

As a final point, play is one of the best ways to get students excited about learning while also improving their natural desire to do so. Language "play" fosters language development, enhances our ability to communicate with others, and helps us become part of a speech community. As a society, we rarely provide newcomers to bilingualism the chance to explore the complexities of word play in order for these individuals to fully participate in their respective speech groups.

There are many emerging bilinguals who are capable of playing with language creatively, but they may lack the self-confidence to do so. There is no doubt in their minds that kids must acquire a new language in order to connect with others, get along at school, and merely live in their environment. It's not uncommon in the classroom for students to be "managed" by English grammar and vocabulary, low-stakes chances to experiment with language in real, content-based projects are infrequently offered to students who are learning a second language become more comfortable manipulating it creatively in real-world situations.

When I was working with students who were emerging bilinguals, I was always intrigued by the ways in which they interacted with language in their free time. It was common for the students to make up jokes and wordplays, using words and phrases from their native tongues to spice up English interactions. Language play and learning took place at the playground without the children's knowledge. They may have sweated in the classroom trying to get their words just right, their sentences arranged in the "correct" order, and their pronunciation just "right," but when it came time to play, these same kids were engrossed, engaged, and motivated in their participation, sweating only from running to get the ball.

We can drastically enhance student involvement by fostering a sense of community, including students' interests and passions, and allowing them to choose their own path in school.

VII. COMMUNITY PARTICIPATION FOR QUALITY EDUCATION

Since the government's declared policy in the sphere of education has been to ensure equal access to high-quality education and to improve educational management and planning. Nonetheless, enhancing the quality of education has proven to be a difficult task. Nepal, for example, does not have a lengthy history of educational progress; but, following the political shift in 1950, the people had a new spirit and desire for the country's overall development. As a result, people began to establish new schools in their own initiations. There has been a growing tendency in the expansion of educational facilities. The school had not received any funds from the government's coffers. People in the neighbourhood did not wait for the government to create new schools and hire instructors in their communities. Most schools began as community-based organisations that received various types of donations from the community, such as land, finances, volunteer teachers, labour, and construction supplies. It was a very good time to accomplish a reasonable level of growth with the direct involvement of the community in terms of educational expansion.

As members of the community were introduced to schools, they were also accountable for their management. At the time, community-managed schools were successfully implemented. The community managed school model was basic in the sense that the community accomplished things like create the school in a site that the people agreed on, build a house for classroom purposes based on their financial status, hire and fire teachers, and get their wages and other perks. Most educationists around the world appear to believe that community participation is critical in promoting education in terms of both quality and quantity, and that community participation and empowerment have the potential to make a significant contribution to educating people and improving their quality of life.

Because of the different components that are directly and indirectly related to education, political, social, and cultural life is becoming a crucial issue. The world is growing increasingly complex on a daily basis. The changing macro-political landscape, the promise of expanded democratisation, the threat of narrow nationalism and fundamentalism, the rising risk of environmental degradation and endemic disease: all of these challenges necessitate more effective human resource development and, as a result, a greater demand for and supply of higher-quality education.

Although research on student engagement has shown a lot, there are still some areas that need to be clarified and expanded.

VIII. CONCLUSION

When faced with a new problem, students' motivation and cognitive processes can be influenced by their feelings, which can either aid or impede their learning. In contrast to negative emotions like worry, which may make it more difficult to accomplish tasks, positive emotions such as joy and pride can help people perform better by concentrating their attention on the job and encouraging them to use adaptive coping methods (**Reschly, Huebner, Appleton, & Antaramian, 2008**). It is fairly uncommon for researchers to look at general opinions regarding the learning environment, such as how much students value or are interested in school (**Stewart, 2008**). How students' real feelings or emotional states influence their academic engagement and achievement during various learning activities is unknown (**Linnenbrink-Garcia & Pekrun, 2011**). Affective states are seldom examined as a factor in student involvement, instead relying on students' retrospective self-reports of their emotional states. Students' recollections of their emotional experiences in the classroom may benefit from the addition of physiological markers of emotional distress (such as facial expressions and heart rate), as well as experience sampling methods for determining classroom emotional states in the real moment.

Thanks to advancements in brain imaging technology, neuroimaging studies show that emotional states during learning are crucial for determining how effectively the brain learns new information (**Schwabe & Wolf, 2012**). No real-time neuroimaging is possible, but neuroscientific techniques are wonderful tools for understanding more about how emotional events alter brain processing and influence task engagement. Can we, for example, intervene in these processes in order to mitigate the negative effects of classroom boredom or apathy? Is it possible that long-term exposure to boredom in the classroom alters the structure and function of the brain? More research is needed on the interplay between hereditary and environmental influences on brain chemistry. The antecedents or triggers of negative affective experiences should be recognised as those environmental supports that can reduce unpleasant feelings, stimulate adaptive coping mechanisms, and enhance learning engagement and performance.

We still don't fully comprehend the benefits of adolescent community involvement, despite mounting evidence to the contrary. For longitudinal studies to reveal the effects of various forms of youth community engagement over time and studies that situate these processes in specific contexts (e.g. using multilevel, geographic and/or relational designs or ethnographic methods), comparisons of specific forms of youth community engagement are required. In addition, more action research should be conducted in connection with initiatives aimed at involving children and youth in their local communities.

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