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THE INNOVATIVE PRO-POOR ENVIRONMENTALLY GREEN ENGINEERING SYSTEMS (PEGES) STANDARD: TOWARDS ACCELERATED SUSTAINABLE DEVELOPMENT IN DEVELOPING COUNTRIES

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ABSTRACT

PURPOSE: This research aims to quantitatively and qualitatively solve the Sustainable Development Decision Problem in developing countries by seeking smart solutions towards the implementation of the 17 SDGs as one package, while observing the consensus core values (i) Collective Benefit; (ii) Equity and Fairness; (iii) Quality and Integrity; (iv) Inclusiveness; and (v) Sustainability (Weaver *et al*., 1997).

DESIGN/METHODOLOGY/APPROACH: The Modified Dynamic Strategic Fit (MDSF) Algorithm (Hassan, 2003) was designed and developed to solve the following major development requirements in the targeted countries: a) appropriate infrastructure; b) social protection measures and systems; c) basic services; d) sound and practical policy framework; e) robust multi-stakeholder partnerships covering the different target circles of SDG 17 (finance, technology, capacity building, governance, institutional policy coherence; multi-stakeholder partnerships, trade) (Griggs *et al*., 2017).

FINDINGS: The resulting algorithm was able to develop a new conceptual framework to solve Agenda 2030's SDG problem by reducing the 169 expected results into only 48 expected results, making the problem and its holistic solution feasible and tractable.

ORIGINALITY/VALUE OF THE PAPER: The international community is herewith called upon to undertake a paradigm shift to facilitate the practical and accelerated implementation of Agenda 2030 in developing economies by focusing and putting SDG 1 (No poverty) at the core of the proposed

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solution framework. The proposed framework calls first for the utilisation of a set of well-designed Poverty Reduction and Social Protection (PRSP) policies; this is part of the innovative and newly proposed Aristotle Framework for Action (AFA) Initiative. The AFA initiative proves the power of the integrated whole system design (IWSD) approach, utilising a newly developed Pro-Poor Environmentally Green Engineering Systems (PEGES) standard, when the correct associated science, technology and innovation (STI) innovative technological applications and programmes and the proper set of values are jointly promoted.

RESEARCH LIMITATIONS: The Sustainable Development Decision (SDD) problem is a special form of ill-defined complex decision problems. This type of problem is inherently unique and should be treated as a one-shot operation, while there is no structured or standard manner for their formulation, and there is no one single criterion of optimality. The complexity of these problems is rooted within many disciplines, their modelling requires a wide range of tools, and the solution necessitates the design and utilisation of a new conceptual framework to allow for the reduction of the problem into a tractable format (Chevallier, 2009).

PRACTICAL IMPLICATIONS: Achieving sustainable development in developing countries necessitates a huge level of human and financial resources. As we base the solution on the best scenario, the financial implications skyrocket, making it almost financially infeasible unless there is an innovative out-of-the-box financial model that can fully engage the private sector on a high return on investment (ROI) basis and away from public or international assistance models. At the same time, however, the other requirements for human resources and capacity building become vivid and within reach to achieve. The model therefore identifies the knowledge and technological base required and the targeted population and groups to make it work.

KEYWORDS: *Poverty Reduction; Pro-poor Coherent Policies; Conceptual Framework; Sustainable Consumption and Production; Infrastructure; Basic Services*

INTRODUCTION TO THE PEGES STANDARD

The proposed Aristotle Framework for Action (AFA) initiative revolves around enacting the principle of Leaving No One Behind by focusing on the well-being and development of the most vulnerable and most impoverished 20–30% of each region's population. Taking these targeted groups out of acute poverty will indeed impact the socio-economic development of these communities and their countries, as in the case of Brazil between 2003 and 2011. To achieve the above goal, this proposal calls on the targeted countries to adopt a newly developed Pro-poor Environmentally Green Engineering Systems (PEGES) standard. This is a green technologies and applications selection mechanism intended to foster the required accelerated sustainable development through a set of mandatory sustainability eco-design requirements. In addition to the easy identification of the appropriate set of green technologies and applications, and the associated green jobs, the PEGES standard allows for building the right type of infrastructure in rural areas, and therefore not only has a positive impact on the environment and meeting climate goals, but also substantively contributes to reducing inequality within societies. Utilising the PEGES standard allows for the development of a fully green economy detached from environmental degradation.

In brief, the AFA initiative, together with the implementation of the PEGES standard will support the implementation of an integrated package of environmental policies,

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employment and social protection, with strong and sustainable economic and socialreturns (Weaver *et al*., 1997). The resulting outcome is so innovative that it also allows for the development of a green infrastructure that permits the easy transformation of poor villages into Agro-based Technopolis (AgbT) and/or Industrial-based Technopolis (InbT), that is, new societies with a concentration of technology-based businesses (with an emphasis on both digital and non-digital green technologies). It also makes possible the adoption and utilisation of the required public policy(s) towards the localisation of the manufacture of these green technologies in developing countries, in a more accelerated dynamically fit and strategic modality. The standard defines a list of the mandatory sustainability eco-design procedural steps and working STI and natural resources management principles, that can easily identify the appropriate set of green technologiesand applications required to foster accelerated sustainable development in the targeted developing countries.

The PEGES standard calls upon communities to incorporate critical thinking and adaptability in finding solutions, while focusing on building resilience through anticipation and reaction to any crisis to ensure the stability of these communities throughchallenging times (Nilsson and Stevance, 2016). The PEGES standard also calls upon the private sector to support building resilience rather than focusing on its growth, profit and own efficiency (UNFCCC, 2015). The standard aims to makethe world a better place by enacting the net positive indicator, calling upon the private sector to become part of the solution instead of being part of the environmental problem (UNFCCC, 2015).

Rather than just mitigating negative effects, the PEGES standard tends to increase focus on sustainability and resilience while also having a positive impact on society. In other words, the PEGES standard extends sustainability through actively pursuing efforts to create a positive change rather than simply reducing, minimising or mitigating climate damage (Nilsson, 2016).

The PEGES standard allows the AFA initiative to conform with the requirements of the Global Accelerator for Jobs and SocialProtection that the Secretary General of the United Nations launched in September 2021. Similarly, the AFA initiative has been designed to (Nilsson, 2016):

1. Generate interest and political alignment.
2. Support resource mobiliation to consolidate the financial backbone.
3. Provide technical support to strengthen existing capacities at country and regional levels, and facilitate and enable policy development, integration and implementation.

In the following sections, we will explain the working STI principles around which the PEGES standard revolves, as well as share some practical examples of how this innovative proposal could substantively contribute to the realisation of the main objective of the International Decade of Sciences for Sustainable Development (IDSSD

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2024–2033) as to how to build a robust science culture in which everyone has the right to participate in, and enjoy the benefits of, scientific and technological progress and its applications in accordance with the Universal Declaration of Human Rights. In brief, and as indicated before, the PEGES standard in junction with the AFA initiative, will support the implementation of an integrated package of environmental policies, employment and social protection, with strong and sustainable economic and social returns.

LINKAGES TO THE IDSSD 2024–2033 (UNESCO, 2024)

The world is currently not on track to reach the Sustainable Development Goals (SDGs) by 2030. Climate disruption is growing, as droughts, floods, storms and other weather-related hazards become more frequent and more severe. More generally, today's production and consumption models are unsustainable. Chemical, synthetic and electronic waste are unfortunately globally in abundance.

For these reasons and more, on 25 August 2023, the United Nations General Assembly proclaimed the period 2024–2033 the International Decade of Sciences for Sustainable Development and invited UNESCO to lead its implementation. This decade presents a unique opportunity for humanity to unlock the full potential of science in pursuing sustainable development and ensuring a safe and prosperous future for all. Governments and all other relevant stakeholders in Member States of the United Nations are encouraged to actively support the implementation of the decade, in collaboration with UNESCO.

The declared mission of the IDSSD 2024–2033 is to engage all societal actors to advance science and ensure that everyone benefits equally from it. This is to be achieved through serious efforts to use and leverage scientific knowledge to accelerate progress towards the SDGs and beyond. More importantly, there is a dire need to build a robust science culture in which everyone has the right to participate and enjoy the benefits of scientific progress and its technological applications in accordance with the Universal Declaration of Human Rights.

To that end, the PEGES standard has been designed as a replicable par that comprises a set of mandatory sustainability eco-design procedural measures and working STI principles that are necessary for the robust development of a green-based economy in developing countries. In a clear way, it defines the new terms of engagement between the rural poor communities, national and local governments, the private sector (national and international) and civil society at large. As demonstrated later, the PEGES standard essentially calls for the application of full green procurement in developing the proposed new and innovative rural-urban centres and infrastructures, including the Agricultural-based Techno-polis (AgbTs) and/or the Industrial-based Technopolis (InbTs).

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This is made possible by enacting twelve sustainability mandates. The following is a brief account of these measures and principles:

1. Calls for the utilisation of the concept of value chains to support the promotion of local manufacturing and production for the majority of the spare parts of the newly proposed engineering systems. This aims to create new markets and SMEs for the selected new products and their associated services in these targeted regions (Pareto Optimal);
2. Calls for the utilisation of the concept of Value Engineering to seek schemes that mandate both efficient designs (i.e., optimal resources allocation, reduced waste, land and space management), renewable energy utilisation and cost-effectiveness, as well as shorter construction lead time when compared to conventional systems and alternatives (Pareto Optimal);
3. Essentially calls for finalising the selection of a set of pre-selected innovative but well-proven green technologies as technological standards for replication in the targeted regions to ensure the development of a strong sub-regional supply chain and industrial base. This aims towards the creation of the required demand for the production of these technological applications in a modality that would promote regional and/or sub-regional integration;
4. Calls for the adoption of the Cooperatives Governance and Financial (CGF) model where all inhabitants within the newly developed rural semi-urban centres are spontaneously affiliated members, and then enacting robust multi-stakeholder partnerships between the newly developed local co-operatives and the relevant national/regional/global private sector towards localised mass production and the creation of small and medium enterprises (SMEs) (UN, 2015);
5. Calls for the creation of a knowledge hub for Sustainable Development Green Technologies Education and Utilization (SDG-TEU) Centres of Excellence (CoEs), mainly as virtually operated platforms in each region. This aims to guide targeted, municipal communities with all the technical and financial requirements clearly identified by implementing the PEGES standard in the poor rural areas;
6. Calls for the utilisation of the international private sector and the proposed SDG-TEU CoEs in building the capacities of national unemployed college graduates as the required critical mass of technical force and practitioners, and deploy them to the targeted rural areas to support the efforts for the implementation of SDGs. Rural villagers would also be trained on relevant technical and vocational education and training (TVET) activities to resume the many jobs facilitated by the new communities set up;
7. Mandates that any natural resource you do not have you do not use, unless its use is critical and there is no other innovative substitution for it;

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8. Mandates that all new and innovative systems are to be designed or re-designed using the Integrated Whole System Design (IWSD) Approach, with the required level of cost-effectiveness through minimal resources utilisation and optimal waste management (Waage and Yap, 2015);
9. Mandates that all newly built rural urban centres, including the AgbTs and/or the InbTs, will refrain from utilising fossil fuel products for all forms of energy consumption;
10. Mandates that all newly built rural-urban centres, including the AgbTs and/or the InbTs, will refrain from utilising products of an energy-intensive production nature, such as ammonia, paper and fertilisers, etc. Cement and steel can only be used in construction;
11. Mandates that all newly built rural-urban centres, including the AgbTs, will refrain from using material that negatively affects biodiversity, such as wood for furniture. Instead, the use of granite stone and cast concrete or even bricks will be promoted for furniture manufacturing;
12. Mandates the design and/or re-design of any system with fewer moving elements, where the majority of wear and tear takes place.

ARISTOTLE'S FRAMEWORK FOR ACTION (AFA) APPLIED

Global reports have identified four major actions for national governments and the international community to focus on to successfully address sustainable development in developing countries. These four actions happen to be among the targets of SDG 1, regarding poverty eradication. Therefore, focusing on addressing these four actions will resultin phase lifting the poor into a newly improved status of livelihoods. These four actions can be summarised as follows (ESCWA, 2017):

1. The implementation of the appropriate social protection measures and systems against exploitation and unfair treatment of the poor from the rich and some government systems;
2. The development of the required infrastructure, such as all-weather roads, bridges, good drainage and sewage systems and possibly water dams in identified areas, ensuring affordability, and facilitating access to efficient, resilient and sustainable infrastructure services;
3. The provision of easy access for the poor to basic services, such as safe drinking water, clean energy, adequate health services, education for all, new technology systems to facilitate the day-to-day life activities, and direly needed financial services, for example, micro-finance;

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4. The formulation of sound and practical policy frameworks, based on gender-sensitive and pro-poor development approaches, and mobilising adequate resources in an innovative manner to boost investment towards poverty eradication.

To facilitate a way of decoding the 2030 Sustainable Development Agenda into an effective set of actions, at the national, sub-regional and regional levels, from among the 169 targets of the 17 SDGs we identified those targets that have direct association with the above four major actions and re-grouped them into subsets according to the four specific targets of SDG 1. This step has reduced the number of 169 targets for the 17 SDGs into only 46 targets, bringing the burden of the implementation of the SDGs to a practical level, while still considering all the SDGs and Agenda 2030 for implementation at the national level.

The above approach was tested, validated and theoretically demonstrated through five years of intensive research on major developmental issues facing developing countries, and the possible adoption of a more multi- and trans-disciplinary approach to problem-solving and policy-making. The resulting socio-economic ecosystem was then identified with the following necessary five platforms/game changers towards achieving sustainable development in developing countries.

The first action emerged as a well-designed Poverty Reduction and Social Protection (PRSP) policies framework (ESCWA, 2017) revolving around the implementation of the AFA initiative, calling for increasing the middle class for a better, stable and just society, and enacting the principle of Leaving No One Behind. Utilising the PEGES standard as a pre-design condition, the above can be simply achieved by focusing on the well-being and development of the most vulnerable and most impoverished 20–30% of each nation's population (US$1.25 or less per day). Taking these targeted groups out of acute poverty will indeed impact the socio-economic development of these communities and eventually the remaining population of their countries, as in the case of Brazil between 2003 and 2011.

The second recommended action called for investment in infrastructures, which are instrumental in meeting the SDGs in developing countries (Alkire *et al.*, 2016). This is true since:

1. By creating jobs and economic activity, infrastructure enables development;
2. It provides the services that underpin the ability of people to be economically productive, for example via transport;
3. By building the right type of infrastructure in rural areas, you not only have a positive impact on the environment and the ability to meet the climate change goals, but you also contribute to reducing inequality within societies.

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Recent reports have shown that continuing population growth and urbanisation across the world are projected to add another 2.5 billion people to the world's urban population by 2050, with nearly 90% of the increase concentrated in Asia and Africa. In the context of the above, the PEGES standard essentially calls for the application of full green procurement in developing the proposed new and innovative rural semi-urban centres and infrastructures, including proposing the transformation of the poor villages and small towns into a number of Agricultural-based Technopolis (AgbTs) and/or Industrial-based Technopolis (InbTs), that is new societies with a concentration of technology-based businesses (emphasis on both digital and non-digital green technologies). The PEGES protocol was utilised as a pre-design condition to identify the optimal type of infrastructure and specifications that will support cost-effective green development in the targeted improvised rural areas. The following are some of the pre-design mandated specifications that the PEGES standard has executed on the proposed infrastructure designs:

1. Minimising the land use for any infrastructure development for cost-effective and efficient utilisation and operations. For example, instead of any village houses scattered horizontally over a large plot of land, the PEGES standard opted for high-rise buildings to reduce the living quarters area(s), while still including in these buildings: community meetings space, schools, science laboratories and research centres, children's science parks, closed/indoors sports and play grounds, well-equipped hospitals and/or clinics, a marketplace, aquaponics facilities on the roof for nutritious food production, and even a public dining commons. The intention of these housing projects is to replace most of the rural poor villages and small towns with resilient green housing projects, where the targeted populations can enjoy the currently missing properly furnished housing, clean energy, safe drinking water and sanitation services, nutritious food, and quality education, together with reliable means of green and cost-effective transportation;
2. Each housing project will consist of a number of high-rise buildings with enough apartments to accommodate the number of families per each relocated village or number of merged villages, as illustrated in Figure 1. Using the Integrated Whole System Design (IWSD) approach, each high-rise building is essentially about 70 floors high (about 200 metres in height) to target the wind regimes at such higher altitudes for continuous energy production, using a large vertical axis wind turbine (estimated up to 250kW). Figure 1 illustrates that some buildings are to be fitted with a dome-shaped solar collector to produce enough heat energy to desalinate brackish water, therefore making safe drinking water readily available for the residents in dry regions.
3. As a pre-design condition, the PEGES standard calls for the development of furniture production facilities from Environmentally Green Material (EGMs) such as granite stone, fabricated cast cement, and/or bricks. The proposed Semi-Urban Rural Housing

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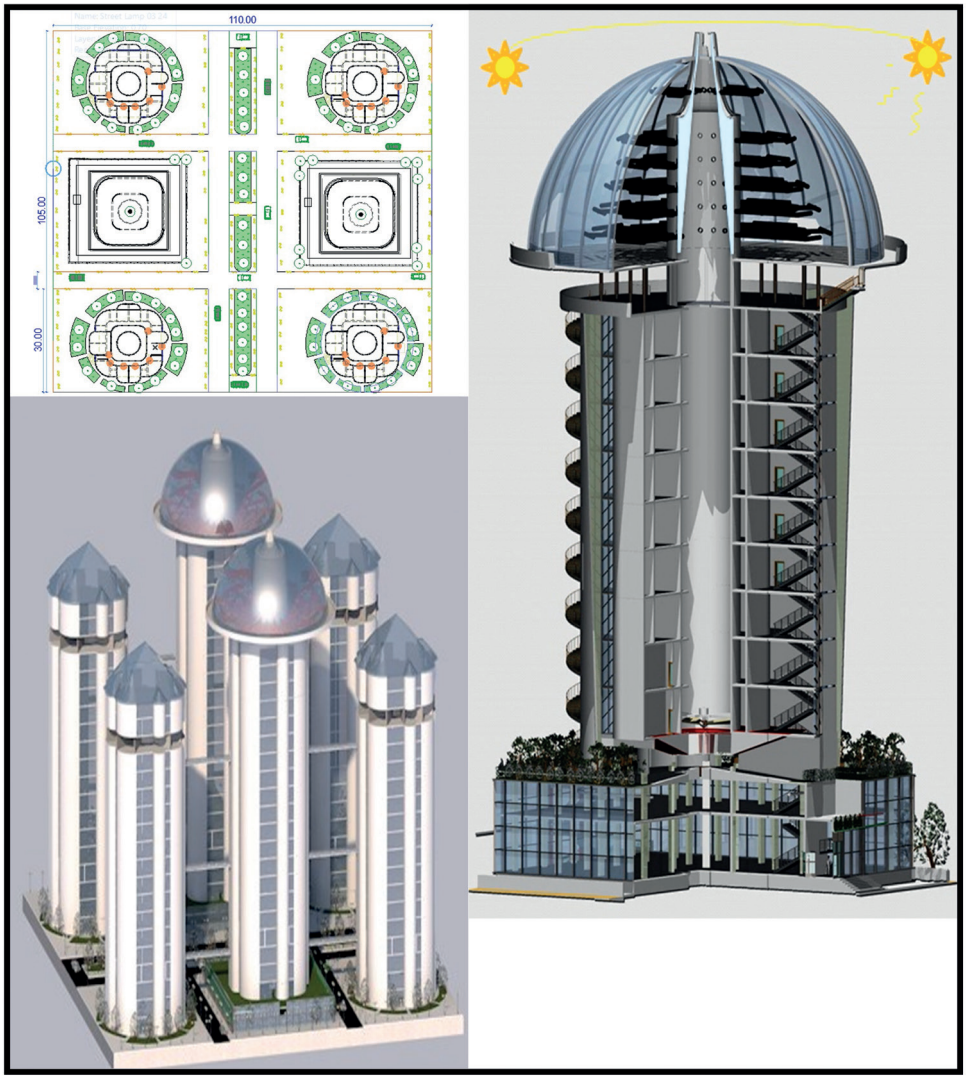

Figure 1 High rise building design accommodating the cost effective implementation of 10–12 SDGs

Source: Developed by the author

Communities are therefore able to enjoy apartments that are fully furnished via local EGMs. This will greatly add to the biodiversity conservation of the current ecosystem in these regions.

4. As a pre-design condition, the PEGES standard also calls for developing and operationalising a number of production facilities to introduce the Prefabricated Prefinished Volumetric Construction (PPVC) approach. Global experience indicates

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that when the PPVC approach is utilised in any high-rise housing project, around 80% of each housing module will be built off-site, with waterproofing, tiling, painting, glazing, cabinetry, plumbing and electrics completed before being delivered to be "stacked and joined together on-site". This technique will enable any housing project to reduce wastage both on-site and off-site with better control of the production processes through a central materials and logistics platform. Many examples of sites set with a minimum level of use of PPVC, has proven to improve construction productivity by up to 40% in terms of manpower and time savings, depending on the complexity of the projects.

5. To raise construction productivity further, the PEGES standard also calls upon the construction industry to embrace the concept of Design for Manufacturing and Assembly (DfMA), where construction is designed and detailed for a substantial portion of work to be done off-site in a controlled manufacturing environment. For example, the Chinese infrastructure company BROAD Group recently managed to build a 10-storey apartment building in just 28 hours and 45 minutes (https://www.youtube.com/watch?v=kiqB_N_SNHY accessed on 01/11/2022). The company used prefabricated modular building units known as the "residential building system". According to the company, the various components of the system are designed in such a way that they can be transported from the factory to the construction site inside ordinary containers; the steel plates it has developed for the structural support of the units have a much lower production cost than those used traditionally. In addition, these units are 10 times lighter and 100 times stronger, so can withstand earthquakes and hurricanes.

6. With the anticipation of building these proposed Semi-Urban Rural Housing Communities in many different locations, transportation within these semi-urban centres and between them becomes vital and very critical. The PEGES standard has mandated that only an electric mode of transportation should be utilised. To consider affordable and cost-effective transportation infrastructure in these impoverished regions, the protocol mandates the use of solar-powered electric buses for public transportation within the network of the Agro-based Technopolis (AgbTs) and/or Industrial-based Technopolis (InbTs) and other urban centres, and to use solar energy powered Segways© for internal individual rides. Even more innovative, the PEGES standard demanded, in the design of long-distance transport, the utilisation of an improved version of the hover-train that does not run on steel wheels or rails; it is similar to a gliding hovercraft floating and guided over an inverted T-shape reinforced concrete railway. Operated by an electric motor, the proposed hover-train has been able to previously attain speeds of 400+ mph; there is, therefore, the grand possibility of reducing both energy consumption and travel time between the different AgbTs, InbTs and other urban areas.

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The third recommended action regarding providing the poor with easy access to basic services has been attained by applying the PEGES standard as a pre-design condition in developing the required infrastructure (ESCAP, 2017). The PEGES standard has mandated the development of a fully green economy detached from environmental degradation by creating a Green Technologies Utilization and Procurement (GTUP) guide in making available all the basic services, including resilient green housing, safe drinking water, brackish water desalination, the use of water-efficient gadgets, well designed compact wastewater and sanitation facilities in every residential high-rise, RE energy generation, affordable and reliable transportation and to design all necessary and relevant infrastructures to suit the requirements of the different preselected technologies to be introduced in these units. Such an approach will allow for both promoting and fostering localised industrial mass production of many spare parts for these systems, and setting new markets for the pre-selected green equipment/products and processes in these targeted rural areas.

The fourth recommended action is related to the need for formulating sound and practical policy frameworks to boost investment towards poverty eradication (UN, 2015). This objective becomes reachable through the implementation of the PEGES standard pre-design condition of adopting the Cooperatives Governance and Financial (CGF) Model in running the rural semi-urban centres. The CGF Model will essentially consider all inhabitants within the newly developed rural semi-urban centre as spontaneously affiliated members to the newly developed local co-operatives, while their new home fixed addresses will bring all these families into the radar of the financial institutions, as they become eligible for receiving loans and micro-finance to possibly start their small businesses. Good governance is indeed a key enabler for sustainable development, together with putting in place the right sustainable finance mechanisms. The following are some of the benefits of such a recommendation:

1. Adoption of the Cooperatives Governance and Financial (CGF) Model will increase the possibilities of raising capital through Waqf and Zakat (prospects of Islamic finance), while designing and implementing e-governance to ensure optimal strategic management of all livelihood-related activities with a substantive reduced level of corruption;
2. The CGF model will facilitate better commodities flow through new supply chains and improved opportunities of financing and/or micro-financing of all activities within the AgbTs and/or InbTs. The CGF model will also facilitate and make available appropriate employment opportunities within these communities;
3. The CGF model will secure all necessary conditions to ensure the flow of investments through banks and other financiers. Developmental plans will be carefully crafted to facilitate the rise of the appropriate agro-industries, small and medium enterprises

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for the production and marketing of new green consumables, such as LED lamps and many other products. The CGF model will therefore facilitate and lead robust multi-stakeholder partnerships among the newly developed local co-operatives and the relevant regional/global private sector towards localised mass production and the creation of SMEs, including strong partnerships with the international private sector and leading industries.

4. Adoption of the CGF model will also allow for new markets for all commodities locally mass-produced, and therefore strongly support the possibility of sub/regional integration. The socio-economic effect of adopting this model goes beyond and above, as it is expected to trigger a reverse city-to-rural migration cycle. AgbTs and/or InbTs within these rural semi-urban centres will offer much better urban life than that offered by the big cities, and more importantly, without the hiccups faced by city dwellers, particularly in the slum areas.

MOVING FORWARD: FROM LAB TO FAB

Among the outcomes of implementing the recommendations set by the PEGES standard, a series of well-established SMEs, as well as small industries, are expected to develop as associated services within these rural semi-urban communities, particularly if the right education and technical and vocational training of these communities are properly planned. These well-established businesses in turn are anticipated to create a Tsunami wave of development to nationally cover each of the targeted countries, maybe not as soon as 2030, but 2050 becomes a great possibility. It is therefore of utmost importance for UNESCO and the UN family and their global partners to gear up and pool the necessary resources to develop and accelerate a specially tailored programme to be associated with the implementation of the International Decade of Sciences for Sustainable Development (IDSSD 2024–2033) in the targeted developing countries, and the achievement of the following main expected outcomes as decreed by the UNGA resolution A/77/L.100:

Outcome 1: The global community is empowered through scientific literacy;

Outcome 2: Actionable scientific knowledge is produced and used to accelerate progress towards the SDGs, in alignment with human rights;

Outcome 5: National innovation systems are transformed, in order to respond better to the needs of science and society to ensure the appropriate effectiveness.

As indicated above, the newly proposed PEGES standard also calls for the creation of a series of regional Sustainable Development Green Technologies Education and

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Utilization (SDG-TEU) hubs/centres of excellence. These centres of excellence will mainly focus on building regional online platforms to develop and implement Training of Trainers (ToTs) in developing countries inmany important educational areas such as:

a) **Functional and digital literacy skills:** Functional literacy refers to the capacity of a person to engage in all those activities in which literacy is required for effective functioning of one's group and community, and for enabling them to continue to use reading, writing and calculation for their own as well as the community's development. Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital devices and networked technologies for participation in economic and social life. It includes competencies that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy. This is to be coupled with high-speed Internet connection for all rural areas within developing countries to ensure the success of education digitalisation.

b) **Technical and vocational education and training (TVET)** is understood as comprising education, training and skills development relating to a wide range of occupational fields, production, services and livelihoods. As part of lifelong learning, TVET can take place at secondary, post-secondary and tertiary levels, and includes work-based learning and continuing training and professional development that may lead to qualifications. Our module in TVET will target most of the required technical education and knowledge for sustainable development in all economic sectors, including resilient housing construction, water desalination, renewable energy systems, sustainable transportation, sanitation, carbon-free energy, transport, environmentally green small and medium industries, sustainable agriculture, nutritious foods production, etc. These will be intimately related to the technologies and services identified in the Green Technologies Utilization and Procurement (GTUP) guide in making available all the basic services preselected for the development of the proposed rural semi urban communities;

c) **Entrepreneurship:** Entrepreneurship education has been defined as "a collection of formalized teachings that informs, trains, and educates anyone interested in participating in socioeconomic development through a project to promote entrepreneurship awareness, business creation, or small business development". Enterprise education (also called entrepreneurial education) on the other hand, is usually conceived more broadly, seeking to foster self-esteem and confidence by drawing on the individual's talents and creativity, while building the relevant skills and values that will assist students in expanding their perspectives on schooling and opportunities beyond. Methodologies are based on the use of personal, behavioural, motivational, attitudinal and career planning activities;

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d) Global citizenship: Global Citizenship Education (GCED) aims to empower learners of all ages to assume active roles, both locally and globally, in building more peaceful, tolerant, inclusive and secure societies. GCED is based on the three domains of learning as indicated below:

i. Cognitive: knowledge and thinking skills necessary to better understand the world and its complexities;

ii. Socio-emotional: values, attitudes and social skills that enable learners to develop affectively, psychosocially, and physically and to enable them to live together respectfully and peacefully;

iii. Behavioural: conduct, performance, practical application and engagement.

iv. Fostering Science, Technology, Engineering and Mathematics (STEM) education for youth through a global Network of Science and Engineering Fairs focusing on girls and young women;

The set of trained trainers will be part of a robust nationwide training programme that is intended to propagate their knowledge further at the national level to train the critical mass of technical force and practitioners that are required to support achieving the SDGs in these communities. Unlike the quality courses produced by the SDG Academy affiliated with the Sustainable Development Solutions Network (SDSN), the plan here is to train all unemployed college graduates in the targeted rural areas to specialise in a set of pre-selected technological solutions within the main economic sectors, including, but not limited to, building and construction, wastewater treatment and sanitation, sustainable transport, renewable energy applications, agro-industry, nutritious food production, and education.

The technology universities around the world and specifically targeted technology manufacturers should also be called upon to support the development of the different digitaleducational modules required to operationalise the SDG-TEU CoEs. Some of these e-modules could be gathered from existing knowledge sources, such as the "…101 for dummies" series and the "Do It Yourself" series.

Last but not least, the international community should pay great attention to ensure High-speed Internet connection for all the rural areas within the targeted developing countries to ensure the successful implementation of education digitalisation, as well as the implementation of e-government systems in these countries, to ensure curbing corruption as much as possible.

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