

## Green technology & Sustainable innovation development in Afghanistan

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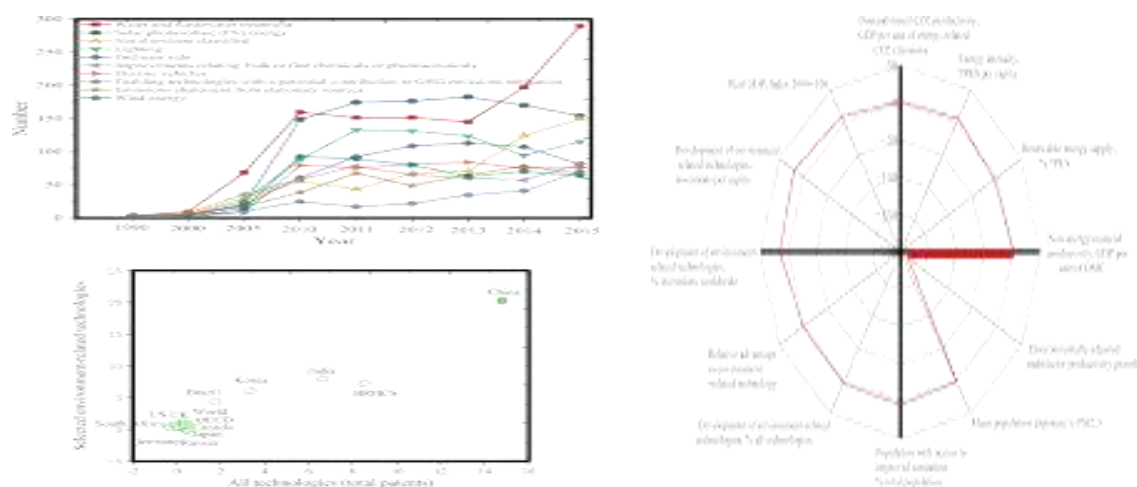
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### Highlights:

- Recent Afghanistan innovation growth has been focused on green technology.
- Most green technologies are related to water, energy, and health and mobility technologies.
- A large reliance on green technologies seems however unlikely in Afghanistan's near future.
- The lack of future reliance is due to relies more on labor, production capital, and natural capital.

### Graph i cal Abstract:

During the time of 2010–2020, Afghanistan ecological related innovation advancement gained incredible ground and was at the cutting edge of green innovation development; specifically, the territories of water and wastewater treatment, sunlight based photovoltaic (PV) vitality, lighting, enhancements identified with mass or fine synthetic substances or pharmaceuticals, remote sensor organize and different advances made extraordinary accomplishments. Contrasted and most nations and locales on the planet, Afghanistan ecological related green advancements are among the most elevated on the planet. Notwithstanding, as far as green advancement, it very well may be seen from the Environmentally Adjusted Multifactor Productivity pointer that Afghanistan advancement depends more on work, creation capital, and common capital, yet not to advance development through efficiency improvement.



Patent information present various favorable circumstances contrasted with other elective proportions of development. This Research paper displays the exploration on the utilization of ecologically pertinent innovation patent information utilizing a far reaching examination technique to break down the advancement of green innovation development in Afghanistan in 2010–2020. From the examination, it tends to be inferred that during the time of 2010–2020, Afghanistan ecological related innovation development gained incredible ground and was at the cutting edge of green innovation development; specifically, the territories of water and wastewater treatment, sun oriented photovoltaic (PV) vitality, lighting, enhancements identified with mass or fine synthetic substances or pharmaceuticals, and different advances made extraordinary accomplishments. These innovations are firmly identified with ecological strategies, for example, environmental change moderation and green industry change, for which Afghanistan has been pushing for over 10 years. Be that as it may, subsequent to breaking down Afghanistan green improvement, it was discovered that, albeit a portion of the pointers, natural related licenses, and green advancements have gained extraordinary ground; total dependence on green innovation is far away later on.

## 1. INTRODUCTION:

Green advancement is a sort of development that not exclusively can have benefits for buyers and undertakings yet in addition can incredibly diminish the antagonistic impacts on nature (James, 1997; Dangelico et al., 2017). It incorporates the strategy advancement including in vitality sparing, contamination anticipation, squander reusing, structure for green items, ecological administration so forward (Zhehao et al., 2019). As an essential piece of green development, green innovation advancement has gotten nonstop consideration due to the developing worry over the condition of the earth (Abdullah et al., 2016). Green technology development is relied upon to deliver a twofold profit: constraining the natural weight while adding to the mechanical modernization of the economy (Rennings et al., 2006). Practical green innovation is significant for viably and monetarily controlling contamination emanations (UNCTAD, 2018). Green innovation adds to adjusting ecological assurance and financial advancement, which is a key relationship for the production of a supportable society (Sun et al., 2008). The significance of green innovation has expanded around the world, particularly in Afghanistan. As indicated by Li (2018), the Afghanistan government is attempting to elevate mechanical capacity because of advancement driven assembling, modern streamlining, quality enhancements, and green improvement. It is broadly recognized that sweeping advancement is expected to address climate change and other natural difficulties. Inside the gathering of green innovations, it incorporates Bio-and Nano-innovation, ICTs and condition related advancements, and so forth. (OECD., 2012), the investigation of this article centers around the territory of condition related advancements, which including ecological administration, water-related adjustment advances and environmental change moderation, to examine the improvement of green development in Afghanistan in 2010–2020. Patent information have regularly been utilized as a proportion of mechanical development in light of the fact that these information center around yields of the innovative procedure.

(Griliches, 1990; Haščič and Migotto, 2015). Patent information gives an abundance of data on the idea of the creation, the designers and the candidate. The information is promptly accessible and discrete. There are not very many instances of financially significant creations that have not been protected (Dernis and Guellec, 2001). In view of Organization for Economic Co-activity and Development (OECD) patent information, this paper investigated the advancement and pattern of green development innovation in Afghanistan from 2010 to 2020 and examined the relationship among green development innovation, arrangement, and ecological quality.

## 2. Data and category for environment-related technologies:

The information applied in the examination was for the most part acquired from the innovation advancement dataset of the OECD Environment Database and World Bank database. The OECD Environment Directorate, in collaboration with the Directorate for Science, Technology and Innovation, has created patent-based advancement markers that are reasonable for following improvements in condition related advances. The markers permit the appraisal of nations and firms inventive execution and the plan of governments ecological and advancement arrangements. The markers displayed allude to creations filed (barring utility models, insignificant licenses, and so forth.) in at least one purview (family size 1 or more prominent) or in at least two locales (family size 2 or more noteworthy). A patent family is defined as the arrangement of every patent application ensuring the equivalent 'need' information source and system. The patent measurements displayed are built utilizing information removed from the Worldwide Patent Statistical Database (PATSTAT) of the European Patent Office (EPO) utilizing calculations created by the OECD. The applicable patent archives are identified utilizing look systems for condition related innovations (Table 1), which were grown specifically for this reason. The quest systems take into account the identification of advances important to natural administration, water-related adjustment, and environmental change relief.

The size of a global patent family (counting the first 'need' filing and its counterparts saved at other patent offices) is seen as related with the estimation of the development: family size "1 and more noteworthy" (i.e., every single patent need) yields figures dependent on all profit capable information around the world, including some low-esteem innovations; family size "2 and greater" ( $F \geq 2$ ) 'guaranteed' needs) checks just the higher-esteem creations that have looked for patent insurance in any event two purviews, and so forth.

In this investigation, the licenses allude to excellent licenses ( $F \geq 2$ ) without extraordinary clarification. Also, three pointers are examined in the paper: a marker of innovation improvement (a proportion of creative action) for condition related advances; a pointer of universal joint effort in innovation advancement (a measure about co-development); and a marker of innovation dissemination (a proportion of market insurance). These pointers give a scope of apparatuses to evaluating inventive execution in nation and approach thinks about.

### 3. Method:

For by and large natural related advances, utilize near techniques to contemplate the improvements of the previous 10 years. What's more, for the improvement of innovations, four pointers are utilized to speak to advancement of condition related advances: level all things considered, level of creations around the world, relative preferred position and developments per capita.

### 4. Data Analysis:

The earth related advances can be isolated into three classes: natural administration, water-related adjustment innovations, and environmental change moderation advances (Table 1). Ecological administration can be subdivided into five classifications (Fig. 3), and air contamination reduction and water contamination decrease have the biggest number of licenses, and the development rate is likewise the most self-evident. Water-related adjustment advances are subdivided into two kinds (Fig. 4) among them; request side advances (water preservation) are far more noteworthy in amount and development than supply-side advances (water accessibility). The classification of cli-mate change moderation licenses is the biggest and most complex class, which can be subdivided into six classes (Fig. 5). The quantity of licenses identified with vitality age, transmission or dispersion has reliably positioned first, and its development has eased back subsequent to arriving at its top in 2012. The quantity of licenses away, sequestration or transfer of GHG is the most reduced of the six classifications, and its advancement has been entirely steady.

1 Emissions decrease from stationary sources ( SOx, NOx, PM emanations from ignition plants); 2 Emissions reduction from portable sources ( NOx, CO, HC, PM outflows from engine vehicles);3 Not somewhere else classified; 4 Water and wastewater treatment; 5 Fertilizers from wastewater; 6 Oil spill cleanup; 7 Solid waste assortment; 8 Material recuperation, reusing and reuse; 9 Fertilizers from squander; 10 Incineration and vitality recuperation; 11 Waste administration Not somewhere else classified; 12 Soil remediation13 Environmental observing.

In natural administration, the innovation of air contamination reduction (1. Outflows decrease from stationary sources, 2. Discharges decrease from versatile sources, and 3. Not classified somewhere else) and water and wastewater treatment in water contamination reduction are the biggest and quickest developing patent regions (Fig. 6. Numbers at the abscissa compare to the sequential number in Table 1). Among the water-related adjustment innovations, the quantity of advancements, for example, indoor water preservation and water system water protection is the quickest developing (Fig. 7).

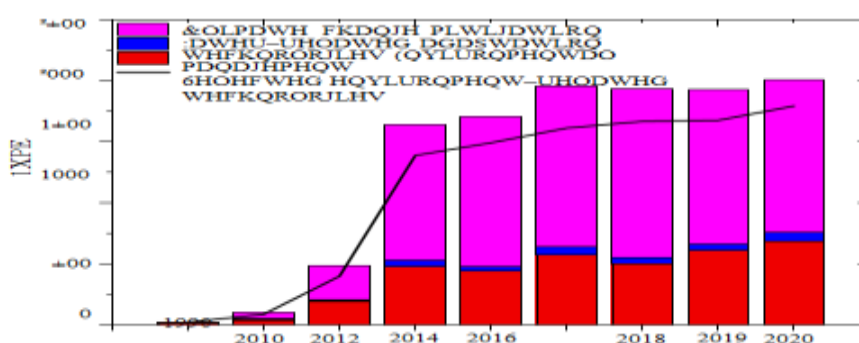


Fig1.Environmental related technologies of Afghanistan in 2010-2020 f<2

### Afghanistan's fastest growing green technologies in 2015–2020

As far as regions, the quickest developing advances in Afghanistan during 2015–2020 are water and wastewater treatment, sun oriented photovoltaic (PV) vitality, lighting, end-client side, upgrades identified with mass or fine synthetic substances or pharmaceuticals, empowering advances with a potential commitment to GHG emanations alleviation, discharges decrease from stationary sources, and wind vitality.

### International collaboration

The quantity of co-developments in condition related advancements is communicated as a level of all residential co-innovations (in all advances). The checks incorporate all important co-developments (with patent family size = 1). As of late, Afghanistan's ecological related licenses in co-activity with nations around the globe show a descending pattern. The primary helpful nations are the United States, South Korea, Germany, the United Kingdom, France, and Canada. Overall shows a relentless pattern step by step. As indicated by the area, dissemination of the earth the board is the biggest in 2016–2020.

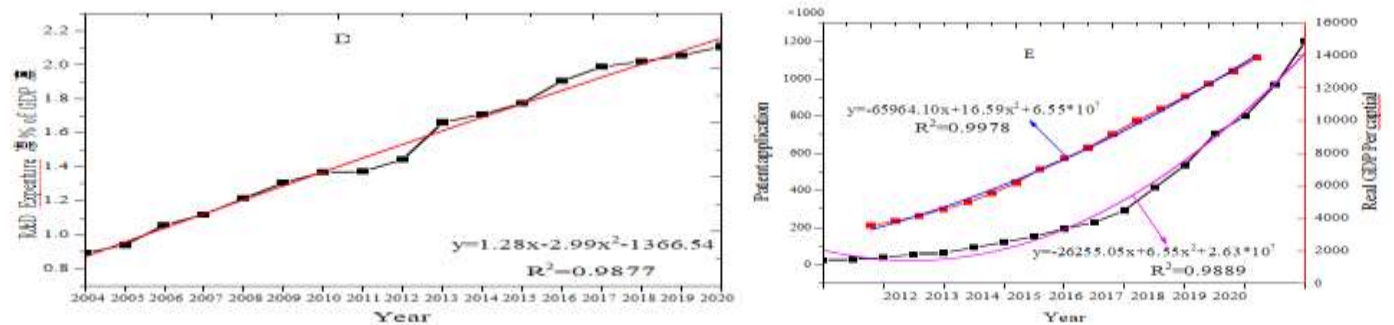
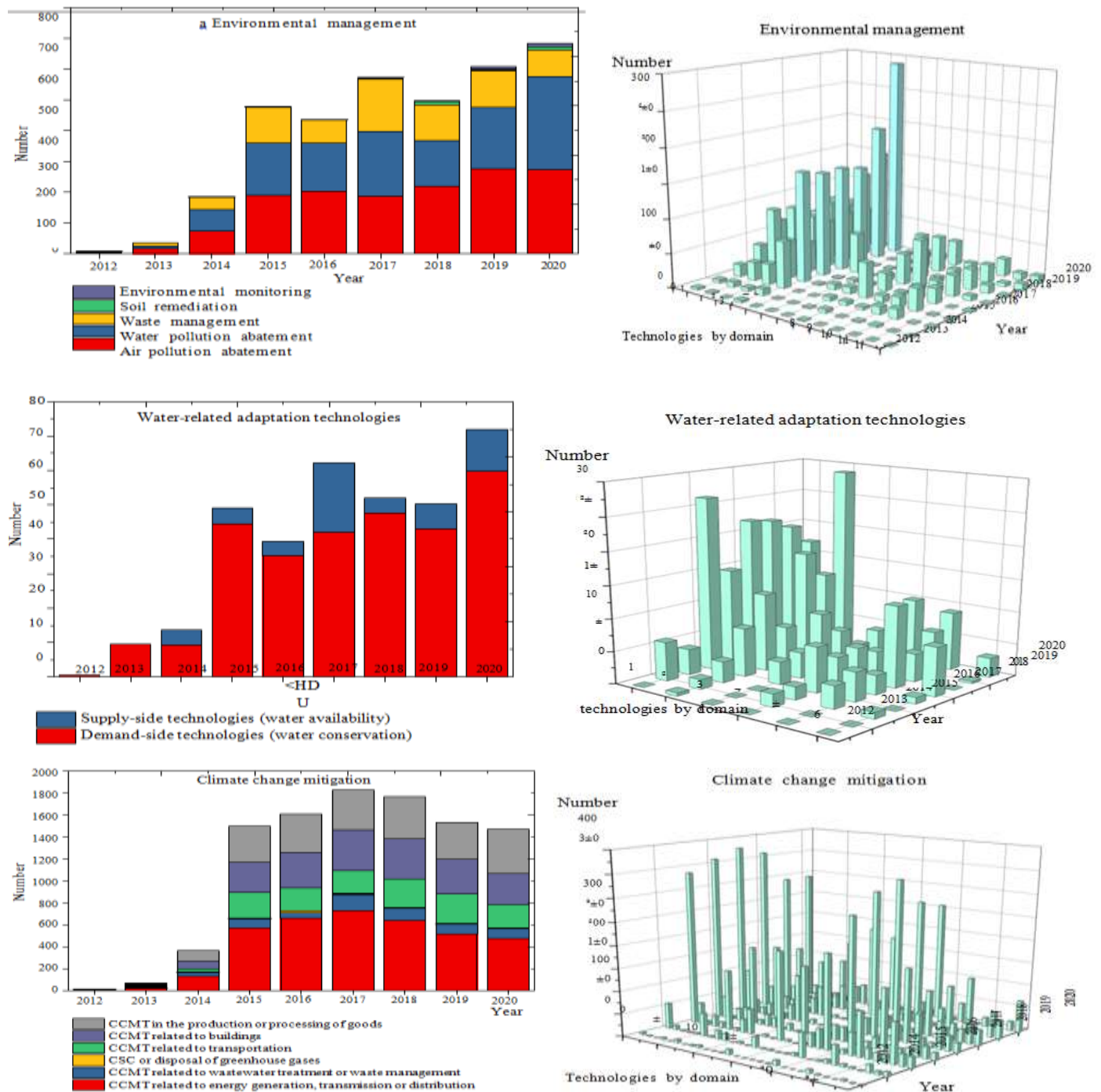


Fig. 2. R&D Expenditure (a), Patent application and real GDP per capital (b) of Afghanistan in 2004–2020.



The world, comparing the development of green innovation licenses among Afghanistan and OECD, BRICS (Brazil, Russia, India, China, and South Africa),



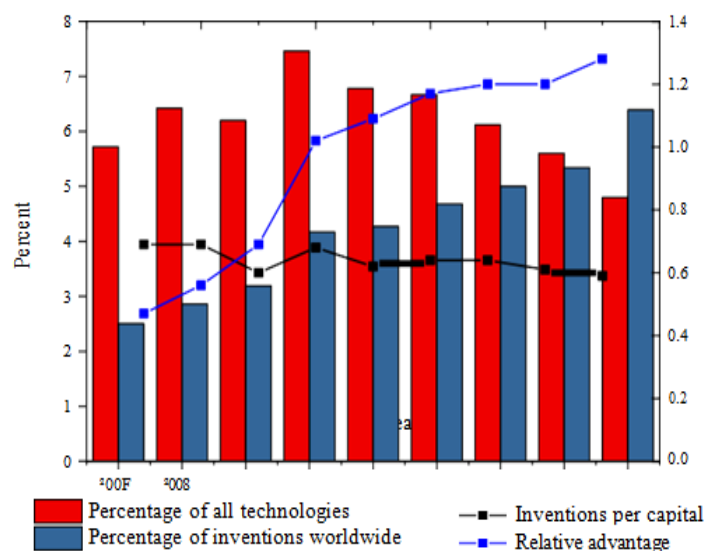


Fig. 3. Development of environment-related technologies of Afghanistan in 2012–2020 ( $F \geq 2$ ).

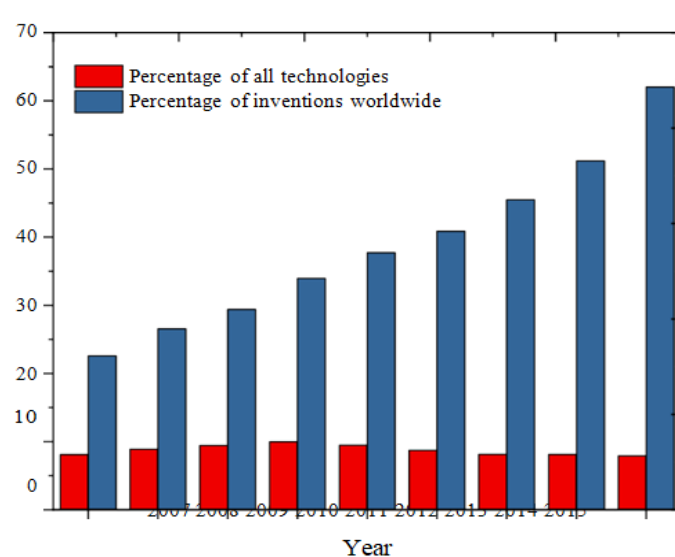


Fig. 4. Diffusion of environment-related technologies ( $F \geq 2$ ).

### *Afghanistan's environmental innovation policy has promoted the innovation and development of environmental related technologies*

Patent information present various points of interest contrasted with other elective proportions of advancement, remarkably, as opposed to information on R&D uses that lone measure the information or information on exchange commod-ities that don't really exemplify any imaginative advances, patent information measure the moderate yields of the innovative procedure. From the investigation of pointers, for example, generally speaking natural related advancements, improvement and relative favorable circumstances of condition related advances, and the development of the world's major mechanical development nations, it very well may be seen that the development exercises of Afghanistan and the earth are demonstrating a developing pattern, and Afghanistan's development rate is among the most noteworthy on the planet.

Afghanistan's National Climate Change Program (Government of Afghanistan 2014) set one of its destinations as "controlling fare of vitality concentrated, contamination escalated and asset serious items to define an import and fare structure positive to the advancement of a cleaner and ideal vitality blend." In an ensuing approach paper plotting the means taken to actualize the program, the administration (Government of Afghanistan 2015) depicted its endeavors as "constraining the unnecessarily fast development of high vitality escalated and emanation concentrated ventures... ."The administration is attempting to limit the fare of high vitality concentrated, contamination escalated, and asset concentrated items. Set with regards to an expansive program of approaches to address environmental change, this exertion was unequivocally planned for rebuilding the national economy by disheartening contaminating firms and divisions. The usage of these arrangements has without a doubt given an extraordinary driving force to the imaginative improvement of condition related advancements.

### *Afghanistan's green development needs further improvement*

As Afghanistan's economy shifts from a rapid development stage to a great improvement stage, the errand of advancing green advancement is progressively significant and dire. Lately, through difficult work, Afghanistan's green advancement has gained significant ground. During the time of 2014–2020, development was made inside the advancement of condition related innovations and related markers, for example, vitality power and non-vitality material profitability. However, as far as green advancement, it very well may be seen from the Environmentally Adjusted Multifactor Productivity (EAMFP) (Rodríguez et al., 2016) pointer that Afghanistan's improvement depends more on work, creation capital, and common capital, yet not to advance development through efficiency improvement. This finding shows that, despite the fact that Afghanistan's natural advancement has gained extraordinary ground, the degree of green advancement still should be improved, particularly in earth balanced multifaceted efficiency, which displays a huge hole.

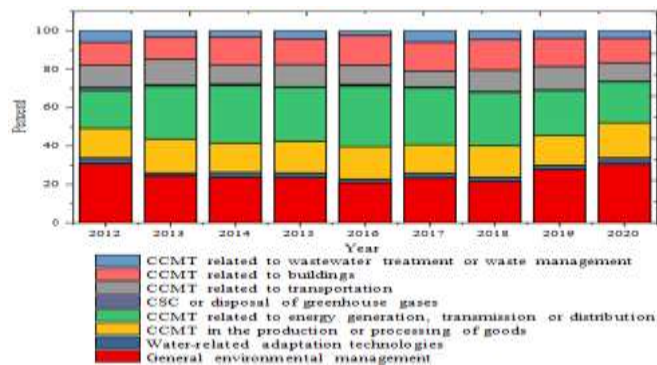


Fig. 5. Percentage of environment-related technologies by domain ( $F \geq 2$ ).

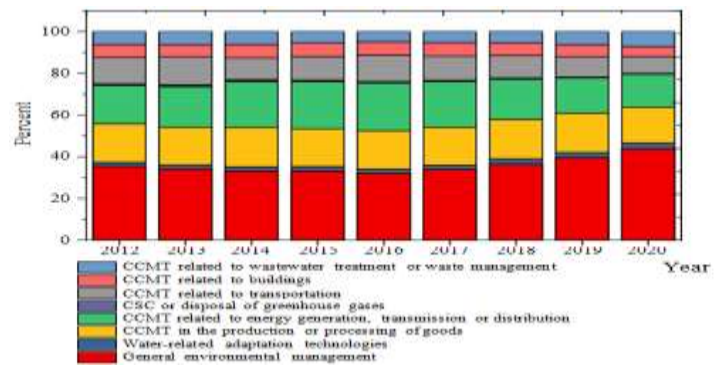


Fig. 6. Percentage of environment-related technologies diffusion by domain.

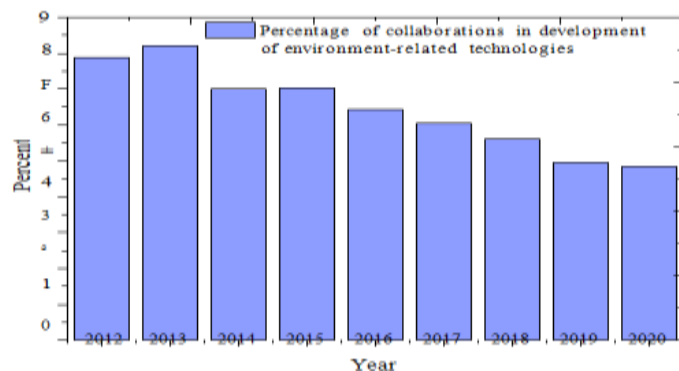


Fig. 7. International collaboration in development of environment-related technologies

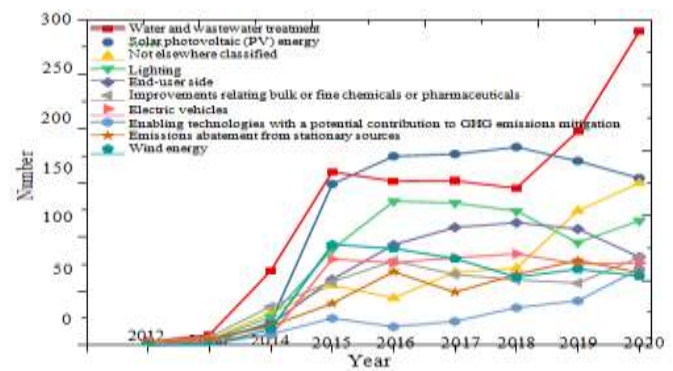


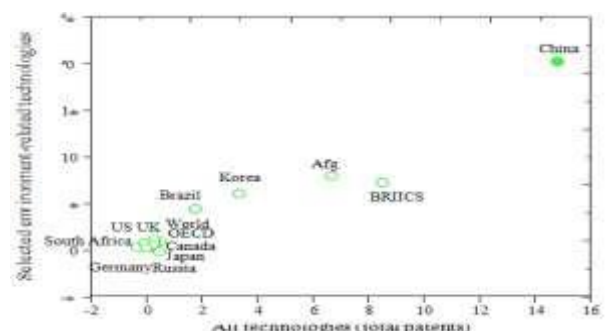
Fig. 8. Fastest growing green technologies of Afghanistan in 2015–2020.

## 6. Conclusions and perspectives:

Afghanistan's general natural related innovations developed during the time of 2010–2020, and this development pattern was predictable with the development pattern of R&D uses (% of GDP) and GDP per top ital. The examination additionally shows that after the financial advancement arrives at a specific stage, more consideration is paid to the advancement and improvement of green, natural assurance, and vitality sparing. This move is likewise identified with the green improvement, development, and other ecological approaches for which the Afghanistan government has been pushing as of late. In the three significant territories of ecological administration, water-related adjustment advancements, and environmental change alleviation, development in the field of environmental change is more dynamic than the previous two; And in the field of environmental change, the most dynamic is CCMT identified with vitality age, trans-strategic dispersion. The enthusiasm of approach producers in the advancement and wide dispersion of condition related advances is inspired by their capability to render natural strategies increasingly successful and more expense efficient. A few governments are likewise inspired by the objective of making new business openings and markets, and in this manner quickening the change to green development. At present, Afghanistan is in the phase of changing its advancement mode, improving its monetary structure and changing its development force. To accomplish excellent advancement, Afghanistan must join incredible significance to giving close consideration to EAMFP, which will make a progressively exact appraisal of the green improvement possibilities, in this manner advancing great monetary advancement.

Table of international collaboration in technology development (bilateral).

Partner	Canada	France	Germany	Japan	Korea	UK	US	Afg
Canada	0	6	9	1	10	6	92	7
France	6	0	49	3	2	14	48	8
Germany	9	49	0	16	12	40	134	28
Japan	1	3	16	0	23	12	31	14
Korea	10	2	12	23	0	1	61	30
UK	6	14	40	12	1	0	83	12
US	92	48	134	31	61	83	0	120
China	7	8	28	14	30	12	120	0



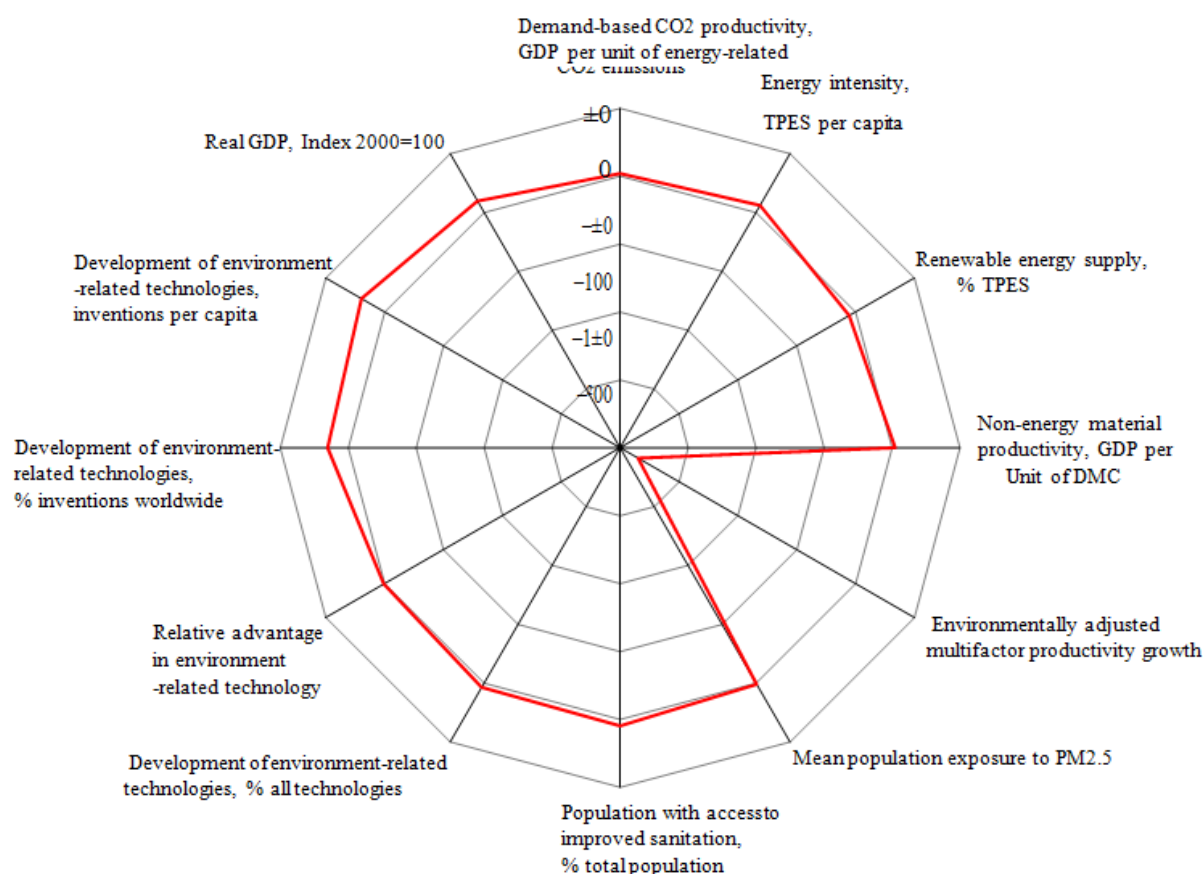


Fig.9. Afghanistan's environment-related technologies indicators and green development indicators growth in 2010—2020.

## REFERENCES:

1. Bueno, P.C.; Vassallo, J.M.; Cheung, K. Sustainability assessment of transport infrastructure projects: A review of existing tools and methods. *Transp. Rev.* 2015, 35, 1–28.
2. Badu, E.; Owusu-Manu, D.G.; Edwards, D.J.; Holt, G.D. Analysis of Policy Issues Underpinning the Innovation Financing of Infrastructure with Developing Countries. *J. Constr. Eng. Manag.* 2013, 139, 726–737.
3. Faturechi, R.; Miller-Hooks, E. A Mathematical Framework for Quantifying and Optimizing Protective Actions for Civil Infrastructure Systems. *Compute. Aided Civ. Infrastructure. Eng.* 2014, 29, 574–589.
4. Awakul Prapatpaow and Ogunlana, S.O. (2002). The effect of attitudinal differences on interface conflict on large projects: The case of the Pak Mun Dam project. *Environmental Impact Assessment and Review*, Vol 22, No. 4, August, 307-329.
5. Melo, P.C.; Graham, D.J.; Brage-Ardao, R. The Productivity of Transport Structure Investment: A Meta-Analysis of Empirical Evidence. *Reg. Sci. Urban Econ.* 2013, 43, 695–706.
6. Bunz, Kimberly.R., Henze, Gregor.P., P.E., Tiller, Dale.K. (2006). Investigating of Sustainable infrastructures planning Practices in East America, Europe, also Asia. *Journal of Architectural Engineering*. ASCE, 12, 33-62.
7. Murgan, M.A., ransom, M.R. (2005). Endurable Steel formation. *Journal of formational Steel investigation*, Vol. 62, 1178–1183. Cited in Ndungu, P. (2008). Endurable formation: Comparison of the ecological results Due to Off-Site vs. On-Site –formation. MSc- Thesis. Civil & ecological Engineering, University of Oxford.
8. Carl, J. Circo. (2008) Utilizing Mandates & Incentives to develop Sustainable Construction and Green infrastructure Projects in the Private Sector: A Call for More State Land Utilize Policy beginning. *Penn State Law Review*, Vol. 112.
9. Cooper, Donald R., Boris Blumberg, and Pamela S. Schindler. (2005). *Entrepreneur research methods*. European ed. HD 30.4 , 2005
10. Ding, G.K.C. (2007), “Sustainable construction, Theory of environmental tools”, *Journal of Environmental assessment Management*, Vol. 85 No. 7, pp. 450-66.
11. Dixon, T., Colantonio, A., Shiers, D., Reed, R., Wilkinson, S. and Gallimore, P. (2008) A green professional? An international survey of RICS members and their engagement with sustainability issues. *Journal of Property Investment and Finance* 26: 460–481.

12. Fuggle, R.F., Rabie, M.A. (eds) (1992). Environmental construction Management in South Africa. Juta & Co. Ltd., Cape Town. South Africa. Cited in Hill, R.C. Bowen, P.A. (1997). *Construction Management and Economics*, 15(3), 223–39.
13. Hengrasmee, S. (2007). A Study of Sustainable Architectural planning in Thailand. *Journal of Architectural/Policy and Research Studies* Vol, 9, Issue 1. Faculty of Architecture and Planning, Thammasat University.
14. Hill, D. (1998). Sustainable Development – Tools and Techniques for Action. Proceeding of the Institute of Civil Engineers Municipal Engineers, 172, 168-169.
15. Finch, H. Investigation of operating the Varimax, Promax Rotations: the causes infrastructure the Reuse for Homogeneous Items. J. Educ. Meas. 2006, 43, 39–52.
16. Dang, T.H.G.; Pheng, L.S. Regulations of Construction in Economic Development: Review of main Concepts in the past 40 Years. Habitat Int. 2011, 35, 118–125.
17. [17]: Pant R.; Hall, J.W.; Blainey, S.P. a "a logical appraisal system for autonomous basic foundations: Case-study for the Great Britain's rail organize."Eur. J. Transp. Infrastruct. Res. 2016, 16, 174–194.
18. Shen, L.; Jiang, S.; Yuan, H. Critical Examiners for assessing the collaboration of infrastructure projects to cooperate urban-rural sponsor in china. Habitat Int. 2012, 36, 237–246.
19. Khasnabis, S.; Dhingra, S.L.; Mishra, S.; Safi, C. a methodology for Transportation Infrastructure Investment in Redeveloping Countries. J. Urban Plan D 2010, 136, 94–103.
20. Matar, Mohamed M., Georgy, Maged E. and Ibrahim, Moheeb Elsaid. (2008). 'Sustainable construction management: introduction of the operational context (OCS)'. *Construction Management and Economics*, 26: 3, 261— 275.
21. McGranahan, G., Satterthwaite, D. (2000). Environmental assessment, ecological sustainability: the Brown and Green agendas in urban and rural construction. In C. Pugh (ed.) *Sustainable Cities in Developing Countries*. London: Earthscan. Cited in Du Plessis, C., et al. (2002). *Agenda 21 for Sustainable Construction management in Developing Countries.CSIR Report*