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Indicative Review Through Biodiversity Concept in Construction of Composite Appraising Supportive Progress (CASP) of Armenia

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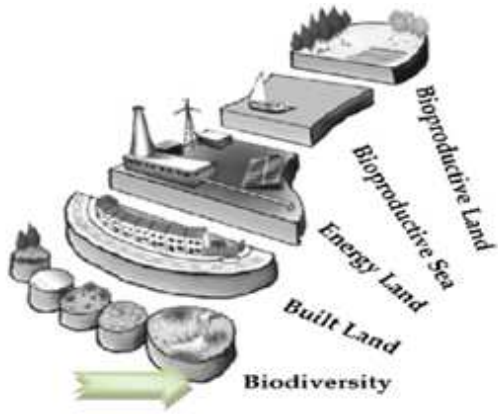
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Abstract

Economic Sustainability indices has an ability to sustain development towards progressive economy. Composite Appraising Supportive Progress (CASP) is a new index which is derived from Combined Sustainable Development Index (CSDI). Biodiversity economics coincide with the concept of sustainable development (SD) in the course of educational and industrial perspectives with use of Geographic Information Systems (GIS) or Remote Sensing (RS) in terms of CASP, while having the next presentations: 1. Genes - Society (S) - Students - Studying - Space Science; 2. Species - Economy (E) - Professors - Teaching - Production and Consumption; 3. Ecosystems - Nature (N) - Scientists - Creating - GIS & RS; 4. Functions - SD as CASP - Research - Performing - Computer Appraisals. The current paper is dedicated to construct CASP for Armenia. The new construction of CASP is performed by using Armenian existed statistical data and representing an innovative CASP model for Armenia with newly defined categories in 3D magnitudes. Spontaneous estimations of biodiversity concept in Armenian CASP will allow to finalize the view of current sustainable development with an approximate level of progressive economy in Armenia with the application of Composite Progressive Indicators (CPI) procedures as: α . Design Process, i.e. Constructions: 1. CASP Indicators as per preferred Category within apt Magnitude; 2. ARMSTAT and NKRSTAT Indicators as per preferred Category within apt Magnitude; 3. Number of authors as per chosen Category within apposite Magnitude; β . Framework Model, i.e. Computations 4. AMCP=Approximate Main Coordinate Proportion; 5. ANCP=Approximate iNdicative Coordinate Proportion; γ . Approaches, i.e. Selections: 6. Apt Categories within each defined magnitude. As the result, the sequence is categorized form the environmental footprint (EF) into two (2) categories, namely, vegetation and other types. Air (N3) from other type is the dominant category required for all categories for Environment (N) magnitude with the use of Geographic Information Systems (GIS) or Remote Sensing (RS) and, particularly, the estimation of categories within vegetation type. An attractive approach is given as recommendation to combine science with results, to flourish novelty of biodiversity (BD) concept in Sustainable Development (SD) with species hierarchical intervention through professions and to proceed Armenian CASP.

1. Introduction

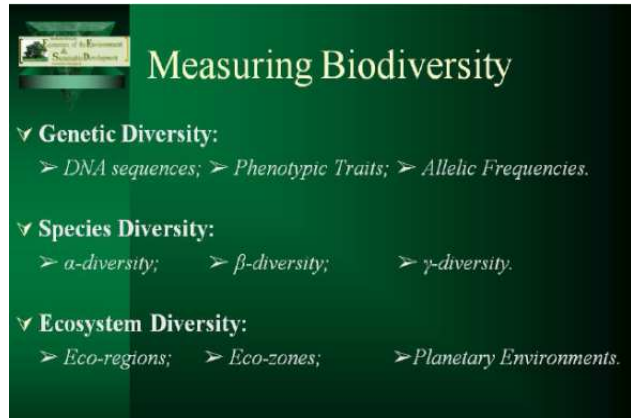
The approach of Ecological or Environmental Footprint (EF) recognizes the stands on humanity in front of tricky challenges, composes encouraging perceptions and expresses accomplishments toward sustainable existence. Wackernagel and Rees (1996) transmits EF concept as the recognition of



Source: Eaton et al. (2007); Hammond (2006)

Picture 1. Environmental Footprint (EF).

eco-systems within boundaries supplying efficiency mandatory to support human society. Costanza (2000) proposes an easy metric of the Ecological Footprint which views human impacts on the world in many places. Eaton et al. (2007); Hammond (2006) correlate Environmental Footprint in *Picture 1*.



Source: Petrosyan (2005); Nunes et al. (2001); OECD (2001)

Picture 2. Biodiversity stages.

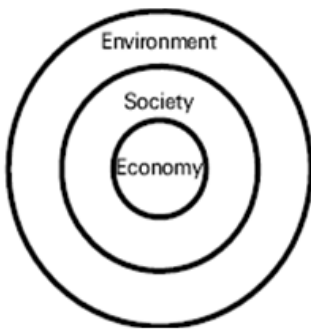
Petrosyan (2005); Nunes et al. (2001); OECD (2001) further deepens the retrieved biodiversity category from Eco-Footprint approach of Eaton et al. (2007); Hammond (2006); and represents as per stages in *Picture 2*.

(Wackernagel and Rees, 1996). Lyytimaki and Rosenstrom (2008) demonstrates Holistic illustration of SD framework in *Picture 3*. Levett (1998) presents SD proposed by Russian dolls model in *Picture 4*. Walton et al. (2005) reveals the key concept of sustainable development in approach with 3 magnitudes in *Picture 5*.



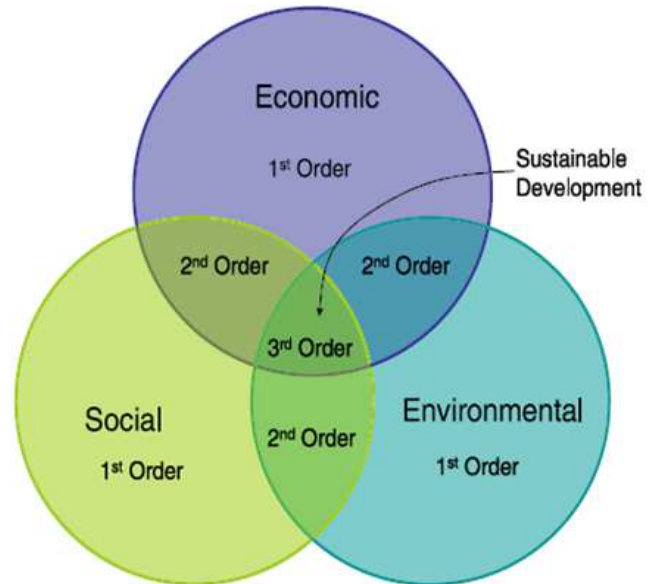
Source: Lyytimaki and Rosenstrom (2008)

Picture 3. Holistic Illustration of SD Framework.



Source: Levett (1998)

Picture 4. SD Proposed by Russian Dolls Model.



Source: Walton et al. (2005)

Picture 5. Key Concept of Sustainable Development.

Eco-Footprint is connected to sustainable development (SD)

2. Literature Review

The book of Petrosyan (2014) corresponds with the paper of

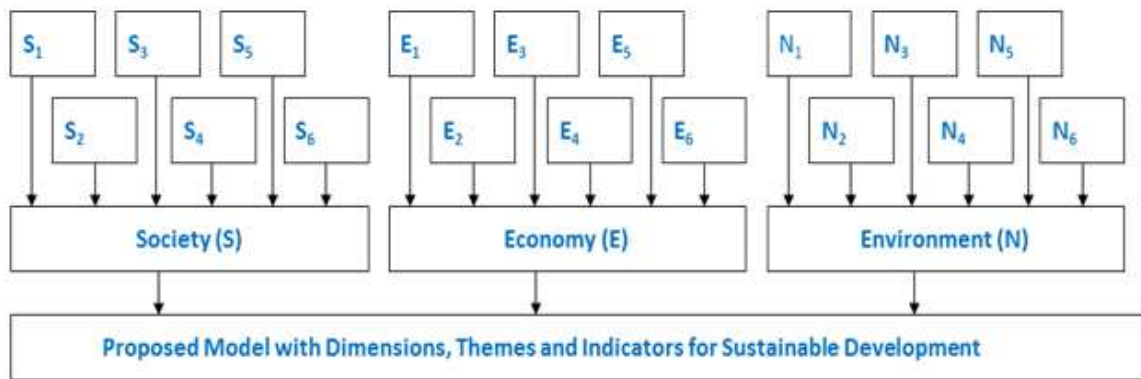
Petrosyan (2010) in *Table 1* and *Picture 6* which is postured to integrate three (3) magnitudes of SD as per authors of Lyttimaki and Rosenstrom (2008); Walton et al. (2005);

Levett (1998) respectively in *Pictures 3, 5, 4*; such as society, economy and nature, with group of six (6) categories per each magnitude.

Table 1. Eighteen (18) Categories of CASP.

S	Society	E	Economy	N	Nature
S ₁	Humans	E ₁	Investment	N ₁	Land
S ₂	Society Concerns	E ₂	Human Standards	N ₂	Water
S ₃	Knowledge in Practice	E ₃	Production & Consumption	N ₃	Air
S ₄	Space Science	E ₄	Agriculture	N ₄	Biodiversity
S ₅	Political Performance	E ₅	Industry	N ₅	Energy
S ₆	Transport	E ₆	Tourism	N ₆	Landscape

Sources: Petrosyan (2014)



Sources: Petrosyan (2014)

Picture 6. Proposed Terms of CASP through Magnitudes, Categories & Indicators.

Petrosyan (2014) further clarifies the Environmental Footprint concept of Eaton et al. (2007); Hammond (2006) in the following sequence:

- α. Biodiversity (N₄);β. Construction suitable with nature

(N₆);

- γ. Energy (N₅);δ. Sea (N₂);ε. Land (N₁).

Petrosyan (2014) proposes the interpretation of magnitudes of CASP as per biodiversity concept in *Table 2*.

Table 2. Portrayal of Nature (N) Magnitude as per Biodiversity concept.

Stages	Class			Landscape
Vegetations	Sparse	Medium	Dense	Eco-zones
Categories	Genes	Species	Ecosystems	Functions
Diversities	α	β	γ	Planetary
Fragstat Numeration	C ₁	C ₂	C ₃	L ₄
Apt Numeration	N ₁	N ₂	N ₃	N ₄

Sources: Petrosyan (2014)

Petrosyan (2015a) paper amplifies the importance of Composite Progressive Indicators (CPI) shepherding indicators and appraising compassionate SD towards progress (Petrosyan, 2010). CPI evolution requires nine (9) consequent steps:

- α. Preparation of features:
 1. Aspects;
 2. Goals;
 3. Criteria;
 4. Categories;

- 5. Principles;
- 6. PSR;
- β. Identification of ways:
 7. Design Process;
 8. Framework Model;
 9. Top-Down and Bottom Up Approaches.

3. Materials and Methods

3.1. Study Area



Picture 7. Map of 18 areas of Armenia and Nagorno-Karabakh Republic.

Armenia (Picture 7) is located in the southern Caucasus and covers almost 10% of the Armenian upland (29,800 km²). Mainly, the military phase complies with theoretical and logic asymmetric conflicts during 1992-1994 over Nagorno-Karabakh with specific factors led to victory (Deriglazova and Minasyan, 2011). Nowadays, Nagorno-Karabakh Republic, i.e. Artsakh, (Picture 7) is a smaller (4400 km²) autonomous area between Armenia and Azerbaijan. Armenia and Nagorno-Karabakh support diversity of landscapes with a range of species, due to their geographic position (Arakelyan and Parham, 2008). ARMSTAT (2015) specifies eleven (11) Armenian areas & NKRSTAT (2015) presents seven (7) areas of Artsakh in Picture 7.

3.2. Data Sets

Two (2) types of datasets are used to group eighteen (18) categories of existing indicators within the current paper as:

1. ARMSTAT (2015) and NKRSTAT (2015) statistic data;
2. Petrosyan (2014) prescribed indicators appearances.

First type of datasets are chosen from ARMSTAT (2015) and NKRSTAT (2015) statistic data as per following steps:

α. Armenian and Nagorno-Karabakh, i.e. Artsakh statistic categories existence:

- 21 ARMSTAT (2015) categories;
- 23 NKRSTAT (2015) categories.

β. Coincide ARMSTAT (2015) with NKRSTAT (2015) data

γ. Choice of 6 Society categories

δ. Choice of 6 Economy categories

ε. Choice of Nature Category

Second type of datasets are chosen from indicators prescription of Petrosyan (2014) book to correspond as per first defined ARMSTAT (2015) with NKRSTAT (2015) statistic data with emphasis of on the best fit of indicative approach to CASP.

Two (2) aforementioned data sets are retrieved from ARMSTAT (2015) and NKRSTAT (2015) in co-ordinance with 18 categories of Table 1 as per eleven (11) Armenian and seven (7) Nagorno-Karabakh areas further addressed in Table 3.

Table 3. Armenian categories representation as per ministries and areas of Armenia and Nagorno Karabakh Republics.

Num / Picture	Armenian Categories	CASP Categories	Ministries	Areas / Statistics
Society				
S ₁ / Pic. 8	Demography (Population)	Humans	Ministry of Territorial Administration and Emergency Situations http://www.mta.gov.am	Askeran Marz / NKRSTAT (2015)
S ₂ / Pic. 9	Employment	Society Concerns	Ministry of Labor and Social Affairs http://www.mlsa.am	Syunik Marz / ARMSTAT (2015)
S ₃ / Pic. 10	Education	Knowledge in Practice	Ministry of Education and Science http://www.edu.am	Shirak Marz / ARMSTAT (2015)
S ₄ / Pic. 11	Science	Space Science	Ministry of Defense http://www.mil.am/	Lori Marz / ARMSTAT (2015)
S ₅ / Pic. 12	Economic Activities	Political Performance	National Assembly of the Republic of Armenia http://parliament.am/	Yerevan Marz / ARMSTAT (2015)
S ₆ / Pic. 13	Transport & Communication	Transport	Ministry of Transport and Communication http://www.mtc.am	Vayots Dzor Marz / ARMSTAT (2015)
Economy				
E ₁ / Pic. 14	Finances	Investment	Ministry of Finance http://www.minfin.am/	Qashatagh Marz / NKRSTAT (2015)
E ₂ / Pic. 15	Living Conditions	Human Standards	Ministry of Culture http://www.mincult.am	Armavir Marz / ARMSTAT (2015)
E ₃ / Pic. 16	Prices and Tariffs	Production & Consumption	Ministry of Urban Development http://www.mud.am/	Shushi Marz / NKRSTAT (2015)
E ₄ / Pic. 17	Agriculture	Agriculture	Ministry of Agriculture www.minagro.am/	Ararat Marz / ARMSTAT (2015)
E ₅ / Pic. 18	Industry	Industry	Ministry of Economy www.mineconomy.am	Aragatsotn Marz / ARMSTAT (2015)
E ₆ / Pic. 19	Trade and Services	Tourism	Ministry of Diaspora www.mindiaspora.am/ Ministry of Foreign Affairs http://www.mfa.am	Martuni Marz / NKRSTAT (2015)
Nature				
N ₁ / Pic. 20	Land	Land		Hadrut Marz / NKRTAT (2015)
N ₂ / Pic. 21	Water	Water		Gegharkuniq Marz ARMSTAT (2015)
N ₃ / Pic. 22	Air	Air	Ministry of Nature Protection http://www.mnp.am	Martakert Marz / NKRTAT (2015)
N ₄ / Pic. 23	Biodiversity	Biodiversity		Tavush Marz / ARMSTAT (2015)
N ₅ / Pic. 24	Energy	Energy	Ministry of Energy and Natural Resources www.minenergy.am/en	Kotayk Marz / ARMSTAT (2015)
N ₆ / Pic. 25	Eco Resources	Eco Resources	Ministry of Nature Protection	Shahumyan Marz / ARMSTAT (2015)



Picture 8. S₁ Askeran Marz.



Picture 9. S₂ Syunik Marz.



Picture 10. S₃ Shirak Marz.



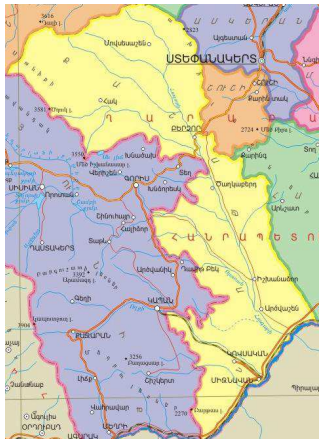
Picture 11. S₄ Lori Marz.



Picture 12. S₅ Yerevan Marz.



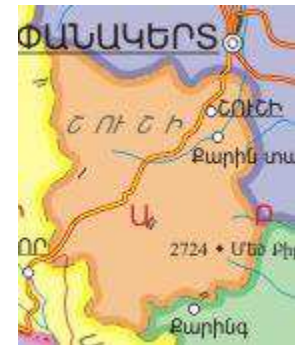
Picture 13. S₆ Vayots Dzor Marz.



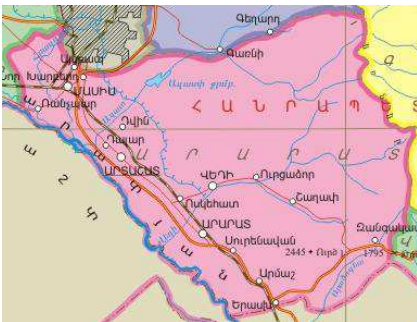
Picture 14. E₁ Qashatagh Marz.



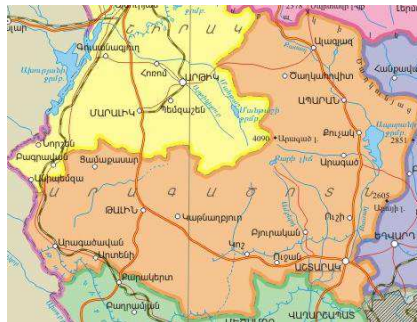
Picture 15. E₂ Armavir Marz.



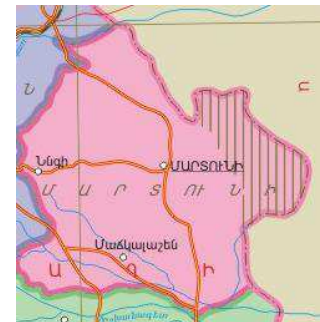
Picture 16. E₃ Shushi Marz.



Picture 17. E₄ Ararat Marz.



Picture 18. E₅ Aragatsotn Marz.



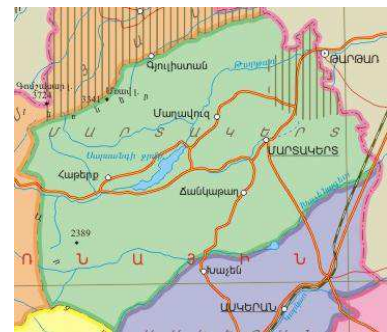
Picture 19. E₆ Martuni Marz.



Picture 20. N₁ Hadrut Marz.



Picture 21. N₂ Gegharkunik Marz.



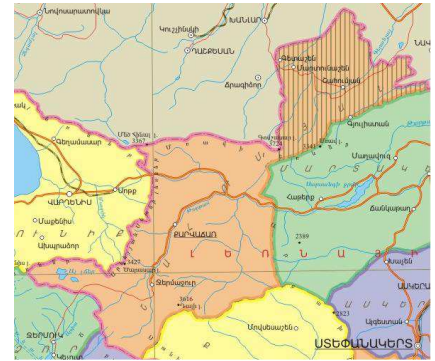
Picture 22. N₃ Martakert Marz.



Picture 23. N₄ Tavush Marz.



Picture 24. N₅ Kotayk Marz.



Picture 25. N₆ Shahumyan Marz.

3.3. Methodology

CPI has an important role in sustainable development to proceed approximation of CASP. Petrosyan (2015a) has mentioned nine (9) steps of CPI to collect indicators into CASP indicators with further CASP computation as per book of Petrosyan (2014). The current paper refers to the second part of Petrosyan (2015a) paper with identified ways to construct methodologies following the next structures:

- a. Design Process, i.e. Calculations:
 1. CASP Indicators as per preferred Category within apt Magnitude;
 2. ARMSTAT (2015) and NKRSTAT (2015) Indicators as per favored Category within appropriate Magnitude
 3. Number of authors as per chosen Category within apposite Magnitude
- b. Framework Model, i.e. Computations
 4. AMCP=Approximate Main Coordinate Proportion;
 5. ANCP=Approximate iNDicative Coordinate Proportion;
- c. Approaches, i.e. Selections:
 6. Apt Categories within each defined magnitude.

4. Results

Results of the Design Processes, i.e. Calculations are represented in *Tables 4, 5, 6* as per the following points:

1. CASP Indicators as per preferred Category within apt Magnitude;
2. ARMSTAT (2015) and NKRSTAT (2015) Indicators as per favored Category within appropriate Magnitude
3. Number of authors as per chosen Category within apposite Magnitude

Table 4. Indicators representation per authors for Society (S) Magnitude.

Num	Indicators			# of Authors
	CASP	ARM	Ministry	
S ₁	13	20	mta.gov.am	30
S ₂	45	35	mlsa.am	35
S ₃	20	23	edu.am	24
S ₄	32	7	mil.am	16
S ₅	16	12	parliament.am	27
S ₆	13	23	mtc.am	25

Table 5. Indicators representation per authors for Economy (E) Magnitude.

Num	Indicators			# of Authors
	CASP	ARM	Ministry	
E ₁	15	29	minfin.am	26
E ₂	13	25	mincult.am	26
E ₃	21	9	mud.am	25
E ₄	22	18	minagro.am	31
E ₅	16	20	mineconomy.am	21
E ₆	10	10	mindiaspora.am; mfa.am	12

Table 6. Indicators representation per authors for Environment (N) Magnitude.

Num	Indicators			# of Authors
	CASP	ARM	Ministry	
N ₁	33	14	mnp.am	50
N ₂	19	9	mnp.am	32
N ₃	13	4	mnp.am	20
N ₄	22	16	mnp.am	48
N ₅	5	-	minenergy.am	19
N ₆	25	9	mnp.am	47

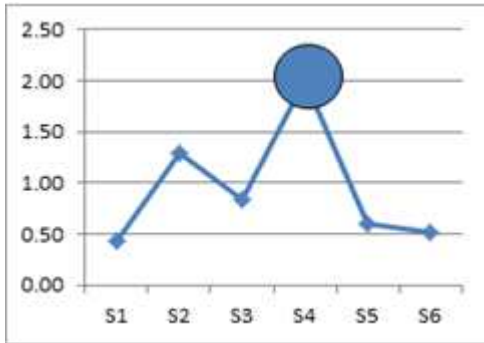
5. Discussions

Computational Framework Model is shown in *Table 7* with respective graph representations on *Pictures 26-31*:

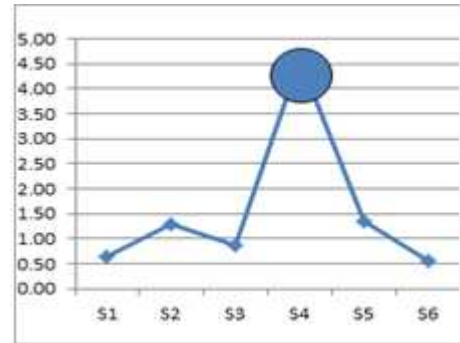
Table 7. Computational Framework Model.

Num	Name	Formula	Magn	Picture
AMCP	Approximate Main Coordinate Proportion	$AMCP = \frac{Num \text{ CASP Indicators}}{Num \text{ Authors}}$	S	26
			E	28
			N	30
ANCP	Approximate iNDicative Coordinate Proportion	$ANCP = \frac{Num \text{ CASP Indicators}}$	S	27

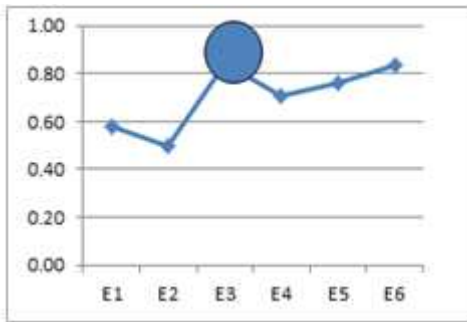
Num	Name	Formula	Magn	Picture
			E	29
			N	31



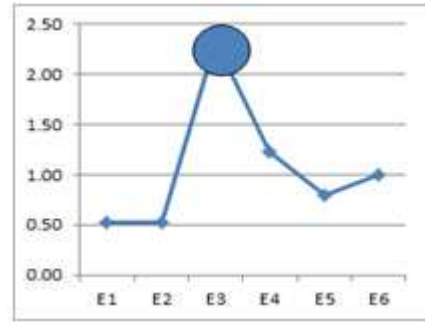
Picture 26. S – AMCP.



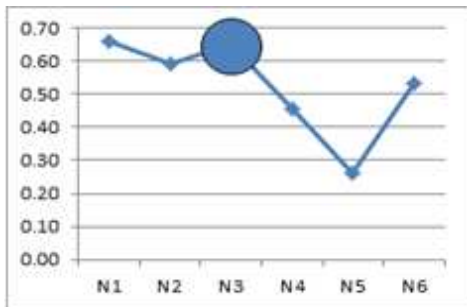
Picture 27. S – ANCP.



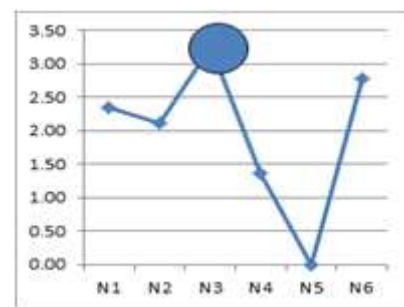
Picture 28. E – AMCP.



Picture 29. E – ANCP.



Picture 30. N – AMCP.



Picture 31. N – ANCP.

Nine (9) subsequent points are true as consequences of Computational Framework Model for AMCP and ANCP as per Society (S) - Economy (E) - Environment (N) Magnitudes with representative graphs in Pictures 26-31:

a. Society (S):

1. AMCP and ANCP have similar curves for Society (S) category;
2. S₂ and S₅ categories have an approximate fit of ARMSTAT (2015) with NKRSTAT (2015) to CASP;
3. AMCP coincides with ANCP with S₄ category;

b. Economy (E)

4. AMCP and ANCP have similar curves for Economy (E) category;

5. E₁ and E₆ categories have an approximate fit of ARMSTAT (2015) with NKRSTAT (2015) to CASP;

6. AMCP coincides with ANCP with E₃ category;

c. Environment (N)

7. AMCP and ANCP have similar curves for Nature (N) category;

8. N₅ - Energy Category and all the rest categories are required represented per each category;

9. AMCP coincides with ANCP with N₃ category.

6. Conclusion

Armenian and Nagorno Karabakh, i.e. Artsakh composite appraising supportive progress (CASP) value has an approximation of 70% as mid value of society, economy and nature (SEN) percentages which are show in *Table 8*. The percentage of CASP is represented in percentage and computed as:

$$CASP = \frac{1}{3}S + \frac{1}{3}E + \frac{1}{3}N = 70\%$$

Table 8. Percentage of SEN fits.

Magnitude		Category		Percentage
Num	Name	Num	Choice	
S	Society	S ₄	Space Science	80 %
E	Economy	E ₃	Production & Consumption	80%
N	Environment	N ₃	Air	50%
CASP	Composite Appraising Supportive Progress			70%

Further on, each value of Society, Economy and Environment (SEN) magnitude in percentage is shown in *Table 8* with chosen representative category as a leader within each magnitude.

An interesting approach is proposed to Armenian CASP to proceed Space Science (S₄) for Society (S) magnitude as per Petrosyan (25015b; 2014), to emphasize on Production &

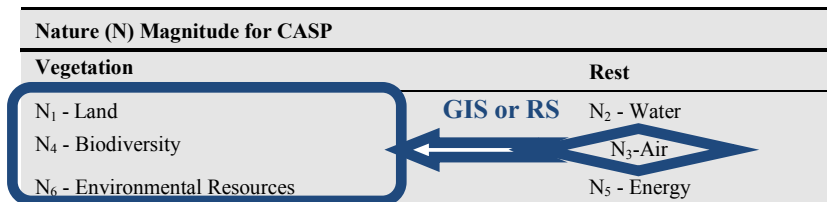
Consumption (E₃) for Economy (E) magnitude and to advance the aerial view (N₃) for Environment (N) magnitude.

Petrosyan (2014) pointed on the sequence of the Environmental Footprint concept of Eaton et al. (2007); Hammond (2006) in *Picture 1*. Categorization of Environmental (N) Magnitude is characterized into two (2) ways as vegetative and other topics shown in *Table 9*. Air (N₃) is the dominant category required for all categories for Environment (N) magnitude with use of Geographic Information Systems (GIS) or Remote Sensing (RS) in *Table 9* and *Picture 32*.



Picture 32. GIS or RS Approach to Armenian CASP.

Table 9. GIS or RS choice through Aerial (N₃) Representation of Vegetation.



Aerial representation (N₃) through use of GIS and RS are the main indicative factors with emphasis on Space Science (S₄) towards Production and Consumption (E₃) procedures to proceed Armenian CASP.

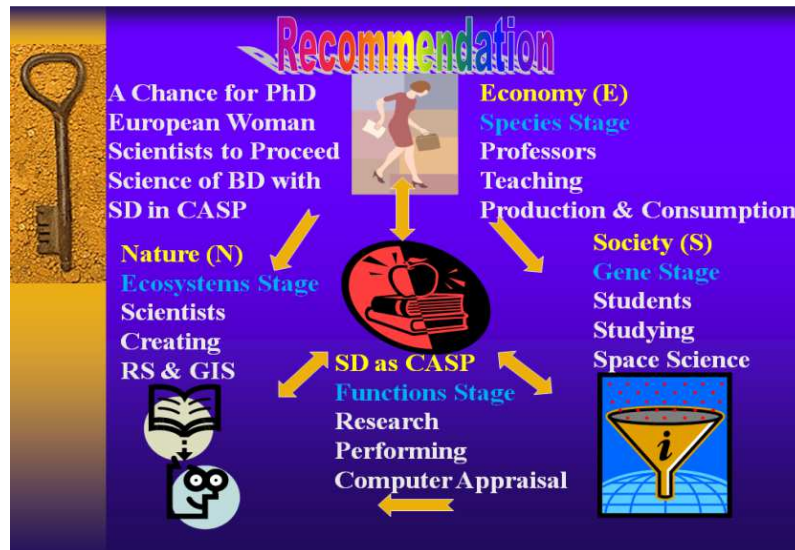
Recommendation

A chance for PhD European woman scientists is proposed in *Picture 33* to proceed science of biodiversity (BD) with sustainable development (SD) as per in composite appraising supportive progress CASP. Biodiversity economics match up with the concept of sustainable development (SD) all the way through educational and industrial perspectives with use of Geographic Information Systems (GIS) or Remote Sensing

(RS) in terms of CASP, while having the subsequent presentations:

1. Genes - Society (S) - Students - Studying - Space Science;
2. Species - Economy (E) - Professors - Teaching - Production and Consumption;
3. Ecosystems - Nature (N) - Scientists - Creating - GIS & RS;
4. Functions - SD as CASP - Research - Performing - Computer Appraisals.

An attractive approach is given to combine science with the aforementioned results, to flourish novelty of BD concept in SD with species hierarchical intervention through professions and to proceed Armenian CASP.



Picture 33. Use of GIS or RS as per BD with SD in CASP.

References

- [1] ARMSTAT (2015). *National Statistical Service of Armenia*. Website available at: <http://armstat.am/en/>
- [2] Arakelyan, M., Parham, J., (2008). *The Geographic Distribution of Turtles in Armenia and the Nagorno-Karabakh Republic (Artsakh)*. *Chelonian Conservation & Biology* 7(1): 70–77.
- [3] Bithas, K.P., Nijkamp, P., (2006). *Operationalising ecologically sustainable development at the micro-level: pareto optimality and the preservation of biologically crucial levels*. *International Journal of Environmental Sustainable Development* 5(2): 126–46.
- [4] Costanza, R., (2000). *The dynamics of the ecological footprint concept*. *Ecological Economics* 32: 341–345.
- [5] Deriglazova, L., Minasyan, S., (2011). Nagorno-Karabakh: the Paradoxes of Strength and Weakness in an Asymmetric Conflict. *Caucasus Institute Research Papers*, # 3, June 2011. –Yerevan: Caucasus Institute: 104pp.
- [6] Eaton, R.L., Hammond, G.P., Laurie, J., (2007). *Footprints on the landscape: An environmental appraisal of urban and rural living in the developed world*. *Landscape and Urban Planning* 83:13–28.
- [7] Hammond, G.P., (2006). “People, planet and prosperity”: the determinants of humanity’s environmental footprint. *Natural Resource Forum* 30: 27–36.
- [8] Levett, R., (1998). *Sustainability indicators—integrating quality of life and environmental protection*. *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 161 (3): 291-302.
- [9] Lyytimaki, J., Rosenstrom, U., (2008). *Skeletons out of the closet: effectiveness of conceptual frameworks for communicating sustainable development indicators*. *Sustainable Development* 16 (5): 301-313.
- [10] NKRSTAT (2015). *National Statistical Service of Nagorno-Karabakh Republic*. Website available at: <http://www.stat-nkr.am/en/>
- [11] Nunes, P.A.L.D., Van den Bergh, J.C.J.M., (2001). *Economic Valuation of Biodiversity: Sense or Nonsense?* *Ecological Economics* 39 (2): 203-222.
- [12] OECD - Organization for Economic Cooperation and Development, (2001). *Valuation of Biodiversity Benefits*. Selected Studies. Paris.
- [13] Petrosyan, A.F. (2015a). *Procedures Designing Composite Progressive Indicators*, *International Journal of Econometrics and Financial Management, Science and Education Publishing* 3 (2): 104-109.
- [14] Petrosyan, Azniv Felix, (2015b). PhD, “Comparisons of Basic Approaches as per Space Science Applied Researches”, *Journal of Basic and Applied Research International*, Vol.: 3, Issue.: 3 (2015): 86-93
- [15] Petrosyan Azniv (2014), *Appraising Biodiversity in Supportive Progress Using GIS Means*, LAP LAMBERT, Academic Publishing Company in Saarbrucken, Germany, ISBN: 978-3-659-34415-2, 668 pp.
- [16] Petrosyan, A.F., (2010). *A Model for Incorporated Measurement of Sustainable Development Comprising Remote Sensing Data and Using the Concept of Biodiversity*. *Journal of Sustainable Development* 3 (2): 9-26.
- [17] Petrosyan, A.F., (2005). *Economic valuation of biodiversity loss: the case of Mediterranean forest*. Participation on the sixth meeting of the “Développement d’Actions pour le Marketing et la Gestion post-événements”- DAMAGE. Athens, Greece, October.
- [18] Wackernagel, M., Rees, W., (1996). *Our Ecological Footprint: Reducing Human Impact on the Earth*. New Society Publishers, Gabriola Island, BC.160 pp.
- [19] Walton JS, El-Haram M, Castillo NH, Horner RMW, Price ADF, Hardcastle C., (2005). *Integrated assessment of urban sustainability*. *Engineering Sustainability* 158 (2):57–65.