On Exploration of the Challenges Faced by Zoo and National Parks and Bio Diversity Reserves in India

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ABSTRACT
Wildlife sanctuaries and national parks were created as per the provisions of the Wildlife (Protection) Act of 1972 in areas considered to be of ecological, geo morphological and natural significance. India has around 160 National Parks and 515 wildlife sanctuaries. However, there are certain challenges that threaten to undo the conservation efforts carried out by these areas. Following paper tries to explore the hierarchical inter-relationships amongst the various challenges faced by Zoo, National parks and bio-diversity parks in India. ISM methodology has been used to study the hierarchical inter-relationships amongst them.

Keywords
Bio diversity Park; Wild life Sanctuary; National park; Hierarchical inter-relationships, ISM methodology

1. INTRODUCTION
Conservation of a resource means the rational usage. But, according to Wild life Act, National parks are part of preservation (No usage of resources) and in WLS minor activities like R&D can be carried out without disturbing the ecological balance. In biosphere reserves there can be adequate number of human activities like tourism, settlement, agriculture.

India being a tropical country had variety of species of animals and birds sheltered in its forest and mountain areas. These areas are divided into wildlife sanctuaries and national parks to conserve and provide a safer environment to the species. Wildlife sanctuaries and National Parks are crucial in maintaining the biodiversity of the region.

In spite of these conservation and preservation measures, still we have some challenges. Following paper tries to explore the hierarchical inter-relationships amongst the various challenges faced by Zoo, National parks and bio-diversity parks in India. The paper is arranged as follows. Section 2 highlights the major challenges. Thereafter, ISM methodology is presented in section 3 . Section 4 deals with case example.

2. Challenges faced by national parks and wild life sanctuaries in India
Some of the basic challenges faced by national parks , wild life sanctuaries in India are as follows :

1.1 **Overcrowding and overuse [O&O]:** Many national parks in India are facing the challenge of overcrowding, as the increasing number of visitors is putting a strain on the park's resources and ecosystem.

1.2 **Poaching and illegal wildlife trade [PIWT]** : Poaching and illegal wildlife trade remain a significant threat to many national parks in India, as some animals are hunted for their meat, body parts, or as trophies. Poaching and hunting continue to occur in these protected regions, like rhino in Kaziranga National Park. Economic activity even in the core buffer zone is causing trouble to the wildlife and degrading their habitat.

1.3 **Habitat destruction and fragmentation [HDF]:** The expansion of agriculture, urbanization, and other human activities are causing habitat destruction and fragmentation, which can have a negative impact on the animals and plants living in national parks.

1.4 **Industrial areas and urbanization [IA&U]:** Industrial areas near national parks illicitly resort to natural resource extraction without consent of forest dwellers, in addition pollute the natural ecosystem with toxic chemicals. Urbanization has resulted in mass exodus of population to urban cities, where limited resources are being exploited and discriminated for human self-interests.

1.5 **Pollution [Po]:** Pollution from industrial activities, agricultural runoff, and other sources is a major threat to the health of national parks in India. Smog from nearby cities can cause issues for the parks. They can disrupt views, harm plants and wildlife, and negatively affect the water supplies. It can also deter human visitors and cause problems for them as well. The Great Smoky Mountains are suffering from smog from nearby power plants and industrial centers. The smog then gets trapped between the mountains and lingers around the park.

1.6 **Loss of biodiversity [LoB]:** Many national parks in India are facing the loss of biodiversity due to a variety of factors, including habitat destruction, poaching, and the impact of invasive species.

1.7 **Lack of funding and resources [LFR] :** National parks in India often face a lack of funding and resources, which can limit their ability to effectively protect and manage the parks and their ecosystems.

1.8 **Conflicts with local communities [CLC]:** National parks in India can sometimes be at odds with local communities, who may be affected by the park's conservation efforts and may feel that their needs are not being adequately addressed.

1.9 **Inadequate infrastructure and facilities [IIF]**: Many national parks in India lack adequate infrastructure and facilities, which can make it difficult for visitors to access and enjoy the parks, and can also hinder the parks' conservation efforts.

1.10 **Lack of strict measure [LSM]:** Owing to lack of strict measures to enforce speed limits on vehicles on roads passing through adjacent areas, a number of animals especially elephants have been killed recently.

1.11 **Mining, refining and deforestation [MRDF]:** Mining in Kudremukh area, oil refining in Kaziranga National Park

cause pollution. In the case of Keoladeo National Park there are water issues that have adversely affected the migratory pattern of birds. Deforestation is another threat.

1.12 Irrational usage of resources [IUR] : Tribals living there in enjoy certain rights in accordance with Forest Rights Act, 2006. There is **a possibility of irrational usage of resources due to illiteracy or poor economic background.**

1.13 **More workforce [MW]:** Involving the local inhabitants in the conservation efforts by training them to become guides and guards. Today there is inadequate security personnel and armed guards to defend the sanctuaries against poachers and illegal logging.

1.14 **Challenge of Waste Management [CWM**]: Perhaps not surprisingly, a small range of everyday items are the main culprit for the waste issues, because they are the main waste items sent to landfills. Plastic waste mainly, including items such as "water bottles, plastic bags, non-recyclable or compostable food packaging, and paper hot cups."

3. ISM METHODOLOGY

Interpretive Structural Modelling (ISM) is an interactive learning process in which a set of unique, interrelated variables are structured into a comprehensive model presented as a hierarchy graph. It involves the steps such as *Identification of elements* ; *Establishing the contextual relationship* between elements with respect to which pairs of elements will be examine. Thereafter, d*eveloping a self-interaction matrix (SSIM*) which includes establishing VAXO relationship amongst the two variables i.e. ' i' and 'j'. Thereafter, reachability matrix is formed which first includes an initial reachability matrix and thereafter and final reachability matrix . Thereafter, level partition matrices and canonical matrices are created from the final reachability matrix using reachability set , antecedent set and the intersection set . The element for which the reachability and intersection sets are the same is the top-level element. The whole process of partitioning is based on establishing the precedence relationships and arranging the elements in a topological order. *Classification of Variables Based on relative driving power and dependence power,* factors are classified in various categories like autonomous, dependent, driver and linkage and finally d*evelopment of Diagraph/ ISM from the canonical matrix form.*

4. CASE EXAMPLE

14 major challenges discussed in section 2 viz. Overcrowding and overuse [O&O] ; Poaching and illegal wildlife trade [PIWT] ; Habitat destruction and fragmentation [HDF] ; Industrial areas and Urbanization [IA&U] ; Pollution [Po][air , water , land] ; Loss of biodiversity [LoB]; Lack of funding and resources [LFR];Conflicts with local communities [CLC]; Inadequate infrastructure and facilities [IIF]; Lack of strict measure [LSM] ; Mining, refining and deforestation [MRDF]; Irrational use of resources [IUR] ; More workforce [MW] ; Challenge of Waste Management [CWM] are studied with the help of ISM methodology for the possible hierarchical interrelationships amongst them .

4.1 Structural Self – Interaction Matrix [SSIM]

This matrix gives the pair-wise relationship between two variables i.e. i and j based on SSIM has been presented below in Fig 1.

Fig 1: SSIM matrix for pair wise relationship amongst challenges faced by bio diversity park in India

S. No.	Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		O&O	PIWT	HDF	IA&U	Po	LoB	LFR	CLC	IIF	LSM	MRDF	IUR	MW	CWM
1	O&O		V	V	X	V	V	V	V	X	X	V	V	V	V
2	PIWT			V	A	V	V	V	V	V	A	V	A	A	V
3	HDF				A	X	V	X	A	A	A	X	A	A	V
4	IA&U					V	V	V	V	V	V	V	V	X	X
5	Po						X	A	X	A	A	A	A	A	A
6	LoB							A	A	A	A	A	A	A	A
7	LFR								A	A	A	A	A	A	A
8	CLC									A	A	A	A	A	X
9	IIF										V	V	V	V	V
10	LSM											V	V	V	V
11	MRDF												V	V	V
12	IUR													V	V
13	MW														X
14	CWM														

4.2 Initial reachability matrix [IRM] and Final reachability Matrix [FRM]

The SSIM has been converted in to a binary matrix called the initial reachability matrix shown in fig. 2 by substituting V, A, X, O by 1 or 0 as per the case. After incorporating the transitivity, the final reachability matrix can be obtained.

Fig 2: IRM matrix for pair wise relationship amongst challenges faced by bio diversity park in India

S. No.	Barriers	1	2	3	4	6	7	8	9	10	11	12	13	15	16
		O&O	PIWT	HDF	IA&U	Po	LoB	LFR	CLC	IIF	LSM	MRDF	IUR	MW	CWM
1	O&O	1	V	V	X	V	V	V	V	X	X	V	V	V	V
2	PIWT	0	1	V	A	V	V	V	V	V	A	V	A	A	V
3	HDF	0	0	1	A	X	V	A	X	A	A	X	A	A	V
4	IA&U	1	1	0	1	V	V	V	V	V	V	V	V	X	X
5	Po	0	0	0	0	1	X	A	X	A	A	A	A	A	A
6	LoB	0	0	1	0	1	1	A	A	A	A	A	A	A	A
7	LFR	0	0	0	0	1	1	1	A	A	A	A	A	A	A
8	CLC	0	0	00	0	1	1	1	1	A	A	A	A	A	X
9	IIF	0	0	00	0	1	1	1	1	1	V	V	V	V	V
10	LSM	0	0	00	0	1	1	1	1	0	1	V	V	V	V
11	MRDF	0	1	00	0	1	1	1	1	0	0	1	V	V	V
12	IUR	0	0	0	0	1	1	1	1	0	0	0	1	V	V
13	MW	0	1	0	1	1	1	1	1	0	0	0	0	1	X
14	CWM	0	1	0	1	1	1	1	1	0	0	0	0	1	1

Fig 3 : FRM matrix for pair wise relationship amongst challenges faced by bio diversity park in India

S. No.	Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
		O&O	PIWT	HDF	IA&U	Po	LoB	LFR	LOC	IIF	LSM	MRDF	IUB	MW	CWM	D.P
1	O&O	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
2	PIWT	0	1	1	0	1	1	1	1	1	1	1	1	1	1	12
3	HDF	0	0	1	0	1	1	1	1	0	0	1	1	1	1	10
4	IA&U	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
5	Po	0	0	1	0	1	1	0	0	0	0	0	00	0	0	3
6	LoB	0	0	1	0	1	1	0	0	0	00	0	0	00	0	3
7	LFR	0	0	0	0	1	1	1	0	0	0	0	0	00	0	3
8	L0C	0	0	00	0	1	1	1	1	0	0	0	0	0	1	5
9	IIF	0	0	1	0	1	1	1	1	1	1	1	1	1	1	12
10	LSM	0	1	1	0	1	1	1	1	0	1	1	1	1	1	11
11	MRDF	0	1	00	0	1	1	1	1	0	0	1	1	1	1	9
12	IUB	0	0	0	0	1	1	1	1	0	0	1	1	1	1	8
13	MW	0	1	1	1	1	1	1	1	0	0	1	1	1	1	11
14	CWM	0	1	0	1	1	1	1	1	0	0	0	0	1	1	8
	De.P.	2	6	9	4	14	14	12	11	4	5	9	9	10	11	

4.3 Driving power and Dominance diagram

Table 4.3.1: Driving Power & Dominance Diagram (MICMAC analysis)

Driving power- →	14		O&O		IA&U										
	13														
	12				IIF		PIWT								

	11					LSM					MW				
	10									HDF					
	9									MRDF					
	8		Drivers						Linkage	IUB		CWM			
	7														
	6														
	5											LOC			
	4		Autonomous						Dependent						
	3												LFR		Po,Lo B
	2														
	1														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Dependence power -→													

4.4 Level Partition matrices

Iteration I

Reachability set	Antecedent set	Intersection set	Level
5,6	**1,2,3,4,5,6,7,8,,910,11,12,13,14**	**5,6**	
5,6,7	1,2,3,4,7,8,9,10,11,12,13,14	7	
14,5,6,7,8	1,2,3,4,8,9,10,11,12,13,14	14,8	
5,6,7,8,14,13,11,12	1,2,3,4,8,9,10,11,12,13	13	
5,6,7,8,14,13,11,12	1,2,3,4,8,9,10,11,12,13	11,12	
3,5,6,7,8,14,11,12	1,2,3,4,9,10,13	3	**I**
2,3,5,6,7,8,14,11,12	1,2,4,9,10	2	
2,3,5,6,7,8,10,11,12,14	1,2,4,9,10	10	
2,3,5,6,7,8,9,10,11,12,14	1,2,4,9	9	
2,3,4,5,6,7,8,9,10,11,12,14	1,4,9	4	
1,2,3,4,5,6,7,8,9,10,11,12,14	1,4	1,4	

Iteration II

Reachability set	Antecedent set	Intersection set	Level
7	**1,2,3,4,7,8,9,10,11,12,13,14**	**7**	
14,5,6,7,8	1,2,3,4,8,9,10,11,12,13,14	14,8	
5,6,7,8,14,13,11,12	1,2,3,4,8,9,10,11,12,13	13	
5,6,7,8,14,13,11,12	1,2,3,4,8,9,10,11,12,13	11,12	
3,5,6,7,8,14,11,12	1,2,3,4,9,10,13	3	**II**
2,3,5,6,7,8,14,11,12	1,2,4,9,10	2	
2,3,5,6,7,8,10,11,12,14	1,2,4,9,10	10	
2,3,5,6,7,8,9,10,11,12,14	1,2,4,9	9	
2,3,4,5,6,7,8,9,10,11,12,14	1,4,9	4	
1,2,3,4,5,6,7,8,9,10,11,12,14	1,4	1,4	

Iteration III

Reachability set	Antecedent set	Intersection set	Level
14,8	**1,2,3,4,8,9,10,11,12,13,14**	**14,8**	
8,14,13,11,12	1,2,3,4,8,9,10,11,12,13	13	
8,14,13,11,12	1,2,3,4,8,9,10,11,12,13	11,12	

3,8,14,11,12	1,2,3,4,9,10,13	3	**III**
2,3,8,14,11,12	1,2,4,9,10	2	
2,3,8,10,11,12,14	1,2,4,9,10	10	
2,3,8,9,10,11,12,14	1,2,4,9	9	
2,3,4,8,9,10,11,12,14	1,4,9	4	
1,2,3,4,8,9,10,11,12,14	1,4	1,4	

Iteration IV

Reachability set	**Antecedent set**	**Intersection set**	**Level**
14,8	**1,2,3,4,8,9,10,11,12,13,14**	**14,8**	
13,11,12	1,2,3,4,8,9,10,11,12,13	13	
8,14,13,11,12	1,2,3,4,8,9,10,11,12,13	11,12	
3,8,14,11,12	1,2,3,4,9,10,13	3	**IV**
2,3,8,14,11,12	1,2,4,9,10	2	
2,3,8,10,11,12,14	1,2,4,9,10	10	
2,3,8,9,10,11,12,14	1,2,4,9	9	
2,3,4,8,9,10,11,12,14	1,4,9	4	
1,2,3,4,8,9,10,11,12,14	1,4	1,4	

Iteration V

Reachability set	**Antecedent set**	**Intersection set**	**Level**
11,12	**1,2,3,4,9,10,11,12,13**	**11,12**	
3,11,12	1,2,3,4,9,10,13	3	
2,3,11,12	1,2,4,9,10	2	
2,3,10,11,12	1,2,4,9,10	10	**V**
2,3,9,10,11,12	1,2,4,9	9	
2,3,4,9,10,11,12	1,4,9	4	
1,2,3,4,9,10,11,12	1,4	1,4	

Iteration VI

Reachability set	**Antecedent set**	**Intersection set**	**Level**
3	**1,2,3,4,9,10,13**	**3**	
2,3,11,12	1,2,4,9,10	**2**	
2,3,10,11,12	1,2,4,9,10	**10**	
2,3,9,10,11,12	1,2,4,9	**9**	**VI**
2,3,4,9,10,11,12	1,4,9	**4**	
1,2,3,4,9,10,11,12	1,4	**1,4**	

Iteration VII

Reachability set	**Antecedent set**	**Intersection set**	**Level**
2	**1,2,4,9,10**	**2**	
2,10	1,2,4,9,10	10	
2,9,10	1,2,4,9	9	**VII**
2,4,9,10	1,4,9	4	
1,2,4,9,10	1,4	1,4	

Iteration VIII

Reachability set	**Antecedent set**	**Intersection set**	**Level**
10	**1,2,4,9,10**	**10**	
9,10	1,2,4,9	9	**VIII**

4,9,10	1,4,9	4	
1,4,9,10	1,4	1,4	

Iteration IX

Reachability set	Antecedent set	Intersection set	Level
9	**1,2,4,9**	**9**	
4,9	1,4,9	4	
1,4,9	1,4	1,4	**IX**

Iteration X

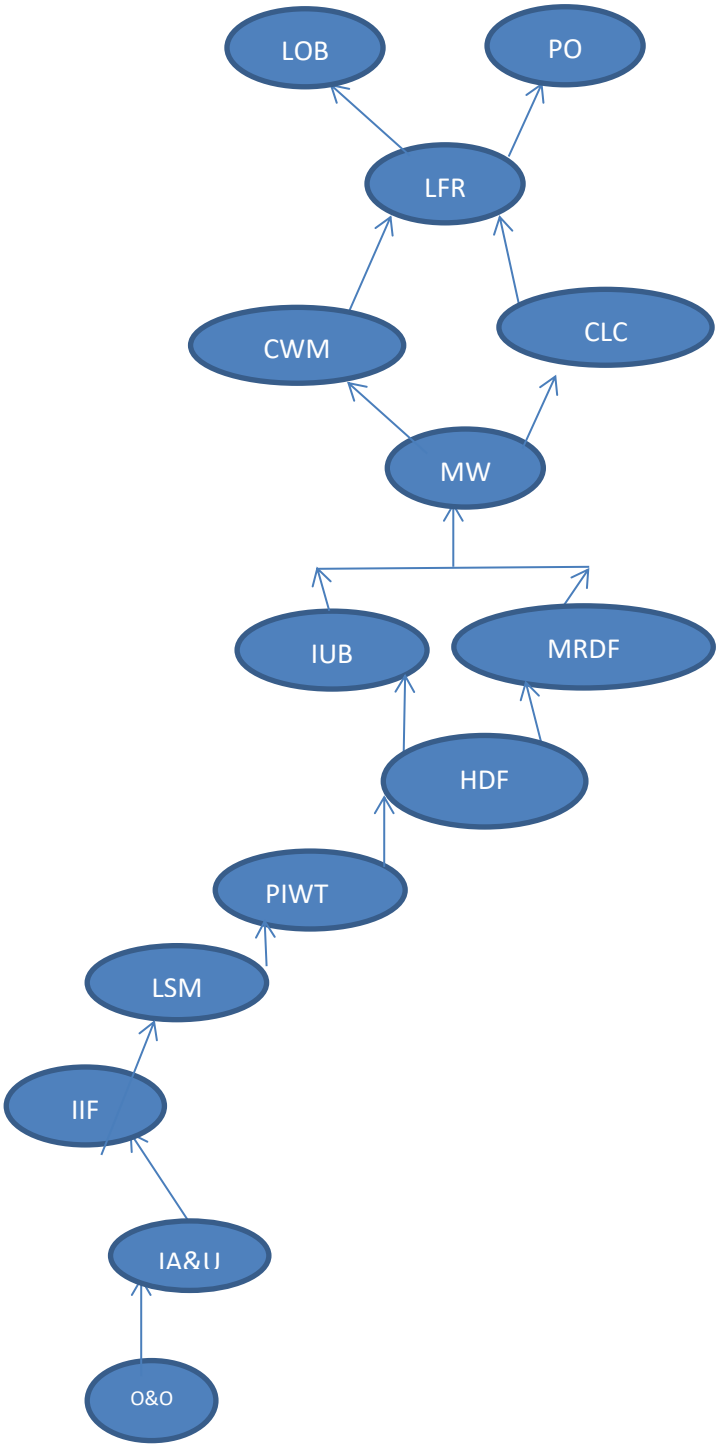
Reachability set	Antecedent set	Intersection set	Level
4	**1,4**	**4**	
1,4	1,4	1,4	**X**

Iteration XI

Reachability set	Antecedent set	Intersection set	Level
1	**1**	**1**	**XI**

Possible sequence would be: 5,6->7→14,8-->--→13→11,12→3→2→10→9→4→1

4.5 ISM DIAGRAPH



5. CONCLUSIONS

Following paper tries to explore the hierarchical inter-relationships amongst the various challenges faced by Zoo, National parks and bio-diversity parks in India. ISM methodology has been used to study the hierarchical inter-relationships amongst them.

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