On Studying the Inter-relationships Amongst the various Challenges to Archaeological Sites Particularly in Context of Asian Countries

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ABSTRACT
Present research deals with first exploring the various challenges faced by government of developing countries for restoring the archaeological sites . Thereafter , it studies the inter-relationship amongst them using ISM methodology .

Keywords
Archaeology ; ISM methodology

1. INTRODUCTION
Archaeologists are increasingly fond of arguing that knowledge of the long-term trajectories of past societies can provide unique insights into contemporary problems and their potential solutions [1-2]. Adding this concern for the present to archaeology's traditional focus on the past has fostered research on coupled social and ecological systems and has led to an increasing focus on the processes underlying cultural transformation and change, building on the field's reconstructionist history. At the same time, archaeology as practiced in North American universities is arguably transforming itself from a sub-discipline of anthropology to a largely independent social science with strong intellectual ties to several natural and social sciences, including anthropology.

The paper presents an exploratory research. It searches the related literature through online as well as offline research databases. It makes use of search engines such as google scholar, Mendeley research database software etc. Most of the challenges in this paper is taken by [2]. [2] makes use of crowd sourcing to recognize about 25 challenges to archaeological sites. The research paper is arranged as follows : Section 2 deals with literature review . Section 3 deals with ISM methodology. Section 4 presents the case example . Section 5 presents the implications and future directions .

2. LITERATURE REVIEW: IDENTIFYING THE CHALLENGES
Archaeologists from multiple theoretical vantage points (materialist, sociobiological, historical) have explored the various transformative effects , the past leaders have . Studies analyzing the relationships of economic differentiation in the context of consensus, agency, memory and legacy to institutions, community and governance using temporally and spatially rich archaeological datasets can evaluate cause and effect in ways that will produce ultimate explanations of long-term and large-scale change [1-4].

2.1. Social Inequalities (SI): In contemporary societies, the social inequalities and individual differences in strength, intelligence, ability, age, gender etc. also fluctuate significantly over surprisingly short intervals. Inequality can be systematically inferred through studies of landscapes, monuments, residences, and mortuary remains [5-8].

2.2 Changing market systems (CMS) : Market economies— in which buyers compete for sellers and sellers compete for buyers, mediated by the mechanism of "price"— are not universal, but comprise of a number of differently constituted economic systems [9-12].

2.3 Small-scale human communities (SSHC): Human communities can transcend single localities to become regional, supra-regional, and, with modern communication, even global in scale. Many different kinds of interactions— social, political, economic, and cultural— connect members to one another. Understanding this variability in the strategies for political organization around the world, and the consequences of these strategies for inequality, health, and well-being provides an empirical foundation from which debates can proceed regarding the longer-term consequences of reorganizations resulting from present day political upheavals [12-14].

2.4 Social and demographic processes (SADP) : Historical cities provide especially rich data, both archaeological and archival, on the social and demographic processes that resulted in the layout, organization, and affordances of urban life. Archaeological data on cities range from small architectural details and short-lived cities to broad patterns of heterogeneous urban textures covering many square kilometers and presenting a historical depth of millennia [12,13,19] .

2.5 Conflict and complex cultural formations [CCCF] : Exploring the dialectical relationship between conflict and complex cultural formations will undoubtedly foster new approaches to the archaeological record. Conflict is notoriously difficult to identify and quantify through archaeological remains. Understanding the impact of conflict on our ancestors will surely help us to identify both its impacts today and its implications for the future[23-25].

2.6 Social and environmental diversity and complexity in creating resilience [SEDC] : When considering diversity with social and ecological systems more broadly, there is no simple, positive relationship between social diversity and resilience or how different dimensions of social and environmental diversity interact to affect resilience. Integrating insights from ecology and archaeology can contribute to contemporary understandings of the role of diversity and complexity in the resilience of socioecological systems [26-28].

2.7 Social collapse or decline [SCD] : Given the growing concern about the sustainability of our planet amid well-documented demographic and environmental trends and pressures, the causes and warning signs of collapse examined over long time periods may provide useful contexts for modern planning efforts. These efforts can build on widespread biological and ecological studies that describe major declines in plant and animal communities and that highlight warning signals (e.g., slowing return time after perturbation, higher variance, conflict) among communities at risk [28-30].

***2.8 Cosmology and ideology [C&I]* :** Recent efforts have documented past ideologies and cosmologies using such material evidence as iconography in design, architectural layouts, and the symbolization of social relations. Specific progress has been made on a number of cases for which we have both archaeological and ethnohistoric ethnographic/linguistic evidence, but a general formal representation of such thought systems remains a challenge [32].

2.9 Environment, population dynamics, settlement structure, and human mobility [HM] : Modern humans left Africa and dispersed across the Old World about 60,000 B.P. and by 12,000 B.P. had colonized the New World. These colonizers faced enormous challenges— new environments, new sources of raw materials and food and, in some cases, the presence of other hominin species or new predators. Exploring these challenges raises a variety of questions [33-37].This framing entails defining and measuring essential aspects of four theoretical domains: environment, population dynamics, settlement structure, and human mobility. Effectively characterizing these domains requires biological, environmental, sociological, historical, anthropological, and archaeological data [38-40].

2.10 Cultural and biological adaptations (CBA) : The immediate value of further research in regions with extreme environments (high altitude, high latitude etc.) lies in the testing of theories of cultural adaptation at the limits of viability, limits at which the weaknesses of theories often become evident and new understandings must be generated . These are difficult and expensive places to work areas [41-43].

2.11 Migration (Mi) : Migration has been a widespread phenomenon since the earliest times and involves movement of individuals as well as groups to new settings. Simple mechanical explanations have given way to studies of migration that are fundamentally concerned with relationships among time, objects, persons, and spaces [44-47] .

2.12 Cognition, Behavior, and Identity [CBI] : Investigations in southern Africa present compelling evidence for early developments characteristic of behaviourally modern humans, such as abstract art, complex technology, substantial trade or transport of materials, and perhaps even plant management, but there are great lacunae in the record until around 40,000 B.P. Archaeological evidence and analysis of a massive body of emerging data are critical to resolving this question— one essential to understanding the fundamental nature of humanity [49-51].

2.13 Spatial and material reconfigurations of landscapes [SMC]: Space and matter are fundamental dimensions of human experience; they shape and constrain the direction of cognitive development, social change, and biological evolution. From technologies and houses to landscapes and cyberspace, the processes of making, doing, sensing, inhabiting, and relating to things and beings are intimately connected to human neurological development, cultural values, identity formation, social structure, and political change [52-55].

2.14 Human-Environment Interactions [HEI]: Resource availability, human fertility and physiology, agricultural production, health, technological developments, political economy, socioeconomic and historical processes all serve to both drive and constrain population growth. But ancient demographic research requires multidisciplinary collaborations and comparative research over wide geographical areas [55-58].

2.15 Health and well-being [HWB] : Archaeologists now combine studies of ancient and modern DNA and bioarchaeological analyses of human remains with contextual information from the archaeological record and from documents, where available. Archaeologists must continue to deepen research collaborations with specialists in other fields to determine the impacts of climate change, emergence of inequality, population/resource balances, diet, and microbiomes on health and wellbeing [59-65].

2.16 Productive capacity, population, and innovation [PPI]: Three closely related factors are critical to understanding how agricultural economies arose, proliferated, and, in some cases, collapsed *viz* . the productive capacity ; the population and the innovation. Analyses of integrated data— on crop and livestock species, agricultural practices, environmental parameters, settlement size and distributions, social structures that impact agricultural capacities, and symbolic systems that shape the identity of agriculturalists— will reveal the relationships that have structured agricultural economies [66-68].

2.17 Abrupt Environmental change [AEC] : Detecting and assessing the intensity and frequency of abrupt and short-term environmental perturbations in the archaeological record will require the integration of data from settlement archaeology, zoo-archaeology, paleoecology, sedimentology, seismology, geomorphology, and allied disciplines [69-74]. Studying the effects of environmental change on human societies has long been a dominant theme of archaeological research.

3. INTERPRETIVE STRUCTURAL MODELLING METHODOLOGY

Proposed by Warfield [75], ISM methodology is a technique for establishing inter-relationships amongst the criteria of interest . The process begins with the identification of relevant elements and thereafter establishing contextual relationship amongst them . After that, the structural self–interaction matrix is created using the VAXO concept which is then followed by the creation of initial reachability matrix . Final reachability matrix is then created after correcting the initial reachability matrix for any possibility of transitivity . From the reachability matrix, the reachability set and antecedent set

for each criterion is found . Then the intersection of these sets is derived for all elements. The element for which the reachability and intersection sets are the same is the top-level element. Then, the reachability matrix is converted into the canonical matrix format by arranging the elements according to their levels. Based on the relative driving power and dependence power, factors are classified in various categories like autonomous, dependent, driver and linkage. Finally, a diagraph is constructed from the canonical matrix .

4. CASE EXAMPLE

4.1 Challenges In Archeological Sites

The 17 possible challenges have been recognized viz. Social Inequalities (SI), Changing market systems (CMS), Small-scale human communities (SSHC), Social and demographic processes (SADP), Conflict and complex cultural formations [CCCF] , Social and environmental diversity and complexity in creating resilience [SEDC], Social collapse or decline [SCD], Cosmology and ideology [C&I] , Environment, population dynamics, settlement structure, and human mobility [HM], Cultural and biological adaptations (CBA) , Migration (Mi), Cognition, Behavior, and Identity [CBI] , Spatial and material reconfigurations of landscapes [SMC], Human-Environment Interactions [HEI], Health and well-being [HWB] , Productive capacity, population, and innovation [PPI] , Abrupt Environmental change [AEC] are now studied for possible inter-relationship amongst them using ISM methodology .

Fig 1: SSIM matrix for pair wise relationship amongst barriers

S. No.	Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		SI	CMS	SSHC	SADP	CCCF	SEDC	SCD	C&I	HM	CBA	MI	CBI	SMC	HEI	HWB	PPI	AEC
1	SI		A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2	CMS			A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
3	SSHC				A	A	A	A	A	A	A	A	A	A	A	A	A	A
4	SADP					V	V	V	V	V	V	V	V	V	V	V	V	V
5	CCCF						A	A	A	A	A	A	A	A	A	A	A	A
6	SEDC							V	V	V	V	V	V	V	V	V	V	V
7	SCD								A	A	A	A	A	A	A	A	A	A
8	C&I									V	V	V	V	V	V	V	V	V
9	HM										V	V	V	V	V	A	V	V
10	CBA											A	V	V	V	V	V	V
11	MI												O	A	A	A	A	A
12	CBI													O	X	X	A	A
13	SMC														X	X	V	V
14	HEI															X	X	A
15	HWB																A	O
16	PPI																	X
17	AEC																	

Fig 2: Initial reachability matrix

S. No.	Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		SI	CMS	SSHC	SADP	CCCF	SEDC	SCD	C&I	HM	CBA	MI	CBI	SMC	HEI	HWB	PPI	AEC
1	SI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	CMS	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	SSHC	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	SADP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	CCCF	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
6	SEDC	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1
7	SCD	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0

8	C&I	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1
9	HM	1	1	1	0	0	0	1	0	1	1	1	1	1	1	0	1	1
10	CBA	1	1	1	0	0	0	1	0	0	1	0	1	1	1	1	1	1
11	MI	1	1	1	0	0	0	1	0	0	1	1	0	0	0	0	\0	0
12	CBI	1	1	1	0	0	0	1	0	0	0	0	1	0	1	1	0	0
13	SMC	1	1	1	0	0	0	1	0	0	0	1	0	1	1	1	1	1
14	HEI	1	1	1	0	0	0	1	0	0	0	1	1	1	1	1	1	0
15	HWB	1	1	1	0	0	0	1	0	0	0	1	1	1	1	1	0	0
16	PPI	1	1	1	0	0	0	1	0	0	0	1	1	0	1	1	1	1
17	AEC	1	1	1	0	0	0	1	0	0	0	1	1	0	1	0	1	1

Fig 3 : Final reachability matrix

S. No.	Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	D. P
		SI	CMS	SSHC	SADP	CCCF	SEDC	SCD	C&I	HM	CBA	MI	CBI	SMC	HEI	HWB	PPI	AEC	
1	SI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2	CMS	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
3	SSHC	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
4	SADP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17
5	CCCF	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	15
6	SEDC	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	15
7	SCD	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4
8	C&I	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	14
9	HM	1	1	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	12
10	CBA	1	1	1	0	0	0	1	0	0	1	0	1	1	1	1	1	1	11
11	MI	1	1	1	0	0	0	1	0	0	1	1	1	1	1	1	1	1	12
12	CBI	1	1	1	0	0	0	1	0	0	0	1	1	1	1	1	1	0	9
13	SMC	1	1	1	0	0	0	1	0	0	1	1	1	1	1	1	1	1	12
14	HEI	1	1	1	0	0	0	1	0	0	0	1	1	1	1	1	1	1	11
15	HWB	1	1	1	0	0	0	1	0	0	0	1	1	1	1	1	1	1	11
16	PPI	1	1	1	0	0	0	1	0	0	1	1	1	1	1	1	1	1	12
17	AEC	1	1	1	0	0	0	1	0	0	1	1	1	1	1	1	1	1	12
	De.P	17	16	15	1	2	2	14	4	5	10	12	13	13	13	13	13	12	

D.P : Driving power ; De.P : dependence power

4.2 Level Partition

From the final reachability matrix, reachability and final antecedent set for each factor are found. The elements for which the reachability and intersection sets are same are the top-level element in the ISM hierarchy. After the identification of top level element, it is separated out from the other elements and the process continues for next level of elements. Reachability set, antecedent set, intersection set along with different level for elements have been shown below in table 4.

Table 4.3.1: Iteration I

S.No.	Reachability set	Antecedent set	Intersection set	Level
1.	**1**	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	1	
2.	1,2	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	2	

3.	1,2,3	3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17	3	
4.	1,2,3,7	4,5,6,7,8,9, 10,11,12,13,14,15,16,17	7	
5.	1,2,3,7,12, 13,14,15, 16	4,5,6,8,9,10,11,12,13,14,15, 16,17	12,13,14, 15,16	
7.	1,2,3,7,10, 11,12,13, 14,15, 16,17	4,5,6,8,9,10,11,13,16,17	10,11,13, 17	
8.	1,2,3,7,9, 10,11,12, 13,14, 15,16, 17	4,5,6,8,9	9	**I**
9.	1,2,3,7,8,9, 10,11,12,13,14, 15, 16,17	4,5,6,8	8	
10.	1,2,3,4,6,7, 8,9,10,11,12,13,14, 15, 16,17	4,6	4,6	
11.	1,2,3,4,5,7, 8,9,10,11,12, 13,14, 15, 16,17	4,5	4,5	

Table 4.3.2: Iteration II

S.No.	Reachability set	Antecedent set	Intersection set	Level
2.	**2**	2,3,4,5,6,7,8,9,10,11,12, 13,14,15,16,17	2	
3.	1,2,3	3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17	3	
4.	1,2,3,7	4,5,6,7,8,9, 10,11,12,13,14,15,16,17	7	
5.	1,2,3,7,12, 13,14,15, 16	4,5,6,8,9,10,11,12,13,14,15, 16,17	12,13,14, 15,16	
7.	1,2,3,7,10, 11,12,13, 14,15, 16,17	4,5,6,8,9,10,11,13,16,17	10,11,13, 17	
8.	1,2,3,7,9, 10,11,12, 13,14, 15, 16, 17	4,5,6,8,9	9	**II**
9.	1,2,3,7,8,9, 10,11,12,13,14, 15, 16,17	4,5,6,8	8	
10.	1,2,3,4,6,7, 8,9,10,11,12,13,14, 15, 16,17	4,6	4,6	
11.	1,2,3,4,5,7, 8,9,10,11,12, 13,14, 15, 16,17	4,5	4,5	

Table 4.3.3: Iteration III

S.No.	Reachability set	Antecedent set	Intersection set	Level
3.	**3**	3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17	3	
4.	3,7	4,5,6,7,8,9, 10,11,12,13,14,15,16,17	7	
5.	3,7,12,13,14, 15,16	4,5,6,8,9,10,11,12,13,14,15, 16,17	12,13,14, 15,16	
7.	3,7,10,11,12, 13,14, 15, 16,17	4,5,6,8,9,10,11,13,16,17	10,11,13, 17	
8.	3,7,9, 10,11,12, 13,14,15, 16, 17	4,5,6,8,9	9	**III**
9.	3,7,8,9,10, 11,12,13, 14,15,16,17	4,5,6,8	8	
10.	3,4,6,7,8,9, 10,11,12,13, 14, 15,16,17	4,6	4,6	
11.	1,2,3,4,5,7,8, 9,10,11,12, 13,14, 15, 16,17	4,5	4,5	

Table 4.3.4: Iteration IV

S. No.	Reachability set	Antecedent set	Intersection set	Level
4.	**7**	4,5,6,7,8,9, 10,11,12,13,1	7	

		4,15,16,17		
5.	7,12,13,14,15, 16	4,5,6,8,9,10,1 1,12,13,14,15, 16,17	12,13,14, 15,16	
7.	7,10,11,12,13, 14,15, 16,17	4,5,6,8,9,10,1 1,13,16,17	10,11,13, 17	
8.	7,9,10,11,12, 13,14,15,16, 17	4,5,6,8,9	9	**IV**
9.	7,8,9,10,11,12, 13,14, 15, 16,17	4,5,6,8	8	
10.	4,6,7,8,9, 10,11,12,13, 14, 15, 16,17	4,6	4,6	
11.	4,5,7,8,9,10, 11,12,13,14, 15,16,17	4,5	4,5	

Table 4.3.5: Iteration V

S. No.	Reachability set	Antecedent set	Intersection set	Level
5.	**12,13,14, 15,16**	4,5,6,8,9,10,1 1,12,13,14,15, 16,17	12,13,14, 15,16	
7.	10,11,12,13, 14,15, 16,17	4,5,6,8,9,10,1 1,13,16,17	10,11,13, 17	
8.	9,10,11,12,13, 14, 15,16, 17	4,5,6,8,9	9	
9.	8,9,10,11,12,1 3,14, 15, 16,17	4,5,6,8	8	
10.	4,6,8,9,10,11,1 2,13,14, 15, 16,17	4,6	4,6	**V**
11.	4,5,8,9,10,11,1 2, 13,14, 15, 16,17	4,5	4,5	

Table 4.3.6: Iteration VI

S. No.	Reachability set	Antecedent set	Intersection set	Level
7.	**10,11,17**	4,5,6,8,9,10,1 1,17	10,11,17	
8.	9,10,11,12,13, 14, 15,16, 17	4,5,6,8,9	9	
9.	8,9,10,11,17	4,5,6,8	8	
10.	4,6,8,9,10,11,1 2,13, 14, 15,16,17	4,6	4,6	**VI**
11.	4,5,7,8,9, 10,11,12,13, 14, 15, 16,17	4,5	4,5	

Table 4.3.7: Iteration VII

S.No.	Reachability set	Antecedent set	Intersection set	Level
8.	**9**	4,5,6,8,9	**9**	
9.	8,9	4,5,6,8	8	
10.	4,6,8,9	4,6	4,6	
11.	4,5,8,9	4,5	4,5	**VII**

Table 4.3.8: Iteration VIII

S.No.	Reachability set	Antecedent set	Intersection set	Level
9.	**8**	4,5,6,8	8	
10.	4,6,8	4,6	4,6	**VIII**
11.	4,5,8	4,5	4,5	

Table 4.3.9: Iteration IX

S.No.	Reachability set	Antecedent set	Intersection set	Level
10.	4,6	4,6	4,6	
11.	4,5	4,5	4,5	**IX**

4.3 Classification of factors

The critical success factors described earlier are classified in to four clusters *viz*. autonomous factor, dependent factors, linkage factors and independent / Driving factors are mentioned below.

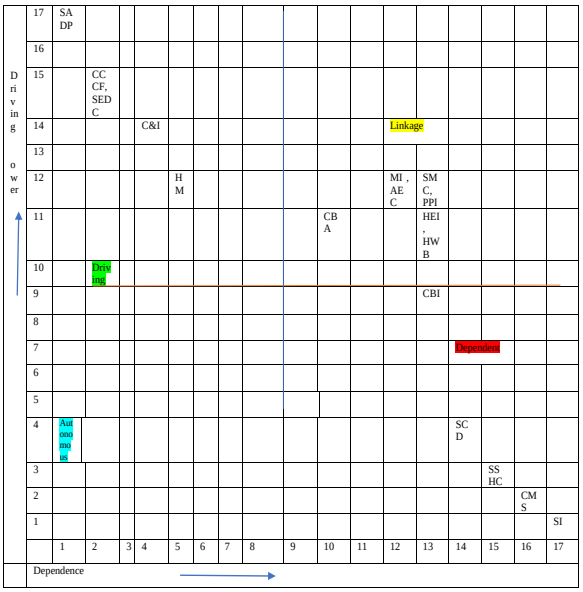

Fig. 4.Driving Power and Dependence Diagram

5. LITERARY OBSERVATIONS AND RECOMMENDATIONS

- In addition to the imposing intellectual challenges, we face the unfortunate fact that the archaeological record is diminishing— quite rapidly in many parts of the world— with differential impacts for different aspects of the record.
- Addressing many of these problems will require intensive, cross-disciplinary collaborations. Although those collaborations will be demanding and time consuming, they have the potential to yield transformative results with cascading impacts far beyond archaeology.
- Many of the cultural processes implicated in these challenges undoubtedly involve complex, nonlinear relationships in which cause and effect are not readily distinguished.
- The challenge is to move from case or regional studies to larger scale comparative research . These efforts will require making data from relatively small field projects widely accessible and increasing current technological capabilities to allow for studies of human-environment interaction to increase in scope and complexity.

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