

Tainter, J.

The Collapse of Complex Societies. Cambridge University Press, 1988. (ISBN 978-0-521-38673-9)

Chapter 1: Introduction to collapse

-the discovery of past/lost civilizations raises the implication that “civilizations are fragile, impermanent things” and that modern societies may likewise be vulnerable (although some argue that science and technology will prevent it)

-a recurrent theme in Western history has been social disintegration and the reason why complex societies do so is significant to those living in one; collapse has not received as much scholarly attention as the development of complexity

What is collapse?

-for Tainter, “Collapse...is a political process. It may, and often does, have consequences in such areas as economics, art, and literature, but it is fundamentally a matter of the sociopolitical sphere. A society has collapsed when it displays a rapid, significant loss of an established level of sociopolitical complexity.” (p. 4)

-it manifests itself “...as:

a lower degree of stratification and social differentiation;

less economic and occupational specialization, of individuals, groups, and territories;

less centralized control; that is, less regulation and integration of diverse economic and political groups by elites;

less behavioral control and regimentation;

less investment in the epiphenomena of complexity, those elements that define the concept of ‘civilization’: monumental architecture, artistic and literary achievements, and the like;

less flow of information between individuals, between political and economic groups, and between a center and its periphery;

less sharing, trading, and redistribution of resources;

less overall coordination and organization of individuals and groups;

a smaller territory within a single political unit.” (p. 4)

Collapse in history

-simple societies through empires can experience changes in complexity, including ‘collapse-level’ shifts; it is “a process recurrent in history and prehistory, and global in its distribution.” (p. 5)

-examples include: Western Chou Empire; Harappan Civilisation; Mesopotamia; Egyptian Old Kingdom; Hittite Empire; Minoan Civilisation; Mycenaean Civilisation; Western Roman Empire; Olmec; Lowland Classic Maya; Mesoamerican Highlands; Casas Grandes; Chacoans; Hohokam; Eastern Woodlands; Huari and Tiahuanaco Empires; Kachin; Ik (**Tainter provides a short synopsis for each of these**)

Remarks

-ancient societies and modern ones differ in collapse susceptibility

After collapse

-the characteristics of societies after collapse may be summarized as follows.

There is, first and foremost, a breakdown of authority and central control. Prior to collapse, revolts and provincial breakaways signal the weakening of the center. Revenues to the government often decline. Foreign challengers become increasingly successful. With lower revenues the military may become ineffective. The populace becomes more and more disaffected as the hierarchy seeks to mobilize resources to meet the challenge.

With disintegration, central direction is no longer possible. The former political center undergoes a significant loss of prominence and power. It is often ransacked and may ultimately be abandoned. Small, petty states emerge in the formerly unified territory, of which the previous capital may be one. Quite often these contend for domination, so that a period of perpetual conflict ensues.

The umbrella of law and protection erected over the populace is eliminated. Lawlessness may prevail for a time...but order will ultimately be restored. Monumental construction and publicly-supported art largely cease to exist. Literacy may be lost entirely, and otherwise declines so dramatically that a dark age follows.

What population remains in urban or other political centers reuse existing architecture in a characteristic manner. There is little new construction, and that which is attempted concentrates on adapting existing buildings. Great rooms will be subdivided, flimsy façades are built, and public space will be converted to private. While some attempt may be made to carry on an attenuated version of previous ceremonialism, the former monuments are allowed to fall into decay. People may reside in upper-story rooms as lower ones deteriorate. Monuments are often mined as early sources of building materials. When a building begins to collapse, the residents simply move to another.

Palaces and central storage facilities may be abandoned, along with centralized redistribution of goods and foodstuffs, or market exchange. Both long distance and local trade may be markedly reduced, and craft specialization end or decline. Subsistence and material needs come to be met largely on the basis of local self-sufficiency. Declining regional interaction leads to the establishment of local styles in items such as pottery that formerly had been widely circulated. Both portable and fixed technology (e.g. hydraulic engineering systems) revert to simpler forms that can be developed and maintained at the local level, without the assistance of a bureaucracy that no longer exists.

Whether as a cause or consequence, there is typically a marked, rapid reduction in population size and density. Not only do urban populations substantially decline, but so also do the support populations of the countryside. Many settlements are concurrently abandoned. The level of population and settlement may decline to that of centuries or even millennia previously." (pp. 19-20)

-this breakdown of complexity can occur in simpler societies and be seen as a loss of social structure elements

-“In a complex society that has collapsed, it would thus appear, the overarching structure that provides support services to the population loses capability or disappears entirely. No longer can the populace rely upon external defense and internal order, maintenance of public works, or delivery of food and material goods. Organization reduces to the lowest level that is economically sustainable, so that a variety of contending polities exist where there had been

peace and unity. Remaining populations must become locally self-sufficient to a degree not seen for several generations. Groups that had formerly been economic and political partners now become strange, even threatening competitors. The world as seen from any locality perceptibly shrinks, and over the horizon lies the unknown.” (p. 20)

2. The nature of complex societies

Introduction

-to understand the collapse of complex societies it is necessary to understand their development

Complexity

Nature of complexity

-growth of complexity refers to size, distinctiveness and number of parts, variety of social roles, distinctiveness of social personalities, variety of mechanisms to organize parts into whole

-concepts for inequality and heterogeneity are important and interrelated but not necessarily positively correlated to sociopolitical complexity

-inequality is a vertical differentiation or ranking with unequal access to resources

-heterogeneity is the number of distinctive parts/components and how a population is distributed amongst them

Simpler societies

-complex societies are an anomaly in human history with autonomous, self-sufficient local communities being the norm (99.8% of existence); large, hierarchical complex states have only been around the past 6000 years or so, but once established, expanded and dominated

-while ‘simpler’ societies are indeed smaller (from a handful to a few thousand) than ‘complex’ ones, they still displayed great variation in size, complexity, ranking, and economic differentiation; they tend to be organized upon kinship relations; leadership is minimal (based upon personality, charisma, and persuasion) and without privilege or coercive power, and usually restricted to special circumstances; equitable access to resources exists and wealth accumulation does not; where political ambition exists, it is channeled towards public good and any acquisition of excess resources is redistributed, bringing greater social status

-where more complex political differentiation exists, permanent positions of authority/rank can exist in an ‘office’ that can be hereditary in nature; inequality becomes more pervasive; these groups tend to be larger and more densely populated; political organisation is larger, extending beyond local community; a political economy arises with rank having authority to direct labour and economic surpluses; with greater size, comes a need for more social organisation that is less dependent upon kinship relations, but such kin-ties constrain individual political ambitions

States

-states are characterized by their territorial organisation (i.e. membership determined by place of birth/residence); as well, “a ruling authority monopolizes sovereignty and delegates all power”, with the ruling class being non-kinship-based professionals that hold a monopoly on force within the territory (e.g. taxes, laws, draft) and is validated by a state-wide ideology; maintaining territorial integrity is stressed; being more populous, society becomes more stratified and specialized, particularly with regard to occupation

-complex states, like their simpler societies, must divert resources and activities to legitimizing authority in order for the political system to survive; while coercion can ensure some compliance, it is a more costly approach than moral validity; states tend to focus on a symbolic and sacred 'centre' (necessarily independent of its various territorial parts), which is why they always have an official religion, linking leadership to the supernatural (which helps unify different groups/regions); the need for such religious integration recedes--although not the sense of the sacred--once other avenues for retaining power exist

-support also requires a material base and can decline when output failure (political and/or material) ensues; this process is ongoing and necessitates resource mobilisation in perpetuity

Levels of complexity

-typologies have been developed to differentiate human social organizations

-some view the shifts as discreet while others see it along a continuum, the most obvious and agreed upon is state vs. non-state

-the major features of a state include: "territorial organization, differentiation by class and occupation rather than by kinship, monopoly of force, authority to mobilize resources and personnel, and legal jurisdiction." (p. 29)

-these are not exclusive to states, however, and can occur in non-state organizations and Tainter argues the evidence suggests a continuum of features may be most appropriate

-just as the rise of complexity occurs on a continuum, so does its decline; and, it occurs across the various organisations--state and non-state

The evolution of complexity

-how complex societies come into being is hotly debated and various theories exist (managerial hierarchies emerge as population or other stress increases; internal class conflict creates a need for protecting the privileged; conflict with competing groups that leads to needed sociopolitical shifts; several interrelated factors combine)

-two main schools exist: *conflict* and *integration*

-the conflict theory basically posits that "the governing institutions of the state were developed as coercive mechanisms to resolve intrasocietal conflicts arising out of economic stratification...to maintain the privileged position of a ruling class that is largely based on the exploitation and economic degradation of the masses" (p. 33)

-integrationists argue that complexity arose because of social needs such as shared social interests, common advantages, and consensus; a positive response to the stresses affecting human populations and the differential rewards to certain members is the cost for the benefits of centralization

-both theories have pros and cons

-conflict theory suffers from psychological reductionism in that it depends on the wishes/desires/ambitions of a small, privileged segment of society, but leaves unexplained how these arose

-integration theory avoids this pitfall by focusing upon real, observable needs and the compensation bestowed upon those performing these; this is an oversimplification and the coercive aspect of the role is often overlooked

-both theories acknowledge the role of legitimising activities--some of which must include real, material outputs--symbolic manipulation, and coercive sanctions

-both appear to see the state as a problem-solving organization that arose out of changed circumstances

Summary and implications

-"Complex societies are problem-solving organizations, in which more parts, different kinds of parts, more social differentiation, more inequality, and more kinds of centralization and control emerge as circumstances require." (p. 37)

-they are the anomaly of human history

-collapse can be seen as a rapid, significant decline in complexity where society is smaller, less differentiated and heterogeneous, less specialized, and has less control over individual behaviour, surpluses are smaller, benefits are less; it is a continuous variable much as its emergence and can be a drop within a level or between (i.e. state to chiefdom)

3. The study of collapse

Introduction

-while there exists substantial research around the process of collapse, it is little understood

-often, such research "is not only a scholarly attempt to understand the past and a practical attempt to ascertain the future, but also, in many minds, a statement of current political philosophy" (p. 39)

What collapses?

-as with this study, ancient and medieval writers viewed collapse as a fall of political entities

-modern scholars, however, have shifted towards seeing it "as a transformation of the features or behaviours that characterize a cultural entity" (p. 40); i.e. 'civilisation'

-Tainter argues the modern view is problematic in that what constitutes a civilisation is vague and value-laden, with cultural forms constantly changing making distinct shifts impossible to discern

-research using this view, however, still offers insight due to the links between civilization and complexity

Classification of theories

-the themes of collapse theories include:

1. "Depletion or cessation of a vital resource or resources on which the society depends.
2. The establishment of a new resource base.
3. The occurrence of some insurmountable catastrophe.
4. Insufficient response to circumstances.
5. Other complex societies.
6. Intruders.
7. Class conflict, social contradictions, elite mismanagement or misbehaviour.
8. Social dysfunction.
9. Mystical factors.
10. Chance concatenation of events.
11. Economic factors." (p. 42)

Framework of discussion

-the current study's goal "is to understand collapse as a general phenomenon, to gain an understanding not limited to specific cases, but applicable across time, space, and type of society." (p. 43)

-a major focus will be upon the 'logic' of explanations, relegating 'facts' to lesser importance; the conclusion being explanations so far cannot account for sociopolitical collapse

Resource depletion

-characterised by gradual deterioration of a resource base (usually agriculture) or a more rapid loss due to environmental/climatic shift

-while a popular cause for collapse, the argument assumes societies fail to take corrective action; however, Tainter argues complex societies are well-equipped to deal with such situations and if they cannot it is likely due to other constraints (e.g. political, structural, economic)

-some research shows that resource depletion can actually lead to greater complexity, the opposite of this theme

New resources

-reversal of resource depletion argument where alleviation of resource inequalities dispels need for social control, resulting in less complexity

-the restriction of this phenomenon to simpler societies precludes its use as a general explanation

Catastrophes

-there is only a subtle difference between this explanation and that of resource depletion

-this approach fails to be broadly applicable since many catastrophes are routinely overcome by complex societies

Insufficient response to circumstances

-this explanation argues that various systems (e.g. political, economic) are limited in their ability to respond to certain situations, leading to collapse

-while better than previous explanations, these theories require implicit assumptions about complex societies: they are large and inflexible, incapable of rapid, adaptive change; they become embroiled in positive feedback loops from which they can't escape; and/or, they are inherently fragile, with low reserves

-current knowledge of complex societies, however, suggest none of these assumptions are generally true

Other complex societies

-this approach argues competing societies can lead to collapse

-more often than not, conflict leads to one society expanding at the expense of the other

Intruders

-this common explanation usually suggests less complex societies impinge on more complex ones until overwhelmed

-such an approach, however, cannot be generalized and does not clarify much

Conflict/contradictions/mismanagement

-this may be the most commonly-used explanation of collapse with a common theme of social class conflict/antagonism that leads to peasant revolts

-this approach lacks the ability of being generalized as it has been used to explain increases and decreases in complexity; several concepts are also not fully understood, such as greed or

rationality; exploitation and misadministration are 'normal' components of sociopolitical hierarchies and thus difficult to blame for occasional collapse; peasant revolts usually lead to transformation rather than collapse

Social dysfunction

-this identifies mysterious internal factors as the cause of collapse but unfortunately fails to offer analysable factors

Mystical factors

-another popular approach that depends upon biological growth analogies and value judgements, and lacks empirically knowable processes (e.g. decadence, senility, vigour, morality, natural cycles, civility, ethics, vitality)

-problems include: the lack of a controlling mechanism in sociocultural growth and decline; the use of judgements/evaluations that preclude scientific standardization and are open to subjective interpretation and applicability; and reliance upon intangibles that are difficult/impossible to observe and/or measure

Chance concatenation of events

-a series of events or problems coalescing to cause collapse/decline is an approach difficult to generalise and apply to a recurrent process

Economic explanations

-three main themes exist: "(a) declining advantages of complexity; (b) increasing disadvantages of complexity; or (c) increasing costliness of complexity." (pp. 86-87)

-while many are skeptical of these explanations, they are superior to previous ones as they recognise the need to look for internal factors that cause weakness, identify specific mechanism/events causing change, and seek causal chains between the outcome and mechanism of control

Summary and discussion

-summarised, these explanations for collapse include:

- 1) Resource depletion-most complex societies can overcome this; where they can't one must identify the characteristics that prevent it.
- 2) New resources-usually restricted to simple societies.
- 3) Catastrophes-contingencies usually exist for this, failure should focus upon identifying sociocultural aspects that prevent it.
- 4) Insufficient response to circumstances-where this exists, it is usually specific characteristics of the society.
- 5) Other complex societies-usually result in cycles of expansion/contraction, not collapse.
- 6) Intruders-overthrown societies are to be explained, it is not an explanation.
- 7) Conflict/contradictions/mismanagement-these are common elements of a complex society and need to be explained.
- 8) Social dysfunction-precludes objective analysis.
- 9) Mystical-no scientific basis.
- 10) Chance concatenation of events-cannot be generalised.
- 11) Economic explanations-these are the best but to date have failed to develop a globally-applicable framework.

-for all but mystical explanations (it lacks scientific merit) relevant variables and processes are identified but they are inadequate mostly due to assumptions being necessary to accept them

4. Understanding collapse: the marginal productivity of sociopolitical change

-societies are dependent upon continuous energy flows

-the acquisition and distribution of resources is integrated within sociopolitical institutions

-these must evolve in harmony and the energy must be enough to maintain the sociopolitical complexity

-White argued that sociocultural evolution was linked to human-harvested energy, with greater complexity requiring greater energy per capita and greater amounts allocated to maintaining organisational institutions

-regardless of whether one holds a conflict or integrationist view, "complexity is a solution to perceived problems, and its facility in resolving these problems is based in part on its ratio of benefits/investment. Where this ratio is unfavorable, complexity is not a very successful strategy." (p. 92)

-Tainter proposes that return on investment in complexity varies and such variation follows a specific curve; that "in many crucial spheres, continued investment in sociopolitical complexity reaches a point where the benefits for such investment begin to decline, at first gradually, then with accelerated force. Thus, not only must a population allocate greater and greater amounts of resources to maintaining an evolving society, but after a certain point, higher amounts of this investment will yield smaller increments of return. Diminishing returns, it will be shown, are a recurrent aspect of sociopolitical evolution and of investment in complexity." (p. 92)

-concepts important in understanding why collapse of complex societies occurs include:

"1. human societies are problem-solving organizations;

2. sociopolitical systems require energy for their maintenance;

3. increased complexity carries with it increased costs per capita; and,

4. investment in sociopolitical complexity as a problem-solving response often reaches a point of declining marginal returns." (p. 93)

The marginal productivity of increasing complexity

-the main constituents of the interdependent system of complexity include: agriculture and resource production, information processing, sociopolitical control and specialisation, overall economic productivity

Agriculture and resource production

-Ester Boserup proposed "that increasing intensity in agricultural use of land is brought about by labor investment that is disproportionately greater than returns received." (p. 94)

-her typology of land uses are:

- 1) Forest-fallow cultivation (aka swidden, milpa, slash and burn) that clears an area of forest to use for a few years until weeds and declining yields force abandonment for about 25 years.
- 2) Bush-fallow cultivation that uses a shorter fallow cycle (6-10 years).
- 3) Short-fallow cultivation that uses a very short (1-2 years) fallow cycle.
- 4) Annual cropping that has only a few months between plantings.

5) Multi-cropping where intensive planting with no fallow breaks (only possible in favourable climates).

-agricultural output rises with increasing inputs (e.g. irrigation, human/animal labour, fertilizer, etc.) but expanding population places increasing strain on this eventually resulting in a decline of productivity

-it seems clear that "marginal returns on agriculture, in a subsistence economy, decline with increasing labor." (p. 95)

-investments in nutrition have also been shown to exhibit declining returns for life expectancy

-energy and mineral production also demonstrate this

-the most accessible, abundant, economically exploited, and easily converted resources are always used first

Information processing

-complex societies also depend upon large information processing (e.g. research and development, education, etc.), yet costs of this show a trend of declining marginal productivity

-the number of patents has fallen despite population increasing

-investment in more specialized education has similarly shown diminishing returns with increasing costs serving narrower interests

-of course, increasing need to invest in particular spheres necessitates decreased investment in other areas

Sociopolitical control and specialization

-"In complex societies a recurrent and seemingly inexorable trend toward declining marginal productivity in hierarchical specialization" (p. 106) occurs

-as societies become more complex, greater resources must go towards bureaucracy/administration as more disparate parts must be integrated and more information processed

Overall economic productivity

-well-developed economies can sustain modest to low rates of economic growth with late-comers to pursuing such growth having higher rates

-while some contend technical innovations can push rates higher, it too shows diminishing returns

Explaining declining marginal returns in complex societies

-although it doesn't always occur, declining marginal returns is "a problem common to many situations of increasing complexity, intensification in resource extraction, and economic growth." (p. 110)

-serious consequences result where it does happen

-why it occurs helps to demonstrate its regularity for investments in complexity

Agriculture and resource production

-"rationally-acting human populations will first exploit those resources that yield the best return per unit of effort, and still meet the needs of the population. If this is so, then it follows that any change in resource extraction must be in the direction of using resources that are more costly to obtain, process, distribute, and/or market, so that the marginal product of labor and other inputs declines." (p. 110)

-humans don't always act with economic rationality but the law of diminishing returns almost always applies

-and it isn't always population increase that creates the situation, although it often is

Information processing

-general knowledge is more lasting and attained at little relative cost, providing greater benefits than more specialized education and thus better marginal returns

-the same is true for research and development, with returns from specialized science less than more general research

-“The decreasing benefits from specialized, derivative work, viewed from the perspective of the overall history of science, are acquired at substantially greater cost.” (p. 112)

-“As more generalized knowledge is established early in the history of a discipline, only more specialized work remains to be done. This tends to be more costly and difficult to resolve, so that increasing investments yield declining marginal returns.” (p. 114)

Sociopolitical control and specialization

-complex societies are maintained through control and specialization

-“The reasons why investments in complexity yields a declining marginal return are: (a) increasing size of bureaucracies; (b) increasing specialization of bureaucracies; (c) the cumulative nature of organizational solutions; (d) increasing taxation; (e) increasing costs of legitimizing activities; and, (f) increasing cost of internal control and external defense.” (p. 115)

-as a society becomes more complex, its costs increase but the benefits of each additional change is not in proportion to the costs, and in some cases there are no benefits at all

-once more complex features are added, they are rarely abandoned so growth in complexity tends to be exponential

-by adding greater complexity “the potential for problems, conflicts, and incongruities develops disproportionately.” (p. 116)

-there are benefits for many added complexities but they only provide less and less positive return for the cost

-eventually “societies do reach a level where continued investment in complexity yields a declining marginal return. At that point the society is investing in an evolutionary course that is becoming less and less productive, where at increased cost it is able to do little more than maintain the status quo.” (p. 117)

Overall economic productivity

-as a society's economy expands, its growth rate slows and follows a logistic curve

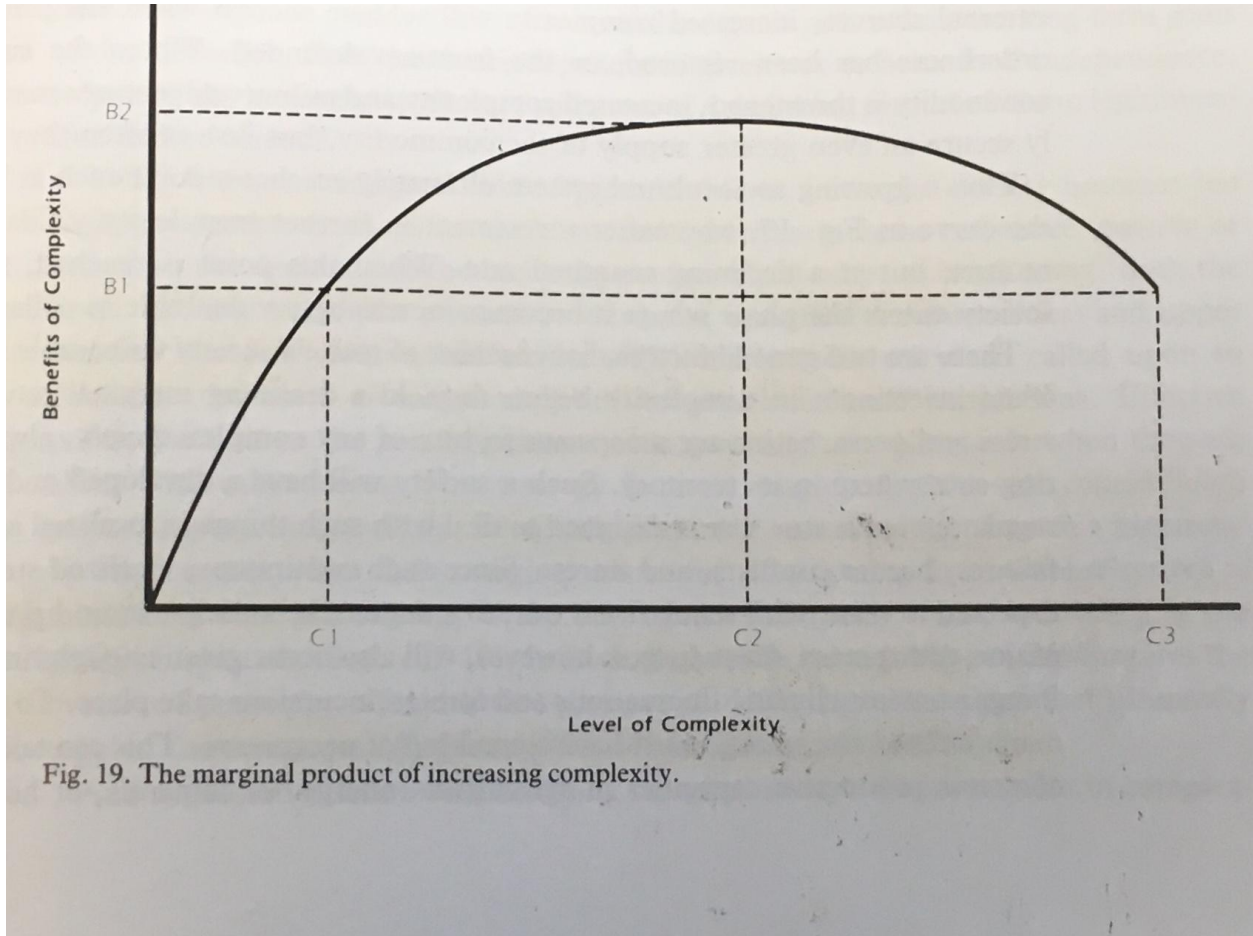


Fig. 19. The marginal product of increasing complexity.

- this may be the result of “an overall trend of declining marginal productivity in a society simply leaves proportionately less capital for investment in future growth.” (p. 118)
- this phenomenon impacts mature economies much more than young ones

Explaining collapse

- “A society increasing in complexity does so as a system. That is to say, as some of its interlinked parts are forced in a direction of growth, others must adjust accordingly.” (pp. 118-119)
- prior to the exploitation of fossil fuels, the energy cost of this growth was met mostly through human labour
- benefits relative to costs occur but follows the curve above so “that *at some point in the evolution of a society, continued investment in complexity as a problem-solving strategy yields a declining marginal return.*” (pp. 119-120)
- stresses are met via greater complexity that provide greater benefits per unit of cost to begin with as the least costly and easiest solutions are attempted first
- as time passes and further problem-solving is required, more costly and difficult solutions must be used
- “Barring the acquisition of new energy sources, most often through conquest, such increased costs are usually undertaken *merely to maintain the status quo.*” (p. 120)
- success is achieved when the factor(s) causing instability ceases to do so

- a point is eventually reached, however, where further investment yields returns at a declining marginal rate and it is here where a society becomes increasingly susceptible to collapse
- collapse may occur if an unexpected stress surge cannot be met by reserves
- stress is a constant feature of any society and is dealt with regularly, usually using previous production surpluses
- a society experiencing declining returns, however, uses these productive surpluses to meet current needs, eventually depleting reserves
- “Unexpected stress surges must be dealt with out of the current operating budget, often ineffectually, and always to the detriment of the system as a whole. Even if the stress is successfully met, the society is weakened in the process, and made even more vulnerable to the next crisis. Once a society develops the vulnerabilities of declining marginal returns, collapse may merely require sufficient passage of time to render probable the occurrence of an insurmountable calamity.” (p. 121)
- in addition, declining marginal returns can lead people to view complexity as a failed problem-solving strategy
- “Where marginal returns decline, the advantages to complexity become ultimately no greater (for the society as a whole) than for less costly social forms. The marginal cost of evolution to a higher level of complexity, or of remaining at the present level, is high compared with the alternative of disintegration.” (p. 121)
- for some, the option of detaching from larger sociopolitical forms is more attractive since fewer benefits are resulting from the costs
- smaller social units begin to pursue their own goals, forsaking those of larger units
- the status quo may respond through greater legitimisation activities and/or control
- peasant revolts may occur or, more commonly, apathy towards well-being of the polity
- sustaining services for a population becomes increasingly difficult as rising marginal costs due to declining resources saps economic strength
- unexpected stresses and normal operations are met by using reserves
- society disintegrates as local entities break away or is toppled militarily
- a society increasing its complexity through ever-increasing investment will eventually reach a point when marginal productivity can no longer rise; complexity can still accrue benefits past this point but at a declining marginal rate and stress will begin to rise (e.g. between growth/no-growth factions)
- although greater investment is made in research and development and education in an attempt to find solutions, taxes and inflation increase making collapse more likely
- a point may be reached when increasing complexity actually results in decreased overall benefits; a society with inadequate reserves becomes extremely vulnerable at this time since a significant stress surge can overwhelm
- the leadership may impose strict behavioural controls in response in an attempt to decrease inefficiencies

Alternatives to collapse

- contemporary society’s technical innovations are unprecedented in human history but they too are susceptible to the law of diminishing returns

-using a new energy source to help fund continuing economic growth can help stave off, but not eliminate, declining marginal productivity; this may not help eliminate diminishing returns in others areas (e.g. agricultural production)

-in the past, this was accomplished through territorial expansion (which also eventually encounters diminishing returns); today it is being done by exploiting fossil fuels and nuclear power

5. Evaluation: complexity and marginal returns in collapsing societies

-“The shift to increasing complexity, undertaken initially to relieve stress or realize an opportunity, is at first a rational, productive strategy that yields a favorable marginal return. Typically, however, continued stresses, unanticipated challenges, and the costliness of sociopolitical integration combine to lower this marginal return. As the marginal return on complexity declines, complexity as a strategy yields comparatively lower benefits at higher and higher costs. A society that cannot counter this trend, such as through acquisition of an energy subsidy, becomes vulnerable to stress surges that it is too weak or impoverished to meet, and to waning support in its population. With continuation of this trend collapse becomes a matter of mathematical probability, as over time an insurmountable stress surge becomes increasingly likely. Until such a challenge occurs, there may be a period of economic stagnation, political decline, and territorial shrinkage.” (p. 127)

-three examples of collapse will be reviewed to see if the process can be understood

1. The Western Roman Empire: one of the most complex and best documented examples.
2. The Classic Maya of the Southern Lowlands: developing from small hamlets to city states and regional systems, most data is archaeological in nature.
3. Chacoan Society of the American Southwest: a hierarchical, regional confederation exhibiting the least complexity of the examples.

The collapse of the Western Roman Empire

-a great success and failure, totally understandable through its declining returns on investments in complexity

-expansion of the empire was accompanied by emigration to new provinces suggesting restricted opportunities in the centre

-early success of this practice was via surplus accumulation and permanent tribute/taxes and created a positive feedback loop

-eventually this geometric expansion could no longer pay for itself and the focus turned to trying to maintain stability from a shrinking revenue base

-taxes that had been eliminated when conquered lands were subjugated had to be reinstated to pay for the military and welfare

-benefits (e.g. relative peace and prosperity, public works, border maintenance) continued but state wealth lessened

-the agricultural base that underpinned the economy could support regular expenses but could not handle crises; reserves built by prudent emperors were quickly depleted by their successors

-an increasingly common response was to debase the currency (that resulted in inflation)

-as difficulties increased, the expansionist policy was curtailed by some and attempts to shrink the administration took place (except the military which grew in costs to attract/keep soldiers--desertion was an issue); public welfare costs also continued to increase

-“The half century from 235 to 284 A.D. was a period of unparalleled crisis, during which the Roman Empire nearly came to an end. The chief features of this time were foreign and civil wars, barbarian incursions, devastation of many provinces, increases in the size of the army and the bureaucracy, financial exigency and increased taxes, debasement of the currency, and unparalleled inflation.” (p. 137)

-the Empire survived but was significantly altered with much decreased literacy and increased propaganda about external threats; political instability rose with constant struggle for claims to the throne and costly legitimizing actions; central control lessened with some provinces breaking away/revolting; lawlessness spread;

government needs government funding needs rose (infrastructure, welfare, military, etc.) but decline/disrepair expanded; taxes were raised and currency debased; inflation followed; literary decline limits data for certain periods

-those on fixed incomes, including government employees, bore the brunt; once revenue needs could no longer be met via taxes/currency debasement, forced labour was used and then taxes in kind (e.g., useful and/or needed supplies)

-barbarian incursions and civil wars proliferated

-having not recovered from an earlier plague (165-180), the crises of 235-284 fell upon a declining population, and the plague reemerged (250-270)

-the wealthy tended to emerge okay with most stress being felt by the middle class

-later governments were “larger, more complex, more highly organized, and that commanded larger and more powerful military forces. It taxed its citizens more heavily, conscripted their labor, and regulated their lives and occupations. It was a coercive, omnipresent, all-powerful organization that subdued individual interests and levied all resources toward an overarching goal: survival of the State.” (p. 141)

-military personnel became the dominant need, along with infrastructure to support the military (e.g., roads and fortresses)

-another major change was the establishment of an eastern and western half, each ruled by separate emperors (assisted by caesars) to help deal with increasing occurrences of crises, subdivided provinces, increased administration and bureaucracy (increasingly segmented/specialised), state factories were enhanced (for armaments and other imperial material needs), state transportation systems maintained

-funding increased for activities that legitimised power (e.g., public displays such as construction projects) and for welfare

-Constantine supported a universal religion (Christianity) that he used to legitimise his position and power (sanctioned by divinity); coins showed symbols of imperial power; both of these supported increased authoritarianism

-while making the empire more efficient and better defended the costs of these changes were significant, placing an increased burden upon society

-as taxes increased the role of government in economic life rose

- attempts to restore sound currency failed and inflation continued with little pause; in some regions, hyperinflation occurred; coinage was constantly debased; price edicts failed
- expanded military and civil administration drew on a depleted population, resulting in declines in agricultural and industrial output
- conscription was reinstated to bolster the military
- occupations became hereditary, and then the military also
- public and private sector differences blurred as government directed more and more private affairs
- agricultural labour became tied to the soil and serfdom arose where tenants became bound to large estates (benefiting land owners); arable land was abandoned as population declined; some city councils became responsible for taxes on these lands; military veterans were offered large tracts of land if they farmed them (significantly less if they did not)
- three unsatisfactory explanations for the abandonment are: soil exhaustion, labour deficiencies, and barbarian invasions
- contemporaries of the time blamed overtaxation, with some arguing there were more living off the treasury than those paying into it; not only were rates constantly increasing but they were flat taxes with no regard to ability to pay and with little variation based upon yield fluctuations or land quality
- abandoned land would be assigned to others nearby, as well as its taxes; or to the local town/city
- poll taxes remained rigid regardless of population decline with villages responsible (sometimes even for nearby abandoned villages)
- obligations (and back taxes) would be applied to widows, children, and dowries
- to survive, many took on credit and lost land to creditors; crops were sold for taxes and many farmers fled to cities where stores of grain existed
- those who couldn't meet tax obligations were jailed, children sold into slavery, homes/fields abandoned
- a patronage system arose where powerful landowners protected peasants against government demands and legislation to this was unsuccessful
- even city endowments were expropriated
- rigid control of individuals evolved as guilds/localities were commanded to produce essentials for the Empire but this led to land abandonment, crop yield decline, countryside depopulation, and impoverishment of cities
- military might declined as necessary occupations competed for personnel (eventually barbarians were part of the Roman army)
- taxes were exorbitant with revolts against them periodically occurring
- both rich and poor are said to have wished the barbarians would free them from the Empire's burdens; some even joined with the invaders
- invaders were increasingly successful as the Empire's wealth and manpower dwindled
- as peripheral lands that supplied food was lost, civil services began to breakdown
- when the army (almost totally comprised of barbarians) could not be remunerated (asked for Italian lands), they deposed the Western emperor and placed their own King in control (476 AD)

Assessment of the Roman collapse

- Roman expansion was a successful policy when initiated (middle of 3rd century BC)
- conquered subjects/lands supplied resources for further expansion, allowing little burden be placed on Rome itself
- the benefit/cost ratio of this approach was very high but this fell as time passed
- profitable conquest numbers fell and equitable competitors were encountered (e.g., Persian Empire) or those that required much greater costs (e.g., Germanic tribes)
- lands further afield were more difficult to govern (especially inland away from the Mediterranean Sea lanes)
- these factors led to an end to the expansion policy, particularly when such conquests could not even pay for themselves
- the administration and defense costs of new lands quickly depleted marginal surpluses requiring new income be used decreasing cost/benefit ratio, sometimes to negative values
- “So the process of geographical expansion, if successful, yields a marginal return that is initially very high, but which inevitably begins to decline. By the time the conquest of the rich Mediterranean lands was completed, this was the situation in the Roman Empire.” (p. 149)
- the imperial administration had to be supported by annual agricultural outputs that were variable as the political environment increased in hostility
- fiscal inefficiencies became endemic and stress surges depleted surpluses and annual income
- land and other treasures had to be sold on occasion to meet demands
- more commonly, the currency was devalued, delaying temporarily the true costs through inflation that taxed the future to pay for the present
- the policy that was initially a windfall had become a burden
- marginal returns on investment continued to fall leaving insufficient reserves to meet emergencies
- the two options to deal with this (direct taxes and indirect ones via currency debasement/inflation) were adopted
- civil war and barbarian invasions increased costs with no return
- maintaining the status quo was the best that could be accomplished
- this process intensified with time and devastated the population who received no increased benefits for the significant increase in costs
- the Empire sustained itself by increasingly depleting its capital resources (i.e., peasant population and productive lands); output declined as a result and the ability to meet future crises fell
- when a society encounters declining marginal returns, collapse may occur due to this inability to meet a sudden stress surge or from an overtaxed population being alienated
- some overtaxed peasants welcomed barbarians and many other were apathetic towards collapse as the Empire had lost most of its legitimacy (Empire was no longer beneficial as either barbarians or tax collectors were problems)
- autonomy was preferred as complexity no longer gave benefits better than the costs
- collapse actually increased the marginal return on investment

- barbarian rule was more effective and less costly, and although complexity was lost, benefits increased
- the East survived longer as it was economically stronger and less vulnerable than the West (smaller frontier to guard)
- the East's population was wealthier, more numerous, and thus less tax-burdened; as a result, the government held more legitimacy
- circumstances were also such that the East couldn't collapse
- some have suggested that the lack of economic development was because agriculture didn't intensify and industry didn't develop
- such innovation and technical development, however, are rare in history
- in addition, the later Empire was significantly underpopulated; cultivated lands were abandoned and labour was in short supply
- attempts by government to reverse these trends were unsuccessful
- it is usually demographic and/or economic pressures, not top-down impositions, that spur such innovation/development

The Classic Maya collapse

The setting

- the Southern Lowland Maya experienced a sudden collapse between 790-890 AD
- the area occupied is dominated by tropical rainforest with flat-topped limestone ridges interspersed with seasonal swamps
- May to November is both the rainy and agricultural seasons
- droughts occur but a relatively minor, with rainfall fluctuations rarely impacting agriculture
- there exists debate regarding ecological diversity of the region, which has implications for sociopolitical evolution
- some believe there exists topographical redundancy but ecological homogeneity while others view it as quite diverse

Views of the Maya

- the Classic Maya were initially believed to be scattered, practising slash-and-burn agriculture
- their ceremonial centres were visited periodically, housing only a small number of priests/nobles
- they were a peaceful people with few elite demands, although the peasants eventually refused to meet their demands leading to a revolt and collapse
- the above characterisation runs counter to most early civilisations that displayed high population densities with labour-intensive farming and a hierarchical social organisation
- more recent evidence has required a reassessment of the above: urban centres existed with tens of thousands of occupants, intensive agriculture would have been required, sociopolitical complexity was high, and warfare/fortifications were present

The evolution of Maya Civilization

- Early-Preclassic Mayan villages appeared beginning in 2000 BC (200-300 people)
- Middle- and Late-Preclassic farmers were successful, supporting a growing population
- this growth began to place a strain on agriculture and it adapted by becoming more labour intensive with hydraulic engineering projects

-by the Middle-Preclassic (1000-400 BC) population pressures led to the water deficient interior being settled

-the Late Preclassic (400-50 BC) witnessed deforestation of central areas and fortifications at some sites (indicative of population pressures on resources)

-population pressure, resource base strain, and increased competition led to agricultural intensification and greater sociopolitical complexity (especially during Middle- and Late-Preclassic) as seen through public building on platform, status differentiation in burials, noticeably larger residences for some, monuments, increasing public architecture

-these trends continued through the Classic

-while centres were spread rather equally early on, several took on greater significance with more monuments and perhaps the role of a regional capital (e.g., Tikal during Early-Classic (250-550 AD))

-a hierarchy of centres eventually emerged as did defensive construction projects (e.g., earthworks, moats)

-at the end of the Early-Classic a decline in new monuments, new sites, and ceramic/architectural styles appear (termed the Hiatus (550-600AD)) along with apparent political decentralisation

-trends resurfaced during the Late-Classic (600-800 AD)

-major centres were surrounded by secondary ones, alliances were formed via marriages, investment in architecture increased

Population

-population growth continued during the Classic period peaking in most regions during the Late-Classic and then levelling off

-Tikal was the most densely populated centre (10,000-11,000 in 16 square kilometres, and another 39,000 in the immediate area)

-200 people per square kilometre is the estimate for the entire Southern Lowlands (highest density in preindustrial world)

-local agriculture would not be able to sustain such populations

Subsistence

-permanent and organised intensive agriculture included: canalisation of raised/channelled fields, water channelling and storage, and terracing of hills

Canalization/raised fields

-areas prone to flooding were converted to raised fields with canals (e.g., swamps, lakes, lagoons, rivers)

-benefits included: fish propagation, organic soil from canal bottoms, transportation, moist root environment

-estimates of 1250-2500 square kilometres of such fields exist

Water channeling and storage

-water was stored via canals, dams, reservoirs, wells, and use of cenotes (limestone sinkholes)

-hydraulic engineering was significant in some regions (e.g., Edzna with a moat, canals, and reservoir for defense, agriculture, and consumption)

Terraces

-hundreds of thousands of terraces and related stone works existed dating from the late Early-Classic through to the Late Classic

Miscellaneous features

-checked dams and walled fields (some time part of terrace system) have also been found

Mayan crops

-maize was certainly a staple

-some reliance on nuts and root crops has been suggested

-evidence exists for squash, avocado, cacao, and cotton

-art depicts some fruit-bearing trees

Sociopolitical complexity

-society was highly stratified and complex

-there existed a ruling class, mid-level artisans/bureaucrats, and peasants (each of these levels was further stratified)

-leadership tended to be hereditary with reigns legitimised by sculptural art

-art depicts elite concern with alliances, conflict, hierarchy, and politics

-each polity was represented by a Major Centre (e.g., Tikal) that dominated Minor Centres (less art/architecture) which administered local peasants

-residential areas were segregated by status

-density declined between centres for the most part, although some regions displayed continuous occupation for some distance (e.g., 40-50 kilometres with no more than 100 m between structures)

-concentration in centres increased through time, especially in the Late Classic, and even some rural areas witnessed densification

-dominance hierarchies existed amongst the major centres with local polities in the surrounding regions (each hosting an administrative centre)

-hierarchies shifted as political fortunes changed

-there is disagreement over whether certain centres held significant power over others or large regions as there was little advantage to it

-increasing complexity can be found via public architecture, monuments, pottery styles, art, and increasing importance of nobles and administrators

Warfare

-military competition appears to have begun at least by the Proto Classic (50 BC-250 AD) with evidence of major fortifications (e.g., ditches, parapets)

-competition over resources was likely the result of population growth

-concentration in centres would also result

-Classic period warfare appears to have been small and sporadic in most regions (some, however, hold evidence of major conflict)

The collapse

-a burst of monumental construction preceded collapse and political decentralisation was evident before its completion (i.e., new centres arose on the periphery)

-construction at major centres stopped as it rose at more distant, small sites (until they got caught in the collapse)

- collapse occurred relatively quickly (repeating itself in varying degrees at different sites throughout the Southern Lowlands)
 - at the time of collapse, foreign incursions are evident
 - initial theories suggested these led to collapse but more current ideas argue these took advantage of collapse as attempts to fill power vacuums
 - various elements of complexity were lost with collapse: temple erection/refurbishment, residential/administrative structures, luxury item manufacture, stela erection, writing and calendrical systems, elite class
 - a decline in population also occurred (3,000,000 to 450,000 over 75 years) primarily due to an increased mortality rate (10-15%) and/or emigration out of the region
 - the relationship between population loss and collapse is not clear since population leveled prior to collapse and decline varied across the region
 - some centres retained a portion of their population
 - some areas show a sharp drop off in elite populations but not commoners (this could be due to sampling error)
 - depopulation and collapse could be related, but the relationship is very complex and varies across time and space
 - collapse of one centre soon impacted nearby ones as distressed populations raided nearby regions
 - what occurred at Tikal exemplifies the post-collapse period (80-400 AD): about 1000-2000 Eznab people lived in the vaulted structures, depositing their refuse in courtyards, down stairs, in rooms; when structures deteriorated, they occupied an empty one with no rebuilding; pottery was less perfect than at peak; burials were with former elite but with few accessories; Classic tombs/caches were looted; attempts to copy Classic ceremonialism were poor; when the people left, Tikal's collapse was complete
 - this pattern was repeated at other centres and even amongst rural populations
 - some areas, however, did not collapse (e.g., Northern Lowlands, regions of Belize)
- Assessment of the Mayan collapse***
- research has contradicted the traditional view showing instead that the Maya "were a high-density, stressed population, practicing intensive agriculture, living largely in political centers, supporting both an elite class and major public works programs, and competing for scarce resources." (p. 169)
 - the similar topography that existed in the Southern Lowlands contributed significantly to the development of military competition as a result of population/resource stress and eventual collapse
 - increasing population puts stress on food production systems and fluctuations in productivity become more significant as this stress increases
 - areas with lots of topographic diversity will have food systems with different productivity cycles that can alleviate natural fluctuations via economic trade/symbiosis (surpluses can provide for others creating reciprocal obligations taken advantage of during scarcity)
 - such 'energy averaging' systems are quite common and crucial in densely populated, complex systems

- these only arise, however, in the ideal environment where diverse systems that fluctuate non-synchronously and are sufficiently close for an economical transport system
- economic cooperation of this nature is unlikely in an environment with synchronised fluctuations where competition, raiding, and warfare is the more likely result
- the intensive agricultural systems of the densely populated Preclassic and Classic periods were susceptible to fluctuations at the same time due to similar topography
- the rise of raiding/warfare was natural given the circumstances, as was greater agriculture intensification and establishing a hierarchically-managed economy
- warfare, population, and complexity appear to be systemically related
- with population placing stress on food systems and periodic natural fluctuations occurring, raids upon neighbouring fields and villages/storage complexes near harvest time rose leading to clustering around centres that could offer security; this created greater stress on food systems and left hinterlands relatively abandoned; these shifts also resulted in greater sociopolitical complexity/hierarchies
- positive feedback loops seems to have existed in the sense that the solution to population stress (warfare and agricultural intensification) resulted in further population increases
- once this competitive system was established, deterrence was needed and a signalling system grew (monumental architecture, art) that reflected population size (and thus potential defense), ruler strength (military depictions), and served to attract support from nearby rural populations
- advantages went to larger centres with competitive displays and that could mobilise large populations
- warfare expanded beyond its original subsistence procurement aim to impact political relations/dominance hierarchies
- “among the Classic Maya high population density occurred in association with vast hydraulic and agricultural engineering, sociopolitical complexity, massive public works , and military competition. More importantly, each of these variables was increasing (except for population, which eventually levelled off). Complexity and architectural investment grew significantly just prior to collapse.” (p. 173)
- skeletal remains indicate the people experienced a growing food supply crisis climaxing in the Late Classic
- marked stature differences between the elite and lower status populations began around 1 AD, increasing until the Early Classic but by the Late Classic both groups of males began to show nutritional deterioration
- many of the deficiencies (infections and nutritional) found would have impacted normal functioning and work capacity; urbanites died earlier than their rural counterparts and lower class populations witnessed significant death in older children/adolescents
- the Mayans lived under increasing stress for about 1000 years (Late Preclassic to Classic); it was more prevalent in rural regions but more severe in urban centres
- collapse appears to have been the result of various stresses and pressure that set in motion costly complexities (i.e., regional competition/warfare, elite hierarchy, monumental construction projects, hydraulic/agricultural engineering, political administration) that fell upon the agricultural population

- while this investment had benefits at first and grew over time, eventually marginal returns began to deteriorate with increasing investments (i.e., warfare, complexity, agricultural intensification) yielding no improved benefits in health and nutritional status; in fact, the support population experienced a decline in these
- that stress is mainly evident in males, it is likely females were favoured to help increase the population (as did the late Roman Empire via tax incentives)
- society was ripe to succumb to a stress surge by the Late Classic being weakened by declining marginal returns
- the peasant population likely experienced an improved standard with the collapse in the short-term as their burden of supporting the elite was removed, but they too were soon decimated
- the Northern Lowlands did not collapse as the south did and actually grew

The Chacoan collapse

- Chacoan society of the San Juan Basin of NW Mexico developed in a challenging environment with the major topographic feature being the Chaco Canyon whose drainage system helped to capture relatively insufficient precipitation but held poor soil for agriculture and had a short growing season
- while various societies arose at different times in the area, the Chacoan one displayed unparalleled social complexity, political stratification, and economic symbiosis
- Chacoan architecture was its outstanding feature
- Chacoan 'Great Houses' were: significantly larger than nearby structures (some with several hundred rooms and several stories); the result of extensive planning, construction, and labour; included costly masonry and high-ceilinged rooms with timber roofs; decorated with elaborate religious architecture (Great Kiva)
- the majority of the population lived, however, in small pueblos that were small and unplanned with simple masonry, small rooms with low ceilings, and small, simple Kivas
- Great Houses had what are believed to be many storage rooms with minimal occupation relative to their size
- burials in these Great Houses were associated with many valuable items whereas those of the Pueblos were not
- these architectural and mortuary differences suggest a highly stratified society with the elite occupying the Great Houses
- the largest sites are in and close to Chaco Canyon with a well-constructed road network radiating out (masonry curbs, causeway over drainages, carved stairways at cliff faces)
- small Outlier Great Houses are along the roads probably serving as way-stations
- social complexity appears in the San Juan Basin with its Basketmaker III phase (400/500 -725/750 AD) and Pueblo I (725/750-900 AD) [Early Pueblo II (900-1000 AD); Late Pueblo II (1000-1050 AD); Early Pueblo III (1050-1150 AD); Late Pueblo III (1150-1225 AD)]
- a number of small, independent pueblos were supported by 900 AD, then changes began with several sites developing Great Houses and Kivas along with water control systems
- agricultural villages had been established to support Outlier Great Houses and roadways to connect them

-a flurry of construction began about 975 AD and then suddenly declined significantly just after 1100 AD

-economic integration of the region had been growing as had the population (4400-10,000 at peak)

-by the early 1200s, however, the system had collapsed with no Great House construction and abandonment of agricultural sites

Assessment of the Chacoan collapse

-marginal lands were increasingly relied upon for subsistence by 900 AD due to population growth and lack of alternative territories to exploit

-the produce of other areas was also acquired via trade, particularly from the well-watered, higher diversity areas at the Basin's edge (these two regions could help each other since warm, dry years were good for the higher elevations and cool, wet years for the lowlands)

-a Basin-wide energy averaging system to take advantage of such differences was situated in the Chaco Canyon being in the centre of the Basin

-the advantages of a hierarchical management of this economic integration included: a reduction of competition/conflict due to equitable distribution of resources; the authority to request surpluses from regions with them to avoid balancing delays; centralised pooling of resources for a large, diverse territory; support for specialists to monitor surpluses/deficits

-a 3-level system seems to have developed: the elite of Outlier Great Houses administered local agricultural villages and interacted directly with the elite of Chaco Canyon

-resources involved included: food, firewood, construction materials, pottery, animal products, stone, cotton, salt, and turquoise

-the establishment of this system would have had a high return on investment, but as it expanded this return would have fallen

-as time passed, less productive lands were incorporated and Outlier Great Houses were situated closer and closer together

-late trends indicate Outlier Great House numbers increasing; a jump in building activity and thus labour needs; functional architectural specialisation; decreasing distance between Outliers; Outliers increasingly in low productivity areas

-these trends increased costs as effectiveness fell

-as Outlier Houses came closer together, their agriculture experienced similar conditions reducing availability of surpluses, especially in the lower diversity Basin

-the advantage of diversity was lost, reducing efficiency

-the building boom came at a time when efficiency of the regional system was declining

-facing increased costs for declining returns, some communities began to withdraw from the established network and further weakened the system (especially problematic when productive land communities withdrew)

-participation could not be enforced, leaving weaker areas contributing less

-Chacoan society success led to its downfall

-subsistence security reduced natural checks on population requiring increasing use of marginal lands for agriculture and creation of an exchange network

-Outlier communities produced little surplus and an increase in storage architecture suggests a concern with food security and possible food shortages (classic example of declining marginal returns)

-a prolonged drought (1134-1181 AD) may have been the final stress surge, although the Chacoans had survived previous droughts

-there were strategies that could have been pursued to counter the drought but likely were not due to their costs (marginal return too low); collapse was a preferred option economically

-while the drought didn't 'cause' the collapse, it simply changed "the curve of marginal return on investment in complexity from a smoothly to a sharply declining one, and so to hasten the end."
(p. 187)

Evaluation

-the Roman, Mayan, and Chacoan collapses can be understood by similar principles despite their different sociopolitical structures, complexity levels, economies, and environments

-it is how the factors that contributed to their collapse related to the cost/benefit ratio of investment in complexity

-collapse became increasingly likely when stresses significantly reduced the ratio or occurred alongside declining marginal returns

The Roman collapse

-the Roman Empire was largely paid for by successive conquests where subjugated regions subsidised more military conquests

-as expansion became more costly, profits fell and administration/defense costs came out of agricultural production

-fiscal insufficiency rose but peace/prosperity continued for a time so increased costs were still beneficial

-significant stress surges (e.g., barbarian incursions) began to impact the empire negatively and costs could not be covered by surpluses so the currency was increasingly debased shifting costs to the future (which assumes no similarly stressful crises will occur)

-escalating crises had a detrimental impact for an already stressed population

-currency debasement, tax increases, and stringent regulations on citizens helped for a time, but the resulting costs decreased marginal returns for the people

-a stressed populace could not recover from plague outbreaks, productive lands were abandoned, and the State lost its ability to support itself

-barbarian incursions became increasingly successful

-the advantages of empire fell so significantly that many peasants welcomed and joined invaders, experiencing an improvement in the cost/benefit ratio that had fallen as part of the Roman Empire

The Mayan collapse

-the Maya of the Southern Lowlands existed in a constraining environment due to geography and neighbouring societies

-population pressure in some areas created several stress responses including: marginal lands brought into cultivation; intensification of agriculture; sociopolitical hierarchy expansion; warfare with neighbours

- rural insecurity led many to concentrate in political centres adding pressure to local resources and resulting in intensive agricultural practices (e.g., raised fields, terraces)
- accompanying more defensible farm plots came increased military strategy, and social and economic stratification; and possibly encouragement of population growth
- monumental architecture, that served, to signal a polity's strength via wealth, population, security, and health/nutrition appeared to show decline so increasing demands fell upon a weakening population

The Chacoan collapse

- the energy averaging system employed early on took advantage of the Basin's diversity, distributing environmental vagaries of food production in a mutually-supportive network that increased subsistence security and accommodate population growth
- at the beginning, such a system can be improved by adding more participants and increasing diversity but as time passes duplication of resource bases increased and less productive areas are added causing the buffering effect to decline
- as return on investment dropped, communities began to withdraw, and this occurred at a time that the elite expanded monumental construction

Conclusions

-observations about the collapse process include:

- 1) Benefits to the population fell as the costs of complexity rose;
- 2) Shortly before the collapse, costs increased substantially and burdened a population already weakened by declining marginal returns;
- 3) The demands of supporting a complex system negatively impacted the well-being of people, who's population had leveled off/declined before collapse;
- 4) Growth appears to have negatively affected the environment (perhaps due to population pressures on resources);
- 5) Peripheral peoples rose to prominence after the collapse.

-Rome's collapse was not due to barbarian invasions or internal weaknesses but "the excessive costs imposed on an agricultural population to maintain a far-flung empire in a hostile environment" (p. 191)

-the Mayan collapse was not brought about by peasant revolts, invasions, or agricultural deterioration but "due to the burdens of an increasingly costly society borne by an increasingly weakened population" (p/ 191)

-the collapse of the Chacoan society was not due to environmental deterioration but because the population choose to disengage when the challenge of another drought raised the costs of participation to a level that was more than the benefits of remaining

-all of these collapses "can be understood as responses to declining marginal returns on investment in complexity" (p. 192)

6. Summary and implications

Summary

-"Collapse is recurrent in human history; it is global in its occurrence; and it affects the spectrum of societies from simple foragers to great empires...Political decentralization has repercussions in economics, art, literature, and other cultural phenomena, but these are not its essence.

Collapse is fundamentally a sudden, pronounced loss of an established level of sociopolitical complexity.

A complex society that has collapsed is suddenly smaller, simpler, less stratified, and less socially differentiated. Specialization decreases and there is less centralized control. The flow of information drops, people trade and interact less, and there is overall lower coordination among individuals and groups. Economic activity drops to a commensurate level, while the arts and literature experience such a quantitative decline that a dark age often ensues. Population levels tend to drop, and for those who are left the known world shrinks.” (p. 193)

-complex societies represent points along a continuum and are a relatively recent phenomenon that require constant reinforcement to maintain

-activities to legitimize complexity/stratification require a material resource basis creating an economic cost

-the conflict school argues that the state arose to protect the propertied classes while the integration school suggests it emerged as a result of social needs and adaptation

-there are positive/negative aspects to both, but they both view the state as “a problem-solving organization, emerging because of changed circumstances” (p. 194) and requiring resource mobilization

-“Four concepts lead to an understanding of collapse, the first three of which are underpinnings of the fourth. These are:

1. human societies are problem-solving organizations;
2. sociopolitical systems require energy for their maintenance;
3. increased complexity carries with it increased costs per capita; and
4. investment in sociopolitical complexity as a problem-solving response often reaches a point of declining marginal returns.” (p. 194)

-humans tend to exploit the easiest to access/extract/process/distribute resources first, leaving more costly ones until later and experiencing declining returns on investments as a result

-to preserve the status quo, sociopolitical organizations must increase their investment in complexity with the support population bearing the cost but experiencing decreasing benefits

-as costs rise, investments for future growth decline “at first gradually, then with accelerated force. At this point, a complex society reaches the phase where it becomes increasingly vulnerable to collapse.” (p. 195)

-two factors can increase the possibility of sociopolitical collapse

-first, because of declining marginal returns, surpluses deteriorate making the ability to address an unexpected stress surge less effective and increasing vulnerability to the next crisis

-“Once a complex society enters the stage of declining marginal returns, collapse becomes a mathematical likelihood, requiring little more than sufficient passage of time to make probable an insurmountable calamity.” (p. 195)

-second, declining marginal returns create a situation where increasing investments/costs are seen as less attractive than separation/disintegration and regions begin to resist continued investments

-collapse of the Western Roman Empire, Southern Lowland Maya, and Chacoans reflect this process of declining marginal returns on investments in complexity creating a more vulnerable society

Collapse and the declining productivity of complexity

-most researchers on civilization “see complexity as a desirable, even commendable, condition of human affairs. Civilization to them is the ultimate accomplishment of human society, far preferable to simpler, less differentiated forms of organization...

With such emphasis on civil society as desirable, it is almost necessary that collapse be viewed as catastrophe.” (p. 197)

-because complex societies are a relatively recent phenomenon, collapse is “a return to the normal human condition of lower complexity...an economizing process. It occurs when it becomes necessary to restore the marginal return on organizational investment to a more favorable level.” (p. 198)

-in fact, for those receiving little return on their investments in complexity (usually the majority of a population), the collapse can bring economic gains; it is an appropriate response to declining marginal returns, not a catastrophe as those who cherish civilization argue (usually the elite and those who cannot produce primary food sources)

-the population decline noted in the archaeological data does not suggest it was a result of collapse but of emigration (during or before collapse)

-there is not a clear answer as to whether declining marginal returns guarantees collapse, but if left unchecked it certainly increases vulnerability to it

Further implications of declining marginal returns

-the marginal product curve arose in the manufacturing sector to characterize cost/benefit ratios in resource extraction and the concept of diminishing returns impacting economies developing in nineteenth-century classical economics

-one common cause of collapse—peasant revolt—is likely more attributable to declining returns on their support to the local polity than unfair tax levels; once the disabilities associated with complexity outweigh the benefits, revolt becomes more likely

-there are some regions where ‘collapse’ does not occur because of the role of peer polities, smaller states that interact on a relatively equal footing and expand/contract with little loss of complexity (unless they all collapse together); if one polity collapses, a neighboring one (or more) usually expands to absorb it

-in such a scenario, peasant action focuses on reformation and not decomposition, resulting in increased political participation to increase investment returns and attempts to prevent a neighboring polity from expanding into their territory

-slow disintegration (gradual loss of power/territory to competitors) is not collapse as such (sudden loss of complexity)

-“*Collapse occurs, and can only occur, in a power vacuum.* Collapse is possible only where there is no competitor strong enough to fill the political vacuum of disintegration. Where such a competitor does exist there can be no collapse, for the competitor will expand territorially to administer the population left leaderless.” (p. 202)

-peer polities locked in endless competition (increasing investment in political and military complexity) regardless of declining returns, tend to reach economic exhaustion together and collapse in unison if no competitor can take advantage

Suggestions for further applications

-“Declining marginal returns, in general, can arise from any of the following conditions:

1. benefits constant, costs rising;
2. benefits rising, costs rising faster;
3. benefits falling, costs constant; or
4. benefits falling, costs rising.

In undertaking to study the collapse of any complex society, these conditions should be looked for.” (p. 205)

Declining marginal returns and other theories of collapse

-declining marginal returns can incorporate previous explanatory themes (except for the mystical)

Resource depletion

-as a cause of collapse, this depends upon a society's position on the marginal return curve
 -a society experiencing declining returns may be unable to take advantage of the economic development necessary to respond to resource constraints

New resources

-if these can alleviate shortages/inequalities, then further investment in complexity are unnecessary

Catastrophes

-it is only societies that are experiencing economic weakness (perhaps due to declining returns) that cannot recover from such events

Insufficient response to circumstances

-failing to adapt to certain circumstances is a subjective evaluation when one considers rejection of complexity (i.e. collapse) may be a beneficial economic choice in a time of declining returns

Other complex societies

-when the return on investment to support complexity declines to a point where the population considers it too low for the cost, collapse is a beneficial economic option; if the cost of expansion for a neighbouring polity to a collapsing one is considered too high, conquest will not take place

Intruders

-a more powerful and complex society experiencing declining returns can fall victim to a lesser one ascending the complexity continuum, particularly if it has depleted reserves

Conflict/contradictions/mismanagement

-class conflict tends to become exacerbated during periods of declining marginal returns as inequality increases; such times also highlight elite misbehaviour as opposed to it remaining less obvious/important when returns on investments are increasing/stable

-in addition, good or bad behaviour by individuals/groups have little significant impact on large, complex systems

-“Complex societies do not evolve on the whims of individuals. Circumstance-induced perception is likely to be of greater consequence: rulers look good when the marginal return on investment in complexity is rising, for in such a situation almost anything a leader does is overshadowed by a large payoff to society-wide investment. Conversely, when marginal returns are declining there are usually very little that leadership can do in the short term to arrest this trend, and so anything that is tried is bound to appear incompetent.” (p. 208)

Social dysfunction

-this vague, ethereal notion provides little understanding and a better approach would be to look at the cost/benefit of adopting complex social features

Mystical

-another non-scientific, subjective/value-laden explanation (e.g. cyclical oscillations that collapse due to 'burn out'; vigour vs. decadence) better explained via declining marginal returns

Chance concatenation of events

-inadequate explanation unless society already weakened economically

Economic explanations

-these are united by three themes that fall under declining marginal returns: increasing costs of complexity, declining advantage of complexity, increasing disadvantage of complexity

-the principle of declining marginal returns appears to unite "both internal/external theories of change, and conflict/integration models of society" (p. 209)

-less costly (internal) organizational solutions are adopted initially in response to changing (external) conditions; and, the cost/benefit ratio of investment in organizational changes are considered whether a beneficiary or victim of complexity with both repressive and benign regimes impacted by declining marginal returns

Contemporary conditions

-complex societies are prone to collapse

-collapse is an adjustment on the economic level and can be significant to those unable to produce primary food resources (e.g., highly industrialised modern society)

-the result would certainly be a huge loss of life and much lower standard of living for survivors

-contemporary threats to humanity include: nuclear war and associated climate impact; increased atmospheric pollution and the impact on climate and circulation patterns; industrial resource depletion; and economic breakdown due to unpayable debts, fossil fuel shortages, and hyperinflation

-in fact, "a respectable segment of the population of Western industrial societies fears that one or several of these factors will bring a breakdown and a new dark age" (p. 210)

-individuals to international politics are influenced to a certain degree by these threats

-"Certainly none can argue that industrialism will not someday have to deal with resource depletion and its own wastes. The major question is how far off that day is. The whole concern with collapse and self-sufficiency may itself be a significant social indicator, the expectable scanning behaviour of a social system under stress, in which there is an advantage to seeking lower-cost solutions" (p. 210)

-what is important to consider is the cost/benefit ratio of investments in complexity

-declining marginal returns have been observed in: education; agriculture; research/development; technical design; health; government/industrial/military management; mineral/energy production

-some countertrends likely exist but "some industrial societies are now experiencing declining marginal returns in several crucial and costly spheres of investment" (p. 211)

-some economists view the situation as solvable dilemmas that human ingenuity can overcome

-environmentalists, on the other hand, view our current well-being coming at the cost of future generations with faster depletion and expedited collapse being the result of concerted efforts to address declining marginal returns

- both of these views fail to consider key historical aspects
- economists tend to base their view on the principle of infinite substitutability
- while this may hold for certain resources it cannot apply to organisational complexity (e.g., sociopolitics) and it cannot apply indefinitely to resources
- it has been shown that marginal costs of research and development increase significantly over time and while they may be capable of finding solutions to our issues this would require an increasing portion of society's investments and thus reduce living standards
- and any respite from diminishing returns is always temporary
- past societies have tended to find the costs of overcoming certain problems too high and not finding any becomes the economic option chosen
- today's world is different from the past in that it is now filled with complex societies and there are no power vacuums with most linked in some way
- “Collapse today is neither an option nor an immediate threat. Any nation vulnerable to collapse will have to pursue one of three options: (1) absorption by a neighbor or some larger state; (2) economic support by a dominant power, or by an international financing agency; or (3) payment by the support population of whatever costs are needed to continue complexity, however detrimental the marginal return. A nation today can no longer unilaterally collapse, for if any national government disintegrates its population and territory will be absorbed by some other.” (p. 213)
- past collapses occurred in two different political situations: a dominant state in isolation or as part of a cluster of peer polities
- with global travel and communication, the isolated dominant state disappeared and only competitive peer polities now exist
- such polities tend to get caught up in spiraling competitive investments as they seek to outmaneuver others and evolve greater complexity together
- the polities caught up in this competition increasingly experience declining marginal returns and must invest ever-increasing amounts leading to greater economic weakness
- withdrawing from this spiral or collapsing is not an option without risking being subsumed by a competitor
- it is this trap of competition that will continue to drive the pursuit of complexity regardless of human/environmental costs
- incentives and economic reserves can support this situation for a lengthy period as witnessed by the Roman and Mayan experiences where centuries of diminishing returns were endured
- ever-increasing costs and ever-decreasing marginal returns typify peer polities in competition
- this ends in either domination by one state and a new energy subsidy or collapse of all
- “Collapse, if and when it comes again, will this time be global. No longer can any individual nation collapse. World civilization will disintegrate as a whole. Competitors who evolve as peers collapse in like manner.” (p. 214)
- capturing a new energy subsidy was an ancient society's solution to declining marginal returns (i.e., territorial expansion)
- in today's world, diminishing returns are slowed by technological innovation and productivity increases but a new energy subsidy must be found

- whether the world has reached diminishing returns for its overall investments in complexity is unknown, although some argue it has
- it certainly appears we have reached declining marginal returns with respect to fossil fuels and some other finite resources
- to avert global collapse, a new energy subsidy is necessary
- the world has been provided respite from collapse due to the lack of a power vacuum and the peer polity competition, and it would be wise to use this respite to develop a new energy subsidy even if it means reallocating resources from other investments
- just because collapse is not imminent does not mean our standards of living can be maintained; they are likely to remain static or experience decline
- “However much we like to think of ourselves as something special in world history, in fact industrial societies are subject to the same principles that caused earlier societies to collapse. If civilization collapses again, it will be from failure to take advantage of the current reprieve, a reprieve paradoxically both detrimental and essential to our anticipated future.” (p. 216)