



**Review Paper**

# **Riverbank erosion as an impediment to rural development in Bangladesh: the applicability of system theory**

**Md. Shamim Hamide<sup>1\*</sup> and AHM Zehadul Karim<sup>2</sup>**

Department of Sociology and Anthropology, International Islamic University, Malaysia  
shamimhamide@gmail.com

Available online at: [www.isca.in](http://www.isca.in), [www.isca.me](http://www.isca.me)

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## **Abstract**

*This paper contributes to the broad-ranging topic of natural disaster management from a sociological perspective. In particular, it draws attention to the relevance of System Theory and advocates its suitability for designing frameworks to understand natural disaster phenomenon, which grab the head-lines like hurricanes and floods, but also more neglected, insidious, and equally vicious disasters like riverbank erosion in Bangladesh. This holds especially true for impoverished regions of the world like South Asia, which are still predominantly agrarian and rural. The recovery of rural system to indemnify its status to pre-disaster stage is influenced as much by the developmental activities as is the development system's restoration to previous developmental pace is reinforced by the affected area's resurgence, resilience, and re-organization of social order. These interrelated topics can be studied in unison effectively through system theory to understand better the implications of riverbank erosion on rural development.*

**Keywords:** Natural Disasters, Riverbank Erosion, Framework, System Theory, Social Sciences.

## **Introduction**

The incapability to comprehend fully the milieu of natural hazards characterizes one of humanity's utmost obstacles to handling the consequences of natural disasters. To view every one of the angles adding to a characteristic of natural (and man-made) catastrophes, by cutting crosswise over expert and disciplinary limits in both time and space, is daunting. General intra-disciplinary methodologies are not fit for grabbing all qualities of natural disasters, including numerous social, financial, political, mechanical, hierarchical, and physical variables. Also, existing literature review shows us that perspectives stemming from singular disciplines frequently overlook the potential for new ways to deal with combating aftermath of disasters that come into view on the off chance that one expands the locus of analysis to assess the full scope of collaborating disasters that happen in 21<sup>st</sup> century societies.

Natural disasters cause massive damage to the ecosystems worldwide, impair socio-economic aspects of human lives, impede economic growth, and cause untold sufferings at a broad scale.<sup>1</sup> While advanced economies of the world are capable of combating the ills of natural hazards, the developing or less developed countries lag behind due to dilapidated infrastructure capacities, inadequate resources, lack of financial support, and often being geographically disadvantaged. Riverbank erosion is one such calamity which befalls many impoverished countries around the world who are ill-equipped to deal with its consequences. What sets riverbank erosion apart from other headline-grabbing and sensational hazards like cyclone, flood,

tsunami, etc., is its insidious and slow nature. Its impacts are long-term but equally devastating. Some scholars go as far as to say that rehabilitation and recovery from riverbank erosion is worse than other, more vicious disasters due to lack of attention it draws from its unremarkable nature. In academia, as well as in policy level research, attention to this deceptive threat to humanity is scarce. As a result it doesn't come as a surprise that researchers haven't developed an adequate framework to understand and study the implications of riverbank erosion's damage on social and economic scale. Bulk of studies in this area are conducted from environmentalist perspective, dealing nearly exclusively on bio-technical, geological and agricultural elements. Not much attention is serviced to sociological inquiry of damage to human lives, livelihoods, land loss, breakage of social ties, etc. Therefore, governments, regulators, and policy level stakeholders too don't fully recognize the potency of this sneaky disaster which has uprooted many communities and decimated countless lives and acres of lands. This paper outlines some pertinent aspects of riverbank erosion, how it impedes rural development, and advocates system theory as an appropriate framework to study this phenomenon, which interested researchers can espouse to better understand riverbank erosion's ramifications from diverse perspectives.

This article invites a sincere plea to reevaluate existing framework of natural disasters adopted by academicians and policymakers. It undoubtedly becomes clear that the way we consider common disasters will impact where we search for remedies, and the shape and character of the methods we use to accomplish those solutions. All through time, societies have

managed the greater part of the marvels that we now call natural disasters by clarifying them as demonstrations of God, good fortune, misfortune, evil's whispers, or destiny. Be that as it may, the physical procedures were the same however natural-mystical state of mind decided mindfulness; normal fiascos translated as *force majeure* deadened logical contentions, counteractive action and specialized measures. After some time, the clarifications of the reasons for regular disasters have moved from heavenly or mysterious dispositions, to nature, and with some hesitance, to people (or to society in general) who have made pragmatic choices<sup>2</sup>.

## Riverbank Erosion

Experts identify natural disaster as a definite outcome of a geo-environmental phenomenon that produces perils that menace individuals or communities, either during the event or throughout the aftermath. The United Nations International Strategy for Disaster Reduction (UNISDR) considers natural disaster to entail a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. One of the effects stemming from natural disasters, which is of paramount importance to sociologists is the aspect of *vulnerability*. Akter and Mallick consider it as a multidisciplinary phenomenon conferred to a point that vulnerability is a situation when shocks and pressures attack a community incessantly, leading to a diminution of resources available to absorb or combat the shocks causing it<sup>3,4</sup>. Davis asserts that environmental degradation triggers vulnerability to other elements of socio-cultural life, which leads to an inability of the environment to meet social and iconological obligations and goals<sup>5</sup>. Adger, Huq, Brown, Conway and Hulme posit that all vulnerabilities that arise from natural calamities are dealt by societies in unique ways due to the singular and independent attributes of every disaster, which in itself relies on social and economic realities of the citizens in question<sup>6</sup>.

The type of natural disaster topical to this study is riverbank erosion. As the name suggests, when natural flow of rivers erode the banks of the river and cause re-shaping of the river course and as its by-product destroy previously stale land, riverbank erosion occurs. Naturally endemic mechanisms such as shifting of major rivers and the unstable nature of many rivers in deltaic plains cause majority of riverbank<sup>7</sup>. This compels millions of poor people to leave the afflicted regions each year. Riverbank erosion thus causes people to be homeless, destitute, landless and helpless while forcing them to desolation. These predicaments suffered by riverbank erosion displacees are detailed by Saleheen who defined them in terms of mobility characteristics<sup>8</sup>. He considers a person to be a displacee if he or she experiences minimum of one migration move because of erosion in lifetime. The territory in which mobility of displacees takes place leads to a consideration of distance from original homestead. Ahmed, Urasawa and Taniguchi adopted a more

stratified analysis of displacement through classifying displacees based on number of forced migrations in lifetime: displaced once, displaced twice, displaced thrice, and displaced more than thrice<sup>9</sup>. Occupation and trade-wise, Amin classified displacees on basis of agrarian involvement<sup>10</sup>. Amin's classification thereby involves of a party consisting of people primarily reliant on agriculture with little to no vocational skills or experience, and of another group whose constituents possess some degree of education, skill and/or experience in non-farming professions. This classification is significant because of how being homeless and/or landless impacts the members of either group.

Another angle of examining the impact of riverbank erosion on displacement is documented by Elahi, who infused a rural and urban outlook on the condition of displacees' family size, educational background, vocative participation in the economy, ownership of farm-land, income performance, etc.<sup>11</sup> Riverbank erosion is a significant issue connected with the extensive waterways of many countries around the world—majority of which are economically disadvantaged and poor. Furthermore, even in affluent countries, it can hit the local population hard, given that it is the poor people who are the most vulnerable to riverbank erosion's menaces due to their proximity to vulnerable localities. To put the matter in perspective, let us take as example the large 12 km wide Brahmaputra/Jamuna River. It has extreme consequences for the vocations of those living on its alluvial floodplains. While ordinary floods are viewed as valuable for cultivation and fisheries, erosion and consistent riverine augmenting causes the loss of vital base and also as extremely beneficial farming grounds and destabilizes settlements. Erosion also keeps on distressing on those living on the highly denser populated floodplains, and is liable to be increased by environmental change. Uncontrolled and expanded riverbank erosion builds the peril of flood harm separated from the loss of essential foundation. Further ventures are conceded and the full farming capability of the prolific floodplain land can't be acknowledged as a result, crop creation has a tendency to stay below productively optimal levels in the absolute richest parts of agricultural landscape.

Consequences of riverbank erosion are huge both for the afflicted coastal regions, as well as a nation as a whole. For almost all disasters, with the exception of earthquakes, people lose their household structures at most. For riverbank erosion, however, people lose their land and become homeless. Though the death toll is markedly lower, it proves a lowly consolation, as the erosion induced displacement's losses are beyond measure. Aside from simple loss of land, people also lose their assets. Previous researches have shown that rootless people struggle to get re-integrated into their new locality, face social discrimination, and suffer from an acute dearth of family and social bondage, a loss almost improbable to recuperate.

Riverbank erosion has dreadful socio-economic impressions on people of developing nations. Very frequently it creates adverse

effects on people damaging standing crops and infrastructure, extinguishing settlements and disturbing communications. The grade of economic loss and miseries of people has amplified in recent. Neumayer and Barthelposit the monetary value of losses incurred by certain economies can amass beyond USD 500 million annually for poor areas<sup>12</sup>. Riverbank erosion displacees' losses are limitless. Moreover, in addition to the loss of land, farmers also lose other belongings, and being homeless, they become devoid of assets and means too. Erosion victims lose their agricultural and farmstead lands in one hand and on the other hand they become rootless, ejected from their community, breaks down their family ties and social bondage. The effect is enormous and the loss is nearly impossible to recuperate.

The frequent events of natural disasters have prolonged in recurrence over the globe over the past century or so. Appraisals of the fiscal and money related calamities from natural disasters have moreover increased. While the reporting of natural disasters has enhanced, these upward patterns are expected basically to a recorded ascent in the number and power of climactic disasters, and to an increment in the centralization of individuals and physical resources in regions more presented to catastrophes. Some studies have found that common catastrophes have a noteworthy negative effect on development and destitution. The effect of catastrophes on an economy and society will rely on upon numerous variables like the nature of the shock, the size and structure of the economy, orientation of society, public policy, administrative efficacy, populace fixation, per capita wage, solvency, administration, and openness. In the short term, debacles ordinarily result in a compression in monetary yield and an exacerbating in outer stability of society as whole and financial equalizations.

Due to riverbank erosion, many people lose their farmstead and communities. When erosion is sluggish they can shift their household materials. But when erosion takes place quickly and approaches their housing premises, they all together disassemble their households themselves chasing to transfer household materials. Most often they hardly manage to shift all materials needed. Many of them become fatalities of such occurrences numerous times. Minor owners of lands grieve a lot. After getting displaced from the living place probing for farmstead land becomes the main urgency and a few of them can achieve to develop land ownership. Sometimes they become destitute and live in Government owned properties.

Erosion induced displacees face countless difficulties: individual, household and communal. One major individual problem is connected to income erosion that forces them to live a deficient life. As the migrants' earnings are battered it influences their amount of food consumption, health care, education of the children. Due to riverbank erosion, many farmers become poor suddenly. As agriculture is the chief livelihood for majority of people, losing cultivable lands economically they become defenseless. Finding no other substitutes most farmers become day-laborers. Occasionally

they fail to survive with transformed condition. Some sort of loss of Industry/grocery shops/ business center is found in every location faced by the erosion impacted population. Many people losing livelihoods become from poor to poorer. Additionally, from an environmental perspective, trees and plants sometimes become the alternate basis of money to the rural people. Poor villagers often eat fruits and occasionally earn money vending the fruits in local marketplace. The trees are also sources of wood. Meeting their household demands they sell trees for money. In countryside areas of some South Asian countries that are vulnerable to riverbank erosion, bamboo trees are very common in nearly every household. The bamboo not only caters their native requirements but also aids to earn some money. However, because of riverbank erosion the victims lose all the possibilities to recuperate.

The effect is now and then mitigated by an expansion in exchanges from abroad. Regular disasters can likewise have a huge negative effect over the long haul on neediness; what's more, social welfare. The poor have constrained investment funds and access to credit, so are not ready to supplement their earnings taking after an emergency. This can drive families into "destitution traps" with negative wellbeing and social impacts<sup>13</sup>. Without a doubt, fiascos have been found to have durable outcomes on mental wellbeing and intellectual advancement<sup>14</sup>.

With the enduring development of urbanization in creating and center pay nations and desires of more extreme characteristic disasters identified with worldwide environmental change, the human furthermore, financial expenses of common fiascos are prone to continue rising. While normal calamities can't be kept, the strategy reaction will importantly affect the velocity of recuperation. Additionally, the writing proposes that much should likewise possible ex risk to diminish the human enduring and monetary expenses of the effect of characteristic fiascos. These incorporate migrating groups from catastrophe inclined ranges, authorizing construction regulations, holding sustenance inventories as cradles against dry spell, and creating crisis reaction systems.

## **Rural Development**

Majority of developing countries around the world still have a great proportion of their populace residing in rural areas. Thus, for these countries overall development is nearly synonymous with development of the villages. A big chunk of this rural population has been living life under uncertain circumstances due to non-synchronization of policymaking efforts and inaction. The academics too can't be absolved on this ground. Nonetheless, the tides have been shifting. Rural development has been gaining amplified attention in recent years from regulators and policymakers around the globe. This is significant for several reasons. First, governments are realizing that industrialization alone isn't the elixir once thought. This means they recognize if their villages are left behind the nation can't prosper. Next, governments recognize boosting GDP from

urban areas alone can't propel the economy to higher levels—especially if bulk of the population lives below poverty level, many of whom are villagers. Thus, governments' realization that fate of the nation is intertwined with fate of the villagers is laudable. South Asian agrarian economies are a start example of this phenomenon.

Unlike popular misconceptions, rural development is not a charity venture whose goal is to raise the capacity of bigger crop production, higher quality crops, variations of vegetation and agricultural products, higher output per unit of input, lower overall input, etc. more concern is required to create higher incentives for putting in more endeavors towards investment and raising efficiency of the society as a whole, which can in turn benefit the economy. Thus, education, information, research, innovation, training, and application of the research are all within the ambit of rural development. As we understand it, rural development espouses the whole gamut of which via which a social system graduates from a stage of life perceived as inferior toward a materially superior and spiritually more rewarding state of life. One analogy can be of train where one bogie pulls another and the chain reaction pulls the whole engine forward. The engine of this train, however, reacts to external stimulants. This is where system theory comes in. In our train analogy, the social parameters of afflicted area as a whole constitute a society. The subsystems are bogies—individual, communal, economical, vocational aspects of affected people—which react to external environmental stimulant of natural disasters like riverbank erosion. The destination of the train of rural development is to reach an economically and spiritually affluent destination. This journey can be better guided through understanding riverbank erosions' impact on rural development via the lenses of general systems theory.

### Advocating general system theory

Before understanding General Systems Theory, it is necessary to understand what a system is. The basic principle of a system is that everything is connected to everything else. It is not possible to eliminate the observer, and most truths are relative. It also holds that most views are complementary. Elements of a system define it. Purposefulness, openness, and hardness are some of its examples. Scientists, when choosing system theory to describe systems usually choose a boundary and strive to explain behavior through it.

Scientists usually understand the world through reductionism or statistics. In the first way, a phenomenon is broken down to its constituent parts—reducing a set of equations governing interactions. Conversely, through statistics, average behavior is measured for a very large number of occurrences. For example, gas pressure emanates from averaging random movements of numerous atoms. Also, error tends to zero when the number of instances grow higher exponentially. However, as von Bertalanffy points out, sometimes none of the previous two

approaches work. For instance, systems that are too interconnected to each other cannot be broken into constituent elements<sup>15</sup>. Also, behavior may not be random enough for statistical analysis. Thus, came along general systems theory—which has its roots in Biology. Its original intent was to develop a better system to understand the human body, and the phenomenon of life. The basic ideas advanced include treating inter-related phenomena as system, studying the link between pieces and the system as a whole, and not fretting over not understanding all facets at once.

Having prefaced the origins this way, now let us adopt a more historical look at chronology of its emergence. General Systems theory was suggested in the 1940's by Ludwig von and furthered by Ashby in 1956. Von Bertalanffy was both responding against reductionism and trying to recover the harmony of science. He emphasized that real systems are open to, and interact with, their environments, and that they can obtain qualitatively new properties through emergence, resulting in continual evolution. Rather than dropping an entity (e.g. the human body) to the properties of its parts or elements (e.g. organs or cells), systems theory focuses on the organization of and relations between the parts which connect them into a whole—referred to as holism. This particular organization determines a system, which is independent of the concrete substance of the elements. Thus, the same concepts and principles of organization inspire the different study faculties such as: physics, psychology, technology, sociology, biology, *inter alia*, providing a foundation for their union. Systems concepts include: system-environment boundary, input, output, process, state, hierarchy, goal-directedness, and information.

### Discussion on applicability

This section deals with applicability and pertinence of general systems theory to understand sociological impacts of riverbank erosion on rural development. The basic tenets of General Systems theory, its origination, major proponents, usage in area of sociology are articulated below. Dictionaries refer to system as an approach to industrial relations that likens an enterprise to an organism with inter-dependent parts, each with own specific functions and interconnected responsibilities. The historical origins of system lie in Greek antiquity. Today it is normally referred to in natural sciences, physics, and social sciences. A system consists of two or more component units that relate to each other in a structural relationship and coalesce an entity, elements of which or functionality are inter-dependent. Systems theory was proffered first by biologist Ludwig von Bertalanffy in the 1940s, as a modeling device accommodating inter-relationships and overlap between separate disciplines. The reality is that when scientists and philosophers first attempted to explain how things operated in the universe no separate discipline existed at the time that was capable of explanation. But as scientists began to understand more and more, the sciences were dissembled into chemistry, physics, biology and then bio-physics, bio-chemistry, physical chemistry, etc. This

way related component of a problem was examined in isolation from one another. The systems theory promulgated by von Bertalanffy propounds the value of integration of parts of a problem and that it cannot be solved satisfactorily when considered in isolated from interrelated components. The modern general system theory (GST) originated from Henderseon's formulation of social equilibrium, Cannon's principle of homeostasis, Weiner's formulation of cybernetics, and von Bertalanffy's concept of the open system. Following pare to, Henderson viewed the organism as possessing a self-regulating mechanism, whose aim is maintaining the equilibrium. Cannon developed the theory of homeostasis, a relatively stable condition of an organism strives to maintain. He sought to identify the principles of stabilization that help maintain the homeostasis in the human as well as social organism. Von Bertalanffy considers the attributes state of the living organism as that of an open system that exchanges

components with its environment and maintains itself in a steady state. He believes that all sciences—physical, natural, social and philosophical—will ultimately culminate in a general systems theory.

The foundations of systemic analysis in sociology were pioneered by Pareto through formulation of the concept of society as a system in equilibrium. He then conceived of the system as a whole comprising of interdependent parts. In such a system, change in some part impacts other parts as well as the whole. The combination of forces that maintain social equilibrium involves three factors: i. Extra human environment on physical condition with characteristics similar to climate, soil, vegetation, etc. ii. External conditions like a given society's previous states and contact with external societies and cultures. iii. Inner elements of the system such as race, interest, knowledge, values, ideologies and sentiments.

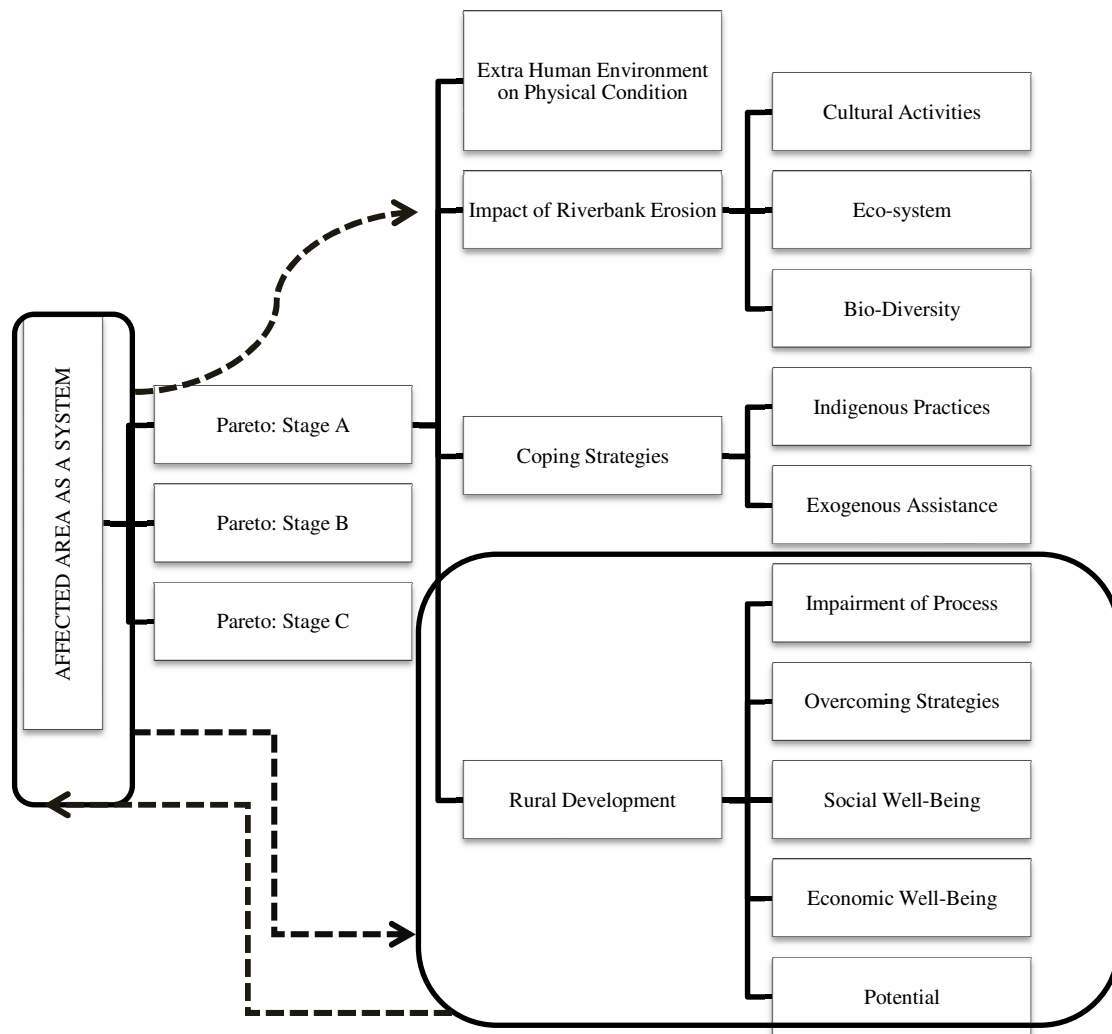


Figure-1: A Proposed Framework based on System Theory.

Pareto contended that if the social system is subjected to pressure of external forces, inner forces will then push forward, culminating in the restoration of equilibrium, restoring society to its previous normal state. After Pareto's groundbreaking assertions, other sociologists like Henderson and Parsons expounded on the system model and employed it extensively as a conceptual framework for analysis of social phenomena. Olsen presented a capsule summary of the social system mode<sup>16</sup>. Accordingly, a system is bounded as a unified set of interconnected dynamic and stable processes. Olsen identified five core properties of all social systems, which are: open boundaries, input and output, feedback and feed-forward, internal ordering, and key functionaries. The two basic types of processes displayed by social systems are: Morphostasis and Morphogenesis<sup>17</sup>. The former refers to all processes tending to preserve or maintaining a system, present conditions, or overall state, giving it suitability through time<sup>18</sup>. The latter denotes those processes that tend to alter or elaborate a system's conditions or state, producing change or growth through time.

In modern times, the most influential systems theorist is Niklas Luhmann. He considers systems as self-referencing as contingent and as always less complex than the environment. As such, systems have to reduce *complexity*. They cannot be as complex as their environment as they would be overwhelmed and unable to function properly. Luhmann's most seminal contribution is his sense of systems as being autopilotic.<sup>19</sup> That means systems produce their own basic elements. They organize own boundaries and relationships among their internal structures. They are thus self-referential and closed. Two systems singled out by Luhmann are the social and psychic systems. Social systems are plagued by problem of double contingency. Every communication has to be taken into account—how it is received, perceived, how it is received depends on the receiver's estimation of the communicator<sup>16</sup>.

## Conclusion

Despite the advances of modernity in the 21<sup>st</sup> century, both natural and technology-induced disasters the protection, prevention, and reaction measures are routinely the same. In this viewpoint, a natural disaster, in an unadulterated sense does not exist. Instead, there is the collaboration of changes in physical frameworks with existent social conditions. The disaster itself happens inside society and not inside nature. A flood in sparsely populated polar region or a well of lava ejection on an uninhabited island would hardly qualify as a natural disaster by the common people or the media. On the opposite side, the view of natural risks shifts with time and space. Changes in social conditions with existent physical frameworks are unmistakable<sup>20</sup>. What societies had once in the past viewed as a substantial resource is known as a flood today. Natural disasters like riverbank erosion are along these lines; all the more precisely observed as social marvels though the general harm because of common perils is the outcome both of regular occasions that go about as "triggers", and a progression of

societal elements. Practically speaking, there is just an indistinguishable difference amongst assets and risks, between headline grabbing disasters like hurricanes or floods on one hand, and slow, insidious, but devastating in the long run calamities like riverbank erosion.

The discussion above, particularly Pareto's analysis demonstrates how system theory can be applied to understanding rural development's hindrances caused by riverbank erosion. First off, the afflicted area can be understood as a system itself. Its component parts are constituent systems (individual, communal, social, ecological sub-systems, etc.). Not only do these sub-systems interrelate and influence each other, they also influence the system as a whole. As Pareto's exogenous factor A suggests, an external environmental shock like riverbank erosion throttles the equilibrium stage. This disturbance is to be dealt with by the system in such a way that equilibrium re-emerges. Thus, if we consider rural development itself an independent system, this system too is influenced by the impact of riverbank erosion on the rural system (mentioned earlier). Thus, two seemingly independent systems are caught in a cross-fire of exogenous shock like riverbank erosion. How the two systems can recover also depends on performances of both systems. The recovery of rural system to indemnify its status to pre-disaster stage is influenced as much by the developmental activities as is the development system's restoration to previous developmental pace is reinforced by the affected area's resurgence, resilience, and re-organization of social order. Thus, these intertwined disciplines can be coagulated beautifully through systems theory to understand better the implications of riverbank erosion on rural development.

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