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The Tragedy of Ruhi Nala, An Orphaned Water Common

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Abstract

In 1965, guns blazed from across a vast body of water between Pakistan Army and the Indian Army. Bunkers were set up every half mile along the banks of this canal now known as B.R.B (Bambanwali-Ravi-Bedian) Canal. BRB canal has a long history dating back to Mughal times, who first constructed it for irrigation purpose. The British then further added to the canal in 1861 by extending it to reach the Raiwind side of Lahore to combat the effects of the 1837-1838 famine hit lands and avoid any more damages by the famine. Albeit, it was not until 1948 when the citizens of the young state came together on the request of the then Chief Minister of Punjab to protect against the Indian belligerence by extending the canal.

Keywords: Pakistan Army, BRB canal, Chief Minister of Punjab.

1. Introduction

The BRB Canal starts from the Upper Chenab Canal near Bambanwali Village, passing through Daska, Lahore, and then ending in the Sutlej River which is around 100 miles from its base[3]. The Lahore part of the canal is around 37 miles (Rukh, 2019). After partition of the subcontinent, the Madhupur and Ferozepur Headworks on the Indus River System became part of India thus causing the dispute between India and Pakistan in terms of the Indus water flow. The water supply from the Upper Bari Doab Canal was cut off and made irrigation downstream difficult leading to water scarcity in Pakistan (Irfan et al., 2019). The BRB link Canal thus was not only a defense line but also a continuous provision of water to the fertile and agro based lands of Punjab particularly those in Lahore and its vicinity.

As years went by the population of Pakistan grew from 50.9 million in 1965 to 221 million in 2020 increased to 229 million in 2022. Lahore's population in which has increased from 1.5 million in 1965 to 13.5 million in 2022, around 8% increase in the last 57 years (data retrieved from World Bank: https://data.worldbank.org/indicator/SP.POP.GROW?locations=PK).

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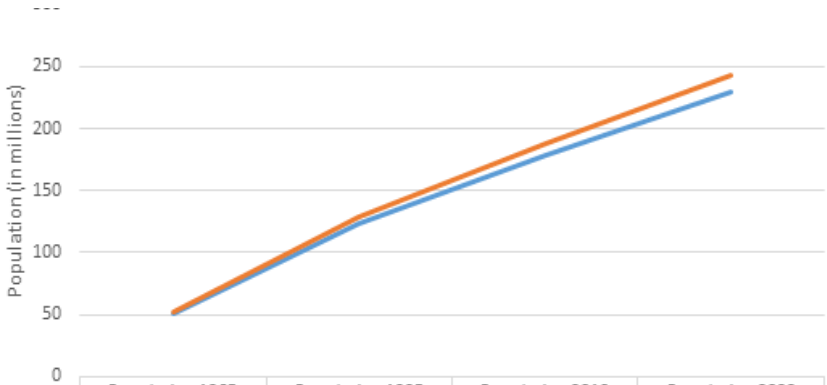
Figure 1 Population Growth - Pakistan & Lahore



	Population 1965	Population 1995	Population 2010	Population 2022
Lahore	1.4	4.6	8.4	13.5
Pakistan	50.9	124	179	229

Therefore, it was no surprise when urbanization and increasing population lead to development of multiple housing societies. As demand for shelter increased, Lahore had to be expanded and a vast area of previously agricultural land was now turned into housing schemes to accommodate the increasing population and the inflow of residents from outside of Lahore as well.

Research done by University of Sargodha, revealed that every year more than 1200 hectares of fertile agricultural and forest land is taken up for urban use. GIS mapping revealed a loss of 32500 hectares of agricultural land and 5000 hectares of forest land due to expansion of urban Lahore from 1972 to 2009 – a whopping 68%! Since 1972, more than 100 housing schemes have been warranted to accommodate the growing population and more than 200 (previously) rural localities have been added into the expanded urban area (Riaz et al., 2014).

When it comes to understanding the extent of this conversion of arable land to residential schemes, a lot of governance related issues arise. From lower or no taxation on vacant lands and the practice of buying land as a safeguard against the rising inflation, the conversion of this arable land is aided by flexible by-laws (Khaliq-uz-Zaman & Baloch, 2011).
Consequently, population growth and urbanization become root causes of a lot of social problems, the menace of which facing Lahore is that of pollution. From vehicular and industrial emissions causing air pollution to poor waste management causing water pollution (Mohammad Ali, 2021).

Lahore has no sewage treatment facility as of May 2018 which results in the Ravi River being the recipient of all the untreated wastewater coming from all over Lahore and its housing schemes. This not only affects the water quality of water used for agriculture and drinking water due to contaminants infiltrating the Lahore aquifer which is replenished by the Ravi River but also affects the quality of the groundwater throughout Lahore. This makes River Ravi the principle source of more than 50% of the water pollution in the Indus River Basin as well (Asian Development Bank, 2018).

Many researchers have tested the water quality. (Qureshi & Sayed, 2014) found faecal coliforms

in the drinking water including waterborne diseases such as typhoid that resulted from this contamination. When it comes to pumped water, elements such as arsenic are found in high concentration which according to WHO standards are excessively high and contaminate groundwater (shallow) wells as well (Qureshi & Sayed, 2014). The question arises of where does this high concentration of arsenic come from? It actually is sourced from fertilisers and kiln factories (Qureshi & Sayed, 2014). Now as River Ravi is the main source of irrigation water, the farmers in the periurban areas of Lahore have no choice but to use the untreated water for production of their crop, which further propagates the spread of the aforementioned waterborne diseases (Qureshi & Sayed, 2014)

The problem and issues are not localised, as Lahore is at the upstream end of the water system in Pakistan, it inevitably flows its problems to other regions as well affecting drinking and agriculture water in these regions too (Asian Development Bank, 2018).

In the urban areas of Lahore, Water and Sanitation Agency (WASA) is responsible for providing safe drinking water. It provides drinking water to more than 6 million people using more than 400 tube wells. Albeit, only 78% of houses in areas concerned with WASA are piped and the demand for water is increasing day by day. In 2013, the demand of water capita was 247 litres per capita per day (Cooper, 2018). WASA also provides water for industrial purposes. These include factories, hospitals, mosques etc. while larger and established housing schemes such as Walton and Lahore Cantonment Boards, Model Town, Defence Housing Authority take up the responsibility to supply water to their respective housing areas. When it comes to non-WASA areas, around 50% houses use hand pumps, publicly available water and other devices to pump up groundwater. In addition to this, there is a huge policy gap when it comes to legislation around water and water rights. This has further resulted into private housing schemes installing tube wells and pumping water more than they should resulting in depleting water table. Even though the Public Health Engineering Department (PHE) installed 16 water supply schemes in the rural areas of Lahore district, around 80% are not functional due to unpaid electricity bills (Cooper, 2018).

All these situations burn down to the damaging of water commons in Lahore, may it groundwater, aquifers, inundation canals, perennial canals or any other natural or man-made water structures along with the ramifications. One of these water structures is that of a drain locally called as *'Ruhi Nala/Nullah'*, which will the focus of this research.

A 'Nullah' is an intermittent watercourse that is mostly manmade and is popular in south Asia which accommodates excess water from heavy rainfalls like monsoon season or originates from canals to capture flood water. Mostly it is dry with a light stream within narrow, steep embankments but fills up when it rains or floods.

The upcoming chapters will discuss in detail the theories that make up the foundation of this research with heavy focus on the polycentric nature of governing the commons along with two real life examples from Bolivia and USA in escaping the 'inevitable' end of the commons as stated in Hardin's 'Tragedy of the Commons'. Furthermore, the research will question and present a theoretical view on Lahore's Ruhi Nala and its tragedy pertaining to social institutions and customs. This research focuses on the misuse of these commons by different housing schemes, residents of nearby areas and even administrative stakeholders in transforming these excess water storing ravines into waste flowing rivers. Eventually, conceptualizing the scope of research on this aspect of governing the commons taking the example of Ruhi Nala in creating an empirical dimension for future policy decisions.

The research consists of five chapters. The first chapter introduces the historical significance of Nala and highlights the research question, the second chapter reviews the existing literature

including detail of the successful case studies of Bolivia and USA, the third chapter puts spotlight on the case of Ruhi Nala, while the last two chapters discuss the case of Ruhi Nala in relation to the theories and provides concluding statements for future research.

1.1. Statement of the Problem

As each day goes by, Pakistan's population is growing. With that growth comes a great burden of providing shelter and other essential provisions to its citizens. In order to better their lifestyle, citizens from rural areas of Pakistan tend to flock towards metropolitan cities to find employment and education. Lahore has thus become one of the metropolitan cities that is facing the brunt of this problem.

As Lahore's population grew, so did the human burden on its land. What once was a fertile agriculture land with lush fields of sugarcane, wheat and rice as far as the eye could see has turned into a naturalist nightmare. With concrete building, cut down trees, cemented lands and an extremely grey landscape, Lahore has expanded to its periphery villages and towns to accommodate the human population.

It is a great miracle that the Lahore canal originating from BRB canal is still snaking throughout the centre of the city of Lahore providing a coolness to the eyes that only nature can provide. Other such waterworks and drains have not met the same beautiful fate. They have been succumbed to human transgressions and have become carriers of human, industrial and animal waste. One of these waterworks is the Ruhi Nala, that follows through the most posh and elite areas of Lahore but is either covered up by cement structures or blocked by the filth in it. The communities (peripheral villages and town) are affected by it, different business establishments are disturbed by it but yet there is no once stakeholder that has taken up the responsibility of preserving its purpose. This study aims to investigate why the Ruhi Nala which was used as a rain water and flood water reservoir met its bleak fate of becoming a flowing stream of filth and who is responsible for it.

1.2. Objective of the Study

The study primarily focuses on looking at the past and present of the Ruhi Nala through a theoretical lens while building connections within the complex governance, community and administrative aspects of the reasons Ruhi Nala is in the state that it is. The study also takes into account the possibilities of future changes that arise from the dynamic and polycentric nature of a formal governance system or the lack thereof.

- To create meaningful connections between Commons literature and the Ruhi Nala
- To understand and detangle, to some extent, the complexity of the polycentric governance system in place (informal and formal)

1.3. Research Question

How do polycentric governance structures help in escaping Hardin's "Tragedy of the Commons", through the example of one of Lahore's abandoned Nala?

1.4. Scope and Significance of the Study

There has been no research related to such water commons in Pakistan. Most of the research work done focuses on the biochemical and health hazard of the water commons. Extensive studies have been done to check water quality, diseases arising from the drinking water and the social implications of poor water governance in Pakistan.

This research is one of the few stepping stones to further research when it comes to social

cohesion, mutual decision making and public policy making with special emphasis on common pool resources such as water. This research uses the case study method that under the critical theory paradigm builds the foundation for future governance related researches around manmade water structures, their jurisdictions and the law making when it comes to preserving their purpose and active usage in containing flood plans year-round.

1.5. Methodology

This research uses case study approach to explore in-depth the phenomenon of polycentricity and tragedy of commons on the drains of Lahore, but focus on Ruhi Nullah drain which is 10km long runs parallel and 8 km away to Lahore canal. A particular segment of the Ruhi Nala (2 km) is studied. The research only completes the 'foundation phase' of the case study approach. This phase focuses on developing a thorough background on the topic.

For this particular research, the critical theory paradigm was used to conduct interpretive research by consulting secondary sources. The critical theory paradigm was chosen to allow highlight contradictions, instruments of power and social constructs that revolve around the Ruhi Nala. The research was of an exploratory nature along with the primary sources, in which the researcher travelled physically along the Ruhi Nala to collect information from natives and capture images.

These secondary sources included all available material regarding the research in books, videos, research papers, webpages, newspapers, conference proceedings, journal articles, reports and political commentaries. The secondary data collected was checked for reliability and validity while also keeping its suitability to the research in mind.

2. LITERATURE REVIEW

This chapter will review theories, ideas and introduce cases that are relevant to the research. The first part of the review will focus on literature associated with polycentricity, tragedy of commons and governance of commons. The second part will focus on case studies from Bolivia and United States of America.

Zetland, (2022) in his book 'Little book of Commons', identifies four types of good. He identifies these good based on if the goods are subtractable or not, excludable or not, type of allocation (political or economic) and the risk in terms of over and under appropriation. In theory, a non-excludable, subtractable good which is at risk of over-appropriation and is allocated politically via either the government or the community is a common pool good. Thus, shared natural resources or 'commons' in theory are goods that everyone and anyone can consume from a supply that is diminishing (Zetland, 2022). On the other hand, commons can also be defined as "collective arrangement to manage resources useful for all members of the community" (Vivero, 2016). Thus, clearly perpetuating the complex nature of understanding and defining commons.

In 1968, it was G. Hardin's recurring metaphor 'Tragedy of the Commons' was popularized. It is attributed to how multiple problems and chaos is synonymous to usage, maintenance and protection of public or collective goods and resources. Hardin's 'Tragedy of the Commons' created an allegory of a pasture that is open to all and each sheepherder is expected to maximize and keep maximum number of 'his' herd on the commons. He insisted that this setting may work for years but one day this practice will generate tragedy as in each sheepherder's effort to maximize his gain in increasing his herd without limit, the limited common (pasture) will run out and lead to overgrazing (Hardin, 1968).

Perhaps the most quoted portion of his explained the utility of doing so:

"Explicitly or implicitly, more or less consciously, he asks, "What is the utility to me of adding one more animal to my herd?" This utility has one negative and one positive component. 1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly + 1.

2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of -1.

Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd..." (Hardin, 1968)

The conclusion of maximizing gain through increasing the size of his herd will be reached by each rational sheepherder as it only made sense to do so. If any sheepherder decides not to maximize his benefit it would only be self-destructive and foolish, as this restraint will only increase the marginal benefit for other sheepherders. The fixed set of resources available and the homogeneity of needs in ever-growing population would exhaust the world. Although at its core, Hardin was able to encapsulate the issues that come about from interdependency.

In 1970's, Elinor and Vincent Ostrom readily disagreed with Hardin's conclusion. They believed that their work proved him wrong. Their work questioned the similarity of the allegory to reality, its ability to predict real-life behavior and existence of other means (instead of political or governmental) means of communities acting collectively. In terms of how 'real' the allegory was, E. Ostrom explained (Ostrom, 2007):

"...Hardin's influential work was based on an extremely sparse view of the commons. Situations characterized by these assumptions, in which individuals independently make anonymous decisions and primarily focus on their own immediate payoffs, do tend to overharvest open-access resources." (Ostrom, 2007)

Therefore, clearly identifying the distorting aspect of the allegory. (Ostrom, 2000) was also able to revolutionize the rational actor model used in Hardin's allegory to one that individuals can act rationally while simultaneously learning the norms and thus cooperate with each other for collective action. Further opening up the space for alternative institutional arrangements that were not only bound to privatization or governmental control as (Hardin, 1968) had concluded the only solution to the social dilemma (Frischmann et al., 2019).

Ostrom, (2000, 2007) made it quite clear that collective action can help combat the reduction list approach off the tragedy of Commons. This further brought up the question of how the Commons could be governed that did not stem from governmental or private control. The concept of social dilemmas always took up on an individualistic view of human action but looking at governance of these commons it is clear that the concept of 'governing' concerns itself with how the rule-ruler-ruled relationships work together to come up with solutions of the problems that collectively affect the community.

According to (Young, 2002), the process of governing is to eventually arrive at choices and decisions that are made collectively and are regarded as legitimate by the people living in the community for whom the choices have been made. Therefore, this process is not only bound to the limits of government or the public sector but expands beyond this domain by involving stakeholders and actors that belong to the nonprofit and the private sectors.

Lam, (2011) outlined three premises that become the basis of an individualistic concept of governance. Firstly, as the social reality is constituted by the interaction of multiple individuals

any theory of governance should take individual actions and aggregate it into the bigger picture. Secondly, any theory of governance should be grounded on the assumptions about the cognitive aspect of human nature. Thirdly, it should acknowledge that collective action can sprout in a multitude of settings which can be different spatially, temporarily and can even happen at distinct levels of jurisdiction.

A lot of research on governing the Commons revolves around resource management and how the bureaucratic mode of governance which is heavily top down oriented often results in disappointing performances. A notable example of such failure of the bureaucratic mode would be that of irrigation governance in Nepal. (Lam et al., 1997) found that systems that governmental agencies were managing were outperformed by farmer run systems.

Regmi, (2008) concluded that sometimes it is difficult for external actors to put in place institutions and rules that can devise solutions that are optimum for situation specific problems. Therefore, it is better that local users of the resource develop institutional solutions. The key insights found in this paper revolved around how under certain conditions governmental agencies cannot effectively and efficiently develop infrastructure - institutional and physical - as compared to the local resource users because of their knowledge of the resources and their familiarity with the resource as exemplified by the farmer led irrigation system in place right now in Nepal.

Examples as such of Nepal further solidify the multifaceted and complex system of governing the Commons. Vincent and Elinor Ostrom introduced a fundamental concept of polycentricity in their work. This term implies that there are multiple centers of decision making each having their own degree of autonomy which form the complex system of governance (Vincent & Elinor, 1977).

Unsurprisingly, as there are multiple levels of jurisdiction that is local, national, provincial and state level, there are overlapping governance arrangements that are polycentric in nature. It is not enough for a system to be characterized as polycentric if there are multiple decision-making centers. These decision-making centers should also be able to take each other as competitive form cooperative relationships and resolve any conflicts that arise (Carlisle & Gruby, 2019).

Stephan et al., (2019) outline the eight potential measures for a polycentric governance system as outlined in Table 1. They classified it as a dynamic process with a greater chance of combating redundancy in governing commons by formation of informal groups, diversity in communication channels, wider range of decisions and a unanimity when it comes to shared values, norms and understanding.

On the other hand, it is pertinent to understand that polycentric governance systems are not a universal fit to all institutional shortcomings and problems when it comes to governing commons. The very same reasons that help make the polycentric model successful can be the reason for unsuccessful and chaotic institutional models that may result in Hardin's assessment of the 'Tragedy of the Commons".

Multiple decision centres (of varying sizes and types)	Multiplicity of decision centres: number of relevant units, distribution of size of each (number of people, spatial scale, magnitude of resources, scope of functional responsibilities); distribution of decision structures (decision processes, degree of formality, are decisions compulsory or voluntary?)
Formal independence / de facto autonomy	Range of decision latitude of each unit; measures of hierarchical structure or resource dependence across decision units.
Overlapping jurisdictions (and spillover effects)	Proportion of people or resources under jurisdiction of multiple decision units; number of decision units involved in specific types of policy interactions or other measures of degree of functional interdependence.
Multiple processes of mutual adjustment among decision units	Number and diversity of communication channels available to (and used by) decision centres; number and relative use of mechanisms to establish contracts, collaboratives, partnerships, mergers, councils; number and relative use of legal forums, options for arbitration, mediation, and other forms of alternative dispute resolution.
Low costs of entry into or exit from decision centres	Economic, legal, and social transaction costs for joining or leaving new decision centres (or for dismantling existing ones).
Overarching system of rules or law	Degree of convergence of beliefs, values, shared understandings, values, norms, rules, and laws; extent of similarity in internal structures of organizations or institutional processes (institutional isomorphism).
Orderly patterns of behaviour, interactions, and outcomes (may be emergent)	Regularity and predictability of behaviour of decision centres and collective outcomes, such as stability of communication networks and patterns of social interaction
Emergent or intentional means of effective coordination and decision- making at systems level	Measures of successful achievement of goals shared by a high proportion of individual citizens and/or decision centres; number of decision units with authority that spans multiple decision units, proportion of regulations enacted or implemented by higher authorities; proportion of resources collected/spent by central authorities

Table 1 Potential Measures for the 8 characteristics of polycentric governance (Adapted from (Stephan et al., 2019))

Ostrom's, (1990) Institutional Analysis and Development (IAD) Framework allowed study of the common pool resources and how they are governed by the communities using them without the state being perceived as the regulation machinery in these communities. Since its development, the design principles as shown in Table 2 have been used by planners, researchers and policy makers in achieving successful institutions surrounding the governance of the institutions.

Table 2 Ostrom's Design Principles - Commons Institutions (Adapted from (Ostrom, 1990))

1.	**Clearly defined boundaries (membership and physical boundaries of resource are clear)**
2.	**Congruence between appropriation and provision rules and local conditions (rules are congruent with local conditions)**
3.	**Collective choice arrangements (individuals affected can participate in modifying operational rules)**
4.	**Monitors are accountable to the resource users**
5.	**Graduated sanction against violators**
6.	**Ready access to conflict-resolution mechanisms**
7.	**Recognition of rights to organize, by external government authorities**
8.	**Nested enterprises (Where the resource is part of a larger system)**

These eight design principles make up the institutional framework which to some extent help dictate robustness in self-governing common pool resource settings (Ostrom, 1990).

The first principle (defined borders) stipulates the presence of defined boundaries surrounding the users in the community along with the resource that is being used by the community (Agrawal, 2002). The principle combated much criticism mostly nested in the theoretical realm. The main critique focused on the rigidity of the principle. As (Mandondo, 2001) and (Blaikie, 2006) refer that sometimes for successful governing common pool resources, flexible and blurry boundaries, geographical or social, are needed to make properly functioning arrangements. Other criticisms include (Turner, 1999) who states,

"Practitioners tend to expect the 'community' to be an immutable group of people jointly managing a delimited common resource through uncontested, clearly defined rules of access. Agro-pastoral reality strongly diverges from this model. Rules of access are often politically malleable and spatial boundaries fluid." (Turner, 1999)

Thus, setting forth the idea that the strength of certain groups can change the boundaries, an idea further supported by (Ruddle, 1996) in the 'gradient' quality of the boundaries-increasing and diminishing across distance.

The second principle focuses on the rules being compatible and conforming to the local conditions. (Agrawal, 2002) recognizes two conditions that are stipulated by the principle. Firstly, the conformity of the provisional and appropriation rules to the conditions present locally and secondly, harmony between the rules set down for provision and appropriation.

(Pomeroy et al., 2001) research supports the importance of this principle stating,

"Individuals have an expectation that the benefits to be derived from participation in and compliance with community-based management will exceed the costs of investments in such

activities."

Thus, a successful system would include participants/users practicing reinvestment of benefits in the community to effectively manage common pool resource related activities.

Ostrom, (1990) states, *"Most individuals affected by the operational rules can participate in modifying the operational rules."* The third principle highlights the importance of the local knowledge when it comes to effectively managing common pool resource. The best way to modify operational rules would be the local users mobilizing their first-hand experience, knowledge and wisdom connected to the predicaments they face to concoct strategies and rules for their area in dynamic changes of the local conditions as mentioned in principle 2.

The fourth principle puts the focus on monitoring and the accountability of the monitors to the users as well. Monitoring is a mechanism and strategy that allows the identification of the deviant users in the community. This enforces rules and the effectiveness of order when it comes to the users who comply with the rules and show desirable behaviour (Cox et al., 2010).

Cox et al., (2010) and Schmidtz & Willott, (2003) classify monitoring as a by-product of common pool resource management with low costs. Cox, (2010) and Cox et al., (2010) identifies a decentralized monitoring pattern that is effective as per the example of irrigation system in Peru in making irrigation a communal affair also practiced in New Mexico's acequia irrigation systems. Numerous studies were carried to find the correlation between presence of monitors and prevalence of accepted behavior. Bardhan, (2000) and Cox, (2010) study statistically analyzed 48 systems of irrigation and reported a positive relation between presence of monitors and cooperation from the community.

The fifth principle prescribes that graduated sanctions in the system which are essentially community-based interventions are effective. Sanctioning dissuades the participants from repeatedly going against the rules set up in the community. (Cox et al., 2010) pointed out that sanctioning maintains proportionality in-between sanctions and how severe the transgressions were in the same way as it did with appropriation and provision rules. Even though sanctions tend to become stricter and harsher with each repetition but it is pertinent to note that excessively harsh punishments would be used hesitantly and in severe cases may result in social breakdown through rebellion (Levine, 2022). Therefore, effective communities may use smaller penalties initially to deter violators rather than completely outcast them from the social group. As (Cleaver, 2000) clearly emphasized participants/users' preference in terms of social cohesion and the collective decision making of communities as stated in her account of practices in Nkayi district of Zimbabwe relating to water management that,

"We have already seen that people prefer to spend more time negotiating consensus than establishing and imposing sanctions…… The village apparently most successful at collective action regarding water supplies was also remarkable for its other cooperative activities, for its success in agricultural production and for the frequency and cheerful creativity of its public social occasions." (Cleaver, 2000)

Ostrom, (1990) states that the systems which have conflict resolution mechanisms in place and are low-cost have a higher probability of surviving. Just as Hardin highlighted in his 'Tragedy of Commons', the prevalence of conflict over finite resources is 'inevitably' high. Therefore, appropriators should have easy access to conflict resolution mechanisms. (Larsson, 2016) recognises the use of early modern local courts in Scandinavian civil law while acknowledge collective and individual rights in agricultural settings to solve collective action problems of the locals using the common pool resources and avoiding free riding.

Fazlur-Rahman & Tabassum, (2014) in their study of Mehlp Valley in Chitral, Northern Pakistan highlight the key role played by micro-level management mechanism in place along with

indigenous institutions that have conflict resolution arrangements resulting in robustness and longevity for the appropriators of the valley without any external intervention.

The seventh principle stipulates that local users have the rights to create and set up their own institutional arrangements without any intervention from external agencies mostly governmental agencies. As discussed in the second principle, if the externally imposed rules are not congruent to the local conditions the system will fail. An analysis done on 69 case studies relating to forest management globally, (Pagdee et al., 2006) found that tenure security and local authority went hand in hand as the key aspect foe management practices that were sustainable. Thus, proving that violating this principle would result in lower community resilience and unprosperous common pool resource management system.

Ostrom, (1990) took into account common pool resources that are part of larger systems and states that "governance activities are organized in multiple layers of nested enterprises". The principle comes under the umbrella of Ostrom's polycentricity paradigm which undertakes smaller units into a larger system in creating a social system that has multiple decision-making centres each pertaining autonomy of some level. (Cox et al., 2010) points that linkages may be vertical or horizontal. Horizontal connections include the intercommunity linkages while vertical connections are thought of as linkages between jurisdictional levels. Table 1 highlights how measures in nested enterprises can help create polycentric governance systems that are beneficial for social systems nested.

Saunders, (2014) analyses how the design principles and the promises brought forward by CPR theory need to be in compliance to the reality of such common projects. Therefore, in order to measure the functionality and 'successes of the commons management certain social aspects need to be kept in mind. Understating the power operations and navigation of conflict in limited common resources should be examined thoroughly keeping the context and community social structures in the forefront. Aspects that stem from the formal and informal institutions in a community cannot be ignored and neither can be approached ingeniously.

This section analyses two cases related to water commons and how communities came forward to regain their right to organize without external government intervention.

Bolivia's third largest city- Cochabamba came alive when thousands of protestors filled the streets in 2000 to protest against the privatization of the local water systems. The people paraded with slogans adorning the phrase: *'El Agua es Nuestra Carajo*' (The Water is Ours Damn It!) which turned out to be the first victory that changed Bolivia's course towards self- organization and management. The 'Water War' has two sides of the story. On one hand the story goes like this, 'Bechtel' a transnational corporation privatized the supply of water in the city but the people protested and the water supply was recuperated. On the other hand, it was not only the privatization and municipalization but the struggle of the people towards water commons and its ownership (Dwinell & Olivera, 2014).

After the municipalization, community leaders took it upon themselves to provide water services in a new and unique way through a more non-hierarchical and decentralized form of decision making. The people did not want to return to the 'municipal' or 'public' way of looking at the local water supply due to its corrupt and inept handling caused by repeat of but under different jurisdiction hierarchical forms of management. This resulted in the 'social re-appropriation of wealth', where water users had now taken back the right to self-organize and make decisions (Gonzalez et al., n.d.).

Still community run-financed water systems and small irrigating farmers' associations are the backbone of the water services in Bolivia. Appropriators have come together to build independent water systems that are managed by informal committees, resident elected councils

and/or by independent cooperatives.

The case of Cochabamba highlights how collective action can bring about harmonious institutions and successful systems of governance of common pool resources.

As New York's population grew along with the technology and industrialization of farm operations, by the 20th century the sources that supplied water to New York City were no longer 'clean'. The upstream Catskill aqueduct farmers increased their nutrient use which increased erosion and led to New York City's water supply being contaminated with pathogens. Simultaneously, as the urban sprawl increased, increased forest spaces were converted into dwellings adversely decreasing the forested lots that acted as natural filters for the water supply. This combined with sewage spillage by the sanitation system led health specialists declaring that the drinking water had to be extensively treated to be safe for human consumption but this treatment came at inflated costs for the city.

As the main source of pollutants in the water supply were the excrements of the cattle, the regulators heavily sanctioned the local farmers who felt that now their livelihoods were in direct danger. The regulation on water quality was seen as a hierarchical top-down decision with no knowledge of the local areas or the practices in the rural regions,

Thus, the Catskill farmers came up with the 'Whole Farm Planning' under the Watershed Agricultural council to mandate context-specific practices that would satisfy the city's need for safe drinking water and the farmers' livelihood. Each participating farm developed unique pollution mitigating and forest management plans with expertise from the Department of Agriculture and Forestry.

"If you don't want the city on your back, design a programme that meets both your needs and ours. We don't want to run a regulatory agency; we want clean water. If your proposals can achieve that, we'll embrace it" – Albert F. Appleton (Appleton, 2002)

To ensure participation of farms (as participation in the plan was voluntary on the farmers' parts) an initial 85% participation was demanded if they failed to do so the participation would become mandatory along with fines and penalties. In five years, the programme was able to enrol 95% of the Catskill farmers with 80% reduction in pollution originating from the farms (Organic without Boundaries, 2018).

Through this programme and the farmer community coming together the city did not have to spend a copious amount of money in treating the polluted water and New York City was able to re-establish the commons for use at an affordable price (Organic without Boundaries, 2018).

3. Case Study: Ruhi Nala

3.1. History and origin – basic info

The Ruhi Nala is approximately 18 kilometers or 11 miles long (see Figure 3). It originates from Harbanspura area of the BRB canal and falls into the Hudiara Drain. It flows through Phularwan, Paragon city, Eden Gardens across Bedian then towards, Malikpur, Sehjpal, Eden City, then enters BaooWala, crossing under Burki road towards the Khaira Distributary with divides Defense Housing Authority Phase 8 and 6. From there it weaves through the city, crossing Kamahan village and falling into the Hudiara drain near the Dullu Kalan Village (refer to figure 3).

Figure 2 Ruhi Nala Length - measured in Google Earth and Maps (Satellite View)

Throughout its way, the Nala is

constructed with steep concrete sides and a narrow base, almost like V-shaped cross section. In areas such as DHA Phase 5 and 6 it is on a higher ground and is concealed with dense and moderately tall bushes but as it flows downstream into village areas and underdeveloped housing schemes it loses the bushes and lays parallel to the roads on either side of it.

In upstream areas (DHA, Park View, Eden City), the Nala is situated on higher ground with a mixture of well-built wide roads and narrow mud roads. The Nala has been considerably cleaned and restored till DHA sector Z with a well-built road but as you travel further into the villages the road is filled with potholes and is not concretized (See Figure 4 and 5).

3.2. Lahore's Administrative Zones and the NalaLahore has been divided in 10 administrative zones (Hussain Tahir et al., 2020), out of which the Ruhi Nala flows through 4 of these zones – namely: Wagha Zone (slightly touches it), Aziz Bhatti Zone, Cantonment, Nishtar Zone where it falls into the Hudiara Drain (See Figure 6).

While travelling along the Ruhi Nala through the different administrative zones, the type of neighborhoods dictated a lot of how the Ruhi Nala was being exploited. Starting from Harbanspura and going downstream, the upscale neighborhoods such as DHA and Lahore Cantonment had gone to great lengths to either conceal or completely keep the Ruhi Nala out of sight. They had used concrete slabs to cover up parts of the Nala along with using greenery barriers to conceal both edges of the Nala.

One prime example of this would be that of Systems Limited, a Fortune500 IT company that deals with international clients on a daily basis. The headquarters of this company is located on the right side of the Nala. Therefore, in order to deal with the putrid smell and the uncanny visuals of the Nala, the Systems Limited decided to cover up the area that directly affects them. They used big concrete slabs to cover over the wide expanse of the Ruhi Nala. As population has increased, the Nala has been increasingly used a dump for animal fecal and other waste matter. This has resulted into the putrid smell from the Nala itself. The company decided that in order to keep the aesthetic for their international clients the best way would be to cover the view. Refer to the Figure 7 and 8, the images taken from Google Earth, the first image shows the uncovered expanse of the Nala and the building of Systems Limited on Sehjpal road in 2013, while the second image shows the white covered up expanse of the Nala in 2022.

Moving forward, the Nala goes downstream towards the Hudaiara Drain passing multiple housing schemes, encroachments, overcrowded residential areas, barren spaces and ironically green pastures. The Nala throughout its journey takes many turns throughout the zones while maintaining a consistent green covering of trees or tall grass covering its embankments. At some points, the Nala is also seen to be filled up with mud in order to level up the ground. The Nala also passes by big farmhouses on the outskirts to big housing schemes as well as polo clubs who are openly using the Nala to discard their sewage waste. (See Figure 9).

Along its 18 km (about 11.18 mi) length, the Nala goes through phases of waste disposal at the hands of multiple users surrounding it. In the outskirts, we see farmhouse waste and mostly liquid waste being expelled into the Nala through huge pipes. Moving in the developed areas, the bigger housing schemes such as DHA and Cantonment have taken unusual care to keep the Nala clean to some extent and if not, they have taken proper measures to at least hide it. Downstream into the more crowded places, the Nala takes up the bulk of human waste, plastic and other discarded materials that not only clog the flow of the Nala but also result into dumping of all this toxic waste into the Hudaira drain – eventually polluting the Ravi River.

4. Discussion

4.1. Polycentricity and Social Systems

Commons are a much-debated topic when it comes to questions addressing who, what and why of the common itself. Who owns it? Who handles its maintenance and protection? Why is the common being exploited? What are the boundaries of the common itself? All these questions make governing and supporting the commons a complex situation with a quagmire of problems associated with it. Commons tend to be dynamic, with them being used, abused, restored and then used and abused again as a cycle (Dwinell & Olivera, 2014). Therefore, the way these commons are managed keeps changing too.

The Ruhi Nala is an example of how commons especially water commons are run in a fashion that is heavily influenced by institutionalism surrounding it. The Nala travels through multiple administrative zones and comes in direct and indirect contact with authorities, users and many other actors. To understand the complex system attached to the Nala, the dominant trends that need to be considered are the 'uses' and 'customs' attached to the Nala.

We need peer closely at 'who' is using the Nala and for what purposes and do they have decision making autonomy in matters that directly affect them. Side by side, we must intimately unravel the historical use of the common itself to understand the social institutions attached to it and customs built around it.

The appropriators of the Nala essentially were local farmers that used the Nala to as a capturing device for flood water and rain water in order to save their harvest and fields from flooding in monsoon or winter rainfall. Lahore was a particularly fertile land with crops such as wheat, sugarcane, rice along with other pulses were grown. The district also cultivated all types of vegetables and fruits. Thus, the Nala played a vital role in the agricultural economy of eth district.

Albeit, in recent times due to increase in population along with horizontal and uncontrolled expansion of the district, more agricultural land is being converted for commercial and residential uses. This has significantly affected the quality and nature of the common pool resources including air, land and water (Hassan, 2018).

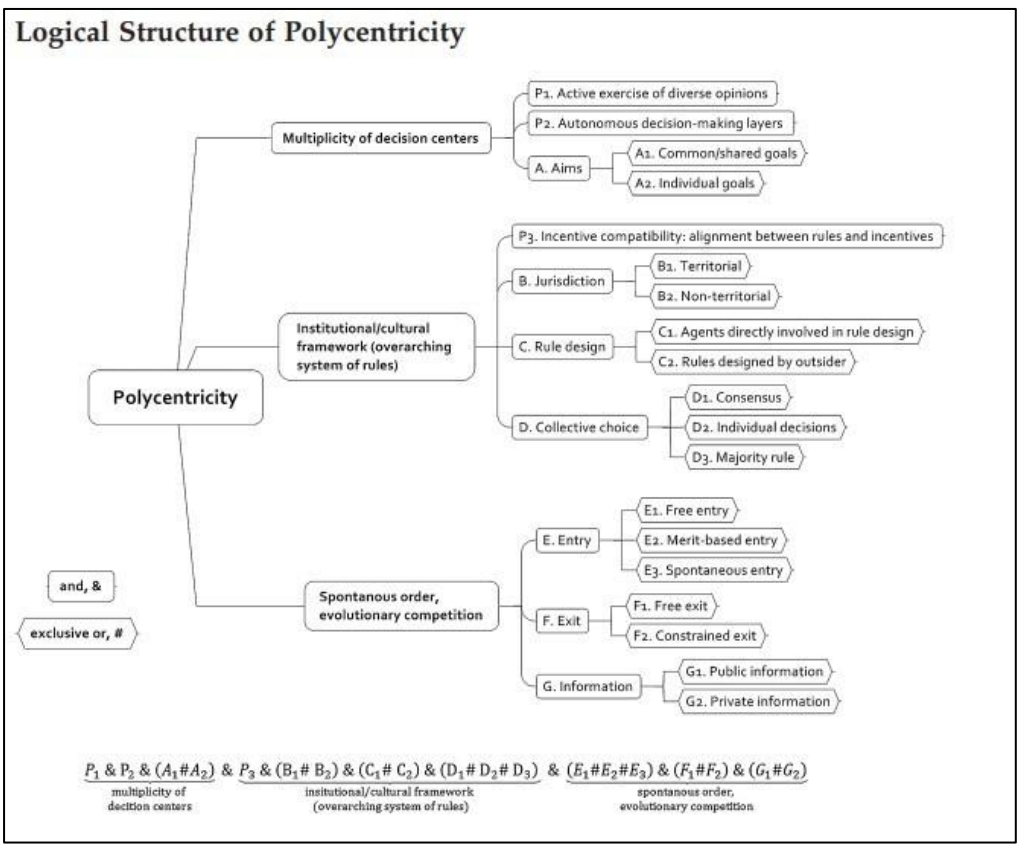
To accommodate the growing population, housing schemes have expanded and sprouted everywhere. Gated communities have made their boundaries clearer and the zones are demarcated in terms of lifestyle and income brackets. The once rural villages have swept along with the newer housing schemes and have become hubs supplying manual labour and house help to the surrounding communities (Ali et al., 2020).

The social system that has developed from this expansion is one that bifurcates the rich from the poor based on education, lifestyle and wage but there is one thing that is similar to both these strata's- the abuse of water commons specifically the Ruhi Nala. As discussed earlier, the Ruhi Nala flows through 4 different administrative zones of Lahore District out of which two are relatively much richer areas. The research concluded that the influential and the weaker communities living around the Nala use it for the same purpose of discarding effluents. The difference appears in the practice of how it is being done. For the richer communities, the housing schemes take care of collecting and discarding the sewage into the Nala while keeping the Nala covered to ensure the 'clean' image of their neighbourhoods. The farmhouse owned by the powerful and influential do the same through drainage pipes as shown in Figure 8. While on the other hand, residents of the lesser affluence tend to throw compost, household waste and other excrements into the Nala directly.

The question that arises is what compels the 'users' in exploiting the commons in the same manner. (ALIGICA & TARKO, 2012) provide a clearer image of how a logical structure of polycentricity embarks on the presence of an 'institutional/cultural' framework in any social system (See Figure 9). These overarching rules tend to not only affect collective choice, D, but also simultaneously affect the individual decisions, D2, and the built consensus around it, D3.

Coming to the predicament of the Ruhi Nala, the vehement absence and/or neglect of P3 directs the collective choice made by the users to use the Nala as a sewage dump. As the Nala flows through different jurisdictions, B, the territorial (B1) cultural framework of affluent housing schemes make keeping the Nala visibly clean a priority to keep their image and aesthetic as a clean and hygienic space in order to attract more residents into their housing schemes. Whereas, ad hoc and random settlements in other non-territorial, B2, jurisdictions depend greatly on rules designed by outsiders, C2, to dictate their use of the Nala.

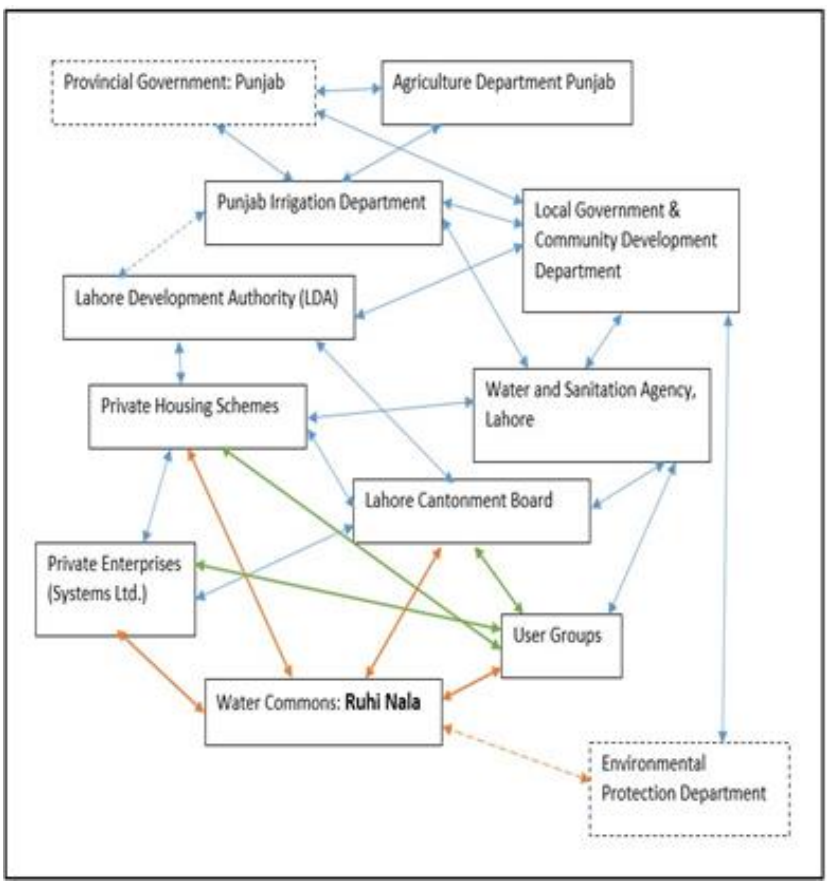
The problem arises when, decision centres such as the Lahore Development Authority, Punjab Irrigation Department and local governments fail to implement the designed rules in non-territorial jurisdictions. Thus, building a replicating pattern of behaviour where D1, D2 and D3 coincide. In this case on deciding that the Nala will be used as a sewage dump. As figure 10 shows the interconnectivity of different decision centres in deciding the faith of the Ruhi Nala, it is the blatant neglect of creating a context-specific common pool resource management plan that would help alleviate the problems associated with the Nala.



Each appropriator, actor or stakeholder is directly or indirectly involved with eth Ruhi Nala. It may be through responsibilities, jurisdiction or even through the consequences and repercussions of the abuse. Each decision centre has limited yet autonomous entitlement to do something about the Nala near them. A prime example would be that of Systems Limited, they decided on covering up the Nala to get rid of the smell but they could only do so for the area that directly affects them. On the other hand, we have villages on the Ruhi Nala that still practice the rural lifestyle with livestock and use the Nala to bathe the animals. The Nala is also used by these small-scale farmers in throwing the faecal matter of the cattle further polluting the Nala with pathogens. Surprisingly, in some areas, pastures are being irrigated using water from the Nala too.

5. 4.1.2 Ostrom's 7th design principle and the Ruhi Nala

This brings us to Ostrom's design principles. The 7th design principle suggests the right to organize for the local communities through self-organization. Presently, the Punjab Irrigation



department and local government is solely responsible for the Nala, while the Environmental Protection department is indirectly involved with what the Nala is causing to the Ravi River and other water bodies of Lahore in terms of pollution. Yet the direct appropriators of the Nala, small scale farmers, cattle farmers and villagers are left in the dark. The external government agencies are the ones that have abandoned the Nala.

These small-scale farmers, cattle farmers and villagers have been living in the area for years and

have ample local knowledge of the origin, use and importance of the Nala way before Lahore extrapolation hit them. Thus customs, rules and informal institutions may already be in place for the use of the Nala, under the 7th principle government officials need to give legitimate recognition and importance to these informal institutions.

Furthermore, Ostrom's design principles 2, 4 and 5 are missing in action. The blatant abuse of the Nala is the failure of the system due to absence of strong monitoring authorities, sanctions and incongruence in operational rules of the common itself. When one individual decides to show deviant behaviour, there is no monitoring system in place to punish the unwelcome behaviour, in this case through trash and spilling sewage into the Nala.

As discussed earlier, the polycentricity framework in figure 9 supplies an analytical design of studying contextual social phenomenon. The social phenomenon that this research studies is the replicating behaviour patterns followed by each appropriator regardless of their status.

Ostrom, (1990) argued that social learning processes help resource institutions to evolve. This argument would entail the view that communities learn and unlearn patterns of behaviours while intentionally adopting positive, more effective institutions thus eventually learning to self-organize. We are assuming that benefits of cooperation will outweigh the rational egoist urge as described in 'Tragedy of the Commons' thus making collective action an increasingly robust and efficient arrangement. If we look at the Ruhi Nala through this aspect, the collective action that is being showed right now alludes to adoption of negative practices that will eventually crumble the system. Yet one of the reasons in same behaviour patterns are due to the unknown benefits of communities coming together in a polycentric model to preserve, maintain and protect the commons (Ruhi Nala). As the common pool resource theory assumes smaller, rural and homogenous objects of analysis, the interpretation of the Ruhi Nala would be somewhat generalized. It would be much more proper to diagnose the Ruhi Nala in pieces as per the zone to get a much clearer understanding of the social systems in place.

6. Conclusion

Commons are complex and dynamic systems that involve a multitude of layers of social, economic and ecological foundations. Ruhi Nala is one such case. The abandoning of a historic structure in lieu of growing population, urban expansion and land exploitation has left many unanswered questions. The scholarship on such exploitation of commons is scarce and leaves a huge space for empirically understanding and analysing the social phenomenon of such structures. The social systems that govern the actions and behaviours of the users when it comes to the common resource can provide great insight to Pakistan to not only protect our commons through cost cutting institutional arrangements such as the example of New York but also help move Pakistan towards a more self-organizing cultural arrangements like that in Chitral and Bolivia. These commons are our assets and we should contribute as a community in preserving their function to build sustainable practices and behaviours for our generations to come. It is a saddening sight to bear when Hardin's 'inevitability', which can be easily avoided and redirected, is coming true in reality. The continuous boom in population does challenge our practices but it also allows us to actively engage in governance structures that do not make Hardin's pessimism a reality.

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