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Responsible consumption choices and individual values: an algebraic interactive approach

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Abstract

This paper develops an algebraic formulation summarizing various forms of socioeconomic interaction in and across individuals, groups, corporations, and states. The proposed articulation accelerates the understanding that coordination among economic agents leads to the efficient allocation of resources in society. The study considers an approach whereby the State has a regulatory *role* which helps attain responsible consumption and production choices (RCP). This study has the potential to encourage the use of resources in a way that promotes RCP decisions based on an understanding of values. The fundamental structure of socioeconomic interaction is described in work using finite algebra. It presents how governance structure comprising intra- and interactions involving the State, corporation, groups, and the individual will attain (RCP). The prevailing economic structures functioned lower than the projected level, with enormous damage to the environment. It is deduced that the final level of the economy depends crucially on the initial injection of socioeconomic actions. Furthermore, diverse socioeconomic position patterns are possible depending on the nature of activity impulses undertaken at different levels. The world needs to decouple environmental degradation from economic growth to evolve towards a sustainable and collectively inclusive economy. For that purpose, mutual trust-based coordination among all stakeholders is vital to attain sustainable objectives.

Keywords Socioeconomic interaction · Society · Individual values · Responsible consumption and production (RCP) · Resource management · Economic growth · Mutual trust

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1 Introduction

There was an unspoken belief that purchasers always know what they have at their disposal, always select the best action, and can reliably anticipate their decisions. Because of the unknown nature of future earnings, it is also assumed that people would be risk averse, experience declining marginal value, and be motivated to save as a safety net.[1] Similarly, (Davidson et al. 1978; Nordhaus 1975) stresses that past consumption behaviors cannot predict future consumption decisions and that there is no correlation between the spending functions of any two individuals. In contrast, present consumption is habit-driven, indicating a steady rise in expenditure over time. In addition, resilience to shock depends on the power of habit. The traditional assumptions that the value we obtain from our present consumption level is independent of the community's consumption patterns are challenged (Smith 1937). Consequently, as research progresses, these obsolete ideas seem to diverge from reality because human decision-making is limited by the social effect of relationships and values and seldom incorporates the complete knowledge, time, or reason for the perfect choice. This theory of bounded rationality proposes that people do not always strive for perfection but settle for achievements that are "good enough" (Simon 1956, 1957; Kahneman and Tversky 1979).

Consumer behavior is how people consistently use resources like time, money, and effort to consume goods (Walters 1974). The absence of a framework for identifying responsible consumption and production options that align with cultural values is also derived from the previous research. Socioeconomic interactions determine the extent of influence exerted by the surrounding culture and environment on individual choices. While people are good at heart, they can become morally corrupted by adopting behaviors from society. For instance, while all children start with a pristine intrinsic nature, as they grow up, they are influenced by their upbringing, their surroundings, and the people with whom they interact (Rousseau 2012). Also, the conditions for creating RCP patterns may be understood via established faith value systems. Religions like Buddhism, Islam, Christianity, and Judaism have always encouraged their adherents to consume and produce responsibly through guidance for a religious text (Shah et al. 2020). Several factors, including one's level of religious belief, family values, and community involvement, contribute to one's perceived value in traditional communities. However, when consumer-oriented institutions became the norm, people's worth became tied to their material possessions' quantity, variety, and quality.

Most of us did not grow up during the internet age when the world wide web was starting. Even though the information is more readily available than ever. Moreover, information taken away from us may not make us more responsible for our acts, but it will certainly make us less aware of the consequences of our actions. We may face the most significant challenge humanity has faced in decades due to climate change. The international community has agreed to cut greenhouse gas emissions and achieve landfill-free status drastically. In this part of our study, we have provided

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[1] Persky (1995) evaluates Marshallian realist ideas, which see consumers exclusively in terms of Homo economicus motivated by self-interest and making decisions based on maximum utility.

a policy framework that advocates for cooperation amongst all relevant parties (including people, communities, businesses, and governments). Trust between all stakeholders is crucial to attaining fruitful results.

Corporations and governments make decisions every day. For example, the government need to be efficient in managing its development expenses, like taxes received from people should be spent on the welfare of people by the government in a cost-effective method. The worldwide consumption of some commodities confronts a zero-sum commodity dilemma. The primary process of capital accumulation is that most individual needs to spend less than they generate (or produce more than they are authorized). Moreover, this restraint is enforced most forcefully on the people of the global South. It bears adding that their work is primarily mobilized not to produce for human necessities (food, shelter, healthcare, education) but for corporate expansion so that even if their buying power is boosted, significant shortages persist of essential products. When government and citizens do not work together well, everyone loses. Multiple studies have demonstrated that financial prosperity does not boost happiness after a person's basic requirements have been addressed. Furthermore, an environmental cost is associated with acquiring desires that exceed basic needs. Seventy-one per cent of all emissions worldwide are caused by only one hundred firms (Riley 2017). We are the ones consuming and wasting their products and resources. The past 40 years have seen a dramatic rise in global emissions despite substantial advances in renewable and energy efficiency technologies. Controlling excessive consumption is not the exclusive responsibility of the individual; instead, it is the duty of all stakeholders in the economy.

Historically, civilizations have consisted of individuals with vastly different racial, cultural, religious, and political backgrounds. These discrepancies require interpersonal or mutual trust between governments and people. The word "trust" is synonymous with "belief," "faith," and "liberty," but its primary meaning is "strong dependability in someone." If someone lives in a trustworthy society, the government, neighborhood association, employer and individuals all work together to distribute wealth fairly. Responsible socioeconomic relations so refer to the collaboration required to achieve the goal of lessening environmental deterioration. This engagement would not be possible without easy access to relevant information. The effectiveness of governments may be seen as heavily dependent on the norms and networks of civic involvement. When people in a country have a high level of trust, there is less need to keep tabs on them for deviant behavior and spending less on public welfare services (Lin, 2001). According to (Knack and Keefer 1997), a lack of trust places a substantial financial burden on the State in the form of regulatory expenditures like rehabilitation, providing security against violence and theft, and the cost of enacting laws for rent-seeking. Instead, these resources can be used in money-making endeavors. Efficient delivery of public goods fosters trust, strengthening inhabitants' feelings of belonging in their communities (Delhey and Newton 2005). As a result, trustworthy social interaction serves as a means of gathering useful information and advocating for the realization of goals that may align with society's norms. Disagreement can arise even when the goals do not

counter social norms because competing private interests may override mutually beneficial collective ones.

United Nations Sustainable Development Goal 12 states, "encouraging efficient usage of resources and energy, sustainable infrastructure, and increasing people's quality of life by extending their access to key services, green job opportunities," highlighting the importance of RCP. Our study defines responsible consumption as making decisions based on reasoning and proof. We must find a medium between two extremes because responsible consumption is neither wasteful nor cheap. The primary objective is to design a system that encourages optimum resource allocation and ultimately leads to responsible consumption and production decisions for nations considering their unique values. Applying logic rules is based on mathematical models built from assumptions and definitions. The theory's capacity to describe the social complexity phenomena prevalent in civilizations is sometimes constrained by simple mathematical assumptions.

Competing private interests may easily overpower agreed-upon community interests in the design of goals; it is essential to recognize that there may be substantial disagreement when objectives run counter to societal norms. When discussing the dynamics of two-person groups, (Heider 2013; Newcomb (1953) highlights the need to recognize and respond to prevailing patterns of thought and interacting relations as part of a more extensive, interconnected system. Suppose it can be extended to groups of N people. In that case, we may formulate a sophisticated structure for the group, including the dynamics of power and influence inside the group and the connections between members' perspectives. In addition, (French 1956) claims that, as a group's power grows, so does its incoherence. Mathematical models based on certain assumptions and definitions are the foundation upon which logical principles may be built. The ability of the theory to describe the true social complexity phenomenon present in cultures has often been limited in the prior literature by basic mathematical assumptions. To account for the empirical variables in the present model, we shall make our assumptions using algebra that, according to (Harary and Nash-Williams 1965), does not need any quantitative assumptions.

Algebra and its notions of designing the concept of a vector space using its elements (vectors) can serve as a valuable tool for analysis. Accordingly, to this representation, the inter-temporal accumulation starts with an arbitrary state pushing economic activities. The present study classifies economic agents into four types, which are State (government), corporations, groups, and individuals, denoted by S, C, G, and L, respectively. The state (government) S is denoted as finite algebra $\mathbb{Z}_p$, which has p functional categories (vectors) $0, 1, ..., p-1$, each of which represents a specific economic indicator. For example, with $p = 3$, the states 0, 1, and 2 may represent consumption, investment, and production activities, respectively. By assuming that a higher dimensional linear space $\mathbb{Z}_p^2$ represents a corporation C with p^2 number of $C - vectors$. Likewise, the linear spaces $\mathbb{Z}_p^3$ and $\mathbb{Z}_p^4$ respectively represent a group G with p^3 number of $G - vectors$ and an individual L with p^4 number of $L - vectors$). This more general algebraic representation of the forms of socioeconomic interaction facilitates a broader scope for the interpretation of social

interactions with the possible choices ranging over $0, 1, ..., p-1$ as compared to only two choices, coded as 0 and 1.

The proposed algebraic demonstration is crucial in modelling defined economic entities' responsible consumption and production behavior. This behavior is specified in terms of the agent's economic indicators represented by the system coordinates. Intersections of the common coordinates indicate intra-action within a particular type of agent, while the intersections of different coordinates indicate interactions across different types of agents. Furthermore, anyone category of the intra-actions of interactions results in additional economic activity at the lower end of the agent's spectrum. For example, the top-down approach to manage consumption and production at the government and individual levels (a case of intersecting common coordinates) is expected to generate additional efficiency by individuals (a case of intersecting different coordinates). Eventually, socioeconomic interaction based on mutual trust has a prominent role in determining the effectiveness of government fiscal policy. Here, the proposed algebraic model identifies the possible existence and types of interactions configured through a particular algebraic structure. The proposed model can help devise policies for the world to efficiently decouple environmental degradation from economic growth.

Therefore, the paper is structured as a brief literature review and study intention are provided in Sect. 1. Afterwards, Sect. 2 explains various levels of socioeconomic interactions. Whereas in Sect. 3 basic notion of modular algebra is explained. The mathematical representation of socioeconomic interactions is given in the first part of Sect. 4; however, the second part of Sect. 4 provides an implementation of modular algebra-based responsible consumption and production to the actual situation. The conclusive remarks are given at the end.

2 Socioeconomic interactions

The area of social science known as socioeconomics focuses on how economic activity affects and influences social processes. It looks at how the local, regional, and global economies impact the growth of modern society in broad terms. Additionally, "Social economics" could broadly refer to "the application of economics to the study of society" (Eatwell et al. 1989). Modern practice focuses mainly on the dynamics between people and communities regarding the relationship between economics and social values (Benhabib et al. 2010). People adapt their behavior to their environment because of compliance, socialization, persuasion, respect, and leadership, among other factors. Like this, imitation is a crucial concept in many social and natural sciences. In contrast to social influence, it led to bounded realistic beliefs that people are susceptible to being persuaded. The opinions and social network connections of the members of the tempest group have an impact on this influence. Advertising, censorship, political campaigns, and societal consequences are only a few examples of scenarios that the phenomenon of persuasion can explain. It is necessary to comprehend the natural circumstances where group behavior and competing viewpoints are prominent. In our model, the interplay between individuals, groups, companies, and the State and their desires determines the choice.

People use other people's experiences to update their prior beliefs when the benefits of economic or social decisions are unclear; however, these updates may take longer due to the homogeneity of their environment. Similarly, there are no heterogeneous economic and social payoffs if society is interconnected and everyone has similar environmental concerns. It greatly relies on our environment (including people, type of environment, and in the event of homogeneous preferences, individuals have direct information links within-group rather than cross-group). Recently, the pandemic has taken hold of people's lives worldwide, affecting their spending habits, financial decisions, salaries, and religious practices. The way people allocate their time and resources is also changed. To safeguard people's safety and health, those in power, including the government, devised regulatory practices and emergency preparations. However, numerous frictions and restrictions negatively influence production activities, services, the agricultural sector, tourism, and individual income. In contrast, a formal regulatory framework may be essential for establishing and bolstering all these positive connections. For sales and lending agreements, which usually presume success, it is essential to have well defined property rights supported by a robust legal system.

Not every regulation applies to the government since, societies frequently develop self-regulating laws, such as those governing product payments and wage benefits for productive labor. On the other hand, a society with strong moral ties may work to uphold moral principles and organize itself to do so through the government. Various interactions among themselves can represent the presence of mandated interaction by various organs of an economic system. The economic system must cooperate to offer effective resource allocation. On the other hand, while providing urban and economic services, ineffective coordination between federal, provincial, and district governments frequently results in a chaotic environment. Like this, businesses utilize their time and resources to influence elected officials and institutions to obtain desired modifications to policy processes, such as lobbying for lower environmental fees. In exchange for good improvements in economic policy, such as responsible manufacturing ensured by national and international firms to protect the environment, the government may develop ties with corporations. These interactions frequently foster reciprocity between the public and private sectors. Governments invest money in gaining political support from different groups and people, which fosters reciprocity and trust. Like this, several firms collaborate to generate widespread support for a common cause, such as reducing the negative environmental consequences of industry or fighting a pandemic or natural disaster.[2]

Some companies might increase their sustainability by using their positive image among businesses and customers. Consider a scenario in which a business's clients are familiar with its products because of their dependability and reputation. If that is the case, it might utilize its excellent reputation to instruct the public on reducing its environmental impact. Communities work together through social norms, reciprocal commitments, and information sharing (Coleman 1990). Marketplaces, communities,

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[2] Find out whether the difficulties of collaborative governance are affecting the effectiveness of programmes to respond to climate change. Mukhlis and Perdana 2022; Evans (1996) contends that government-society collaboration plays a role in achieving efficiency in disaster scenarios.
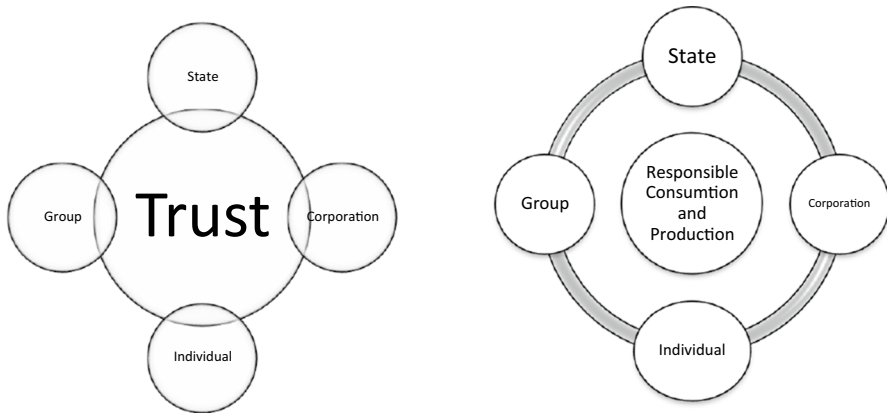
Fig. 1 Trust based on Socioeconomic interaction framework for responsible consumption and production

workplaces, educational institutions, places of worship, and sports venues are where people interact with one another (Lee et al. 2021). Although interactions between a limited number of individuals within groups tend to assume simple forms, they can benefit numerous members of distinct groups in various ways.

The interaction could take place through informal channels instead of following set protocols. However, the development of all such fruitful connections may depend on a formal regulatory system. For instance, the success of sales and loan agreements, frequently taken for granted, depends on well-defined property rights supported by an efficient legal system. Governments do not always make rules, since societies frequently create rules for self-regulation that are commonly used in payment for commodities and productive effort. However, an excellent regulatory framework at the State level promotes and reinforces local regulations. It serves as an illustration of how a powerful state may encourage socioeconomic order. On the other hand, a society that shares strong moral ties can organize itself to advance moral principles and instill them in government institutions (Fig. 1).[3]

In many cases, government constituents will cooperate with a different segment to give help, cooperation, and support, as well as share resources. The State stands to gain from this productive interchange, which will encourage government and citizen collaboration.[4] In Pakistan, the delivery of urban services is typically muddled due to a lack of coordination between federal, provincial, and district administrations. Since the provision of roads may fall under the purview of the provinces. In such a scenario, it may seem impossible to achieve proper resource management[5] and

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[3] These examples can be classified into top-down and bottom-up approaches to socioeconomic interaction.

[4] The Pakistani Ministry of Finance and the State Bank of Pakistan have not been communicating well. As a result, there is not a consistent policy in place within the banking sector to deal with monetary and fiscal crises.

[5] e.g., maintaining a functional road network and a reliable water supply network. In many of Pakistan's largest cities, the responsibility for upkeep the underground water pipelines rests with the respective districts.

RCP, throughout a developmental event, State institutions may experience varying amounts and types of exchange. Cooperation among the State's most vital parts cannot advance based on monetary consideration alone and without the regular exercise of trust and reciprocity.

Lobbyists working on behalf of businesses may invest significant time and resources in influencing policymakers at the State level. Pakistan's government has actively promoted the launch of "buddy capitalist" businesses throughout the country's many industries, from sugar and textiles to automobiles and banking, fertilizer, and energy. The sugar business is one sector where special interests have a noticeable impact on policymaking. On the other hand, governments may try to engage with companies to gain their confidence and get concessions, such as promoting environment-friendly manufacturing processes. These interactions strengthen the mutual respect between the State and businesses. The State-society synergy may bring even more essential advantages than expanding micro-level capital, which is crucial for growth (Varda 2011; Evans 1996). Citizens must appreciate the State's provision of public services as well as recognize the State's role as a rule-making body with the power to enforce its laws. Is sugar a commodity or a common good in our minds? If government intervention in this market is unnecessary, why do they strive to do so? Public goods include services like public schools and hospitals as well as municipal water systems. More than merely creating the regulations, the State's role here must be substantial. It is up to the government to take the lead, make financial investments, and work closely with the private sector to solve these problems. Public good provision discussions between the State and the market are essential. Establishing safety nets like social security plays a significant role for the State. When governments intervene in the market, they should regularly assess the efficacy and appropriateness of their policies.

Government and community may work together to advance sustainable development objectives in the real world. While political, religious, and community organizations typically take the initiative to seek official patronage, governments often devote resources to win over each group's favor. Conversely, state-imposed programmes that do not work might have far-reaching effects if they are implemented poorly. People in Pakistan's cities, towns, and villages communicate with their respective State representatives at the district and union council levels and in the federal and provincial legislatures. Such engagements may not significantly impact the state policy's ultimate course. However, they substantially impact local policies and foster a feeling of local ownership of the policy. According to the findings, individuals with the highest confidence in their government are also the most responsible members of society (Evans 1996).

Corporation also communicates with their competitors on a more strategic or operational level via exchanges with their leadership or staff, (Hirst 2018). Every business deal should benefit both sides. Groups, especially smaller ones, may benefit from working with (more renowned) organizations to establish vertical networks reaching the State level. Communities may create more powerful lobbying organizations by working together. *People in developing countries, where democracy is still in its infancy, often feel alienated from the government.* One possible explanation for the widespread occurrence of these encounters is that having a group of friends around makes individuals feel more secure in potentially harmful environments. Of course, public support may be a potent tool for businesses. Relationships built on

open dialogue, trust, and mutual gain may help businesses and individuals achieve their goals. Trust and social cohesiveness on a neighborhood level may be bolstered by spending time and money facilitating community interaction. Economic cooperation between groups is necessary for society to flourish if it takes place within a framework of shared values, responsibilities, mutual trust, and shared knowledge (Coleman 1990). All other forms of social and economic connection are constructed upon the foundation of interpersonal bonds. It is very uncommon for these conversations to start in a public area like a market, a neighborhood, a store, a school, a church, or a stadium, but they soon go on to other, more private venues. The "rational" consumer, as (Hobson 2004) explains, is ultimately responsible for developing environmentally friendly buying habits. When just a few agents are involved, their interactions tend to be more straightforward.

Some people participate in an irrational or cascading group and encourage wasteful consumption behavior. For this reason, institutions are essential for spreading benefits, legitimization, and shared expectations that boost group efforts and keep us on track when we stray, Corvellec et al. (2021). Demonstrating that positive social change is possible with effort (Maton 2008). Building-wide support for a single cause should be the primary focus to strengthen lobbying power in conversations with the State or to work jointly to secure public support for planned joint initiatives. Reducing the time, money, and carbon footprint associated with transporting goods by locating production closer to consumers is essential to achieving environmental sustainability. The best way to improve biodiversity is to encourage tree planting and wildlife protection. Make it a rule never to throw anything away and promotion of sharing economy. The only way to get to a zero-emissions economy is to cut emissions as much as possible. The consumption of fossil fuels must be reduced, components must be recycled, greener design techniques must be used, and a more efficient attitude to work must be demanded across the whole value chain.

3 Modular algebra

The interaction initiated by the government at the top to facilitate individuals at the bottom to achieve responsible consumption and production corresponding to cultural values needs to be coded for the proposed analysis. The distinctive algebraic structures are used to tabulate the concepts, type, and style of execution amongst different agents. Accordingly, we designate algebraic structures, groups, rings, integral domains, fields, and linear spaces. However, we emphasize the finite nature of these structures. We begin with the following definitions. A non-empty set G equipped with a binary operation $*$ (i.e., $a * b \in G$ for $a, b \in G$). A groupoid $(G, *)$ is a semigroup if the binary operation $*$ is associative. A semigroup $(G, *)$ is said to be a monoid if there exists $e \in G$ such that $e * r = r * e = r$. We refer to e as the identity element in G concerning the binary operation $*$. A monoid $(G, *)$ is said to be a group if, for each $g \in G$, there exists $h \in G$ such that $g * h = h * g = e$, where g and h are the inverses of each other. A non-empty set R with two binary operations. If $(R, +)$ is an abelian group (i.e., $a + b = b + a$)

and $(R,.)$ is a semigroup with binary operation '$\cdot$' which is distributive over the binary operation '+'.

A ring R is commutative if $a.b = b.a$, for all $a,b \in R$. A commutative ring R with identity is said to be an integral domain if $ab = 0$, where $a,b \in R$, implies either $a = 0$ or $b = 0$. An element a of commutative ring R with identity is said to be invertible or unit in R if there exists an element $b \in R$ such that $ab = ba = 1$. $U(R)$ represents the set of all unit elements in the ring R. A commutative ring F with identity is a field if $U(F) = F \backslash \{0\}$. A finite integral domain is a field. A nonempty subset I of a commutative ring R with identity is said to be an ideal of R if $a - b \in I$ and $ra \in I$, for all $a,b \in I$, and $r \in R$. For instance, $n\mathbb{Z} = \{na : a \in \mathbb{Z}\}$, where $n \in \mathbb{Z}^+$, are ideals in the ring of integers $\mathbb{Z}$.

Given non-negative integers $0 < a$ and b, there exist $q \geq 0$ and r with $0 \leq r \leq a$ such that $b = aq + r$, where q and r are the quotient and remainder respectively, which are unique. If $r = 0$, we say a divides b (that is $a \mid b$). For a fixed $m \in \mathbb{Z}^+$, we say $a,b \in \mathbb{Z}$ are congruent modulo m, written $a \equiv b (mod m)$ if $m|a - b$ or equivalently, if $a = b + mt$, where $t \in \mathbb{Z}$. Here m is called the modulus (plural; moduli). Note that $a \equiv 0 (mod m)$ means $m|a, a \equiv b \ (mod \ 1)$ for all $a,b \in \mathbb{Z}$. Therefore we consider the positive integer $m > 1$ and $\{b + mt : t \in \mathbb{Z}\}$ the set of integers for which $b \in \mathbb{Z}$ is congruent modulo m. Every integer is congruent modulo m to exactly one of the numbers in the set $\{0, 1, 2, .., m - 1\}$.

Let $2 \leq m \in \mathbb{Z}^+$, be the modulus, which is fixed. Define the congruence class of $b (mod m)$, written $[b]_m$ or just b as $[b]_m = \{a \in \mathbb{Z} : a \equiv b (mod m)\} = \{a \in \mathbb{Z} : m \text{ divides } a - b\} = \{a \in \mathbb{Z} : a = b + mt, t \in \mathbb{Z}\}$. Thus $[a]_m = [b]_m$ if and only if $a \equiv b (mod m)$.

Every congruence class mod m is equal to one of $[0]_m, [1]_m, [2]_m, .., [m - 1]_m$ (or simply $\{0, 1, 2, .., m - 1\}$) and clearly, all these classes are different. Thus, there is only m congruence classes modulo m. We represent the set of all congruence classes modulo m by $\mathbb{Z}_m$. For example $\mathbb{Z}_2 = \{0, 1\}$, $\mathbb{Z}_3 = \{0, 1, 2\}$, $\ldots$, $\mathbb{Z}_m = \{0, 1, 2, .., m - 1\}$.

In $\mathbb{Z}_m$, we have defined the binary operations $\oplus_m$ and $\otimes_m$ (or take $\oplus$ and $\otimes$). If $n = 2$, then $\mathbb{Z}_2 = \{0, 1\}$ and we define the binary operations as follows.

$$
\begin{array}{cc}
\begin{array}{c|cc}
 & 0 & 1 \\
\hline
0 & 0 & 1 \\
1 & 1 & 0
\end{array}
&
\begin{array}{c|cc}
 & 0 & 1 \\
\hline
0 & 0 & 0 \\
1 & 0 & 1
\end{array}
\end{array}
$$

The ring $\mathbb{Z}_m$ is an integral domain if m is a prime integer; however, the ring $\mathbb{Z}_4$ is not an integral domain. $U(\mathbb{Z}_m)$ represent the set of unit elements of the ring $\mathbb{Z}_m$. It is easy to verify that $U(\mathbb{Z}_m) = \{a \in \mathbb{Z}_m : \gcd(a, m) = 1\}$. The ring $\mathbb{Z}_m$ is an integral domain (and hence a field) if and only if m is a prime integer.

An additive abelian group V is said to be a vector space over the field F if the scalar multiplication map $F \times V \rightarrow V$, defined as $(a,v) \mapsto av$ satisfies: $a(v + w) = av + aw; (a + b)v = av + bv; (ab)v = a(bv); 1.v = v$, for all $a,b \in F, v,w \in V$. A vector space V is said to be an algebra over the field F if V is also a ring and $a(vw) = (av)w = v(aw)$ for all $a \in F, v,w \in V$. A field is a

vector space over itself with dimension 1. Furthermore, for a positive integer n, $F^n = \{(a_1, a_2, .., a_n) = a_1 a_2 .. a_n : \quad a_1, a_2, .., a_n \in F\}$ is an algebra over F with dimension n. If p is prime integer and n any positive integer then $\mathbb{Z}_p$ is a one-dimensional algebra over the field $\mathbb{Z}$ and $\mathbb{Z}_p^n$ is n dimensional algebra over the field $\mathbb{Z}_p$. Let V and W be finite dimensional vector spaces over the same field F. A linear transformation $\phi : V \to W$ that satisfies $\phi(x + y) = \phi(x) + \phi(y)$ and $\phi(ay) = a\phi(y)$ for all $x, y \in V, a \in F$. ϕ is an isomorphism if it is bijective. If ϕ is isomorphism then we say that V is isomorphic to W and we denote it as $V \cong W$. For more details on basic algebraic notions, one might consult (Dummit and Foote 2002; Durbin 1992; Wallace 1998; HungerFord 1974).

The hypothesis is that the State, corporations, groups, and individuals have finite numbers of activities, which finite algebraic structures could represent. Accordingly, government, corporations, groups, and individuals are (algebraic) systems or players. Thus, the vectors of each system are called categories, and their coordinates are labelled as economic indicators.

4 Modular algebra notions interpreting socioeconomic interaction for attaining RCP

Here we consider p-elements (ground) algebra $\mathbb{Z}_p$. Hence the proposed setup can handle p number of economic indicators to provide multiple period analysis. It formulates a mathematical model which asserts that to produce and consume responsibly; there is a need for effective coordination between the State, corporations, groups, and individuals at each level of interaction.

4.1 Mathematical interpretation of socioeconomic interaction for responsible consumption and production

In the proposed model,, four constituents are considered accountable for attaining RCP i.e., State, corporations, groups, and individuals who interact and develop their relevant financial and societal settings.

4.1.1 Tagging

The state S is represented by finite algebra $\mathbb{Z}_p = \{0, 1, ..., p - 1\}$, which has p number of efficient categories (vectors) $0, 1, ..., p - 1$. We refer to these categories as the $S - vectors$ of State activities. For example, category 0 may represent regulatory framework for ensuring RCP, category 1 is consumption spending. We assume that a higher dimensional linear space $\mathbb{Z}_p^2$ represents a corporation C with p^2 number of $c - categories of carporation$. Likewise, the linear spaces $\mathbb{Z}_p^3$ and $\mathbb{Z}_p^4$ respectively represent a group G with p^3 number *of Groups* and and individual L with p^4 *categories of Individuals*. This more general algebraic representation of the forms of socioeconomic interaction facilitates a broader scope for the interpretation of social

Table 1 Algebraic Structure showing interaction among State, Corporation groups and individuals

$\mathbb{Z}_p$		$\leftrightarrow$		State (S)
$\mathbb{Z}_p^2$		$\leftrightarrow$		Corporation (C)
$\mathbb{Z}_p^3$		$\leftrightarrow$		Groups (G)
$\mathbb{Z}_p^4$		$\leftrightarrow$		Individual (L)
Interaction of systems	$\mathbb{Z}_p$	$\mathbb{Z}_p^2$	$\mathbb{Z}_p^3$	$\mathbb{Z}_p^4$
$\mathbb{Z}_p$	$\mathbb{Z}_p \times \mathbb{Z}_p$	$\mathbb{Z}_p \times \mathbb{Z}_p^2$	$\mathbb{Z}_p \times \mathbb{Z}_p^3$	$\mathbb{Z}_p \times \mathbb{Z}_p^4$
$\mathbb{Z}_p^2$	$\mathbb{Z}_p^2 \times \mathbb{Z}_p$	$\mathbb{Z}_p^2 \times \mathbb{Z}_p^2$	$\mathbb{Z}_p^2 \times \mathbb{Z}_p^3$	$\mathbb{Z}_p^2 \times \mathbb{Z}_p^4$
$\mathbb{Z}_p^3$	$\mathbb{Z}_p^3 \times \mathbb{Z}_p$	$\mathbb{Z}_p^3 \times \mathbb{Z}_p^2$	$\mathbb{Z}_p^3 \times \mathbb{Z}_p^3$	$\mathbb{Z}_p^3 \times \mathbb{Z}_p^4$
$\mathbb{Z}_p^4$	$\mathbb{Z}_p^4 \times \mathbb{Z}_p$	$\mathbb{Z}_p^4 \times \mathbb{Z}_p^2$	$\mathbb{Z}_p^4 \times \mathbb{Z}_p^3$	$\mathbb{Z}_p^4 \times \mathbb{Z}_p^4$

Table 2 Categories and number of components in the system

System V	$\mathbb{Z}_p$	$\mathbb{Z}_p^2$	$\mathbb{Z}_p^3$	$\mathbb{Z}_p^4$
No. of categories	p^1	p^2	p^3	p^4
No. of components in a category	1	2	3	4

interactions with the possible choices ranging from $0, 1, ..., p-1$ as compared to only two choices, coded as 0 and 1.

The following shows the correspondence among algebraic structures and four systems (Table 1).

It may be interpreted to indicate that the State is responsible for all activities through interacting with corporations, groups, and ultimately, individuals, thus formulating a top-down mechanism. In this mechanism, mutual understanding between all stakeholders is crucial for attaining sustainable objectives.

4.1.2 Components in Categories of Systems

Based on the cardinality of the systems, *we may say that S is smaller than C, whereas, C is smaller than G, and G is smaller than L.* As $\mathbb{Z}_p^l \times \mathbb{Z}_p^m \cong \mathbb{Z}_p^{l+m}$, where $1 \leq l, m \leq 4$, is $l+m$ dimensional linear space over the field $\mathbb{Z}_p$. Table 2 indicates the categories and number of components in the systems.

Table 1b yields the following three findings.

4.1.3 The top row and first column of the interactive systems

The State $\mathbb{Z}_p$, corporations $\mathbb{Z}_p^2$, groups $\mathbb{Z}_p^3$ and individual $\mathbb{Z}_p^4$ have respectively the, p^2, p^3 and p^4 number of categories. Moreover, the components of a category of any system represent the economic indicators from the set, $\{0, 1, ..., p-1\}$. In some sense, this is an established ground. We may refer to it as stable (canonical/natural) systems (N-systems), i.e., these are on the top row and first column (Table 3).

	$\mathbb{Z}_p$	$\mathbb{Z}_p^2$	$\mathbb{Z}_p^3$	$\mathbb{Z}_p^4$
$\mathbb{Z}_p$				
$\mathbb{Z}_p^2$				
$\mathbb{Z}_p^3$				
$\mathbb{Z}_p^4$				

Table 3 Top row and column representing the interactive system

$\mathbb{Z}_p \times \mathbb{Z}_p$			
	$\mathbb{Z}_p^2 \times \mathbb{Z}_p^2$		
		$\mathbb{Z}_p^3 \times \mathbb{Z}_p^3$	
			$\mathbb{Z}_p^4 \times \mathbb{Z}_p^4$

Table 4 Diagonal interactions explaining intra action of the system

4.1.4 The main diagonal

This system explains the intra-action of the systems or D-Interactions (diagonal-interactions), i.e., these activities are on the main diagonal, and components of the system interact with themselves. It may be observed as follows (Table 4).

For $1 \le m \le 4$, define a function $\delta : \mathbb{Z}_p^m \times \mathbb{Z}_p^m \to \mathbb{Z}_p^m$ by $\delta(a_1..a_m) + (b_1..b_m) = (c_1..c_m) \in \mathbb{Z}_p^m$, for any $(a_1..a_m), (b_1..b_m) \in \mathbb{Z}_p^m$, whereas $c_i = a_i + b_i, 1 \le i \le 4$. We may call δ, the intra-active function, which is interpreted as the economic trade-off among the categories of an N-system. Consequently, one can earn again a category of the same system, which may have $m!$.

If we use, $m = 3$, then the intra-active function $\delta : \mathbb{Z}_p^3 \times \mathbb{Z}_p^3 \to \mathbb{Z}_p^3$ is defined as

$$\delta(a_1 a_2 a_3, b_1 b_2 b_3) = c_1 c_2 c_3 \in \mathbb{Z}_p^3, \text{ where } c_i = a_i + b_i, 1 \le i \le 3.$$

Since $\mathbb{Z}_p^3$ represent the group, therefore, δ explains the group–group intra-action. In this type of intra-action, all components of one group category interact with the corresponding components of another category. It also reflects that the possessions of interactive categories of the community fully operationalized their resources in the given period. The intra-action of any system provides a *reliable mechanism* during disastrous situations among categories of the same system, which might reduce economic and social losses.

4.1.5 Lower and Upper Diagonals

Various off-diagonal elements have the following interpretations.

1. The Interaction of State $\mathbb{Z}_p$ with individual $\mathbb{Z}_p^4$ and or conversely, the interaction of individuals $\mathbb{Z}_p^4$ with State $\mathbb{Z}_p$ has the model $\mathbb{Z}_p \times \mathbb{Z}_p^4$ or $\mathbb{Z}_p^4 \times \mathbb{Z}_p$.

2. The Interaction of State $\mathbb{Z}_p$ with community $\mathbb{Z}_p^3$, (or vice-versa) has the model $\mathbb{Z}_p \times \mathbb{Z}_p^3$ or $\mathbb{Z}_p^3$.

Table 5 Representation of Symmetric, Lower and Upper Diagonal Interactions

	$\mathbb{Z}_p \times \mathbb{Z}_p^2$	$\mathbb{Z}_p \times \mathbb{Z}_p^3$	$\mathbb{Z}_p \times \mathbb{Z}_p^4$
$\mathbb{Z}_p^2 \times \mathbb{Z}_p$		$\mathbb{Z}_p^2 \times \mathbb{Z}_p^3$	$\mathbb{Z}_p^2 \times \mathbb{Z}_p^4$
$\mathbb{Z}_p^3 \times \mathbb{Z}_p$	$\mathbb{Z}_p^3 \times \mathbb{Z}_p^2$		$\mathbb{Z}_p^3 \times \mathbb{Z}_p^4$
$\mathbb{Z}_p^4 \times \mathbb{Z}_p$	$\mathbb{Z}_p^4 \times \mathbb{Z}_p^2$	$\mathbb{Z}_p^4 \times \mathbb{Z}_p^3$	

3. The Interaction of State $\mathbb{Z}_p$ with corporations $\mathbb{Z}_p^2$, has the model $\mathbb{Z}_p \times \mathbb{Z}_p^2 = \mathbb{Z}_p^2 \times \mathbb{Z}_p$.

4. The Interaction of corporations $\mathbb{Z}_p^2$ with individual $\mathbb{Z}_p^4$, and it has the representation $\mathbb{Z}_p^2 \times \mathbb{Z}_p^4$ (respectively the Interaction of Individual $\mathbb{Z}_p^4$ with corporation $\mathbb{Z}_p^2$, and it has the representation $\mathbb{Z}_p^4 \times \mathbb{Z}_p^2$).

5. The Interaction of corporation $\mathbb{Z}_p^2$ with respective group $\mathbb{Z}_p^3$, and it has the model $\mathbb{Z}_p^2 \times \mathbb{Z}_p^3$ (separately, the interaction of group $\mathbb{Z}_p^3$ with corporations $\mathbb{Z}_p^2$, and it has the representation $\mathbb{Z}_p^3 \times \mathbb{Z}_p^2$).

6. The Interaction of group $\mathbb{Z}_p^3$ with individual $\mathbb{Z}_p^4$, and it has the model $\mathbb{Z}_p^3 \times \mathbb{Z}_p^4$ (respectively, the Interaction of Individual $\mathbb{Z}_p^4$ with groups $\mathbb{Z}_p^3$, and it has the representation $\mathbb{Z}_p^4 \times \mathbb{Z}_p^3$) (Table 5).

Lower Diagonal and Upper Diagonal interactions are symmetric, which occurs due to the nature of the model. For instance, the symmetry between $\mathbb{Z}_p^l \times \mathbb{Z}_p^m$ and $\mathbb{Z}_p^m \times \mathbb{Z}_p^l, 1 \leq l, m \leq 4$, is alike in an algebraic perspective. First, it is noticed that if 0 represents $\{0\}$, the zero-vector space consists of 0 only. So, for $l \leq m, \mathbb{Z}_p^l \to \mathbb{Z}_p^m$ indicates embedding of the space $\mathbb{Z}_p^l$ into the space $\mathbb{Z}_p^m$, i.e., $\mathbb{Z}_p^l \cong \mathbb{Z}_p^l \times 0 \times .. \times 0 \subset \mathbb{Z}_p^m$, which means $a_1..a_l = a_1..a_l 0_{l+1}..0_m \in \mathbb{Z}_p^m$. Correspondingly, for $m \leq l, \mathbb{Z}_p^m \to \mathbb{Z}_p^l$ is the embedding of $\mathbb{Z}_p^m$ in $\mathbb{Z}_p^l$, i.e., $\mathbb{Z}_p^m \cong 0_1 \times .. \times 0_{l-m} \times \mathbb{Z}_p^m \subset \mathbb{Z}_p^l$, which is $a_1..a_l = 0_1..0_{l-m} a_1..a_l \in \mathbb{Z}_p^l$.

Now we define functions $\delta_{m \leftarrow l}$ and $\delta_{l \to m}$ as follow: $\delta_{l \leftarrow m} : \mathbb{Z}_p^l \times \mathbb{Z}_p^m \to \mathbb{Z}_p^m$, where $1 \leq m \leq 4$, and $m \leq l$ by $\delta_{l \leftarrow m}(a_1..a_l, b_1..b_m b_{m+1}..b_l) = c_1..c_m c_{m+1}..c_l \in \mathbb{Z}_p^m$ for any $a_1..a_l \in \mathbb{Z}_2^l, b_1..b_m \in \mathbb{Z}_p^m$ and $b_{m+1} = .. = b_l = 0$.

Similarly,

$\delta_{l \to m} : \mathbb{Z}_p^l \times \mathbb{Z}_p^m \to \mathbb{Z}_p^m$, where $1 \leq m \leq 4$, and $l \leq m$ by $\delta_{l \to m}(a_1..a_l a_{l+1}..a_m, b_1..b_m)$

$= c_1..c_l c_{l+1}..c_m \in \mathbb{Z}_p^m$, for any $a_1..a_l \in \mathbb{Z}_p^l, b_1..b_m \in \mathbb{Z}_p^m$ and $a_{l+1} = .. = a_m = 0$,

whereas $c_i = a_i + b_i, 1 \leq i \leq 4$. We call $\delta_{m \to l}$ and $\delta_{l \leftarrow m}$ the inter-active functions are understood as the economic trade-off among the categories of dissimilar N-systems. Because of this trade-off, again, a category is obtained, which belongs to the larger system of across interactive systems.

By across interactive function $\delta_{l \to m}, l \leq m$, we conclude that the system $\mathbb{Z}_p^l$ interacts with $\mathbb{Z}_p^m$, provided that the $l + 1, l + 2, .., m$ component of the larger system (in size and dimension) $\mathbb{Z}_p^m$ remains inactive during the interaction, i.e., the only first l number of components interact with their corresponding l members in the smaller

Table 6 Interaction table illustrating State (S), Corporation (C), Groups (G) and Individual (L) for functional categories (vector) p = 2

L	1010	0110	1000	1100	0110	0100	0010	0000	0001	0011	0101	0111	1010	1110	1101	1111
G					110	100	010	000	001	011	101	111				
C							10	00	01	11						
S								0	1							

Table 7 Interaction table illustrating State (S), Corporation (C), Groups (G) and Individual (L) for functional categories (vector) p = 3

L	1101	0101	0100	0000	0001	0010	0011	0002	0020	0012	0021	0022	0202	0212	0222	2222
G		101	100	000	001	010	011	002	020	012	021	022	202	212		
C				00	01	10	11	02	20	12	21	22				
S				0	1	2										

system (in size and dimension) $\mathbb{Z}_p^l$. Similarly, across interactive function $\delta_{l \leftarrow m}, m \leq l$, we conclude that the system $\mathbb{Z}_p^l$ interacts with $\mathbb{Z}_p^m$, provided that the $1, 2, .., m$ components of the larger system (in size and dimension) Z_p^l remains inactive during the interaction, i.e., the only last m number of components interact with their corresponding m members in the smaller system (in size and dimension) $\mathbb{Z}_p^m$.

- Suppose we consider $\delta_{2 \to 3}$: $\mathbb{Z}_p^2 \times \mathbb{Z}_p^3 \to \mathbb{Z}_p^3$, then.
  $$\delta_{2 \to 3}(a_1 a_2 0, b_1 b_2 b_3) = c_1 c_2 c_3 \in Z_p^3, \text{ where } c_3 = b_3$$

Similarly, across inter-active function $\delta_{m \to l}$, $m \leq l$, we conclude interaction of the system $\mathbb{Z}_p^m$ with $\mathbb{Z}_p^l$, provided that the $m + 1, l + 2, .., l$ components of the larger system (in size and dimension) $\mathbb{Z}_p^l$ remains inactive during the interaction, i.e., the only first m number of components interact with their corresponding m members in the smaller system (in size and dimension) $\mathbb{Z}_p^m$.

Now, if we consider $\delta_{3 \leftarrow 2}$: $\mathbb{Z}_p^3 \times \mathbb{Z}_p^2 \to \mathbb{Z}_p^3$, then.

$$\delta_{3 \leftarrow 2}(a_1 a_2 a_3, 0 b_2 b_3) = c_1 c_2 c_3 \in \mathbb{Z}_2^3, \text{ where } c_1 = a_1$$

Recall that spaces $\mathbb{Z}_p^2$ and $\mathbb{Z}_p^3$ represent the organization and community, respectively. For the function $\delta_{2 \to 3}$ explicates the corporation/companies vs groups' first two components of the category of the group interacting with the corporation's components. It means the group does not operationalize the total assets; rather, a part is left for subsistence for its survival. In the extreme scenario, groups or individuals that consume/spend all their assets/resources in one period do not exist for the next period. Furthermore, it is not like the intra-action of an N-System.

Similarly, if $\delta_{3 \to 2}$: $\mathbb{Z}_p^3 \times \mathbb{Z}_p^2 \to \mathbb{Z}_p^3$, then

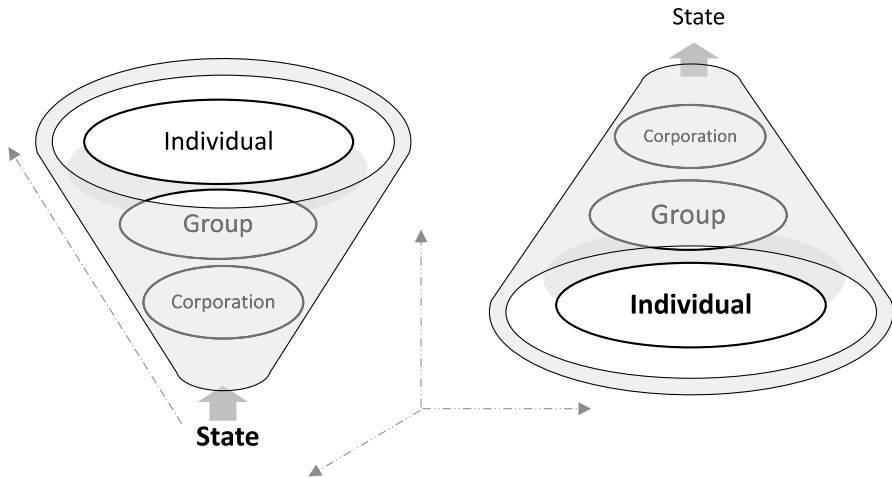**Fig. 2** Rotating Funnel, State initiate Push-start in Economic activities (left), Individual initiate economic activities (right)

$$\delta_{3\to2}\big(a_1a_2a_3, b_1b_2b_3\big) = c_1c_2c_3 \in \mathbb{Z}_p^3, \text{ where } c_3 = b_3$$

Table 6 represents *SCGL* for $p = 2$ and Table 7 represents *SCGL* for $p = 3$.

These are reflected as a funnel shown below in Fig. 2. This funnel rotates around its vertical axis, which reflects the intra-action of each system. However, the embedding from smaller systems to more extensive systems reflects the inter-action of any two systems.

4.1.6 Socioeconomic interactions: a rotating funnel

The present study establishes various intra-system and inter-system interactions. These socioeconomic interactions determine consumption, production, and regulation mechanism. The main diagonal reflects that each system component coordinates and corresponds efficiently within its structure and with other components. The lower or upper diagonal indicates embedding a smaller system in a larger one through interaction across the systems. The processes of intra and interactions together define the funnel in Fig. 2 (based on Table 7) in terms of rotation in the horizontal dimension. Vertical movement in the funnel as economic activities at the lower tier interact with the upper ones to generate additional activities in the upper tiers and produce a socioeconomic cycle. The degree to which members' views inevitably converge toward one another is known as the "funnelling effect," It becomes stronger as the group's power structure becomes intertwined. Social aggregate outcomes, such as the presence or absence of asymptotic learning, are also influenced by the general structure of the observation network. Therefore, the structure of networks provides evidence-based insights into behavior and informs policy actions to enhance wellbeing. Higher consumption damages society and

the environment, while lower consumption can decrease our GDP, so there is a need for optimal allocation of resources. Similarly, based on the majority rules, if we live in a consumer-oriented society, there are more chances that individuals living there adopt/converge to the behaviors of those in the majority.

4.2 Implementation

The state can distribute services, redistribute revenues, and measure direct economic activity. Fiscal indicators are a tool the State uses to control the economy. Responses to fiscal shocks are aided by the public's perception and faith in the government's fiscal responsibility and discretion. A lack of trust in government inevitably leads to tax and debt imbalances and weak socioeconomic interaction at all levels. Thus, it is simple for widely respected governments to adopt policies that reduce revenue loss in times of economic crisis. As a result, there are typically three distinct forms of expenditure in which a state will be engaged. Products and services for public consumption are the first categories. The second category includes dams, schools, hospitals, and railroads. Regulatory activities, such as securing property rights, safeguarding consumer rights, enforcing the rule of law, combating corruption, ensuring public participation and accountability, disseminating information, preventing monopolization, and policing product quality, comprise the third category of state expenditures. A significant economic loss may result from the government's inefficiency in this spending.

Global climate projections are the starting point for top-down vulnerability assessments, utilizing regional data to determine how climate change may impact local communities. Bottom-up techniques, on the other hand, seek actors inside the system to identify climate change pressures, consequences, and adaptation actions, whereas top-down approaches center on external institutions (Dessai and Hulme, 2004). Taking broad ideas as a basis, the responsible person tailors them to their situation. When using bottom-up thinking, one first uses situation-specific, intuitive judgements before moving on to more abstract ideas. Interaction and reflective equilibrium[6] are achieved when top-down and bottom-up viewpoints are in sync. Intuitive judgements are shown to agree with generalizable abstract ideas. A cognitive split occurs when rationalists try to find common ground between top-down and bottom-up methods, changing one another's thinking until they reach the best possible mix of principles and situational judgments. In the bottom-up method, however, each person plays a pivotal role in shaping how a society formulates its choices. Furthermore, individual-level regulations reach firms, which base their product selections on what consumers demand. Then, in a group with many people, a few careless decisions might seriously harm the ecosystem.

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[6] A person's reflective equilibrium shifts when they think about new ideas or the long-term consequences of their current beliefs (Rawls, 1971).He concluded that the finest theory of justice is the one that would be accepted by the masses if they were blinded to their social status. A plan designed to create harmony among a person's (a) collection of reasoned moral judgments, (b) set of moral principles, and (c) set of relevant (scientific and philosophical) underlying concepts, as defined by Norman Daniels.

After the 2008 Wall Street crisis caused a global economic depression, many people lost jobs, and governments had to cut spending across the board. The economic slump has also highlighted the vulnerability of many people, particularly in rural regions. Prolonged droughts and other severe weather are only two examples of the growing evidence that points to climate change (Turan and Cetinkaya 2021; Zeng et al. 2022). The amount of farmable land per person has dropped dramatically over the last century, contributing to the air quality and hunger crises. Is it possible for us to grow our way out of this, or do we need a new approach and definition of economic success? A sizeable segment of the American population believes that market constraints, whether on people as consumer protection laws or on businesses and corporations as regulations are incompatible with political liberty and democracy.

Local community prosperity and individual success have moved to the forefront of the new normal. Since the economy exists to meet human wants and needs, new economic systems are constantly emerging to better the lives of individuals. Bottom-up economies are learning the market's promise and limits. A new story is being told by the farmers, shopkeepers, and activists in those communities. Individual households, neighborhoods, and communities all contribute to the larger economic system called "the economy." Many small enterprises, from the tried and accurate to the novel and experimental, form the backbone of these regional and local economies. *Companies are beginning to realize that it is essential to consider more than just their bottom lines when making decisions and that they are responsible to the communities in which they operate.* This change marks the departure from top-down causes of difficulty in favor of organic, grass-roots remedies. These emerging markets are making the most of their unique history, culture, customs, traditions, natural beauty, and ingenuity. They are establishing regional and national networks for information sharing, collaboration, and public debate and policymaking to broaden and deepen their impact. This way, businesses and the economy can flourish in their distinctive ways rather than becoming interchangeable parts of a larger whole. Businesses are typically privately held, but there is a growing trend toward employee, producer, consumer, and community ownership. Instead of being in the hands of corporations, the economy is now in the hands of the working class and the community. The shift is from lobbyist and money-based politics to community-based politics of engagement and from a corporate media monopoly to energizing civic conversations. It shifts the focus from purely economic considerations to the wellbeing of individuals and the success of their communities, making economic decisions a matter of paramount public importance.

It is possible that several different outcomes, shown here as categories or vectors, might emerge from this collection of permutations. The implications of these findings for economic expansion might be substantial. Their impact on individuals, businesses, groups, and governments might drive economic development. Double-loop learning entails adjusting objectives or behavioral norms based on past performance. With double-loop learning, the goals or criteria for making decisions are used in the first loop. They may be adjusted in the second, considering the possibility that the problem's description and solution are the sources of the issue. It inspires creative thinking, empowering stakeholders to foresee and steer change. It is essential to use double-loop learning when altering the underlying
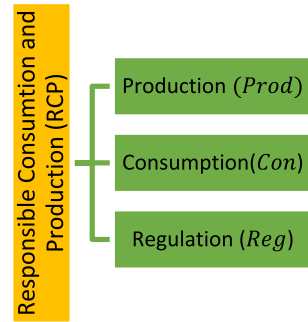
mental model of choice. There are vital differences between these models and simpler loops, including the requirement to account for environmental changes and the representation of such adjustments in mental models. If that happens, the organization's controlling elements will shift more significantly.

The world's governments have contributed much to the progress of this century. They persisted in improving public services and creating a more just and peaceful society. Many countries are still battling chronic corruption and pervasive organized crime which stem primarily from poor leadership. As a result, neither service providers nor regulators can provide the promised services. These issues have been with us long before the advent of COVID-19 and climate change, yet they persist as formidable obstacles for the governments of many countries. In the wake of the COVID-19 epidemic, there is a need to fulfil promises related to climate change and the increase in conflicts. It has become clear that governments at all levels must be more efficient. Authorities at all levels of government, from city councils to state-run businesses, are now responsible for formulating and implementing policies and regulations and providing essential services. Aside from the apparent health shock that the pandemic caused, it also forced governments to *increase their regulation of society to introduce and enforce physical distancing as one of the leading remedies to prevent transmission.* It caused a culture shock in many places where civil liberties and personal freedoms took a back seat to the need for collective action for the greater good. The subsequent economic shock necessitated an immediate increase in governmental support for individuals and, in many instances, businesses. The impacts of COVID-19, climate change, and wars are being felt by people everywhere, putting stress on already fragile social contracts.

Governments have a long track record of being ineffective because they lack long-term vision, leave a wake of broken promises, stumble from one crisis to the next, favor and enrich the few, resist change, and are generally distrusted. On the other hand, the future government should be aware of its role and responsive to the public's demands; it should have clout and deliver on its promises; it should be innovative, productive, trustworthy, and prepared for emergencies. The social contract between the government and the people must be rethought to create a better form of governance. Citizens' needs and expectations of their governments are ever-evolving and never static. Both citizen contributions and State benefits may be subject to reevaluation.

Therefore, it is simple for the responsible government to adopt measures that reduce revenue loss during recessions. As a result, in our system, the State takes on regulatory roles, such as securing property rights, safeguarding consumer protections, enforcing the rule of law, combating corruption, ensuring transparency and accountability, disseminating information, limiting monopolies, ensuring product quality, and managing scarce resources. In order to keep up with consumer demand, many expanding economies are hitting hard-and-fast resource boundaries and pushing themselves to their absolute limits in search of innovative ways to stretch scarce resources even thinner. If the project is to succeed, persistent inefficiencies in public and private resources, particularly in the workforce, procurement, and use of public funds, must be addressed.

Fig. 3 RCP through production, consumption, and regulatory activities

Responsible Consumtion and Production (RCP)

Production (*Prod*)

Consumption(*Con*)

Regulation (*Reg*)

Governments aim to regulate the allocation of resources among citizens, localities, and the private sector in addition to generating commodities and services. Governments in low- and middle-income countries are "stuck" if they do not find ways to boost private sector output to provide for their populations' needs while having access to just a portion of the resources they need. Cost-effectiveness, efficiency, and economy are the three cornerstones of productivity. The all-encompassing idea of "value for money" may help us consider them all.

Our algebraic socioeconomic interaction mechanism pushes those obstructed economic actives and makes them run smoothly in the present and future without compromising environmental sustainability. Several thinkable dimensions and combinations can be obtained for interpreting the categories of the State and then of all other systems. For instance, a category might be based on consumption, health care, educational facilities, water supply, and employment status. If we consider the category of an individual where consumption of several products is undertaken. Whereas the corporations or industries produce goods, hereby, RCP is attainable if there is strong positive coordination between all stakeholders and a better welfare level is obtained. While a government deficient in trust by citizens face imbalances in taxes and debt, whose consequences can be seen in inefficiency in the economy at all levels. We now consider an example with three components of activities to interpret Table 7 and Fig. 2 for the case in which State S is $\mathbb{Z}_3 = \{0, 1, 2\}$, showing the intra-action and across interaction of the systems; State, corporation, group, and individual based on mutual trust.

Production (*Prod*)
Consumption (*Con*)
Regulation (*Reg*)

The following interprets the relationship between the indicators; Production (*Prod*)
Consumption (*Con*) and Regulations (*Reg*)(Fig. 3).

4.3 Presumptions

The socioeconomic indicators and the field $\mathbb{Z}_3$.

We have established the compatibility of socioeconomic indicators; Regulation, Production, and Consumption with elements in the field $\mathbb{Z}_3 = \{0, 1, 2\}$.

0	~	Regulations (**Reg**)
1	~	Production (*Prod*)
2	~	Consumption (*Con*)

Here we assume that other factors affecting these indicators are fixed.

4.3.1 Rules of the game

We have set the rules for socioeconomic interactions. The addition modulo three between the elements 0,1 and 2 of the field, $\mathbb{Z}_3$ is the basis for the interactions between the four systems. The following Tables provide just one example of a sequence in which the State could gear socioeconomic activities at the organization level. Other sequences and the corresponding patterns of economic activities could also be constructed from the given framework.

$\oplus_3$	0	1	2	+	Reg	Prod	Con
0	0	1	2	**Reg**	Reg	Prod	Con
1	1	2	0	**Prod**	Prod	Con	Reg
2	2	0	1	**Con**	Con	Reg	Prod

4.3.2 The categories

- The State has 3 categories and 3 economic indicators.
- The corporation has 9 categories, and each category has 2 economic indicators.
- The group has 27 categories, and each category has 3 economic indicators.
- The individual has 81 categories, and each category has 4 economic indicators.

4.3.3 Socioeconomic status of categories

Now we may define socioeconomic status triggered by the sustainable economic growth commenced by the State as follows.

- Suppose all elements of a system are in the form of trust-oriented regulatory activities. In that case, it will promote a highly disciplined socioeconomic order where *consumption and production are under the limits to attain RCP.*

- On the other hand, when all components of a category are in the form of production governed by regulation, it will produce a socioeconomic system where consumption is smooth over the consumer's lifetime with an efficient level of savings.
- The third extreme position is achieved, where all components are in the form of harmony between production and consumption. If the system is to survive, then this situation will lead to sustainable outcomes (RCP) in the long run.

The hierarchy dynamics of whole phenomena are exemplified as under:

4.3.4 CASE I: intra-action

Each occurrence demonstrates "the ontological inseparability of intra-acting agencies." Co-constitutive action occurs when two entities interact inside themselves. It disproves the assumption that free will always exists. The capacity to act arises because of the association rather than independently. Also, its capability is dynamic, evolving and adapting as it engages in new processes. The two intra-acting entities are not entirely distinct from one other, but in inter-action, all inter-acting parts retain some degree of autonomy. When two separate entities meet, they exist for the first time. Everything that happens inside us that enables us to engage with others, including ourselves, is referred to as "intra-action." According to (Chalari 2016). There is a discordance between the interaction and the intra-action. The link between intra-action and interaction may be explained in two primary ways, both of which stem from the social theoretical study of the relationship between structure and agency. People who believe that social structure and context affect individual and collective behavior. These theorists see intra- and inter-action as 'dualism' or two aspects of the same phenomenon. As the funnel revolves around the vertical axis, it represents the interaction between the systems (Table 4), which include the State, corporations/companies, groups, and individuals (Fig. 2). While this is true,

Consider,

$\{(Reg, Reg, Prod, Prod), (Prod, Reg, Prod, Prod), Reg, Prod, Con, Reg)\} = \{0011, 1011, 0120\}$, the set of categories of individuals having different combinations of socioeconomic indicators. Similarly, $\{(Reg, Prod, Prod), (Reg, Prod, Prod(Prod, Con, Reg)\} = \{011, 011, 120\}; (Prod, Prod),$ $(Prod, Prod), (Con, Reg) = \{11, 11, 20\}$ and $\{Prod, Prod, Reg\} = \{1, 1, 0\}$ are respectively the segments of categories of Community, Organization, and State having similar and dissimilar socioeconomic interactions.

4.3.5 CASE 2: across interaction

The interaction of the systems (Table 5), State, Community, Group, and Individual, is due to the push-start of economic activities. Here, as in case I, we consider $\{0011, 1011, 0120\}\{(Reg, Reg, Prod, Prod), (Prod, Reg, Prod, Prod), (Reg, Prod, Con, Reg)\}$, the set of categories of individual having different combinations of socioeconomic indicators. However, $\{011, 011, 120\} = \{(Reg, Prod, Prod), (Reg, Prod, Prod), (Prod, Con, Reg)\}$,

$\{11, 11, 20\} = \{(Prod, Prod), (Prod, Prod), (Con, Reg)\}$ and $\{1, 1, 0\} = \{Prod, Prod, Reg\}$ are respectively the segments of the categories of Group, Community and State having similar and dissimilar socioeconomic indicators. When individuals engage sequentially, "information cascades" might occur as a result, whereby subsequent actors learn from the choices made by their predecessors. As reported by (Miller and Mobarak 2015), revealing the preferences of key figures, such as prominent community members, greatly enhances the chance of adoption. This trend suggests that the public places greater faith in traditional institutions because they believe they better understand the larger picture. To this end, consumption is a product of social learning. Educating children about the drawbacks of overindulgence is a long-term strategy that will eventually bear results.

The interaction of groups with individuals is represented as the function: $\delta_{3 \to 4} : \mathbb{Z}_3^3 \times \mathbb{Z}_3^4 \to \mathbb{Z}_3^3, \delta_{3 \to 4}(a_1 a_2 a_3 a_{3+1}, b_1 b_2 b_3 b_4) = c_1 c_2 c_3 c_4 \in \mathbb{Z}_3^4$, for any $a_1 a_2 a_3 \in \mathbb{Z}_3^3, b_1..b_4 \in \mathbb{Z}_3^4$ and $a_{3+1} = a_4 = 0$. Thus $\delta_{3 \to 4}(011, 1011) = 1121 \delta_{3 \to 4}(011, 0120) = 0200$ and $\delta_{3 \to 4}(120, 0120) = 1020$.

While the Corporation interacts with Individuals based on the function $\delta_{2 \to 4} : \mathbb{Z}_3^2 \times \mathbb{Z}_3^4 \to \mathbb{Z}_3^4, then \delta_{2 \to 4}(a_1 a_2 a_{2+1} a_4, b_1 b_2 b_3 b_4)$

$= c_1 c_2 c_3 c_4 \in \mathbb{Z}_3^4, for any a_1 a_2 \in \mathbb{Z}_3^2, b_1..b_4 \in \mathbb{Z}_3^4 and a_{2+1}$

$= a_4 = 0. \delta_{2 \to 4}(11, 1011) = 2111 \sim \delta_{2 \to 4}(11, 0120) = 1220$ The State interacts with individuals based on function,

$$\delta_{1 \to 4} : \mathbb{Z}_3 \times \mathbb{Z}_3^4 \to \mathbb{Z}_3^4, \delta_{1 \to 4}(a_1 a_{1+1} a_{1+2} a_4, b_1 b_2 b_3 b_4)$$

$$= c_1 c_2 c_3 c_4 \in \mathbb{Z}_3^4, \text{for any } a_1 \in \mathbb{Z}_3, b_1..b_4 \in \mathbb{Z}_3^4 \text{ and } a_{1+1}$$

$$= a_4 = 0. \delta_{1 \to 4}(1, 1011) = 2011, \delta_{1 \to 4}(1, 0120)$$

$$= 1120, \delta_{1 \to 4}(2, 0120) = 2120.$$

The corporation interacts with some groups that can be represented as,

$$\delta_{2 \to 3} : \mathbb{Z}_3^2 \times \mathbb{Z}_3^3 \to \mathbb{Z}_3^3,$$

$\delta_{2 \to 3}(a_1 a_2 a_{2+1}, b_1 b_2 b_3) = c_1 c_2 c_3 \in \mathbb{Z}_3^3$, for any $a_1 a_2 \in \mathbb{Z}_3^2, b_1..b_3 \in \mathbb{Z}_3^3$ and $a_{2+1} = a_3 = 0; \delta_{2 \to 3}(11, 011) = 121; \delta_{2 \to 3}(11, 011) = 121; \delta_{2 \to 3}(20, 120) = 020$ The State interacts with different groups and corporations present in the country depicted by function, $\delta_{1 \to 3} : \mathbb{Z}_3 \times \mathbb{Z}_3^3 \to \mathbb{Z}_3^3, \delta_{1 \to 3}(a_1 a_{1+1} a_{1+2}, b_1 b_2 b_3) = c_1 c_2 c_3 \in \mathbb{Z}_3^3$, for any $a_1 \in \mathbb{Z}_3, b_1..b_3 \in \mathbb{Z}_3^3$ and $a_{1+1} = a_{1+2} = 0$.

$$\delta_{1 \to 3}(1, 011) = 111$$

$$\delta_{1 \to 3}(1, 011) = 111$$

$$\delta_{1 \to 3}(2, 120) = 020$$

Here we consider the function.

$$\delta_{1\to 2} : \mathbb{Z}_3 \times \mathbb{Z}_3^2 \to \mathbb{Z}_3^2, \ \delta_{1\to 2}(a_1 a_{1+1}, b_1 b_2)$$
$$= c_1 c_2 \in \mathbb{Z}_3^2, \ \text{for any } a_1 \in \mathbb{Z}_3, b_1 b_2 \in \mathbb{Z}_3^2 \text{ and } a_{1+1} = 0.$$

Negotiating ideals, objectives, and agreements on sustainability concerns are part of a resource management transaction that goes above and beyond a standard market exchange.[7] Therefore, the concept that transaction costs might restrict power is widely known (domination and resistance). The transaction costs of cross-scale discussions and linking include learning to engage policymakers using scientific and technical jargon and comprehending the aims of various groups. The first barrier to such interactions is the *fixed expenses* involved with the initial search and network setting. Trust is "cost" built via frequent contacts and institutionalization of the relationships and is essential to maintaining numerous connections. If the costs of creating and maintaining cross-scale linkages are considerable, information asymmetry within the governance system becomes severe. As a result of their financial ability, the affluent and powerful have important information. The governance structures can be undermined by conflicts arising from these asymmetries (Agrawal 2001). Therefore, we contend that certain horizontal and vertical links may only benefit the institutions involved rather than fostering confidence in or flexibility within the management system. Of course, it is not enough to notice that power imbalances exist under existing governing systems.

Three components are necessary for preserving social trust: confidence in political and legal institutions, lower bureaucratic corruption, and private property rights protections (Bjornskov 2008). However, those economies that are underdeveloped or in the developing stage consistently lack these defined components. Similarly, (Rothstein and Uslaner 2005) claim that the low level of trust prevailing in the economy is due to less government control in shrinking inequality. *Additionally, Governments in developing economies face corruption due to less transparency and non-digital documentation, causing mistrust between government and individuals.*

The State has achieved progress in several areas where the primary goals were increased production and decreased costs. Specific efficient procurement techniques have indeed been applied in inefficient systems (Bandiera et al. 2009), particularly regarding technology use. Rather than trying to change the law, it may be best to follow it. Increases in production and service provision may result through stricter enforcement of current norms, e.g., in Brazil, by sending corrupt state-owned business management and personnel to jail (Bajpai and Myers 2020) and by performing more audits (Zamboni and Litschig 2018). However, this can only occur if authorities take the lead, devote significant political capital to these reforms, and take on the privileged head-on. It has been shown that many countries, despite adopting e-government reforms, still have trouble with inefficient procedures and bureaucratic red tape

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[7] It's conceivable that dealing with the law enforcement may incur additional costs. (Falconer 2000) found that the transaction costs of forming contracts with government agencies were too high for British farmers. Reducing farmers' transaction costs associated with voluntary schemes through collective negotiation or governments absorbing the transaction costs themselves and further compensating farmers for their time in negotiations and providing information are two policy mechanisms that aim to avoid this mismatch in transaction costs.

(Othman and Razali 2018). Government fiscal policy and regulation that increases the cost of doing business may directly impact the inefficient deployment and use of private sector assets. For example, assets may get mired in red tape throughout the bankruptcy process. At the same time, interagency integration of e-government systems has the potential to address redundancy worries. Doing so is complicated for several reasons, including a lack of resources, the potential for system instability, capacity issues, and the need to account for the demands of future policy development. *There would be significant gains in government efficiency if these efforts were coordinated.* Spending time and effort to coordinate across different branches and levels of government is exhausting but necessary for solving efficiency problems. The COVID-19 predicament exemplifies the ineffectiveness of having several agencies work independently. Because of their inability to anticipate such a tragedy, various governments have been forced to improve interdepartmental communication and coordination.

When it comes to government spending, new initiatives that are popular with the public tend to get more attention and funding than maintenance on existing projects. Several governments have boosted salaries for government personnel rather than dedicating greater resources to improving service delivery. As a rule, politicians are more likely to start or expand a new programme than to cancel or improve an existing one. Well-organized interest groups are prioritized above ensuring an equitable allocation of resources across regions and underrepresented groups. As a result, costs continue to climb slowly but steadily, and inefficiencies and inequities become more entrenched. It is possible that politicians and the public are more interested in spending money on shiny new school buildings than in improving education practices (Opalo 2022). Developing countries like Pakistan frequently use ineffective and costly strategies to accomplish their goals, such as creating jobs out of thin air. Instead of improving market function by more capacity, improved communication, market-based incentives, or a stopgap measure, we should focus on fundamental market issues. Recurrent increases in government overhead costs may be attributable to a combination of revenue shortfalls, expenditure constraints, and macro-fiscal disruptions.

The widespread adoption of apparently trivial irrational behaviors may have far-reaching implications, leading to the widespread adoption of seemingly insignificant irresponsible spending behaviors. Whether or not the goods and services purchased are considered socially responsible relies on how they are used and how the buyer sees them. Keeping these two aspects in mind, the following definitions of RCP apply to various settings: Consumption that is both (a) reasonable from the perspective of the relevant socioeconomic level and (b) used for its intended purpose is considered RCP (moderate). Money spent by the government to exercise fiscal restraint is to (a) spend no more than the allocated budget, (b) put money toward legitimate government projects. Ineffective resource allocation due to government intervention is a public sector failure that negatively impacts the country's economy.

Government expenditure on delivering services and products directly to the nation is the government's Final Consumption Expenditure (FCE). Production and acquisition of commodities and services (including defense, education, and health care), as

well as redistribution programmes, use a significant portion of government budgets (e.g. pensions and unemployment insurance). The government at the national level may be primarily responsible for education in certain nations. In contrast, the government at the regional or municipal level may have a more significant impact. Keeping tabs on these factors over time may show how government priorities shift in response to incoming pressures. Especially in countries like Pakistan, the government needs to cut down their non-development expenditures, and beaurucracy needs to abolish some of its ministries instead of seeking a bailout package from the International Monetary Fund (IMF) for paying debt instalments. Pakistan was previously renowned as the cereal breadbasket of the subcontinent. Thus, the fact that it is now importing wheat, edible oil, sugar, and other basic foodstuffs is a catastrophe. Since the government foolishly paid the import bills even though they were not required, the country's foreign currency reserves have been depleted. It caused a severe currency decline in September, even though a loan from the International Monetary Fund had been approved. When government agencies waste money inefficiently, it deepens the gap between the people and the state and breeds distrust among all stakeholders involved. Particularly considering Pakistan's current economic crisis, the repercussions for the economy and society are dire.

The public sector has severe challenges delivering high-quality, comprehensive, and equitable services. Drives for efficiency spurred by a minor civil service, privatization, and other reasons have been accused of undermining the government's capacity to provide and regulate. To improve efficiency, many organizations mistake the symptoms of inefficiency for the root problems and address them instead. The inadequacies will manifest themselves in a different part of the system. In the Economy of Pakistan, there are irresponsible attitudes shown by individuals, corporations, groups, and the State.[8] Every action and reaction of a person or society has a cost. This cost may be manifest, or it might be latent behavior, e.g., Pakistan is paying the costs of the Very Important Person (VIP)[9] culture in one way or another. This behavior is entrenched in the social norms and values of Pakistani society. People give respect and honor to the other person depending on their social position (status) or wealth. Unfortunately, this behavior can be observed in every segment of society. Abolishing such culture will save billions of rupees and give the country absolute freedom, equality, and ownership. In short, doing away with such culture may bridge the gap between the State and society by enhancing the trust of individuals in respectful government institutions.

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[8] Corruption and inefficiency in state-run firms and the government have been hot topics of conversation in Pakistan (SOEs). There are eight government-owned businesses, and the annual loss is estimated to be Rs250bn among all of them. The growth of a country may be helped along by SOEs that are well-run and productive. Some of the most prosperous corporations in the world's history were once state-owned monopolies in emerging nations. Emirates Airlines, Singapore Airlines (which is controlled by Singapore's Temasek Holdings), and the Bombay Transport Authority are just a few examples of successful SOEs. Several now-global powerhouses had their starts as state-owned companies (SOEs), including Renault of France and Embraer of Brazil. State capitalism and state-owned enterprises (SOEs) are being re-examined by several developing countries as a potential response to the current global crisis.

[9] Buying 133 VIP protocol and luxury vehicles for Punjab government (Pakistan) officials and staff at a cost of Rs 1.33 billion when there are much more urgent challenges like as floods, unemployment, poverty, inflation, and many others is ludicrous.

A government employee may not have the same motivation to increase efficiency by cutting costs or working diligently. Therefore, this makes the government less efficient than the private sector. On top of that, the public sector is becoming more bureaucratic, and there is friction between political and economic goals. Those frivolously spend money acquired via taxes in public service. Individuals also excessively misuse resources provided by the government.[10] For instance, say the government develops a sustainable technology to help people save the environment. However, in certain cases, organizations (religious groups, for instance) may work to prevent people from using it. An intention-behaviour gap exists between people's stated intentions to be environmentally friendly and their actual actions (for reducing waste and saving money at public institutions). When making decisions about allocating resources, the unequal power dynamics that come with wealth disparities are seldom beneficial (Boyce 1994). Assume that the most benefits from environmentally harmful behaviors usually go to the powerful elite. In such a situation, the less fortunate individuals who experience the worst repercussions are likely to be on the losing end of any compromise. Because the less good side must pay more in transaction expenses throughout the bargaining process, this dynamic often occurs. Suppose there is a correlation between the stakeholders' wealth and resources and their individual and collective influence and status. In that case, there will be fewer mutually beneficial connections resulting in inefficiency because of the disparity in income and resources among the parties involved.

When a single group controls a major institution, winners and losers will always be. Institutions at all levels, from resource consumers to international organizations, employ links to promote their interests and agendas within management systems, whether aiming to control the system or prevent change. Our method suggests that there are means by which government organizations can be protected from collapse. The first step is for the government to implement reward systems and quality standards. The idea of holding public servants accountable for performance is widely supported. Government employees, for instance, can get piecework rather than hourly wages. Those who are prepared to put in the estimated 8 h of labor for $50 will be well rewarded. They will be more driven to get the job done swiftly and effectively. Even though there are numerous areas of the public sector where a profit motive cannot be easily implemented. A hospital's management may be able to save expenses, but doing so might put extra stress on the facility's medical staff or even result in worse treatment for patients. The problem is that governments often provide services to the public that the market either does not offer or only offers in part (e.g., merit goods and public goods).The problem is that these public services do not lend themselves to being transformed into viable enterprises in Pakistan. One's ability to make decisions is constrained not only by one's financial or material standing but also by the values and norms that shape a society.

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[10] If we take Pakistan as an example, we see that even among government university students there is a lack of concern for the institution's own resources. Higher expenses were levied due to the institution's waste of government resources, particularly energy. Their actions are motivated by the thought, "Why should we worry, when we don't have to pay?" It's a metaphor for squandered riches. If companies are imposing negative environmental costs on individuals, then it doesn't matter how much a person tries to control their purchasing habits.

As the argument goes, when government agencies feel threatened by competing firms, they increase their productivity. The disadvantage of competitive bidding is that the least expensive service provider may not provide the highest quality. After that, a government organization should oversee checking up on hospitals to ensure they are up to par. Introducing competition into many government services is difficult due to natural monopolies. After public bus companies in Pakistan lost their legal monopoly, private businesses such as coaches joined the market. Sadly, this often causes unnecessary bus services and longer wait times. Furthermore, when fares increase, private companies' profit margins do so, rather than the communities they serve, because service providers often operate independently. The government must also depend on the goodwill of its citizens. The pursuit of profit is less pressing in other sectors of the economy, such as public service.[11] Staff morale might suffer if they are overworked or if they have too much paperwork to do. Streamlining the associated administrative procedures is one efficient method for making the most of public funds.

5 Conclusion

Needs are interlinked, and individual choices strongly tend to be forced by influence (Baudrillard, 1998; 2018). Individuals learn from each other through interaction, and that learning can be positive and negative from a societal perspective. Based on this perspective, individuals make either sustainable or harmful environmental choices. More importantly, everyday decisions cannot be considered random. They are instead subject to culturally and socially determined regulations. Therefore, it is essential to regulate diminishing resources. People's values are connected to the beliefs and customs of their communities. Cultural norms shape the production and consumption of things. In addition, consumerist civilizations are the most harmful to the environment since they lead to resource depletion and climate change. The world must disengage environmental deterioration from economic growth to progress toward a sustainable and socially inclusive economic system.

Many people feel that people would benefit and behave more responsibly if they reduced their overall consumption, adjusted their lifestyles to meet their fundamental requirements, and opted for products available on the market that promoted sustainability and social justice. The pace of change brought about by human consumption in the last several years is unsustainable and has led to the destruction of most of the world's ecosystems. The worldwide material footprint has increased to 85 billion tons per year owing to the proliferation of electronic waste and the failure of governments to effectively regulate the industry and provide efficient systems for collaboration among businesses, people, and community organizations. While about 1 in 10 people worldwide are undernourished, 1.3 billion tons of food are wasted yearly (Ruan and Yuan 2021). Our primary conclusion is that key stakeholders lack an efficient means of communicating with one another. Industries are recklessly

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[11] For instance, most people who choose to work in the medical area do so not to maximize their earnings but to satisfy a strong motivation to aid others. Healthcare institutions shouldn't be so concerned with pay for performance as they work to boost workers' morale.

creating to satisfy customers' insatiable wants. Unfortunately, from a cultural point of view, there is no theoretical or empirical explanation of responsible consumption and production choices in consumption theories. Theories of aggregate consumption are universally relevant in economics. Different values, cultures, political choices, and institutional designs mean that a model developed for the United States can never work in China. The actual performance of the current economic institutions was far lower than projected, which seriously negatively affected the environment.

This study can potentially encourage the use of resources in a way that promotes responsible consumption and production (RCP) decisions. Without a firm grasp of how stakeholders place a premium on different goods and services, achieving Goal 12 of the United Nations SDGs appears impossible. Therefore, we have used the framework of finite algebra to represent the fundamental structure of socioeconomic interaction. It outlines how the State, corporations, organizations, and people all work together as part of a governing framework to accomplish specific goals (RCP). The ultimate economic level is determined by the initial period of social activity. In addition, the nature of the activity impulses at various levels allows various socioeconomic patterns to emerge. For the sake of algebraic representation, we identify as the system representing any finite number of categories p of economic activities by State, corporations, groups, and individuals, respectively. Assuming any one of the four types of economic agents can independently choose the same number of possible socioeconomic indicators, say p, the algebraic structure is set in a top-down framework to yield p, p^2, p^3 and p^4 numbers of composite indicators at the levels of State, corporations, groups, and individuals.

The policies initiated from the state level reach individuals through a bond of mutual trust that has a long-lasting impact across several economic transactions. Therefore, a typical state typically undertakes three types of spending activities. The first type is the consumption activity, which provides goods and services to the public. The second type is production, and the third type of spending activity at the state level includes regulatory activities like providing property rights, consumer rights protection, the rule of law, control of corruption, voice and accountability, provision of information, monopoly control, and quality control. The inefficiency of the government in this spending can result in sizeable economic distress.

Using universally applicable concepts as a starting point, the responsible individual then applies those principles to specific circumstances. In bottom-up reasoning, the reasoner makes situation-specific, intuitive judgments as a starting point before applying general concepts. Top-down and bottom-up perspectives interact and reach *reflective equilibrium* when in harmony. In other words, when specific intuitive judgments are proven to be in harmony with universalizable abstract concepts. The cognitive difference happens when reasoners attempt to reconcile top-down and bottom-up approaches, adjusting one another until they are satisfied that the optimal possible combinations of principles and situational assessments have been discovered. While in the bottom-up approach, an individual has a critical role in designing society's general attitudes towards consumption Moreover, policies initiated from

the individual-level reach corporations and then make their product choices based on consumer wants. Then in a group where they are more individuals with irresponsible choices affecting the respective community. The inefficiency of the individual in this spending can result in sizeable damage to the environment.

While other countries look at fiscal imbalances in consumption, investment, and regulation, Pakistan takes a social-interactionist stance. A lack of trust negatively impacted economic and social connections at all levels (State, corporations, groups, and people). Indications of a less robust trust structure in a growing economy like Pakistan's have the potential to undermine the success of the country's financial sector. Based on the findings, ongoing frictions in the transactions market will ensure that the perception of weaker rules remains for a more extended period. Furthermore, economic institutions are vulnerable to rent-seeking because of a lack of independence. There is reduced confidence in the government because of less openness about government spending and the weaker rule of law (WGI, 2018).

The world is reaching a turning point. We are amid a perfect storm of global crises: COVID-19, with its persistent health, economic, and financial concerns; climate change, with its potentially existential threat to the globe; and war, with its tremendous human suffering and devastation. We have two unappealing options for our future: The first uses the progress made thus far in the twenty-first century to build a better world for everyone. It includes more prosperity for everyone, less severe poverty, better stewardship of our planet's limited natural resources, and an end to global warming. Uncertainty, inequality, poverty, and discomfort are what the future holds if global health issues, climate change, and armed conflict continue to worsen. Thinking outside the box and using innovative solutions is essential for overcoming challenges. The government might take the lead by initiating talks across sectors with federal and regional authorities. Uniting disparate groups with competing interests may be essential to deal with the economic crisis. Cities and towns might join to discuss safeguarding better people's food supplies in urban and rural areas. It might necessitate initiating conversations between groups that conflict with one another.

Therefore, the proposed algebraic model implies that the State may deploy material resources, sensemaking, and moral capital through various policy tools. Therefore, the robust pervasive capability of the State and conformity of culture make it feasible to exert intimidation in communities. Considering, $\mathbb{Z}_n$ As a state S when n is not prime allows us to extend our findings; in this case, $\mathbb{Z}_n$. It is not an integral domain since it acts like a commutative ring with identity. Examining the systems in an unbiased manner is a natural and practical solution. Since the ring, $\mathbb{Z}_n$. Having no divisors, this broader approach might serve as a starting point for thinking about and analyzing the absence of optimal circumstances for the interaction of categories. This comprehensive framework could explain why socioeconomic interaction is more common than in others in some instances.

Declarations

Conflict of interest The authors declare no conflict of interest.

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