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Sen, Sugata and Sengupta, Soumya

Panskura Banamali College, Panskura Banamali college

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**Neo-liberal Globalization and Caste Based Exclusion in India – Nature, Dimension and Policy : A
Study through Genetic Algorithm and Bio-informatics**

SoumyaSengupta

Faculty of Computer Science,
Panskura Banamali College, Panskura, Purba Medinipur, West Bengal,
INDIA 721152
Email: ssg747@gmail.com

Dr. sugataSen,

Associate Professor of Economics,
Panskura Banamali College, Panskura, Purba Medinipur, West Bengal,
INDIA 721152
Email: sensugata@gmail.com
(Corresponding Author)

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Caste-based exclusion is one of the major problems of contemporary Indian society. It hinders the participation of different social groups into the main stream society due to their caste and ethnicity based identities. In a resource constraint economy caste is a tool to appropriate the resources from its legitimate distribution. Historical facts have shown that caste has appeared as a tool of political economy to deprive a large section of the Indian society from their due returns. This study wants to know the historical sequence of political economy to develop caste as a major tool of exploitation. Caste-based exclusion is a manifestation of systematic exploitation of the ruled by the ruler in the name of caste of genetic difference. As exclusion can be explained as capability deprivation this study has taken into consideration health, education and income as the domains of exclusion. The idea of Genetic Algorithm has been applied to substantiate the existence of exclusion due to genetic divergence in these domains. Here exclusion has been measured through the concept of Hamming distance. This study also wants to develop the optimum policy measures to eradicate the menace of caste based exclusion from a resource constraint economy. The effect of Neo-liberal globalization on the caste-based hierarchies in India is also under the purview of this study.

The term ‘Social exclusion’ as a process of marginalization starts to appear in the contemporary social sciences with the works of German sociologist Max Weber (Parkin, 1979), though the existence of it can be identified in earlier studies. Weber saw exclusionary closure as the attempt of one group to secure for itself a privileged position at the expense of some other group through a process of subordination. Modern usage of the term social exclusion appears to have originated in France, where it was used to refer primarily to those who slipped through the Bismarckian social insurance system; the socially excluded were those who were administratively excluded by the state (Lenoir, 1974) (Duffy, 1997).. The United Nations Development Programme has conceptualized social exclusion as the lack of recognition of basic rights, or where that recognition existed, lack of access to political and legal systems necessary to make those rights a reality (Figueiredo, 1997). According to Centre for Analysis of Social Exclusion

at the London School of Economics (LSE) ‘An individual is socially excluded if (a) he or she is geographically resident in a society but (b) for reasons beyond his or her control, he or she can not participate in the normal activities of citizens in that society, and (c) he or she would like to so participate’ (Burchardt, 1999). Buvinic summarizes the meaning of social exclusion as ‘the inability of an individual to participate in the basic political, economic, and social functioning of the society’, and adds that social exclusion is the ‘denial of equal access to opportunities imposed by certain groups of society upon others’ (Buvinic, 2005). This definition captures three distinguishable features of social exclusion – first, it affects certain groups; second, it is embedded in social relations; and finally, it delineates the consequences of exclusion.

Caste, ethnicity and India

In India, exclusion revolves around societal institutions that exclude, discriminate against, isolate and deprive some groups on the basis of group identities such as caste, ethnicity, religion, gender etc. Indian society is characterized by multiple forms of exclusion associated with group identities like caste, ethnicity, gender, and religion in various spheres of society, polity, and economy. There are very few theoretical attempts at economic interpretation of the caste system, but they do recognize that caste as a system of social and economic governance is determined by certain religious ideological notions and customary rules and norms which are unique and distinct (Akerlof, 1976) (Scoville, 1991) (Lal, 1988). The economic organization of the caste system is based on the division of people in social groups, in which the social and economic rights of each individual caste are predetermined or ascribed by birth and are made hereditary. The entitlement to economic rights is unequal and hierarchical. The system also provides for a community-based regulatory mechanism to enforce the system through the instrument of social ostracism, and is further reinforced with justification from some philosophical elements in Hindu religion (Lal, 1988) (Ambedkar, 1987a). The fundamental characteristic of predetermined and fixed social and economic rights for each caste, with restrictions on change, implies ‘forced exclusion’ of certain castes from civil, economic and educational rights that other castes enjoy. In the market economy framework, occupational immobility operates through restrictions in various markets includes land, labour, capital, credit, other inputs and other services necessary for pursuing any business or educational activity (Thorat & Newman, *Economic Discrimination: Concept, Consequences and Remedies*, 2010). Caste based exclusion is, thus, reflected in the inability of individuals from the lower castes to interact freely and productively with others and this also inhibits their full participation in the economic, social, and political life of the community (Bhalla & Lapeyere, 1997). In India the low ownership of capital assets like agricultural land and business, low ownership of retail business and low employment and wage earnings of the ‘untouchable community’ has close links with the discriminatory access to markets in agricultural land, capital, input and retail consumer goods and employment (Thorat, Mahamallik, & Sadana, *Caste System and Pattern of Discrimination in Rural Markets*, 2010). The dalits have meager ownership of private enterprise and business in both rural and urban areas. This is mainly due to the historical denial of property rights to the dalits (Thorat, Kundu, & Sadana, *Caste Ownership of Private Enterprises: Consequences of Denial of Property Rights*, 2010). Social and cultural capital play a huge role to create selection bias in the urban, formal sector labour market also (Deshpande & Newman, 2010). It also appears that caste favoritism and the social exclusion of Dalits¹ occur in private enterprises even in the most dynamic modern sectors of the Indian economy (Thorat & Attewell, *The Legacy of Social Exclusion: A Correspondence Study of Job Discrimination in India's Urban Private Sector*, 2010). Madheswaran and Attewell (Madheswaran & Attewell, 2010) have shown that

¹ The Indian Government refers to Dalits as ‘Scheduled Caste’, a term dating from the colonial period when an official list or schedule identified certain castes as Untouchables. Scheduled Tribes are indigenous tribal groups, most of whom are very poor (Thorat & Attewell, *The Legacy of Social Exclusion: A Correspondence Study of Job Discrimination in India's Urban Private Sector*, 2010).

employment discrimination on the basis of caste is substantial and that discrimination occurs to a large extent in unequal access to job. Even in the reign of the so-called 'meritocracy' in the era of globalization it is found that commitment to merit voiced alongside convictions that merit is distributed by caste or region, and, hence, the quality of individuals fade from view, replaced by stereotypes that will make it harder for a highly qualified low-caste job applicant to gain recognition for his/her skills and accomplishments. They will be excluded simply by virtue of birthright (Jodhka & Newman, 2010). It is also seen that the discriminatory behavior in the field of education, combined with lack of social capital, increases the likelihood that the school experiences of marginalized children are far more negative than those of upper caste children, resulting in lower levels of academic skill acquisition (Desai, Adams, & Dubey, 2010). Dalit children are subject to discriminatory and unequal treatment in relation to their peers at schools and the social relations and pedagogic processes fail to ensure their full participation (Nambissan, 2010). Naturally very large fractions of the schedule caste (SC) community and scheduled tribe (ST) community are casual labourers, the percentage of those employed in regular jobs is much lower than that of the higher classes. In terms of levels of poverty as well, they turn out to be among the most deprived groups (Das, 2010). Various studies have shown that the people like adivasis² and dalits in India suffer from the greater risk of premature death, poor health and lack of treatment and care (Barooah, 2010). Complete exclusion and/or access with differential treatment may have reduced the use of health services, which result in poor health and high mortality of the dalit children (Acharya S. S., 2010).

Historical perspectives

The origin of ethnicity-based or caste-based marginalization in India can be traced from the Hindu Social Order or more specifically from *Brahmanical* Social Order which originated from *Rigveda*. The Vedic Age (2000 BC to 1400 BC) was the period of wars and conflicts between migrated Hindu Aryans and locals. These Aryans won by force new possessions and realms from the locals. Due to conquest of the Aryans the aborigines either submitted themselves to the conquerors on adverse terms or retreated to the hills and mountain forests. Those who submitted themselves started to follow the culture of the conquerors (Dutt, 1928). During the later *vedic* period the caste system developed and different occupations were taken over by different castes. But the system was not so rigid as it became later in the *Sutra* (manual of instructions) period. Later *Grihya Sutra* made reference to the duties of the people from birth to death. Social system started to follow *Varnashrama Dharma* as instructed by *Grihya Sutra*. Great emphasis was put on the purity of castes. With time the caste based restrictions became very rigid. The four castes in hierarchical order - *Brahmanas*, *Kshatriyas*, *Vaisyas* and *Sudras* were strictly instructed to follow certain duties. The development of the caste structure during this period also bears relation to the social characteristics of the time. The settled agrarian life of the Aryans gave rise to trade and commerce. With the growth of trade and commerce social stratification of the society came to existence. With the development of agriculture some of the agrarian households became very affluent and started to utilize their leisure and wealth for employment of agrarian labour. Agriculture, commerce and social stratification started to grow simultaneously. With time the large farmers abandoned farming and became more interested about exchange between communities, a distinct class of landlords cum traders or *vaishyas* appeared. The class of people who were primarily engaged with the giving security and war were called *Kshatriyas*. The people who were evolving different social norms and religious orders were called *Brahmans*. The rest of the people, who were engaged to serve these castes, to work according to the dictates of these stated castes were called *Sudras*. The *Sudras* did not enjoy same social and religious rights and status as the other three castes. There is a strong debate about the origin of the *Sudras*. According to some these *Sudras* were the aboriginals included within the greater Aryan society in adverse terms. Some others state that the *Sudras* appeared purely due to professional reasons and the

² Adivasi means Scheduled Tribes (ST).

former aboriginals who were included in the greater society in adverse terms formed the fifth caste called 'Achchhuts' or untouchables. This caste system gained momentum with the growth of dynasties (Thapar, 1966) .

The Aryans started to move further east due to population pressure on agriculture and pastoral activities. They moved in small groups and established new settlements in the Indo-Gangetic plane. There were prolong clashes among the migrating groups and with the aboriginals at different geographical spaces. The aborigines who lost the battles were included in the society on adverse terms as *Dasa* or peoples with lesser social rights. The aborigines who did not give up started to leave their own land and migrated to forests. During 600 BCE *16 Mahajanpada* were coming out. The rulers of the *mahajanapadas* became the hereditary rulers. The concept of *kshatriya caste* further strengthened with rise of these hereditary rulers. Simultaneously the *Brahmins* also became powerful in the large chiefdoms and kingdoms as they were performing the rituals and maintaining the relationship with god. On this capacity they started to develop social norms for smooth functioning of the states. As the market grew further with the conglomeration the social division of labour became much complex. The persons who had wealth and were engaged in production and exchange further strengthened their status as *Baishyas*. But the *Sudras* continued as the lowest strata doing only the menial activities. It is also believed that the aborigines also formed some federative settlements like the Aryans. But their settlements were not as affluent as those of the Aryans (Thapar, *The Penguin History of Early India : From the origins to AD 1300*, 2003).

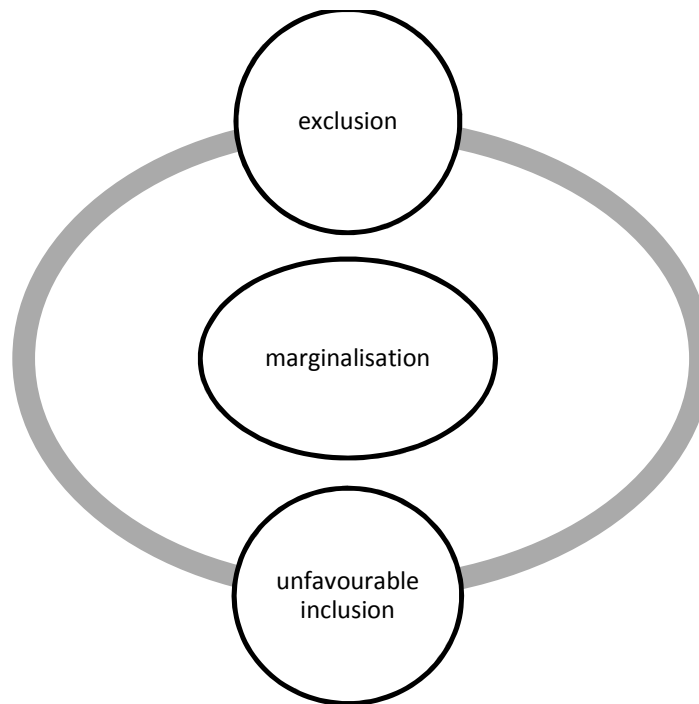
The rise of Buddhism can be attributed to the condition of Hindu society on the eve of Buddha's birth (567 BCE). Hindu society was suffering from the evils of the caste system. Buddhism proposed the advantage of egalitarianism in the face of the hierarchical caste system. Buddhism also had the advantage of missionary disposition against the ethnic reluctance of Hinduism towards outsiders. They wanted to provide philosophical support and a social vehicle to eliminate the hierarchies as present within the contemporary Hindu society. But the *Brahmanical* traditions were so strong that Buddhism could not sustain the confrontation with the Hinduism. Even the patronization of the kings and dynasties failed to limit the decline of the Buddhism . The *Brahmanical* traditions were so deep rooted that those not only became successful to exclude the followers of the Buddhism but even bought the large dynasties having lineage with Buddhism at the verge of extinction. The virtual disappearance of Buddhism from India is not an isolated event but a specific case illustrating a more general historical phenomena – the pertinacity and resilience of *Brahmanical* system in the face of challenges from others. The *Brahmanical* traditions became so powerful the last ruler of the Buddhist Mauryan Dynasty - Brihadratha was killed by his Brahmin commander-in-chief in 187 BCE. Subsequently Pushyamitra Sunga took the support of contemporary Hindus and started to persecute the Buddhists for smooth run of his kingdom. Brahmanism was revived in the hands of Sungas. The successor of Asoka in Kashmir ushered in the *Brahminical* resurgence. He is even said to have started a policy to have persecuted the Buddhism. It is true that after Asoka Buddhism found major patrons in Milinda and in Kaniska but many of the later kings were Hindus so that the thrust of the *Brahmanical* reaction could be eased. Interestingly in assimilation bid by the Hinduism Buddha became in popular view an avatar of *Vishnu* for the Hindus. The disappearance of Buddhism from India thus lies in the opposition of *Brahmanical* system to it and its assimilation by it – what is called the *Nilakantha syndrome*. It is through this paradoxical combination of opposition and assimilation that Hinduism faced Buddhism (Sharma, 1979).

Till the Sultani and Mughal era the kingdoms and empires more or less followed the *Brahmanical* social order with varying degrees and forms (Thapar, *A History of India*, 1966). Theories purporting to explain the growth of Islam in India may be reduced to four basic modes of reasoning. Among them one of the important is Religion of Social Liberation thesis. This theory postulates a Hindu caste system that is unchanging through time and rigidly discriminatory against its own lower order. So when Islam arrived

in the Indian sub-continent, carrying its liberating message of social equality as preached by Sufi shaikhs, these same oppressed castes seeking to escape the bondage of *Brahmanical* oppression and aware of a social equality hitherto denied, converted to Islam en masse (Eaton, 1997). But these converted muslims never got the equal status with the original muslims. Mainly due to this reason a peculiar hindu caste like hierarchical structure is observed among the Indian muslims though the Islam does not recognize this caste system. In many parts of India and in Bangladesh Muslims are broadly divided into Khandan (high status), girhasta (low status) and kamla (lowest status) and there exists sharp cases of exclusion in all spheres of life (Chowdhury, 2009). After the Mughals the Britishers followed a policy of simultaneous exclusion and inclusion towards the tribals. Both of these policies had some specific impact on tribal societies. Inclusion of tribal societies into colonial regime was characterized by breakdown of traditional political system and the means of social control among the tribes leading to social disintegration and cultural maladjustment. Inclusion also exposed tribal societies into a network of economic activities alien to the existing tribal economy. On the other hand, the colonial administration introduced excluded area policy to keep away certain tribal territories from rest of the country. Though these were excluded areas, the administration did not stop penetrating the tribal traditional domain. Many of such traditional social control organizations were made defunct or uncalled for leading to social disintegration. Such exclusions led to stagnation of most vital aspects – the economic progress and education etc and also infrastructure development. The story of exploitation and deprivation did not come to light at all (Sonowal, 2008).

Exclusion inclusion continuum

The marginaliation of the ST community is not only the outcome of exclusion alone but also due to adverse inclusion. Sen (Sen A. , 2000) has mentioned the situations where some people are being kept out and where some people are being included – in deeply unfavourable terms. He described the former as ‘unfavourable exclusion’ and the latter as ‘unfavourable inclusion’ or ‘adverse inclusion’. The latter, with unequal treatment, may carry the same adverse effects as the former. In India the Hindu social norms are responsible for a unique continuum between ‘unfavourable exclusion’ and ‘unfavourable inclusion’. Historically it is seen that the ST community is not a part of the greater Hindu society. At best they may be considered as a parallel segment of the dominant Hindus with different origin, heritage and culture. Through years the Hindu political system tried to include this section of the society through so-called assimilation bids. But these inclusionary processes actually failed to fit the tribals to the upper strata of the hierarchical Hindu society – they started to find them as the lowest section of the Hindus. Naturally these “detrribalization” bids allowed to develop identity crisis among the tribals. The political intrusion of the non-tribals to the tribal world in disguise started to left the tribals vulnerable to socio-economic exploitations. Those who did not include them to the Hindu systems remained beyond the purview of the greater socio-economic life. The Hindu social norms confined these tribals either to the lowest strata of the society or kept them outside of the dominant society. In other words, they were either unfavourably included or involuntarily excluded. It was inevitable for the tribals to face exploitation either as the lowest strata of the society or as the excluded. Naturally, the newly created identity of the tribals through the so called inclusion did not serve the tribals. Most of the tribal groups could not assimilate completely with the Hindus. The contemporary ethnic history of tribal India clearly reveals that this process of newly created identity was not at all a prudent move from the part of the tribals. Frustrated with the deteriorating social relations with loss of identity many of the tribals started to rejuvenate their age old tradition to regroup and reassert their unique separate tribal identity. A process of “retribalization” or revivalism has sprung up among these groups. So a different sort of exclusion started to show where it is self imposed or vountary in nature (Sonowal, 2008). A vicious circle of exclusion and inclusion dynamics is active to marginalize the ethnic tribals in India.



Genetic Difference – Need for Mutation

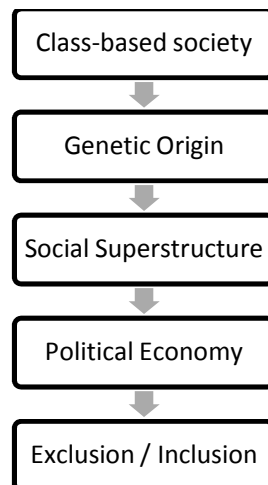
This exclusion inclusion conflict can best be explained through the studies on genetic histories of different social groups in India. This conflict can be stated as a conflict between groups with different genetic origins. Different genetic human groups have tried to dominate the others through unfavourable inclusion or involuntary exclusion. The genetic studies on different ethnic groups in India have shown that these groups have different genetic structure and have affinity to different social groups available at different parts of the world. A study of Bamshad et.al . (Bamshad & al., 2001) has shown that the upper castes of India have a higher affinity to Europeans than to Asians are. Indian upper castes are significantly more similar to Europeans than are the lower castes. To come to this conclusion they have compared mtDNA and y-chromosome variation of different social groups available throughout the world. The study concluded that the higher or privilege caste in India has a definite genetic sequence which is distinctly different from lower caste. So pulling the lower caste to the upper privilege castes through genetic crossover can be a way out to curb the menace of caste based discrimination in India. This can be done through chromosomal crossover where exchange of genetic material between homologous chromosomes takes places. A gene mutation is a permanent alteration in the DNA sequence that makes up a gene, such that the sequence differs from the original one. Mutations range in size; they can affect anywhere from a single DNA building block (base pair) to a large segment of a chromosome that includes multiple genes. To initiate a fruitful genetic crossover between upper caste and lower caste the method of genetic algorithm can be followed. Genetic Algorithm (GA) is a method for solving both constrained and unconstrained optimization problems based on a natural selection process that mimics biological evolution (Appendix – I). The algorithm repeatedly modifies a population of individual solutions. At each step, the genetic algorithm randomly selects individuals from the current population and uses them as parents to produce the children for the next generation. Over successive generations, the population "evolves" toward an optimal solution.

Marxist interpretation

According to Karl Marx all societies in the world are organized on the basis of social exclusion and social inclusion. Exclusion appears due to the struggle for allocation of limited resources. Social exclusion stems from the control of means of production. Therefore class formation and division occur on the basis of property ownership and control of surplus value (Irmak & Guclu, 2012). Caste-based exclusion is undoubtedly a process of division of society to control the power and production. The social norms that legitimized the caste-based exclusion are nothing but some instruments to impose the ideas of ruling class to the ruled class. In Marxist connotation these ideas are nothing but some tools to sustain exploitation (Marx & Engels, 1845).

Posing the Problem

In India different social groups with different genetic origin have different development experiences. The marginalization of certain social groups arising out of exclusion has strong historical significance which appeared from the philosophy of Hindu social order. The political economy developed in India on the basis of *Brahmanical* philosophy has helped sustain the marginalization of some groups through the politics of exclusion. Hindu social order successfully developed the genetic difference among the different social groups into a tool of systematic deprivation of the tribals. This systematic marginalization of the tribals can also be viewed as the exploitation of the ruled by the ruling class. Due to lack of skill, mobility and ability to participate in the existing greater socio-economic life the lot of the tribals are deteriorating further in the age of neo-liberal globalization.



So a genetic crossover or mutation can bring the excluded groups to the main stream. It is true that biological crossover may not be possible in a pseudo conservative society like India but a virtual crossover among different characteristics of different social groups can open new Pareto optimal development paths. This virtual crossover may be expressed as the mutations of bad genes through the good genes. So in the process of virtual crossover we can crossover the good genes of each chromosome with the bad genes of other chromosomes. Here genes are the variables being considered corresponding to each household, whereas each household can be treated as a particular chromosome. Thus in the preceding section we shall undertake crossovers among different chromosomes to establish the genetic superiority of certain social groups. The concept of genetic cross over through genetic algorithm (Appendix – I) will be used to show that fruitful mutation can reduce the level of exclusion. Further we shall try to evolve policy path for inclusive growth in a caste ridden hierarchical structure. Finally we

shall examine the effect of neo-liberal globalization on inclusive growth in a country like India. Thus the specific hypothesis of this study can be described as follows.

Hypothesis

- Firstly, the schedule tribes are lagging behind the other ethnic groups of the society.
- Secondly, genetic crossover can systematically improve the level of inclusion.
- Thirdly, evolving policies for full-fledged meaningful inclusion of all sections of the society may not be possible.
- Fourthly, the genetic divergence has adversely affected the scheduled tribes in the era of globalization.

Methodology

The study is based on 320 households and 17 variables from the three domains of education, health and income (Appendix – II). Each household has been treated as a chromosome and each selected variables affecting the households have been treated as a gene. Thus we have 320 chromosomes and 17 genes in our study. The collected data is tabulated under different heading such that we get a 320 x 17 matrix. In each cell of this matrix we have either 0 or 1. 0 means not excluded with respect to the specific column heading or the particular gene and 1 implies exclusion to the corresponding field. Thus the generated matrix is a set of values corresponding to a two- point binary scale. This matrix signifies the society as a whole in different fields of inclusion and exclusion. In this society we have measured the exclusion of each social group on the basis of caste through the application of Hamming Distance (Appendix –III). Then the rules of genetic algorithm have been applied to initiate genetic crossover among the households or chromosomes. Each of the chromosomes has been crossed over to the other chromosome or row in the matrix. Such that 16 matrices are formed after first order crossover. The best i.e. the matrix with highest number of zero is selected from these 16 matrices. We further continued with the crossover to substantiate the effect of crossovers. Thus the effect of genetic crossover on the outcome of development plans is substantiated. Finally, we have tried to find the best programme combination with the given resource constraints. To that respect the idea of constraint maximization through the technique of Knapsack optimization (Appendix – IV) is used. Capability constraints of each social groups are discussed to show the failure as well as advantages of each social groups to accrue the benefits of neo-liberal globalization on the basis of available secondary data.

Findings

From the dataset it appears that the row 16 in the initial data matrix or the 16th household has the highest number of zero or facing least exclusion in the domains of income, health and education. After tallying the level of inclusion i.e. the aggregate number of zero of each household with their caste status it appears that the households least excluded in the society is form general caste (GC).

We have already defined that Hamming distance measure the minimum number of substitution required to one string to other. The idea of Hamming distance is frequently used in information theory is nothing but the distance between two string of equal length or the number of position at which the corresponding genes are different. In our operation we have calculated hamming distance of each chromosome with respect to the best chromosome and we have taken into consideration only the asymmetry in 0 with respect to the best chromosome. Interestingly our calculation shows that the

minimum Hamming distance between chromosomes from ST community is 7 as where the minimum distance for SC and the best general chromosome is 1. The same between the general and OBC is 1. This operation clearly defines the fact as a social group the ST, OBC and SC communities are trailing behind the general caste as communities. This also clearly shows the presence of caste based discrimination in our society. Another interesting fact has been appeared through this operation is that the hamming distance between the ST community and general caste community is much higher than same between the other communities. This spectacularly high difference that is out of 12 areas in 7 areas the ST community is lagging behind the GC community. Naturally it can be concluded that only a group of development programs cannot benefit all the communities equally unless the social outlook to the different communities at the contemporary society is changes. Immediate steps to eradicate this caste based barriers from our society are urgently needed. So our next step will be to find the efficiency of general development programs in a caste less society. To that respect we shall crossover the best gene and mutate the other chromosome so that we can create a hypothetical society which is free from all sort of ethnic variability.

We start with the cross-over of each chromosome in the initial matrix A with the other available chromosomes in the same matrix. In matrix A the level of inclusion or the total number of 0 is 1581. The first order operation of GA gives us 320 (17 x 320) matrices or 102400 chromosome. Each of the 320 matrix gives us alternative inclusion states with the given policies. It appears from our dataset that the highest number of 0 or highest number of inclusion under different domains for the whole society can be achieved through mutating the chromosome 16 with the rest. Here the number of 0 is 3870. This matrix can be called BB, which shows the best achievable policy outcome after mutation with the best chromosome. To perform the second order crossover we then mutate each chromosome of BB with the other. Thus a dataset of 102400 chromosomes can be termed as D. In other words it can be started that D is actually a combination of 320 matrices of 17 x 320. This 320 matrices actually shows the alternative inclusion outcomes with the existing development plans in a caste based discrimination free society after second order crossover.

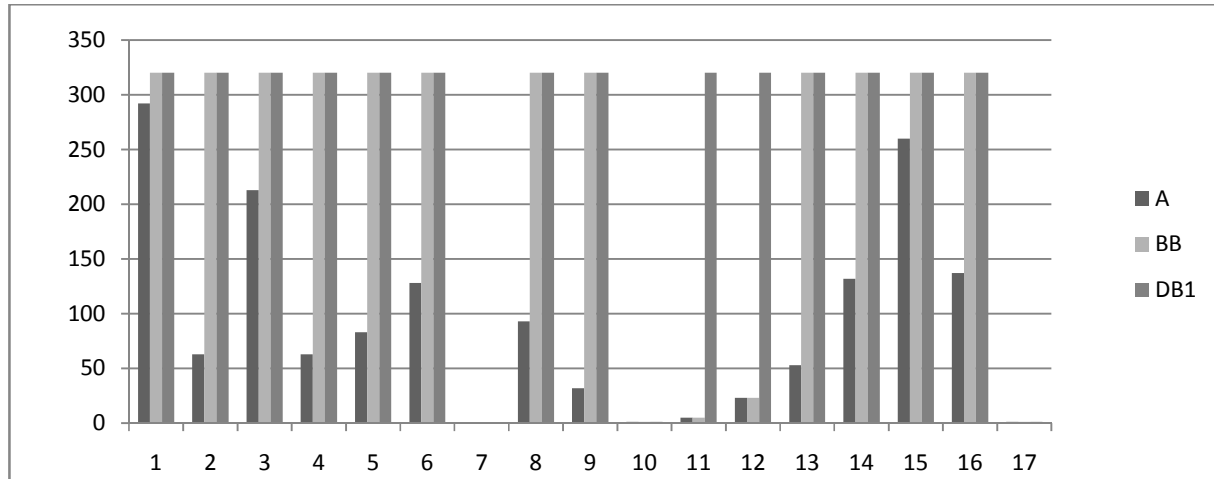
Now we are interested to find the best possible inclusion status after second order crossover. From this dataset of 320 matrices we would choose the best one which would deliver the society the highest level of inclusion or the highest number of 0. From this operation it appears that there are 2 matrices which can deliver highest number of 0 to the society. This 2 matrices can be termed as DB1 and DB2 delivers the society 4482 number of 0. Both of these matrix have the similar chromosome structure. So any one of them can be chosen and termed as DB.

Now it clearly appears that when the caste based discrimination is eradicated through genetic mutation the level of inclusion increases significantly. More over the inclusion status improves with the subsequent crossovers. If we compare BB with DB it will appear that with the same development strategy the level of inclusion can be much higher. It appears that out of 5440 elements 3870 elements were benefited in BB where as in DB out of the same elements 4482 elements have been benefited. Thus with genetic mutation and moving towards caste free society the social welfare increases.

Finding the patterns of inclusion in the matrices A, BB and DB is necessary because these patterns can tell us about the type of policies to be adopted to maximize the level of social welfare. So we have tried to plot the total number of 0 under each domain for A, BB and DB.

Diagram – ‘a’ below shows the level of inclusion under each variable for the 320 households as shown in matrices A, BB and DB1. This diagram draws the conclusion that genetic crossover or genetic assimilation has important effect on the development of India.

Diagram – ‘a’



It appears from the above diagram that caste based discrimination has varied effect on different domains of exclusion. Our chosen indicators of exclusion falls under three domains of income health and education. In diagram “a” variable 1 to variable 5 are related with income generation, variable 6 to variable 15 are related with health and variable 16 and variable 17 are related to education. It clearly comes out that in the income domain the first order crossover has greater effects as comparison to other domains. The effect of crossover on the education domain is mixed. So the effect of caste based exclusion is much stronger in the domain of health. Again it is also observed that under some variables in the domains of health and education the genetic crossover has failed to deliver the desired result.

The aim of any welfare state is to maximize the level of inclusion of all the social groups. In a developing country like India - which is suffering from acute resource scarcity, required resources may not be available to include all the social groups equally in all the development programmes due to resource scarcity. Naturally the question of appropriate policy mix arises. In other words it can be said that in the phase of resource scarcity the aim of the welfare state should be to enhance the inclusion status through optimum policy proper policy mix. To that respect we have tried to maximize the welfare subject to resource constraints. We can assume that depending upon the available resources the state will opt for appropriate policy mix. We have 3 domains as income, health and education which can be denoted as Domain-I, Domain-II and Domain-III respectively. According to our problem Domain-I has 5 variables, Domain-II has 10 variables and Domain-III has 2 variables. On the basis of the available resource the state may opt for any one domain or a combination of two domains for achieving the highest level of welfare with the given resources. The number of variables encountered under each policy mix for inclusion is shown through the following table.

Fig. Table X

Policy mix	Encountered Variables
Domain-I	5
Domain-II	10
Domain-III	2
Domain-I+ Domain-II	15
Domain-I+ Domain-III	7
Domain-II+ Domain-III	12

The idea of constraint maximization has been tried through the principles of Knapsack optimization to get the optimum policy mix for highest level of inclusion in a resource constraint economy. Thus this constraints optimization will maximize the level of welfare subject to the availability of different policy mix.

The output generated for each policy is presented through the following table

Table- Y

Policy	Encountered Variables	Max. Welfare
Domain-I	5	25.051888
Domain-II	10	32.255104
Domain-III	2	14.037736
Domain-I+ Domain-II	15	32.581764
Domain-I+ Domain-III	7	28.992748
Domain-II+ Domain-III	12	32.581764

It is interesting to observe that the maximum level of welfare under different policy mix is maintaining an upper ceiling. It appears from the current problem that the achievable maximum level of welfare is 32.581764 with variable mix of 12 as well as 15. In other words it can be said that the level of welfare becomes fixed after a certain level of policy mix, the increase in variables fails to enhance the welfare level. A minimum level of exclusion is reality of the society. Thus the aim of any genetic mutation combined with policy mix is to minimize this “Natural level of exclusion”. In the Marxist interpretation it can be said that in a class divided society full eradication of caste-based exclusion is not possible. Fruitful genetic mutation or revolution can enhance the level of welfare significantly but due to limitation of resources highest level of welfare may not be possible. The revolution or genetic mutation in the existence of resource limitation can increase the level of inclusion but cannot reach the full inclusion. So what the revolution or the genetic mutation with policy mix can do is to maximize the

inclusion and distribute the level of exclusion equally on all human beings in the face of resource constraints.

Inclusive growth and Neo-liberal globalization

Inclusive growth requires elimination of all social barriers to ensure full participation of social groups in the growth process. To that extent the hypothetical genetic crossover as discussed in this work is a movement towards inclusive growth. On the other hand the capitalistic developments through neo-liberal globalization ensure the process of 'dehumanisation' in the society. Naturally the idea of genetic mutation as developed here is not compatible in the presence of neo-liberal globalization. Indicators of development in India show that the capability of the excluded has not improved in the era of globalization. Moreover the current mode of capitalistic development has pushed the already excluded groups further to the below. With the contraction of the govt. the lowest strata of the society is systematically being excluded from the generation of skill through education and health. Capital intensive productions in the globalised market have shifted the demand for qualified manpower towards modern skill oriented qualities. Naturally the existing excluded are systematically failing to participate in the social life. As the neo-liberal globalization is concerned about the market and efficiency only the Hamming distance between different social groups as developed here will either continue or increase. So the pre-requisite of any successful genetic cross-over is to eliminate every type of capitalistic traits from the society. Unless the process of neo-liberal globalization is reversed caste-based exclusion in India will continue. The character of caste as a tool for appropriation of resources in the society will continue like the earlier phases of capitalistic developments in India. The manifestation of the social superstructure or the political economy may take a different look but the importance of caste and ethnicity as a tool of exploitation will continue.

Conclusion

From the preceding analysis it appears that caste based exclusion is distinctly present in contemporary Indian society. For ages India boasts the habitations of varied human groups with different genetic origins. These genetically different groups clashed with each other to control the available resources in the face of resource constraints. The ruling class or the group of human beings with genetic similarities evolved 'caste' and 'ethnicity' as a tool to exclude the ruled or the group of human beings distinctly different from their own genetic origin from the process of participation. Thus the caste-based exclusion in India has a strong historical significance which appeared from the age old hierarchical *Brahmanical Social Order*. For ages the Hindu social order has used 'caste' or 'ethnicity' to create a division within the society to exploit the resources in the face of resource constraints. The caste-based exclusion is nothing but the manifestation of systematic deprivation of the ruled class by the rulers. Using the concept of Hamming distance it has been observed that interpersonal variation in level of inclusion on the basis of different social groups are remarkably different. This distance between the schedule tribe community and general community is highest. To reduce this caste based sustained discrimination this study has undertaken the hypothetical genetic crossover between different households. The interpersonal genetic crossover of household characteristics has generated 320 matrices from which the best one is chosen for analysis. The best matrix is that which has the highest number of zero or inclusion. Interestingly it is found that the inclusion gap reduced significantly with the first order iteration. The levels of inclusion increase further with the subsequent iterations or crossovers. This analysis establishes that virtual genetic mutation or elimination of caste based social norms can improve the level of inclusion significantly within a society. Determination of development path to pull up the caste ridden society to a caste-based exclusion free society is tried through constraint optimization techniques. To that respect the idea of Knapsack optimization has been used. It is observed that the level of welfare becomes fixed after a certain level of policy mix, the increase in development parameters fails to

enhance the welfare level. A minimum level of exclusion is reality of the society. Thus the aim of any genetic mutation combined with proper development policy mix is to minimize this “Natural level of exclusion”. According to the Marxist interpretation it can be said that in a class divided society full eradication of caste-based exclusion is not possible. Fruitful genetic mutation or revolution can enhance the level of welfare significantly but due to limitation of resources highest level of welfare may not be possible. The revolution or genetic mutation in the existence of resource limitation can increase the level of inclusion but cannot reach the full inclusion. So what the revolution or the genetic mutation with policy mix can do is to maximize the inclusion and distribute the level of exclusion equally on all human beings in the face of resource constraints. But lastly it is to be kept in mind that eradication of all capitalistic traits from the society is an essential pre-requisite for successful inclusive growth with the help of bio-informatics. Naturally the current process of neo-liberal globalization is a potent barrier towards inclusive growth.

APPENDIX -I

Genetic Algorithms (GAs) are adaptive heuristic search algorithm based on the evolutionary ideas of natural selection and genetics. As such they represent an intelligent exploitation of a random search to solve optimization problems. Although randomized, GAs are by no means random, instead they exploit historical information to direct the search into the region of better performance within the search space. The basic techniques of the GAs are designed to simulate processes of natural systems necessary for evolution, specially those follow the principles first laid down by Charles Darwin of "survival of the fittest." Since in nature, competition among individuals for scanty resources results in the fittest individuals dominating over the weaker ones. GA uses the natural laws of crossover between different attributes so that the best outcome can be achieved through the mutation. The concept of GA has been used in different fields of science and technology to get the desired output. The uses of GA have been widely accepted in almost all the braches of science and technology.

Selection ,crossover and mutation are the most important parts of the genetic algorithm. The performance is influenced mainly by these operations. When breeding new chromosomes user need to decide which chromosomes are to be used as parents. Naturally the selection procedure needs to establish the fittest individuals from the populations but the randomization of the selection procedure may sometimes use less fit individuals so that more of the search space is explored. The selection of less fit through randomization will undoubtedly make the creation process more inefficient. Each individuals is given a chance to become a parent in proportion to its fitness evaluation. Those with the largest fitness have more chance to being chosen. Fitness is calculated through some logic or existing norms. Apart from fitness calculation some pre-existing notions can become viable to choose the parents.

In genetic algorithm , crossover is a genetic operation to vary the pattern of a chromosome or chromosomes from one generation to the next. Many crossover techniques are available to breed new generations of chromosomes or data string. Under single point crossover (SPC) technique both parental chromosomes are split at a randomly determined crossover point. At a single crossover point on both parents' organism strings is selected. All data beyond that point in either organism string is swapped between the two parent organisms. Subsequently, a new child genotype is created by appending the first part of the first parent with the second part of the second parent or likewise. Apart from SPC, many crossover algorithms are available involving more than one cut point. It should be noted that adding further crossover points reduces the performance of the GA. The problem with adding additional crossover points is that building blocks are more likely to be disrupted. But an advantage of having more crossover points is that the problem space may be searched more thoroughly. At the same time single point crossover on all the bits or genes are also possible.

Mutation is a genetic operation used to sustain genetic diversity in one generation achieved through crossover from the previous generation. It is analogous to biological mutation. By mutation individuals are randomly altered. Normally, offspring are mutated after being created by recombination (Sengupta, 2015).

This logic of GA can be executed through varied programming languages. This work has used VB.net under Microsoft Visual Studio framework to develop the required algorithm and codes.

Appendix - II

In the first stage four districts of West Bengal were randomly chosen –two from the strata of relatively higher per capita income districts and two from the strata of relatively lower per capita income districts (Bureau of Applied Economics and Statistics, Govt. of West Bengal, 2009). The existence of West Bengal as a benchmark in the discourses of inclusive development is proven within India. That is why sample has been chosen from the state of West Bengal only. The four sample districts are Purba Medinipur and Howrah (also called Haora) – from the strata of relatively high per capita income districts; Cooch Behar (also called Koch Behar or Koch Bihar) and Paschim Medinipur – from the strata of relatively low per capita income districts. At the second stage, two community development blocks from each district were chosen randomly. In the third stage, two villages were selected randomly from each community development block. Ultimately, 20 households from each of the selected villages were chosen randomly. Thus the sample size is 320. The study was undertaken in 16 villages under 8 blocks of 4 districts of West Bengal. Data were collected from these households through field survey based on questionnaire interview method. Survey was undertaken between December 2015 and March 2016.

Appendix – III

In information technology, the Hamming distance between two strings of equal length is the number of positions at which the corresponding symbols are different. Hamming's formulas allow computers to detect and correct error on their own. The Hamming Code earned Richard Hamming the Eduard Rhein Award of Achievement in Technology in 1996.

Application of Hamming Distance:

1. Mingjie Tang (Tang, 2015) used hamming distance in the application of efficient processing of Hamming-Distance-Based Similarity-Search Queries Over Map Reduce. These distance comparisons on the binary codes are usually costly and, often involves excessive redundancies. The author speeds up distance comparisons and eliminates redundancies when performing the two flavours of Hamming distance range queries. Speedup over existing state of the art approaches, while saving more than ten times in memory space. The author introduced a HA index which used for realizing Hamming distance-select and Hamming distance-join operations on a Map Reduce platform are prototyped. The author assume that for HA index which underlying datasets are pre-processed; data is mapped from the high-dimensional space into one dimensional binary codes that are fixed-length strings of 0's and 1's.
2. Sometimes to put things in places on the use of Hamming Distance (HD) in error detection and correction in Computer Networks. HD is a measure of how well the error-

detection/correction can/did perform. Part of the input to HD is the code-words-- the set of valid codes, say set C that are to be transmitted. With this code-set at hand, $dmin$, is the minimum of HDs between any two word pairs in C . In this code set C , the best that an error detection algorithm can do.

- to detect $(dmin-1)$ -bit errors, i.e., errors in which $dmin-1$ of the bits are flipped, and
- to correct $((dmin-1)/2)$ -bit errors

Hamming Distance is a method to set the boundaries how well an error-detection/correction scheme can do on a specific case (specific set of messages transmitted). HD itself isn't an error-detection/correction scheme by itself.

Appendix – IV

We are given n objects and a knapsack or bag. Object i has a weight w_i and the knapsack has a capacity m . If a fraction x_i , $0 \leq x_i \leq 1$, of object i is placed into the knapsack, then a profit of $p_i x_i$ is earned. The objective is to obtain a filling of the knapsack that maximizes the total profit earned. Since the knapsack capacity is m , we require the total weight of all chosen objects to be at most m . Formally, the problem can be stated as

$$\text{maximize } \sum_{1 \leq i \leq n} p_i x_i \quad \dots\dots\dots(1)$$

$$\text{Subject to } \sum_{1 \leq i \leq n} w_i x_i \leq m \quad \dots\dots\dots(2)$$

$$\text{and } 0 \leq x_i \leq 1, 1 \leq i \leq n \quad \dots\dots\dots(3)$$

The profits and weights are positive numbers.

A feasible solution (or filling) is any set (x_1, \dots, x_n) satisfying (2) and (3) above. An optimal solution is a feasible solution for which (1) is maximize. (Horowitz, 2006)

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