

Colonialism, Capitalism and Nature: Debating the Origins of Mahanadi Delta's Hydraulic Crisis (1803-1928)

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Colonialism, Capitalism and Nature

Debating the Origins of Mahanadi Delta's Hydraulic Crisis (1803-1928)

Questions of development and ecological degradation have often been traced to a dyad consisting of population growth and technological choices. The capital/nature relationship, however, is a complex one, influenced by several social and environmental factors, including modes of social relations and various forms of property. This paper attempts to illustrate this argument by analysing a specific historical situation – an inquiry into experiments with flood control in the delta regions of eastern India over 150 years. This region was transformed over this period from a flood dependent agrarian regime to a flood vulnerable landscape – a transformation effected by British colonial rule that not only instituted a new regime of property but also oversaw the deployment of numerous technical interventions. This colonial attempt to synchronise the hydraulic environment with its administrative needs and to subordinate the region to capitalist relations offers an example in which to map the basic dynamics between capital and nature and thereby enable us to address the question raised at the outset – how capital transforms nature.

ROHAN D'SOUZA

What is nature? What is humanity's place in nature? And what is the relationship of society to the natural world?

– Murray Bookchin, *The Philosophy of Social Ecology*

The modes in which a social form organises the appropriation of nature – “the ‘otherness’ to humanity” – determines both the circumstances and constraint within which that society constitutes the basis of its existence and the conditions of its reproduction.¹ A society mediates its ecological² context through a set of social and production relations, which in combination determines the quality and scale of its ecological footprint.³ The society/nature metabolism, however, need not necessarily be stable and can often be unbalanced and assume the proportion of an ‘ecological crisis’: a crisis that is defined by the manner in which it overwhelms every sphere of activity and threatens the foundations of that social order. Assessing an ecological crisis that has been generated by the particularities of a social form, however, requires an approximate of the specific relationship between that society

and its ecological context. In the contemporary period, given the pre-eminence of capitalism, any analysis of ecological degradation must necessarily concern itself with the particularities of the capital/nature dialectic as well. This essay will endeavour to explore one aspect of the tension, viz, whether *capitalism relates to nature through a specific path*.

While the central concern of this paper is to discuss the above, I briefly detour to explain or rather recapitulate in step with several earlier inquiries some of the motivations for advancing a claim for such an exercise.⁴ First, mapping the relationship between a social form and its ecological context is important for evolving a perspective on the diverse ideological positions that environmentalists have come to embrace.⁵ Second, to underline the inadequacy in the neo-malthusian and technocratic analysis of the origins and causes of the current ecological crises. One such example, argued as a historical perspective, is Clive Ponting's masterful survey titled *A Green History of the World*.⁶ Ponting argues that natural ecosystems throughout history have been stressed and ultimately destroyed by a dyad consisting

of population growth and technological choices. Increasing human numbers, according to him, required a matching need to produce the means for livelihood and thereby propelled the adoption of polluting technologies, which intensified stress on the earth's resources and caused the degradation of several natural processes. Though highly simplified and clearly lacking sophistication as a causal model, Ponting's lucidly argued thesis, nevertheless, summarises and mirrors a wide spectrum of literature that deals with questions of development and the sources of ecological degradation. A third motivation is to identify the modes in which social relations and forms of property mediate between society and nature. This emphasis can help establish a basis for dialogues on alternate social forms that will perhaps be less degrading to the environment.

Undoubtedly, the capital/nature relationship is a vast and complex canvas comprising an inestimable number of social and environmental factors and therefore requires one to limit the contours of the inquiry to a manageable exercise. Consequently, I will attempt to illustrate the

argument by analysing a specific historical situation. My case example for the purpose will be served by an inquiry into the experiences with flood control in the deltaic segments of eastern India (1803-1956). The appeal of this case example lies in the fact that the deltaic region was transformed over the period of a century from being a *flood dependent* agrarian regime to a *flood vulnerable* landscape.⁷ The transformation was primarily effected by the agency of British colonial rule, which from 1803 onwards dramatically reconfigured the hydrology of the region by instituting a new regime of property and with the deployment of several types of technical interventions. The colonial attempt to cohere the hydraulic environment in sync with its imperatives of rule and administration and to subordinate the region to the capitalist relation offers us an example in which to map the basic digits of the dynamic between capital and nature and thereby, enable us to address the question raised at the outset. To render the scope of this discussion tractable, however, we shall elaborate some of the concepts and their relational contexts.

I Capitalism, Nature and Ecological Integrity

Capitalism

Capitalism in the broadest sense refers to generalised commodity production in which labour power is a commodity. As a mode of production, capitalism is characterised by the division of society into two antagonistically opposed classes: a class of direct producers who have been dispossessed of the means of production and a class that has monopolised control over the means of production. The former are subordinated to the commodity relation by being rendered 'free' to sell their labour power to the latter.

For the purposes of this argument, however, I will chose to concentrate on determining if there is a specific route by which capitalism impacts on a given ecological context, in other words, to attempt to identify and distinguish a peculiarly capitalist signature on the natural world. More precisely, I hope to trace the impact of certain aspects of primitive accumulation and commodification on the deltaic ecology of the Mahanadi basin. Primitive accumulation – the 'pre-history' of capital – refers to the process in which the independent producer is divorced from the tools and conditions of production, i e, in which the means of subsistence and

production are turned into capital and the immediate producers are transformed into wage-labourers. Commodification is the process wherein an article's production is dictated by the dominance of exchange over that of use. The capitalist commodity is simultaneously the contradiction and unity of use value and exchange value in which commodified labour power is embodied. The drive for capitalist accumulation fuels the extension of capitalist relations, which, however, has historically been uneven and has acquired different densities and shapes in various contexts, especially in the epoch of modern colonialism in which the hammer of capitalist expropriation began to simultaneously smash and refashion the fabric of a great number of social formations and their natural landscapes in Asia and Africa.

As far as our case example; in the south Asian subcontinent is concerned, British colonialism, for various reasons, transformed the existing pre-capitalist social formations into a specific type of peripheral capitalism that was constituted essentially as a subordinate to the metropolitan economy (Britain).⁸ In the process of incorporating the region into capitalist relations, local self sufficiency and production regimes were substantially dismantled or dissolved and indexed instead to the vagaries of international markets. In effect, colonial rule assembled a *disarticulated form of generalised commodity production* in which the circuits were not internally complete but linked to the fluctuations and needs of the metropolitan economy.⁹ Consequently, the imperial drive for raw materials and markets promoted the expansion of the agrarian frontier, the dramatic spread of mono cropping and plantations, the decimation of wild life and the rapid decline of forest cover.¹⁰ This drive was predominantly determined by signals emanating from the metropole rather than being exclusively generated from within the subcontinent. In other words, pressures of the accumulation process in the metropolis were transmitted onto the ecology of the colonies. Along similar lines, it is argued that the process of *extended reproduction of capital* in the colonies was deformed, i e, a large share of the economic surplus that was extracted (pumped out by extremely exploitative fiscal measures) was appropriated by the metropole rather than reinvested in the colony. The siphoning off or the drain of the economic surplus in this manner impoverished and enervated the populace at large and increased the latter's vulnerability to the extremes of famine.¹¹ In fact, the combination of systemic poverty and

frequent famine often caused communities to magnify stress on fragile ecologies by forcing them into distress behaviour.¹² In sum, colonial capitalism in India, with its specific agendas for extraction and rule, etched a particular mark on the latter's environmental landscape.

Nature

The canon in ecology, as a professional discipline, for long has been that nature is imbued with a design and in the absence of any endogenous disturbances it is essentially static and stable. Nature, in other words, had a 'balance' or an 'equilibrium' that it maintained or gravitated towards by natural selection, competition, etc. Two of the most influential concepts that helped endorse the claim for an intrinsic harmony or order in nature were theories on (a) succession and community and (b) the ecosystem. In the succession and community notion, plant communities following a disturbance were assumed to go through a sequence of changes until they reached a stable self-replicating climax. An end point, so to speak, was inevitably achieved wherein the community's dynamism finally drew to a rest and expressed its integrity.¹³ System ecologists built on such insights by plant ecologists and expanded the model to include relationships with non biotic components like energy, geochemical processes and other physical conditions. The emphasis was also shifted from an overt concentration on aspects of structure to an analysis of function. Eugene Odum's 1969 article on ecosystem development proved influential in popularising the concept of nature as having an orderly, directional and predictable path which, he argued, evolved towards greater complexity, diversity and stability. The ecosystem became the basic unit for ecological analysis and it helped fortify the assumption that a universal strategy for homeostasis was integral to all natural processes.

The idea of a natural balance has been subject to severe criticism in recent times and increasingly a revisionist perspective, indicating virtually the opposite, has begun to gain traction. Several studies now posit that nature is random, contingent, discontinuous and always in flux. In the words of the philosopher Mark Sagoff "nature pursues no purpose, embodies no end and develops in no direction".¹⁴ "Undisturbed nature" is, in fact, not at some equilibrium in structure or form but is regularly altered at every scale of time and space by a host of short or long term factors that are regularly generated by both internal and external agents. In contrast,

therefore, to the previous view that nature's "melody leads to one final chord that sounds forever", Daniel Botkin has suggested the metaphor of a "discordant harmony", involving changing tones of often erratic and random complexity.¹⁵

Along similar lines, the single stable state ecosystem community has been supplanted with the notion of a disparate multitude of stable state communities simultaneously operating in any given locale. The patch – an ecologically distinct locality in the landscape – is now described as the basic ecological unit for analysis.¹⁶ As localised discontinuities in landscapes, patches allegedly develop a varied range of associations with each other and often establish a highly differentiated and erratic set of interactions. In such a schema of almost cellular diversity and dynamism, it is argued that each species will respond "individually" to its environmental gradients rather than as a community. Thus, as a classification device the ecosystem is too endemically riddled with micro level variations, disturbances and perturbations to achieve any over-arching integrity that would define it as a stable configuration, i.e., *if an ecosystem is constantly fading into another ecosystem one can't visit the same ecosystem twice*. To this branch of deconstruction ecologists "nature has no essence; it has a history".¹⁷ Even in the case of the inanimate or non biotic part of nature change is recurring and constant, albeit often at a slower more ponderous and glacial pace. Given the absence of a baseline ecology, as argued above, how does one map the impact of a society on its surrounding environment? Sagoff sums up this dilemma:

Because ecosystems have altered dramatically virtually every place in which human beings are found, what do we use as a baseline? Where in the flux of a biological community do we take a "snapshot" and say "here it is in equilibrium" or "here it has integrity" or "now we have reached the carrying capacity of the land"? Is the ecosystem developing towards a "healthy" condition, is it now "healthy" or is it falling apart?¹⁸

While the emphasis on the stochasticity of the natural world has been influential in calling for the revision of the notion of the static climax community in classical ecology, others have argued that these deconstructionists have over-stretched their reasoning to wrongly conflate chaos with randomness. Ernest Partridge, in a scathing rebuttal to Sagoff, contends that the idea of constant change or that nature is in flux does not subvert the basic methodology of theoretical ecology. According

to Partridge, the ecosystem conceptually is intended to register not static but dynamic interactions between the constituent components that comprise an ecological community; the latter furthermore display definitive trends and their contingencies are not arbitrary but subject to constraints. Similarly, in his opinion, ecological communities establish clear patterns of mutual interdependence and are integrated with their environment in specific ways and are not flotsam jetsam biological material in freewheeling association, combination or change.¹⁹ For our purposes, however, the salience in Partridge's scrupulously argued rejoinder is his emphasis that the deconstructionist perspective, besides incorrectly reifying the claim that biotic communities survive in a chaotic nonsystem, make the cardinal error of obscuring the difference between "natural" ecosystems and those "managed" by human intervention. In other words, the rate and scale at which natural ecosystems are "self organising" can in most cases be radically different from those in which anthropogenic management has acted upon. In effect, *the task of arriving at some sort of ecological baseline is central to determining the impact and implications of the society/nature dynamic*.

Ecological Integrity

For an ecological baseline we have chosen to settle on a slight variation of the concept of *ecological integrity* as theorised and defined by members of the Global Integrity Project (henceforth GIP).²⁰ According to some members²¹ of the GIP, ecological integrity is associated with:

... wild, untrammelled nature and the self-creative capacities of life to organise, regenerate, reproduce, sustain, adapt, develop, and evolve itself. These capacities are displayed spatially in a hierarchy of natural systems and temporally as the legacy of aeons of evolutionary and biogeophysical processes with their potential to continue into the future. Finally "integrity" signifies that the combined functions and components of whole natural systems are valuable for their own sake...²²

By "wild and untrammelled" nature the GIP does not suggest that pristine nature

is intrinsically privileged in opposition to that which is modified by human action. Rather, the emphasis is directed towards arriving at an ecological baseline to judge the impact of human interventions. Along the same axis, the plea to determine trends in nature for its own sake, i.e., as a quantity independent of human mediation (though having several political and ethical implications which I cannot deal with in this paper) is intended to recover an understanding of environmental processes that are "invisible to markets and the economy".²³ I reiterate these clarifications in order to deflect any implication which suggests that human impact solely or per se is the cause of disintegrity. Lastly, given the fact that the entire discussion above has been chiefly premised on a reading of biotic communities, our case example, (a non biotic community – fluvial processes), requires a further clarification. Here, I will resort to endorsing some of the qualifications that Alan Holland introduces in his interpretation of the notion of integrity:²⁴

(a) Rather than trying to identify inherent properties in the deltaic system, I refer to particular properties of particular processes, i.e., deltas as part of a geomorphologic process.

(b) Instead of engaging with the issue of a direction for nature (deltas), I concentrate on identifying a de facto particular trend, i.e., the deltaic river system's action in land formation.

(c) Integrity is referred to not as original cause, but as ongoing process, i.e., the integrity of the Orissa delta for the purposes of this argument is not directed at recovering an original pristine pre-colonial state of being but measured instead by the latitude the fluvial system is allowed as a geomorphologic process. In sum, the notion of ecological integrity vis-a-vis our case example refers to deltaic inundation as a geomorphologic process: wherein the fluvial action of erosion and deposition is elemental to the consolidation of the delta as a land form. The grand and extensive deltas of the world like those formed by the *Mississippi, Yangtze, Nile* or the *Ganges-Brahmaputra* are, in fact, colloidal land masses in the process of being recovered and stabilised by hydraulic

Table 1: Hydrology of the Deltaic Rivers of Orissa

Rivers	Length (km)	Distance from Delta Head to Mouth (km)	Catchment (Km)	Delta (Area sq km)	Delta Area Percentage of the Catchment
Mahanadi	853	107	130,560	7526	5.76
Brahmani	701	149	35,840	2186	6.10
Baitarani	344	99	10,240	1678	10.47

Source: N C Behuria, *Orissa State Gazetteer*, vol I, Government of Orissa, 1990, p 48.

action. Though again, I do not suggest that deltas are only a geomorphologic reality, they are complex chemical and biological entities as well. In the next section we briefly discuss the morphology and the hydraulic properties of deltas in general and the features of the Orissa delta before mapping onto it the historical experience of colonial rule.

II Deltas and Their Hydrology

In broad terms, a delta is defined as a land form created by coastal deposits derived from river borne sediment. Lying at the interface of fluvial and marine ecosystems, deltas possess highly volatile hydrological regimes that are in the process of actively building up (prograding) or shaping the deltaic plain. The deltaic land form is moulded by several fluvial and marine processes such as river deposition, wave action, tidal currents, etc, and the relative intensity of these agents lend each delta its peculiar features and characteristics. However, despite the various environmental contrasts amongst deltas, all actively prograding ones have a common attribute: a river supplies sediment to the deltaic plain and the drainage basin (ocean, sea, estuary) more rapidly than it can be removed by marine processes, i.e., the sediment load carried by the rivers is rarely able to be entirely discharged into the drainage basin.²⁵ This causes the fluvial regimes coursing through the deltaic plain to acquire an unusual degree of instability as their channels are constantly and regularly clogged or deteriorated by their sediment load. They, therefore, frequently overflow their banks, inundate surrounding lands, abandon channels or scour new ones. Often flowing in streaming jets of silt-laden waters and in torrential bursts, these rivers and their distributaries roam the soft alluvial plains regularly sculpting the landscape into new shapes, revitalising drainage lines and creating a fresh set of creeks, lagoons, swamps, ox-bow lakes. It is, moreover, not unusual for the basic topography to be suddenly and dramatically realigned in a single flood season itself. In other words, the delta is a highly unstable landscape given to regular and recurrent physical and hydraulic alterations.

The Orissa Delta

The Orissa delta situated in eastern India is a wedge shaped tract made up of a series of flood plains which are cut up and criss-crossed by a vast tangled fluvial network of channels that empty their waters into

the Bay of Bengal.²⁶ The three major rivers that course through the soft alluvial plains are the *Mahanadi*, the *Brahmani* and the *Baitarani*. These rivers issue in magnificent streams from three gorges that mark the boundary between the western hilly region and the bowl shaped coastal expanse.

As is evident from the above Table 1, the catchment, from which a great deal of the monsoon precipitation is discharged into the delta, is almost fifteen times the surface area of the latter. The delta consequently is relatively too narrow and constricted a leeway for jettisoning into the Bay of Bengal the entirety of the voluminous runoff that courses through it, especially during the monsoons, when the riverine network of main channels, their distributaries and minor passageways can be critically burdened following a sudden spike in precipitation. Nearly 80 per cent of the annual average rainfall (56.89 inches = catchment + deltaic portion) is concentrated in just five of the monsoon months (June–October).²⁷ Another significant characteristic is the river's abrupt loss of gradient upon entering the delta, causing its velocity to rapidly flatten. This sudden slackening in the current translates into an immediate dissipation of the river's erosive capacity and results in a high deposition rate of detritus on its bed, leading to the further deterioration of the channel, the inevitable bursting of its banks and the subsequent inundation of the surrounding lands. *In the Orissa delta, therefore, periodic, regular and recurrent inundation of the surrounding flood plains is an integral attribute of its hydrology, which in turn is constituted by its topographic features, fluvial morphology and rainfall pattern.*

The unusual volatility of the Mahanadi basin's rivers systems, not unexpectedly, became an immediate source of considerable anxiety to the early colonialists. Temperamentally, the delta's fluvial regime appeared to be in direct contrast to the relatively placid and docile English rivers. A contrast that was scrupulously conveyed by William Hunter, one of the empire's most accomplished compilers of its Indian acquisitions, in the mid-nineteenth century:

In the first stage [pre-deltaic] it [river] runs on a lower level than the surrounding country, winding through mountain valleys and skirting the base of the hills. During this long part of the career, it receives innumerable streams and tributaries from the higher country on both banks. So far it answers to our common English idea of a river. But no sooner does it reach the delta then its whole life changes. Instead of running on the lower ground, it gradually finds itself hoisted up until banks form ridges which rise high above the adjacent

country. Instead of receiving confluent it shoots forth a hundred distributaries. In short, it enters upon its career as a deltaic river and presents a completely different set of phenomenon from those we are accustomed to in European streams.²⁸

Hunter's description can be treated as a snapshot of the ecological stage, so to speak, upon which the colonial encounter in the region played out. The British attempt to consolidate and extend rule in the region, in fact, became critically dependent on their ability to subdue and train the volatility of the delta's hydrology. The ecological stage, in other words, was not a mere backdrop but became a palpable part of the complication of subordinating the tract and its populace to the new imperatives of the colonial economic and administrative order. However, in order to retain the focus of this paper on the capital/nature dialectic, I will discuss the colonial experience in the delta under three broad themes: (a) calculus of rule, (b) property and protection, and (c) commodification as cure.

Calculus of Rule

In 1803, the British East India Company annexed the deltaic portion of Orissa (districts of Puri, Cuttack and Balasore) by routing an ill equipped *Maratha* detachment stationed in Cuttack. The Marathas had been in control of these territories since 1751, after having seized them from the *Mughal* in that year. The Company's attempt to transit from an occupying army to that of a governing administration in the region inevitably entangled it in the protracted task of attempting to radically overhaul the previous social and property relations and realign it in sync with the new calculus of rule. In other words, the East India Company was compelled to reorder the entire pre-colonial political and social landscape to render it *legible* to the new imperatives of the colonial project.²⁹

In the earliest phase, the Company's actions were primarily motivated by the desire to extract agrarian surpluses. That objective, however, immediately collided with two obstacles. First, the absence of a reliable social segment through which the Company could anchor its rule within native society. Second, the perplexing manner in which property was enmeshed in the pre-colonial social hierarchy and political structure. Before discussing the colonial response to these challenges, we briefly outline the pre-colonial social and property system that the Marathas had been administering and that was, in fact, largely derived from and based upon the previous *Mughal* system (1568-1751) in the delta.

In the pre-colonial arrangement, a dense layer of intermediaries (chaudhuries, qanungoes, ta'allqdars, muqaddams) were interposed between the central authorities and the cultivators.³⁰ Besides these officials, there were also several tribute-paying independent chieftains called zamindars, who were settled as "powerful and formidable chiefs, commanding troops and possessing forts."³¹ The lowest rung on this ladder was the village headman, titled the muqaddam and in his office the locality met imperial governance. On the one hand, he was firmly embedded in the interests of the village by being the man on the spot while, on the other, he served as the representative of the imperial administration.³²

In return for remitting revenue to the central authorities these intermediaries (ta'allqdar, qanungo or chauduri) were granted deductions (*rusum*) from the gross collections and usually given a privileged tenure (*nanker* land). They could also generate income by imposing fines (*abwabs*) and duties (*sair*), besides having privileged rights and access to fishing, orchards and forest produce (*jalker, phalker* and *banker*). However, these intermediaries also carried out two significant functions that involved the granting of agricultural loans (*taqqavi*) and the task of determining the scale and quantity of remission (a total revenue waiver), in the event of a drought or inundation. These interventions were, in fact, critical to moderating the volatile production conditions in the delta by providing incentives and relief for the cultivators. In effect, the Mughal and Maratha intermediary in the Orissa delta was a 'fiscal buffer' and was akin to an entrepreneur or magnate of sorts, who, by regulating production conditions, sustained and often expanded agricultural activity in the delta.

These intermediaries, however, did not possess any title or property in the soil itself and held a transferable office. At best, these officials could alienate their office or a portion of it along with its privileges and perquisites. This formal impermanence of office was, in fact, integrally tied to the Mughal and Maratha calculus of rule, which rested on a constant shuffle of alliances that in turn was based on a continual negotiation over territory and privileges. The pre-colonial Imperial order, therefore, appears to have anchored its rule in a multi-layered segment of intermediaries, who were assimilated through a web of rights, duties, obligations, privileges and perquisites. *In several ways, this dense network of intermediaries were critical to calibrating an equilibrium between the locality's production context and the central authorities' agendas for*

appropriating the surpluses. That is, the Mughal/Maratha fiscal buffer was effectively the repository of expertise and finance for sustaining agricultural production in the delta and for monitoring and determining thresholds for extracting surpluses.

The Company immediately, upon annexing the delta, sought to eliminate the pre-colonial fiscal buffer despite the latter's catalytic role in enabling agrarian production in the delta. It is probable that the Company was ignorant of their significance or that they perhaps simply lacked the administrative depth and capacity to negotiate alliances and thereby neatly superimpose colonial rule over the existing social networks. On the other hand, it appears more probable that the complex social arrangements with their myriad number of claims and counter claims on the surplus made the pre-colonial order illegible to the colonial calculus of rule. In other words, the British East India Company represented a radically different social and property system.

In the initial revenue settlements, in tracts not administered directly by the Company, its officials sought to simultaneously eliminate the old fiscal buffer while instituting a new layer of "proprietors of the soil", who were termed zamindars.³³ These Company zamindars were then to be engaged for the collection and payment of revenue.³⁴ In the process, the East India Company drew widely and indiscriminately upon some of the petty officials and revenue collectors of the previous Maratha regime. The transformation of a layer of revenue officials, who had previously "merely held interests or rights in the revenue", into exclusive proprietors limited to the role of only realising rents marked a decisive break in two significant respects. First, amongst the twenty-one defining features of the new proprietary tenure, it was categorically stated that the zamindar could neither claim remissions for revenue on account of "drought, inundation or other calamity", nor could he grant the same on the rents of the cultivators (*rai-yats*) in his zamindari.³⁵ As noted earlier, deltaic regions are prone to frequent inundation. In the Mughal period and possibly during Maratha rule in the Mughalbandi, the largest share of the revenue collection accrued from the autumn rice harvest (*sarad* crop), which was also the crop most susceptible to damage from flood or drought.³⁶ The granting of timely remissions and agricultural loans (*taccavi*)³⁷ were, in fact, crucial instruments by which the previous intermediaries sought to harmonise collec-

tions with the fluctuations inherent in the delta's cropping regime.³⁸

Second, the new zamindars were effectively only empowered with coercive means to realise rents, while their capacity for investments and managerial interventions was severely constrained, if not actively discouraged.³⁹ Consequently, in the new zamindari areas (as well as in the tracts directly administered by the Company) there was no social hinge which could mediate between local production contexts and the revenue authorities. Rather, the Company zamindars merely transmitted the pressures of the extractive agendas of the colonial administration onto the cultivators. In effect, a social feedback mechanism consisting of a pool of expertise and skills which could read the variability and ecological integrity of the hydraulic environment was eroded and was no longer a significant input in agricultural production.

Property for Protection

The Company zamindars, however, were not merely imbricated in the delta as a social group to buttress colonial rule but, more specifically, were constituted principally by the introduction of a conception of bourgeois landed property.⁴⁰ This form of property in many ways heralded not only a radical change in the mode in which surpluses were assessed and extracted by the colonial authorities but also initiated a vastly different relationship with the delta's hydrology. In the pre-colonial arrangement, the revenue demand was calculated as a share of the gross output of that season, i.e., it was a tax on the total yield of the crop.⁴¹ The success of such a taxing strategy essentially hinged on the administration's ability to adjust the pitch of the demand in a manner that enabled them to extract during peaks in crop output and to make concessions (by remissions) when production hit a trough. In other words, a great deal of flexibility was incorporated in the collection strategy in order to accommodate fluctuations caused by recurring inundation and drought. The season to season negotiation over the rate of taxation, therefore, compelled the Maratha and Mughal intermediaries to closely monitor production conditions on the ground. The region was overwhelmingly rice growing, which was cropped in three seasons - *biali, saradh* and *dalu*; roughly corresponding to autumn, winter and spring varieties.⁴² Though appearing to be discrete cropping schedules, the three rice cultivating seasons were, in terms of actual operation, an aggregated production regime. The delta was predominantly

subjected to inundation in two phases – July 21 to August 7 and August 21 to September 7.⁴³ Innovative practices seemed to have been evolved to side-step these flood peaks. The biali rice would be a bumper crop in the event of rains failing the saradh crop. If floods, on the other hand, were greater than usual during the harvesting period of the biali the saradh could still be made to prosper while the former would be destroyed. In the eventuality of both crops being washed away by heavy floods, dalua grains could be sown in the flooded tracts and rice still harvested.⁴⁴

Besides strategically timing the sowing and harvesting operations, other practices were factored in as well to distribute risk, notably, by growing rice on a variety of land types with differing degrees of moisture retention and fertility and by developing resilient strains.⁴⁵ Though it is unclear, given the absence of credible historical and statistical data, whether the majority of cultivators had access to such diverse production choices,⁴⁶ it is, nevertheless, quite probable that such strategies were widespread enough to be of significance. Lieut. Col. Haig, a government official, during a survey in 1873, for example, observed:

His (the Oriya cultivator's) whole system of cultivation has been adapted to an uncertain and precarious rainfall and periodic inundation. He is a gambler, he has one field on the high ground, another in the hollow and another half-way between, so that if he loses one crop by either flood or drought he is pretty sure to save the other.⁴⁷

While the above listed methods can broadly be considered defensive, in that they essentially sought to minimise losses, there is evidence to suggest that cultivators in the delta considered inundations a necessity for certain agrarian operations. Most critically, for the purpose of bringing the autumn crop to maturity.⁴⁸ That is, though floods could be detrimental to the rice crop in the event of a prolonged submergence, the crop sown much after the flood season prospered because of the moisture and silt deposited by the over flowing rivers. Consequently, even when cultivators incurred losses in the rice crop they would usually be amply "compensated by a bumper autumn crop".⁴⁹ The silt also proved to be beneficial and essential for the rice crop.⁵⁰

Clearly, cultivators in the delta in carrying out their agricultural operations resorted to a wide and varied set of strategies involving risk distribution and the utilisation of inundating waters. Signifi-

cantly, the pre-colonial form of property and taxing format appears to have been sensitive to the fluctuations inherent in such a production context.⁵¹ The colonial dispensation, on the other hand, from the outset, resolved in favour of a property system that was far more rigid and exclusive.⁵² The introduction of bourgeois landed property was, in fact, a defining feature of colonial rule in other parts of the Company's Indian acquisitions as well, especially in the adjacent province of Bengal. In the opinion of Irfan Habib, the noted mediaeval historian, a sharp disjunction in revenue assessment and realisation practices occurred with the imposition of the colonial property regime:

The land revenue under the preceding Indian regimes was fixed as a share of the crop, and varied according to the crop cultivated. The land revenue under the British, whether directly imposed on the ryots (cultivators) or assessed on the zamindars, was a true tax on land. The assessment was on the basis of what and how much it ought to produce, not on what crop it actually raised.⁵³

In the Orissa delta, the colonial authorities effected the change from a tax on the gross produce to a rent on the land through a series of regulations and directives. In one of the clauses of the new regulations, for example, it was stated that engagements for rent were to be concluded only through written obligations involving *pattahs* (leases) that identified and delineated the land to be taxed. Hence, the plot of land – demarcated, numbered, classified and exclusively owned – became the domain of legibility for the Company's revenue administration. The shift, furthermore, involved a radical break with the previous accounting and surveillance procedures; instead of adjusting the tax claim to seasonal variation in output, the Company officials worked towards arriving at an 'average productivity' for each individual plot and then 'settled' on a rate for a specified period of years. Lastly, a rigid emphasis on the punctual realisation of the *kist* (revenue or rent instalment) ended all latitude the cultivators previously had for negotiating the tax burden.⁵⁴ In terms of

the overall collection strategy, therefore, the Company appears to have supplanted an *intensive* practice, premised on siphoning off surpluses by a close monitoring of production conditions on the ground, with an *extensive* one focused upon extracting a steady income from a determinate tax base. With the previous flexibility thus abandoned, inundation in the colonial administrative lexicon was straightforwardly equated with a loss in revenue rather than viewed as part of a process or cycle in which the damage of one season was usually compensated by an abundance in the next. Deltaic inundation, therefore, was increasingly treated in official reportage as an aberration on the production landscape rather than as a phenomenon integral to the fluvial regime. In effect, bourgeois landed property produced a new optic which consolidated the perception that deltaic inundations were *calamitous events* rather than *geomorphologic processes*.

The colonial administration consequently developed the idea of flood control to buttress attempts to secure its property regime and its revenue collection strategies. Embankments – structures designed to insulate lands from inundation – were the first flood control works deployed by the British in the Orissa delta. Drawing chiefly upon their experiences in the adjacent province of Bengal, an Embankment Committee was instituted and the general administration and construction of the structures in the initial period was carried out by military engineers.⁵⁵

The rate of embankment construction, however, in the first two decades, was slow and sporadic. Furthermore, central to this hesitant and uneven pace in flood control was the chasm that had developed between the revenue authorities and the military engineers. While the former was keen on merely securing revenue interests by insulating as much rent paying lands as possible, the latter had to grapple with the hydraulic complications that had resulted from restraining rivers within embankments. In time, the revenue-centric approach of the administration began to be challenged by many military engineers, who argued that the embankments were actually aggravating the flood line by

Table 2: Cropping Schedule in Deltaic Orissa

Cropping Season	Sowing	Harvesting	Land Type
Biali (autumn, rabi)	April-May	August-September	High lands
Saradh (winter, kahrif)	May-June	October-November or December-January	
Dalua (spring)	January- February	March-April-May	Moderately low lands Low, swampy, marshy ground

Note: For a detailed account of agrarian conditions and practices in coastal Orissa during the colonial period, see *SSR*, vol 1, pp 105-08 and N N Banerjee, *Agriculture of the District of Cuttack*, Calcutta, 1898, pp 62-70.

clogging drainage and causing the river beds to rapidly deteriorate. The tussle between the two wings of the government, however, ended with the engineers being defeated with the passing of Regulation XI of 1829.⁵⁶ Through this regulation, the revenue administration now gained a significant advantage over the military engineers by disbanding the embankment committees altogether, even though final authority on embankment expenditure was still vested with the Military Board.⁵⁷

A dramatic spurt in embankment construction followed. From 1831 “progress onwards” was the motto of every executive engineer, who, “urged on by the revenue authorities”, steadily extended the embankment system.⁵⁸ Lieut Harris, in his second report of May 1858, noted the new zeal and zest with which “protection” began to be pursued in this period:

Zamindar A had embanked his little plot of land originally to the detriment of B. B to enable him to pay his enhanced revenue had appealed to the Collector for an embankment calculated to protect his land – to the detriment of C and D – E,F,G,H and indeed more letters than the world can supply...in this way, in every portion of the district...embankments became the rule rather than the exception.⁵⁹

The unabated rise in expenditure on embankments, however, soon set the Military Board on a path of direct confrontation. In 1847, while prohibiting “all but the repairs necessary to prevent actual breaches”,⁶⁰ the Board simultaneously began to press for the dismantling of “fictitious or useless” embankments.⁶¹ Many military engineers also began to openly voice doubts about the viability of “protecting” the delta.⁶² Lieut Harris, for example, after completing his surveys on the Mahanadi river between 1856 and 1860, emphatically asserted that embanking the rivers actually resulted in the “silting up” of the channels and raised the flood line to dangerous levels.⁶³

By the mid-1850s, mounting damages from floods (especially the ones in 1853-54 and 1855-56) had begun to severely undermine the administration’s confidence in the embankment system. The entire schema for protection had, in fact, resolved into a seemingly endless tedium of repairs, rising maintenance charges and the frequent collapse of constructed works. The possibility of a complete abandonment of all flood control structures, however, collided with a fresh set of dilemmas. First, the delta had been literally over run with hundreds of miles of embankments with several new constituencies of “protected” areas that were liable to ex-

treme devastation if the administration demobilised their embankments. These protected lands, having undergone prolonged periods of insulation from inundations, were far more vulnerable to flood currents; in the absence of deposition by river action they were now relatively much lower than the beds of the surrounding fluvial channels. Moreover, the drainage pattern had been substantially altered and, in fact, congested with the indiscriminate location of new habitations in the deltas flood plains and by the advancement of cultivation in former inundation prone, but now protected zones. Hence, paralleling the spike in hydraulic imbalance, precipitated in the main by flood control measures, was the growth of powerful sectional and proprietary interests who came to depend on flood protection structures. In sum, colonial rule and property transformed a *flood dependent* agrarian regime in the Orissa delta into a *flood vulnerable* landscape.

Commodification as Cure

The pursuit of flood control through embankments placed the colonial administration in a profound dilemma. On the one hand, the triad of bourgeois property, the Company zamindari system and an extensive revenue collection strategy were central to colonial rule; on the other, these very same defining elements of the colonial presence lay at the root of the hydraulic crisis that had overwhelmed large swathes of the delta. In other words, the colonial administration’s latitude for manoeuvre vis-a-vis deltaic inundation was constrained by the need to secure its social and economic foundations. This overriding imperative to consolidate and perpetuate the conditions for rule, in fact, explains the administration’s preference for interventions that sought to further intensify capitalist relations. Commodification as cure, so to speak, appears as a determined path by which the colonialists attempted to stabilise their ecological context. That is, efforts were directed towards transforming the delta’s hydraulic volatility into a more pliable quantity through its objectification as a peculiarly capitalist value form. The commodification of the delta’s fluvial system was attempted through a combination of technical and legal means.

This phase was initiated following Colonel Arthur Cotton’s celebrated survey of the delta in April 1858. Cotton’s investigations, carried out entirely in the short span of a month, was concluded by him with the assertion of an axiom that “all deltas require(d) essentially the same treat-

ment”, i e, that their rivers needed to be controlled and regulated into an invariable and constant supply.⁶⁴ Cotton, recommended the diversion of the Mahanadi river into a plexus of irrigation and navigation canals. Marginal embankments were then to line the canal routes and secure the adjoining land from flood-spill. He marked the Orissa Scheme for inevitable success and touted it as a venture that would simultaneously be profitable and protective. The Orissa Scheme, despite resting more on Cotton’s rhetoric rather than investigations, found immediate favour with the Orissa government and was declared a viable project. Soon the privately owned Madras Irrigation and Canal Company (MICC), on whose rolls Cotton was employed as a consultant,⁶⁵ began parleys with the government for taking up the project. On June 16, 1862, a contract was drawn between the secretary of state and the East-India Irrigation Canal Company (EICC), an offshoot of the MICC, for pursuing the Orissa works.⁶⁶

The actual construction commenced in November 1863 and water was made available by the end of 1865. On April 20, 1866, the first irrigation lease was signed for an area of 3½ acres. At the end of February 1867, the area irrigated amounted to 6,674¾ acres, at a time when water sufficient for 60,000 acres was ready for use. By October 1867 the Company was prepared to supply water to 1,53,000 acres, whereas the area actually under irrigation amounted to a meagre 9,836 acres. In that year the gross revenue, since the commencement of the project, amounted to a mere rupees 4,339-9-3 (1 Rupee = 16 Annas and 1 Anna = 6 Pice).⁶⁷ A distant cry from the 30 per cent rate of return envisioned by Cotton. In late 1868, the EICC finally surrendered the works to the government and thereby unceremoniously terminated one more sordid chapter in private irrigation ventures⁶⁸ in the eastern delta.⁶⁹

With the government assuming ownership, a fresh review of the scheme followed.⁷⁰ The appraisals were quick to dispel the false optimism of the private speculators and on the rebound the government stumbled on some very disconcerting evidence. Not only had the EICC exaggerated the area it was capable of irrigating but it had also greatly undervalued the costs of the works. In one such review, calculations showed that even if irrigation was fully developed and utilised on 8,40,000 acres of land along with a high rate of Rs 3-5 willingly paid by the cultivators for the sarad/autumn crop, the scheme would still only be barely able to pay the interest on the capital sunk without

any surplus.⁷¹ The ominous tenor of the findings pushed the government to attempt a complete revamp of the scope and objectives of the project. In short, the colonial state stepped in to complete the task of commodifying the river. While the physical infrastructure of the Orissa scheme, consisting of a network of canals and embankments, was designed to simultaneously restrain and tap the waters of the Mahanadi, the process of the latter's commodification was to be achieved through two mechanisms – a *water rate* and an *embankment rate*.

In the initial period, when the Orissa scheme was under the charge of the EICC, the water rate was decided not on the basis of an actual demand for it, but instead pitched to realise profits on the capital expended on the project.⁷² The rate not only proved to be too high but also could not be collected in many instances because of the ineptness of the then incipient and inexperienced canal administration. In 1872 the colonial government fixed a new rate and determined that supply was to be made only to clearly demarcated plots upon a written application.⁷³ Despite the relatively lower rate and the formalisation of rules for the delivery of water, canal irrigation continued to be unpopular in the delta. The colonial administration, therefore, responded with the Irrigation Bill of 1876. Armed with this new legislation the colonial administration sought to create a demand for water through coercive means. Non lease-holders, hitherto excluded from the ambit of canal administration, could now be drawn into its orbit on the charge of illicit irrigation. Through a clause (Section 79), "joint responsibility" was enforced, i.e., authorities could penalise, on their failure to identify the culprit, all the cultivators who drew water from a channel from which "illegal" irrigation had taken place. The ordinance on illicit irrigation soon became an instrument of terror in the canal tracts. Patrols were frequently on the prowl and unless dissuaded by bribes, fined cultivators for illicit irrigation. In 1883-84, for example, over 28,200 acres were declared to be illicitly irrigated and a total of 7,870 cases were filed.⁷⁴

Ironically, despite the large number of proceedings initiated against the cultivators, the patrols operated with an ill-defined notion of the term "illicit irrigation". Irrigation water from the canal, for example, could just as easily flow from leased to unleased land, much against the wish of the latter's owner. Furthermore, determining the exact irrigation source (tanks, rainfall or canal, etc) by which the field was watered became another seemingly

irresolvable irritant. The patrols, therefore, often employed fairly arbitrary criteria. On one such instance at Laptna and Ramkistopore in 1878, a marginal embankment had been pierced and some water had drained into the *pat* (marsh or depression) fields. After several rounds of accusations and arguments had exhausted the canal officers and cultivators

... a superior officer of the department went, tasted the water in the fields, declared that it had all come from the canals and then gave the people the option to either pay at the surreptitious rates for all the lands or to take out leases for 5 years for the higher lands.⁷⁵

The demand for irrigation, nevertheless, remained sluggish despite the enthusiasm of the patrols. The repeated failure to turn irrigation into a profitable commodity, in time, persuaded the colonial authorities to reorient their emphasis by exploring another option, that of commodifying protection. Arriving at an embankment rate, however, proved to be a far more intractable exercise than bargained for. At the start, the administration "could not command general assent" on the amount of benefit rendered by protection.⁷⁶ Both cultivators and administrators continued to argue that inundations were not always "wholly destructive" and that they often left behind fertilising silt which renewed the productive powers of the soil. A petition, signed by several villagers in Cuttack, typically illustrates the sentiment against the embankment system.

Since the excavation of the Canal there has been no good out-turn of the crops in our fields. Owing to the embankments no silt is deposited in our fields, caused by the overflow of rivers, therefore the out-turn has fallen off. Still we are paying the land revenue, the road and public work cess, the Zamindari dak-cess, bribe and other cesses for which we have become poor and involved in debt.⁷⁷

Added to the confusion about deciding on an embankment rate,⁷⁸ was a legal complication that erupted in the form of a dispute with the Raja of Aul regarding a certain embankment on his estate.⁷⁹ The Aul dispute, in a wholly unexpected manner, ground to a virtual halt the administration's drive to put a price on protection. In an acrimonious and bitter legal battle, stretched over 12 years, the raja was able to successfully assert that the government if it undertook the task of protection in the delta was obliged to compensate the affected parties in the event of the failure of the embankments.⁸⁰ In other words, the government in affixing a charge for protection was legally bound to

ensure the efficiency of the embankment system. In the likelihood of guaranteeing its efficiency, the government, however, would then be open to litigation on the performance of the protective works. Not surprisingly, the administration preferred an organised retreat and overtime dropped plans to implement the embankment rate.

At the same time that the cultivators' traditional access to water was ended by the introduction of canal irrigation, the colonial administration was pressuring the irrigation bureaucracy to energetically seek out and destroy all the non-canal irrigation sources that were considered to be in competition with the canal. A large number of bunds – structures constructed to trap water from drainage lines – were specially targeted for destruction. By Act III of 1876, the government empowered itself with the right to declare any of them as obstructions to drainage and could order their removal. A letter from Baboo Juggo Mohan Lall, a zamindar in the district of Cuttack, submitted to the Canal Commission of 1884 is a typical complaint:

Three or four hundred bunds have been removed or cut by the Department of Public Works under Act XXXII of 1855 and Irrigation Act III of 1876 on the ground that it obstructed the natural drainage of the country... All these bunds had gaps which remained open when the rainfall was abundant, and were closed when the rainfall was scanty. By these bunds the ryots had control over rain water, which they would keep into or let off their fields as the necessity arose. So they were very useful for agricultural purposes, and also yielded fishery revenue, and did not obstruct the drainage as they had gaps in them...⁸¹

Fields were often forcibly drained by the canal staff with channels cut through them and the water was then, ironically enough, in several instances reportedly led into the canal. Closure of these drainage cuts was not permitted and cultivators were often forcibly compelled to apply instead for canal water. Ponds, lakes and tanks in the canal tracts were similarly emptied by drainage cuts. This method of destroying existing water sources is described in a petition jointly signed by cultivators from several villages in Cuttack district:

The rain water of our lands are taken away by the drains dug through our field. Drains have also been dug by the side of ponds and streams, to take their waters away. These drains have been dug by government with the intention of obliging us to take water from the canals...⁸²

A perusal of the petitions submitted to the Canal Commission of 1884, in fact, confirms that much of the destruction

inflicted on the non-canal irrigation structures was by design rather than inadvertence⁸³ Baboo Gauree Shanker Roy, secretary of the Orissa Association, in his evidence to the Canal Commission, for example, clearly indicates the same:

When in 1882 the drainage cut over-drained the fields the ryots (cultivators) petitioned to the collector (district administrative head) to be allowed to make cross-bunds in the drainage cuts to save their crops but their prayer was rejected and the crops suffered. In 1883 the ryots petitioned for storing only rain water in the drainage cut. Mr Roberts (Collector?) rejected the petition but ordered verbally that if the ryots would again take leases for five years he would put cross-bunds across the drainage cut.⁸⁴

Despite the colonial authorities vigorous pursuit for profit, the Orissa canals remained a financial failure throughout the 19th century. The causes underlying the scheme's continued losses have been dealt with elsewhere and are not relevant for the immediate purposes of our argument.⁸⁵ What, however, is to be emphasised in the above discussion is how the drive for the commodification of the delta's fluvial system placed a number of cultivators in a new relationship with their hydraulic environment. On the one hand, the physical infrastructure of the canal system further fragmented the delta into zones antagonistically poised against each other: the irrigated protected, the semi-protected and the unprotected. The unprotected zones, in fact, tended to bear the main brunt of the floods as vicious currents were deflected onto them by embankments located in the protected areas. On the other hand, the water rate and the other processes that accompanied the drive for commodification caused the metabolism, that prevailed in the pre-colonial period, between land and water to be uncoupled. The water market created by the Orissa scheme, in fact, forced the alienation of a section of the cultivators from what was formerly an organic relationship with deltaic inundation. In other words, their dispossession from the means of production (inundation irrigation) caused these cultivators to be poised against the ecological integrity of the delta's fluvial system. In effect, a new production context and set of social relations was constituted that was dependent on flood control and existed in antagonism to inundation as a geomorphologic process. An antagonism that in several ways fatally poised man against nature in the delta and was incisively explained by the 1928 report of the Orissa flood committee:

...that the problem which has arisen in Orissa, is due, in the main, to the efforts

which have been made towards its protection. Every square mile of country from which spill water is excluded means the intensification of floods elsewhere; every embankment means the heading up of water on someone else's land (coastal). Orissa is a deltaic country and in such a country floods are inevitable; they are nature's method of creating new land and it is useless to thwart her in her workings...the solution lies in removing all obstacles which militate against this result...To continue as at present is merely to pile up a debt which will have to be paid, in distress and calamity at the end.⁸⁶

The drive for canal irrigation in the Orissa delta, on the surface, can be adduced to the particularity of a historical juncture in India, in which British finance capital was seeking to invest in public works such as irrigation and the railways.⁸⁷ This explanation is, however, only partial at best, as the investment drive in this period can more meaningfully be discussed as the colonial imperative to extend a particular type of capitalist relation in its colony. The private irrigation experience in the Mahanadi delta was, in fact, the dual movement of commodification (water rate and embankment rate) and primitive accumulation (destruction of traditional sources of irrigation). That is, the private irrigation speculators intended irrigation water to confront the cultivators as a commodity that furthermore was subject to the market imperative. In effect, the imposition of capitalist property resulted in the Orissa delta being reconstituted as a flood vulnerable landscape.

III Conclusion

Though the experiences outlined in our case is perhaps too limited a basis from which to derive broad generalisations about the capitalist nature dialectic, it nevertheless, enables us to reiterate, albeit perhaps with a new emphasis, a proposition – capitalism relates to nature in a *two-stage* path/manner. First, the imposition and consolidation of a capitalist property form over the substance of nature. A type of property that is defined not merely as private ownership but as being *exclusive* as well.⁸⁸ By exclusive I refer not only to the extinguishing of overlapping rights or uses over a unit of land/nature but, more specifically, to the manner in which the latter is uncoupled from its existence in an ecosystem process and subjected instead to the logic of "improvement" or increased productivity.⁸⁹ In the Orissa delta, with the introduction of capitalist property, the organic connectivity between land and water was

sundered. That is, the pre-capitalist revenue administration by negotiating seasonally the tax burden and collecting in kind, was sensitive to fluctuations in output and thereby permitted agrarian production to be regulated in rhythm with the vagaries of the fluvial regimes. Colonial rule, on the other hand, excised production from its ecological process (treating cultivable land as standing apart from its hydraulic context) by instituting capitalist property in land and assessing a fixed rent that was presumed on a non-fluctuating "average" output. The extreme simplification of the pre-capitalist society/nature interface by colonial tax policies has, in fact, been discussed earlier by Michael Watts in a brilliant study of famine and drought vulnerability in Hausaland (Nigeria). Watts incisively argued that rigidity in the colonial (British) taxing schema blocked the revenue administrations' ability to respond to or take account of the several fluctuations in the Nigerian agrarian landscape, brought about by "late rains, locusts, price variability, disease and personal calamity". In time, the inflexibility of the colonial taxing policies became a significant factor (amongst others as well) in attenuating the Hausaland peasantry's ability to override recurring subsistence crisis and, in fact, helped magnify the impact of drought in the region.⁹⁰

Marx was perhaps presciently sensitive to how property forms interfaced with the environment, when he noted, somewhat cryptically, in *Capital* that the payment of "ground rent in kind" was one of the "secrets" of the "self-preservation" of the Ottoman empire, as it facilitated the reproduction of both the relations of production and the "ancient" form of production.⁹¹ In fact, the Mughal, Safavid and Ottoman empires in their classical periods⁹² overwhelmingly relied or rested on a fairly fluid tax base that was premised predominantly on a diffuse property form. Agrarian production, in these empires was regulated through a spectrum of countervailing claims, rights, duties and obligations that were always negotiated seasonally at the level of the locality.⁹³ Fluctuations in output in varying local production contexts, therefore, was factored into the overall tax demand, i.e., land was relatively still treated as a part of nature rather than an isolated factor of production. However, this is not to suggest that pre-capitalist formations did not stress or alter their natural environments, but rather the quality of their interaction with the latter was determined by a non-exclusive form of property, which clearly appears more flexible in our example at least.

The second step of our two-step path is the extension of capitalist relations through the imposition of the commodity form on nature, that is, uncoupling an element of nature from its existence as process in order to regulate it primarily as exchange value and simultaneous with its continued estrangement from man. That is, the attempt to subsuming nature's under the commodity form is coincident with the uncoiling of the trajectory of primitive accumulation – separating the direct producer from the means of production in order for capital to appropriate him as “free” labour. This insertion of the capitalist market between man and nature has, in fact been aptly summed up by Polanyi as the arrangement whereby “man under the name of labour, nature under the name of land” become subject to the new principles of the “self-regulating market”.⁹⁴ Similar aspects of the commodification of nature have been discussed in several earlier studies as well. Jack Kloppenburg's detailed monograph on biotechnology, for example, meticulously maps the manner in which capital penetrates plant breeding through the science of hybridisation. Commodification, in his opinion, served to effectively break the previous unity of the seed as both grain and the means of production, i.e., seed as a commodity is premised on the separation of the cultivator from free access to plant genetic material.⁹⁵

The two-step path to nature, moreover, is also inevitably the subjection of the latter to capital's insatiable drive for profit maximisation through the constant reorganisation of the processes of production and the extension of the hegemony of exchange-value to new spheres of the natural world.⁹⁶ In effect, capital's need to ratchet up productivity and accumulation leads to the adoption of ever newer technologies. In the instance of our example, the recasting of the delta as a flood vulnerable landscape provoked an upward spiral in technological choices that over the span of a century and a half moved from embankments to a canal system and finally the construction of the Hirakud dam on the Mahanadi river.⁹⁷ This intensification in flood control strategies, in fact, had as much to do with securing the delta from periodic inundations as it was intended to sustain capitalist property (qualified nevertheless by the project of colonial rule). That is, colonial rule in the Orissa delta reshaped the agrarian landscape to confront and undermine its hydraulic integrity rather than accommodate the fluvial system as geomorphologic process. A treadmill in flood control initiatives, therefore, trapped the populace in

the Orissa delta (and continues to do so) in a spiral involving the simultaneous play of three interconnected but distinct trajectories – consolidation of capitalist property, the intensification of a hydraulic crises and the deployment of new technical fixes to respond to the changed physical environment. **[FW]**

Notes

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- 1 The concept of nature that I chose to work with derives from Kate Soper, *What is Nature?* Blackwell, UK, 1995. For her qualifications of the use of the term nature see pp 15-36.
- 2 I use the term ecology here in the broad and general way in which Winterhalder defines it as the relationship among living organisms and between them and the physical environment. See Bruce Winterhalder, “Concepts in Historical Ecology: The View from Evolutionary Ecology” in Carole L Crumley (ed), *Historical Ecology: Cultural Knowledge and the Changing Landscapes*, Santa Fe, New Mexico, 1994.
- 3 Ecological footprint analysis is an accounting tool that attempts to estimate resource consumption and waste assimilation requirements of a defined economy and its population. See Mathis Wackernagel and William Rees, *Our Ecological Footprint: Reducing Human Impact on the Earth*, New Society Publishers, Philadelphia, 1962.
- 4 For an explicitly stated exploration of the capital nature contradiction see the works of Paul Burkett, James O'Connor, Martin O'Connor, John Bellamy Foster and the several contributions in the *Journal Capitalism, Nature and Socialism*.
- 5 For a synoptic survey of these positions see David Harvey, *Justice, Nature and the Geography of Difference*, Blackwell Publishers, Mass, US, 1999, pp 176-182.
- 6 Clive Ponting, *A Green History of the World: The Environment and the Collapse of Great Civilisations*, Penguin Books, Great Britain, 1993. He summarises his main thesis between pp 393-407. Also see J R McNeill, *An Environmental History of the Twentieth-Century World: Something New Under the Sun*, Norton, New York, 2000. McNeill offers a similar reasoning in that he argues that ecological degradation is caused by a cocktail of population growth, the conversion to fossil fuel based energy system and the ideological and political commitment to economic growth and military power.
- 7 See Rohan D'Souza, “The Deltaic Rivers of the Bengal Presidency: The Political Economy of ‘Flood Control’ in Colonial Orissa”, PhD Thesis submitted to the Centre for Historical Studies, Jawaharlal Nehru University, Delhi, 1998.
- 8 Hamza Alavi, ‘Structure of Colonial Formations’ in Utsa Patnaik (ed), *Agrarian Relations and Accumulation: The ‘Mode of Production’ Debate in India*, Oxford University

Press, Delhi, 1990. Also see the articles in the same volume by Jairus Banaji, Ashok Rudra and Gail Omvedt pp 119-82.

- 9 In the metropolitan countries generalised commodity production is argued to be an ‘integrated’ process of development in industry and agriculture as well.
- 10 There is now a substantial literature on the colonial impact on India's ecology. See the monographs and articles by Ram Guha, Mahesh Rangarajan, Vasant Sabarwal, Ravi Rajan et al. For a bibliography and survey of the field of environmental history in India see Mahesh Rangarajan, ‘Environmental Histories of South Asia: A Review Essay’, *Environment and History*, Vol 2, No 2, June 1996.
- 11 Mike Davis' monograph is perhaps the most recent argument linking the high mortality from famines and natural calamities in the Indian subcontinent to colonial rule. See his *Late Victorian Holocausts: El Niño Famines and the Making of the Third World*. London, New York, Verso, 2001, *passim*.
- 12 Vinita Damodaran, ‘Famine in a Forest Tract: Ecological Change and the Causes of the 1897 Famine Chotanagpur, Northern India’, *Environment and History* (2), Whit Horse Press, Cambridge, UK, 1996, pp 129-43.
- 13 For broad surveys of ecological theories I have consulted the following two essays Bruce Winterhalder, ‘Concepts in Historical Ecology: The View from Evolutionary Theory’ in Carole L Crumley (ed), *Historical Ecology: Cultural Knowledge and Changing Landscapes*, School of American Research Press, Santa Fe, New Mexico, 1994 and Donald Worster, ‘The Ecology of Order and Chaos’ in Hal Rothman (ed), *Out of the Woods: Essays in Environmental History*, University of Pittsburgh Press, Pittsburgh, 1997.
- 14 Mark Sagoff, ‘Ecosystem Design in Historical and Philosophical Context’ in David Pimental, Laura Westra and Reed F Noss, *Ecological Integrity: Integrating Environment, Conservation and Health*, Island Press, 2000, pp 61-78.
- 15 Daniel Botkin, *Discordant Harmonies, A New Ecology for the Twenty-First Century*, Oxford University Press, New York, 1990.
- 16 The Patch is problem- and organism-defined, relative to the behaviour, size, mobility, habits and perceptive capability of the population being studied. Definition in Bruce Winterhalder, ‘Concepts in Historical Ecology’, p 33.
- 17 Mark Sagoff, ‘Ecosystem Design in Historical and Philosophical Context’, p 62.
- 18 Mark Sagoff, ‘Muddle or Muddle Through? Takings Jurisprudence Meets the Endangered Species Act’, *College of William Mary Law Review*, Vol 38:3, March 1997, p 900. For his critique of the classical ecology position read, pp 877-989.
- 19 Ernest Partridge, ‘Reconstructing Ecology’ in David Pimental, Laura Westra and Reed F Noss, *Ecological Integrity: Integrating Environment, Conservation and Health*, Island Press, 2000, pp 79-97. (henceforth *IECH*).
- 20 Since 1992, the Global Integrity Project has assembled a number of leading scientists and thinkers for the joint task of addressing the problems of (a) threatened human well being, (b) unsustainable economies, and (c) degradation of the ecosphere.
- 21 Laura Westra, Peter Miller, James Karr, William Rees and Robert Ulanowicz, ‘Ecological Integrity and the Aims of the Global Integrity Project’ in *IECH*.
- 22 *IECH*, pp 11.

- 23 *IECH*, pp 24-25.
- 24 Alan Holland, 'Ecological Integrity and the Darwinian Paradigm' in *IECH*, pp 45-60.
- 25 James M Coleman, *Deltas: Processes of Deposition and Models for Exploration*, Burgess Publishing Company, Boston MA, second edition 1982. Also see Robert Kay (ed), *Deltas of the World*, American Society of Civil Engineers, New York, 1993 and Michael N Oti, and George Postma (eds), *Geology of Deltas*, A A Balkema, Rotterdam, 1995.
- 26 For detail on the river system of coastal Orissa see: A.S.Thomson, *The Rivers of Orissa*, Calcutta, 1905; P C Mahalanobis, *Report on the Occurrence of Floods in the Orissa Delta*, np, 1941; B N Sinha, *Geography of Orissa*, Delhi, 1971 and P Mukherjee, *Irrigation, Inland Navigation and Flood Problems in North Orissa During the British Rule*, Bhubaneswar, 1967.
- 27 The total of 56.89 inches of rainfall includes the catchment and the deltaic portion. I have calculated this from data provided in B N Sinha, *Geography of Orissa*, New Delhi, 1971, p 84.
- 28 W W Hunter, *Orissa or the Vicissitudes, of an Indian Province Under Native and British Rule*, Vol 2, London, 1872, p 176.
- 29 Legibility is described by James Scott as relating to aspects of statecraft directed at rendering societies malleable to state functions such as taxation, conscription and the prevention of rebellion, see James C Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, Yale University, New Haven, 1998, pp 1-47.
- 30 The *Qanungo* essentially maintained records relating to the interests in the land. The *Chaudhuri* attested revenue papers and was also associated with the tasks of collecting the revenue. In Bengal the title *Ta'alluqdar* generally referred to a small *zamindar* or holder of a *zamindari* which was recently purchased and was not of long standing. See N A Siddiqi, *Land Revenue Administration Under the Mughals*, pp 25-28 and pp 87-91 and B C Ray, *Orissa Under The Marathas (1751-1803)*, Delhi, 1960, p 132.
- 31 A Stirling, 'Minute on Tenures in Orissa, 10th October 1821' in G Toynebee, *A Sketch of the History of Orissa from 1803-1828*, Cuttack, 1873, p ix (Appendix). During the Maratha regime, the title of zamindar was given only to the holders of one or more parganas and to the Rajas of Killas (Forts). In the later *Sanads*, however, the terms zamindar and *ta'alluqdar* were used synonymously. Refer to K M Patr, *Orissa Under the East India Company*, p 2.
- 32 D H Kingsford, 'Report on the Settlement Operations in the District of Balasore' in *Final Report on the Survey and the Settlement of the Province of Orissa (Temporarily Settled Areas) 1890 to 1900, 2 Vols.* (Henceforth *SSR, Vol II*), p 456.
- 33 G Toynebee, *A Sketch of the History of Orissa*, pp 26-27.
- 34 For a general overview of the British revenue organisation in Bengal and the early settlement operations see B Chaudhuri, 'Agrarian Relations: Eastern India' in Dharma Kumar and Meghnad Desai (eds), *The Cambridge Economic History of India 1757-1970*, Vol II, New Delhi, Reprint 1984, pp 86-176.
- 35 *SSR, Vol II*, p 596. See especially clauses 5 and 6.
- 36 L N Raut, *Socio-Economic Life in Medieval Orissa (1568-1751)*, Cuttack, 1988, p 120.
- 37 While Abul Fazl viewed Taqqavi as loans for extending cultivation, Todar Mal argued that it was to be given to cultivators only during "distressed circumstances." The Taqqavi loans were interest free and usually made available through the chaudhuris and muqaddams. See Irfan Habib, *Agrarian Systems*, pp 253-55.
- 38 In the district of Nanchilnadu (Tamil Nadu), remission given by local lords apart from enabling the peasantry to overcome bad harvests was also directed at reproducing the political power structure of "personal dominance and deference" between tenants and their local landlords. See M S S Pandian, *The Political Economy of Agrarian Change: Nanchilnadu 1880-1939*, New Delhi, 1990, pp 64-68.
- 39 David Ludden noted that, whereas the pre-British Zamindars had been founts of patronage and authority for the provision of public goods, the new landlords instituted by the decree of 1793 became the "focal point for the local accumulation of capital in cash and kind." David Ludden, 'Productive Power in Agriculture: A Survey of Work on the Local History of British India' in Meghnad Desai, et al (ed), *Agrarian Productivity in South Asia*, Delhi, 1984, pp 64-65. Thomas Metcalf's essay on the Oudh *ta'alluqdar*, concludes similarly, that the *ta'alluqdar*, upon British intervention, was transformed from rulers of men - petty Rajas to landlords, and were hence bound to those beneath them only by "ties of rent and revenue." These *ta'alluqdar*s, consequently, found it expedient to seek tangible gains by increasing cash rentals and exploiting their powers as landlords. Thomas R Metcalf, 'From Raja to Landlord: the Oudh *Ta'alluqdar* 1850-1870' in Robert Frykenberg (ed), *Land Control and Social Structure in Indian History*, New Delhi, 1979, p 137. In Bengal, Amit Bhaduri has argued that the introduction of the zamindari system initiated, amongst many other changes, the commercialisation of sub-tenurial rights. This then led to a proliferation of intermediaries below the zamindar and choked off investment in land; there being no viable mechanism for sharing the costs and benefits between the zamindar and his innumerable tenants. Amit Bhaduri, 'The Evolution of Land Relations in Eastern India under British Rule', *IESHR*, Vol XII, 1976, p 48. Ironically, the idea of the zamindar as the sole proprietor of the land was modelled on the English notion of an improving landlord. See Ranajit Guha, *A Rule of Property for Bengal*, Delhi, 1963.
- 40 For the notion of bourgeois landed property I have consulted Neal Wood, *John Locke and Agrarian Capitalism*, University of California Press, Berkeley, 1984. For a discussion on the nature of landed property in the colonial economy in the Indian subcontinent see the essays by Jairus Banaji and Hamza Alavi In Utsa Patnaik (ed), *Agrarian Relations and Accumulation*.
- 41 Usha Ray, 'Maratha Revenue Administration in Orissa', in *Bengal Past and Present*, Vol Lxxlv, 1955, p 63.
- 42 Andrew Stirling noted as early as 1822 that rice in coastal Orissa was the "great article of produce". See Andrew Stirling, *An Account, Geographical, Statistical and Historical*, pp 9-10. Approximately 70 years later in the comprehensive Survey and Settlement report, Maddox reported that rice was grown in 87 per cent of the deltas total cultivated area. See *SSR, Vol I*, p 105.
- 43 B N Sinha, *Geography of Orissa*, Delhi, 1971, p 86. Severe floods, however, have been recorded as early as 13th June and as late as 25th October. Noted in Lieut J W Ottley, 'Note 10th December 1874' in *Papers Relating to the Orissa Canals 1869 to 1877 and 1881 to 1883*, Calcutta, 1884, p 75.
- 44 In 1894, for example after the Brahmini river flooded the Bayang pargana of Balasore district the cultivators sowed a "large area" with dalua paddy. *SSR, Vol I*, p 108.
- 45 For details see S L Maddox, 'Physical and Statistical Accounts of the Cuttack District', in *SSR, Vol I*, pp 98-99. Also see D H Kingsford, 'Report on the Settlement Operations in the District of Balasore' and H McPherson, 'Report on the Settlement in the District of Puri' in *SSR, Vol II*, p 419 and p 556.
- 46 In the interfluves in northern India around Benares, for example, a typical cultivating holding in the early 19th century, consisted of a number of plots dotted over tracts containing a variety of soils. The general cultivating strategy being the attempt to offset seasonal uncertainty by growing a number of cereals, pulses and oilseeds with different capacities for surviving the vagaries of climate. The cultivators in the Benares region in this period were, in fact, noted for their aversion, so to speak, of "putting all their eggs in one basket", i e, risk distribution. See Elizabeth Whitcombe, *Agrarian Conditions in Northern India*, New Delhi, 1971, p 25.
- 47 Note by F T Haig, Officiating Chief Engineer, Bengal Irrigation Branch, May 29, 1873 in *Papers Relating to the Orissa Canals 1869-1877 and 1881-1883*, Calcutta, 1884, p 56.
- 48 In the early decades of colonial rule in central and southern parts of the Orissa delta "abundant crops" of pulses, millets and vegetable oils were raised. See Andrew Stirling, *An Account, Geographical, Statistical and Historical*, p 10.
- 49 Comment of Arnott, executive engineer, after a tour of the delta in 1897. He also noted that on Sanskarisai island, following a flood, a "luxuriant crop" of mustard, biri (*Phaseolus Radiaius*) and kulthi (*Dolichos Biflorus*) was grown. Quoted in A S Thomson, *The Rivers of Orissa*, Calcutta, 1905, p 4.
- 50 For the Mahanadi river, J W Ottley, in his Note, recorded that the silt at Naraj contained 67.3 per cent of organic matter. Lieut J W Ottley, "Note December 10, 1874" in *Papers Relating to the Orissa Canals 1869 to 1877 and 1818 to 1883*, Calcutta, 1884, p 75.
- 51 C M Agrawal, *Natural Calamities and the Great Mughals*, New Delhi, 1987. "...under all methods of revenue assessment [of the Mughal administration] there was some provision for relief in the case of bad harvests", Irfan Habib, *Agrarian Systems*, pp 249-56. For the Marathas see Surendranath Sen, *Administrative System of the Marathas*, Calcutta, 1925, p 67. Stewart Gordon, 'Recovery from Adversity in Eighteenth Century India: Re-thinking "village", "peasants" and Politics in Pre-Modern Kingdoms' in Idem, *Marathas, Marauders and State Formation in the 18th Century India*, p 102.
- 52 "...change from social relationships based on 'interests' to those based on exclusive claims of ownership has been one of the greatest consequences of the period of British rule." Ainslie T Embree, *Imagining India: Essays on Indian History*, New Delhi, 1987, p 7.
- 53 Irfan Habib, 'Studying a Colonial Economy without Perceiving Colonialism', *MAS*, Vol 19, 1985, p 309.
- 54 For a discussion on the *kist* timing and the evolution of the collection schedules refer to *SSR, Vol I*, pp 240-42.
- 55 G Toynebee, *A Sketch of the History of Orissa*

- from 1803 to 1828, Canal Revenue Superintendent, Calcutta, 1873.
- 56 Territorial Department, August 11, 1829, *Board Proceedings (BP)*, Revenue Department, Vol 2-3-1829 to 29-12-1829, p 297. (Orissa State Archives).
- 57 The Military Board, originally established to "watch and control" the expenditure of money on public works, remained largely an accounting body. While it could subject costs for civil constructions to rigorous scrutiny, the power of sanction after the scrutiny lay with the civil administration and ultimately with the Court of Directors. See Elizabeth Whitcombe, "Irrigation" in Dharma Kumar (ed.), *The Cambridge Economic History of India C 1757-1970*, Vol 2, reprint 1984, New Delhi, p 679.
- 58 Quoted in Captain J C Harris, 'Report Upon the District of Orissa, in Respect of the Inundations by the Mohanuddy River and its Branches, and the Measures Calculated to Ensure Relief Therefrom.' in *Papers on the Subject of the Cuttack Rivers containing Capt Harris' 2nd Report*, Calcutta, 1860, pp 39-40. (Henceforth Capt Harris' 2nd Report).
- 59 Capt Harris' 2nd Report, pp 39-40.
- 60 Capt W D Short, Officiating Superintendent of Embankments, Lower Provinces, to the Officiating Chief Engineer, Lower Provinces, Midnapore, August 3, 1857, in *Papers Relative to the Cuttack Rivers, Part I*, Calcutta, 1860, pp 100-101.
- 61 In 1849, roughly 438 miles of embankments out of a total of 774 miles under government charge were dismissed as being fictitious or useless bunds. See Capt N C Macleod, Officiating Executive Engineer, Cuttack Division, to Colonel W. Sage, Superintending Engineer, South-East Provinces, Cuttack, April 20, 1850, in *Papers Relative to the Cuttack Rivers, Part I*, Calcutta, 1860, p 117.
- 62 Notably the views of T W Armstrong and C B Young. Both of them argued for the complete abandonment of all bunds/embankments in Cuttack district. While Armstrong based his views on the plea that the embankments had become hazardous because of faulty construction and bad supervision; Young believed that inundation's needed to be spread across the deltaic plains in order for them to attain their natural levels. See letter of T W Armstrong, Exec-Engineer, to Capt W D Short, Officiating Superintendent of Embankments, September 24, 1857, and Capt C B Young, Officiating Chief Engineer, to Secretary to the Government of Bengal, December 1, 1857, in *Papers Relative to the Cuttack Rivers, Part I*, pp 166 and 159.
- 63 Capt Harris, *Report on the Districts of Orissa Considered with Reference to the Inundations of the Mahanuddy River, Part III*, August 31, 1859, p 91.
- 64 Col Arthur Cotton, *Report on the Mahanuddy*, Calcutta, May 1858, p 2.
- 65 Ian Stone, *Canal Irrigation in British India*, p 45.
- 66 W A Inglis, *The Canals and Flood Banks of Bengal*, Calcutta, 1909, p 4.
- 67 Note by Lieut J W Ottley, December 10, 1874, in *Papers Relating to the Orissa Canals*, p 85.
- 68 Around this time the Sone Canal Works and the Midnapore Scheme were financial failures as well.
- 69 The terms of surrender were fairly benign; the Company received approximately £ 9,90,050 in addition to which 5 per cent was given as interest, its debt of £ 1,52,000 was cancelled and a sum of £ 50,000 was made over to the Company's shareholders. See W A Inglis, *The Canals and Flood Banks of Bengal*, p 14.
- 70 Notably, Col F H Rundall, September 20, 1869; Lieut Col F T Haig, May 29, 1873; Lieut J W Ottley's exhaustive note of December 10, 1874 and Col H W Gulliver's note of December 16, 1874. See *Papers Relating to the Orissa Canals*, pp 23-86.
- 71 Note by Col F T Haig, May 29, 1873, in *Papers Relating to the Orissa Canals*, pp 46-48.
- 72 In the initial euphoria, the company officials pitched the water rate at Rs 3 per acre. By 1876, after repeatedly failing to generate demand for canal water, the rate was lowered to Rs 1-8 per acre for flow irrigation and Rs 1 for lift irrigation for a five-year lease for the entire irrigated lands of the village. The rates could be revised only in 1902 when flow charges per acre were enhanced to Rs 1-12. Similar upward revisions in 1912, 1920 and 1922, however, evoked strong resistance from the cultivators, despite the rise in prices of grain. See L S S O'Malley, *Cuttack Gazetteer*, Patna, 1933, pp 113-15.
- 73 Rs 1 per acre for flow irrigation if leased before May 31 and Rs 1-8 per acre after that date.
- 74 *Report of the Commissioners Appointed to Enquire into Certain Matters in Connection with the Orissa Canals*, Calcutta, 1885, p 3. Henceforth *Canal Commission 1885*.
- 75 *Report of the Commissioners*, Appendix C, p 80.
- 76 H J S Cotton, to the Commissioner of the Orissa Division, January 26, 1882, Board of Revenue Proceedings, File no 1320, Acc no 161, p 12. Listed Under B and O files (1878-1920) (OSA).
- 77 This Petition was published in the *Orissa High Level Canal its Advantages and Disadvantages*. The Balasore National Society, Utkal Press, 1884, p 49. The Balasore National Society collected a total of 57 petitions to which 2,100 signatures of cultivators were appended from the canal tracts. These petitions were submitted to the Canal Commission of 1884 which published its report entitled *Report of the Commissioners Appointed to Enquire into Certain Matters in Connection with the Orissa Canals*, Calcutta, 1885.
- 78 For the deliberation on the embankment rate see *Report of the Committee on the Effects of the Inundation in Orissa in 1866*, np, September 1871, PWD Files (1867-1886), no 60-66, pp 6-24, and Lieut Col F T Haig. Note of May 29, 1873, in *Papers Relating to the Orissa Canals*, p 50 (National Archive of India).
- 79 Certificate Objection Case - No 458 of 1886-87, Collector of Cuttack (Certificate holder) versus the Rajah of Killah Aul (Objector), *Board of Revenue Proceedings*, Embankment Branch, File No 18, No 326, p 23. Listed under B and O files (1878-1920). (OSA).
- 80 For the final ruling on the Aul dispute see letter of P Nolan, Secretary to the Government of Bengal, to the Secretary to the Board of Revenue, January 20, 1888, Calcutta, *Board of Revenue Proceedings*, Embankment Branch, File No 18, No 326. Listed under B and O files (1878-1920) (OSA).
- 81 Baboo Juggo Mohan Lal Zamindar, the president of the Orissa Commission, Calcutta, Cuttack February 13, 1885, Appendix C, *Canal Commission 1885*, p 68.
- 82 Petition 35, *Canal Commission 1885*, p 21.
- 83 In the command of the Sone canal system (southern Bihar), there was a similar attempt by the canal staff to destroy the traditional *ahur* (tank) irrigation by running canal and drainage lines over them. See *Report of the Committee Appointed to Enquire into the Administration of the Sone Canals*, Vol I, Calcutta, 1883, pp 13-19.
- 84 Baboo Gauree Shankar Roy, *Canal Commission 1885*, p 61.
- 85 See Chap 4 in Rohan D'Souza, 'The Deltaic Rivers of the Bengal Presidency: The Political Economy of 'Flood Control' in Colonial Orissa', Centre for Historical Studies, Jawaharlal Nehru University, New Delhi, 1998.
- 86 *Report of the Flood Committee*, 1928, Patna, 1929, pp 12-13.
- 87 This period witness a virtual "canal mania". See Daniel R Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940*, UK, 1988, p 182.
- 88 Polanyi refers to this form of property as the "individualised treatment of the land"; see Karl Polanyi, *The Great Transformation: The Political and Economic Origins of our Time*, Beacon Press Books, Boston, 1957, pp 179. Also see Ellen Meiksins Wood, *The Origin of Capitalism*, Monthly review Press, New York, 1999, pp 80-89.
- 89 The notion of "improvement" was central to Locke's theory of property, which in many ways encapsulated the new aspirations of agrarian capitalism for raising productivity in the English countryside in the latter half of the 17th century. See Ellen Meiksins Wood and Neal Wood, *A Trumpet of Sedition: Political Theory and the Rise of Capitalism, 1509-1688*, New York University Press, New York, 1997, pp 123-134.
- 90 See Michael Watts, *Silent Violence: Food, Famine and Peasantry in Northern Nigeria*, University of California Press, Berkeley, 1983, pp 187-271.
- 91 Karl Marx, *Capital*, vol I, Penguin Classics, London, 1990, pp 239.
- 92 The 'classical' stage of empire for our purposes refers to the period when these formations peaked as political entities and roughly corresponds with the reigns of Sultan Mehmed II (1451-1481) and Sultan Suleyman I, the Magnificent (1521-1566) for the Ottomans, Akbar (1536-1605) for the Mughals and Shah Abbas (1588-1629) for the Safavids.
- 93 On agrarian systems and taxing strategies for the respective empires see: Halil, Inalcik, 'The Ottoman Empire: The Classical Age 1300-1600', Praeger Publishers, New York, 1973. A K S, Lambton, *Landlord and Peasant in Persia: A Study of Land Tenure and Land Revenue Administration*, Oxford University Press, London, 1953 and Irfan Habib, *Agrarian System of Mughal India, 1556-1707*, Asia Publishing House, Bombay, 1963.
- 94 Karl Polanyi, *The Great Transformation*, pp 130-31.
- 95 Jack Kloppenburg, *First the Seed: The Political Economy of Plant Biotechnology 1492-2000*, Cambridge University Press, Cambridge, 1988.
- 96 See Martin O'Connor, 'Codependency and Indeterminacy: A Critique of the Theory of Production' in Idem (ed), *Is Capitalism Sustainable? Political Economy and the Politics of Ecology*, The Guilford Press, New York, 1994 and Paul Burkett, *Marx and Nature: A Red and Green Perspective*, St Martin's Press, New York, 1999.
- 97 For a critique of the Hirakud dam see Rohan D'Souza, Pranab Mukhopadhyay and Ashish Kothari 'Re-Valuating Multi-Purpose River Valley Projects: A Case Study of Hirakud, Ukai, and IGNP', *Economic and Political Weekly*, February, Vol 33, 1998 and Sadhana Satpathy, *Floods and Flood Control Policies*, Centre for Development Studies, Trivandrum, 1993.