

PART II G 1

Demystifying the Desakota – Towards a practical understanding of the Desakota phenomenon, and it's implications for the relationship between water-based ecosystems and poverty alleviation: a case study from Mwanza, Tanzania.

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Introduction

The Lake Victoria catchment, and Mwanza in particular, has been the subject of much academic and development related enquiry and intervention, particularly around issues relating to water and poverty. Tanzania, as a country, is reported as having received the highest ratio of foreign aid per capita on the sub-continent (Huggins 2000:3). This has included a fair amount of capital investment into the water sector, and by 1986 rural water development had a funding ratio of 80:20 for external versus internal funding (Huggins 2000:3). Despite such a large ratio of foreign interest and intervention, access to, and availability of good quality water remains very low, and the Lake's ecosystems are increasingly under threat. This has been attributed to the lack of sustainability of externally driven projects, and a lack of focus on developing appropriate capacity within the region. The uncoordinated nature of these projects, however, and their tendency to address issues in isolation to each other, has further contributed to their long term lack of effectiveness. Most projects have focused either on environmental or social concerns, and often in relation to neatly delineated 'rural' or 'urban' spatial locations. These analytical categories have rarely been challenged, and are frequently relied on as given concepts. Furthermore, the dynamic and changing relationships between social and environmental trends remain largely unexplored. As a result, most analysis in the region has been unable to move beyond traditional notions of the interlinkages between poverty and water, and research outcomes and development initiatives are yet to adequately reflect the complexities created by a highly diversified, mobile population engaged in predominantly informal economic activities, with rapidly changing effects on local and regional environmental processes.

In order to move beyond such conventional analysis, and in an attempt to start to understand how social and ecological processes interact in the context of water and poverty related issues, this case study brings together previously analytically unrelated change processes in the region, and examines their interlinked effects on the current socio-ecological context. Drawing on the Desakota framework, which highlights the importance of understanding interlinkages between trends in the overall political economy, global environmental climate change, water-based ecosystems and poverty, the effects of Tanzania's political-economic processes of villigisation and structural adjustment will be examined, as will the effects of increasing drought in the region, and the introduction of alien fauna and flora to the lake. Through an assessment of ways in which such processes have blurred the rural urban distinction in the region, and led to a situation of increasing ecosystem degradation coupled with increasing poverty and vulnerability, this case study attempts to re-examine the relationship between Lake Victoria's water-based ecosystem goods and services and poverty alleviation through a desakota lens. The municipality is first briefly examined in relation to its broad socio-economic, environmental and spatial context. The emergence of a desakota context and its implications for water based ecosystem goods and services and poverty alleviation are outlined and then examined in more detail in relation to the Perch fishing industry in the region.

Methods

The findings presented in this case study are based on a broad analysis of literature (grey and peer reviewed) pertaining to socio-economic and environmental concerns in and around Mwanza. To gain a degree of longitudinal perspective some attention was paid to older literature and historical analysis, but the bulk of the analysis focused on literature produced in the last 15 years. Due to the inconsistent nature of research in the region, such a long time frame was necessary, and the implications of drawing on older literature and data must be taken into consideration when interpreting the results presented. In order to draw new insights from the existing literature, cross cutting correlations were made between previously

unrelated topics from both the natural and social science literature. The literature review attempted to be as comprehensive as possible, but the absence of fieldwork and primary data analysis leave conclusions suggestive rather than final. Illustrative examples are drawn from across the literature, but particular attention is given to the study of conflict surrounding the perch fishing industry in Kabangaja village by Medard, Geheb and Okeyo-Owuor (2002). This study proved particularly useful as it examines in detail the inter-relationships between various actors in a site that presents a microcosm of the activities and tensions found through the industry. The purpose of this report is to make new linkages, drawing on existing examples, and to illustrate the need for further study. It also aims to present a practical case illustrating the usefulness of the Desakota framework as a lens of analysis when trying to understand the linkages between poverty alleviation and water-based ecosystem services in sub-Saharan Africa.

Regional Context

Lake Victoria is the eighth largest freshwater body in the world, by volume, and the largest lake in Africa (68 800 km²). It is bordered by three east African countries, namely Tanzania, Uganda and Kenya and an estimated thirty million people live in the riparian and catchment areas of the lake (Orindi & Huggins 2003). It is further estimated that two million people depend directly on fishing based livelihoods (Ntiba et al 2001), while the rest engage in a range livelihood activities. The role of the Lake, and it's water-based ecosystem goods and services, however, are not limited to those fortunate enough to live on it's shores. It's water's are utilized by both seasonal migrants in search of water-based ecosystem services in the dry season, and people dependent on the numerous rivers and wetlands in it's catchments. There is serious concern about the Lake's loss of biodiversity, over fishing and the threat of eutrophication.



Tanzania borders on two of Africa's largest inland fresh water bodies, Lake Tanganyika and Lake Victoria, and has a further six large lakes, eight significant rivers and 2.5% of the mainland area is covered by swamps/marsh lands. Fresh water ecosystem services are thus a major concern to a wide range of livelihoods and economic activities in the country. Tanzania presents an interesting case for examining the relationship between water-based ecosystems and poverty alleviation in areas displaying desakota characteristics in Sub-Saharan Africa. In relation to the other countries examined in the sub-Saharan African Report, Tanzania's poverty rate (58% live under \$1/day), rate of urbanization (6.2% / annum) and urban rural population

distribution (38% urbanized) represents a middle path between the extremes found within the sub-continent. It's location on Lake Victoria provides interesting insights into the particular issues affecting wetland and freshwater ecosystems in arid and semi-arid sub-Saharan Africa.

Mwanza Municipality, located on the shore of Lake Victoria is the second largest urban area in Tanzania, and is the industrial, administrative and commercial centre of north western Tanzania. It's economy is

based on a combination of industrial and agricultural activities, including fishing, cotton, mining, food and beverage related industries. The economy is, however, dominated by informal economic activities and smallholder agriculture, estimated to involve 85% of the region's population (Barrett 2001, Flynn 2001, Kaihura 2008).

The urban-rural distinction in Mwanza is particularly blurred. Due to financial and capacity constraints, Tanzanian municipalities have been unable to further develop urban regions. As a result, large areas in cities, presumably set aside for public buildings, parks or bypasses, are left open and utilized for squatting and urban agriculture (Mushumba 2003). Most people settle in slums and marginal areas around the urban center and live in poverty. The most densely populated urban area, Mwanza City, covers an area of 425 km² of dry land, of which 86.8km² (24.4%) is urbanized. Out of the 86.8 km² urbanized area, 32.6 km² is used for residential purposes (RwaRwabigene 2002). According to the Mwanza Master Plan (1994) 6.9 km² (29%) is occupied by unplanned settlements and these host more than 74% of the total population of Mwanza City. The unplanned residential areas include steep hills, stony shores and wetland portions burgeoning out from the city center into the rural hinterlands.

A study by Bryceson et al. (2002) of rural household's income diversification in sub-Saharan Africa, including Tanzania, concluded that most households made use of non-farm income and that they do so through out the year at different levels of intensity. Mwanza region contributes 8% to Tanzania's GDP (Lanjouw 2001). There seems to be a lack of differentiation between the activities of rural and peri-urban households. Lanjouw et al. (2001) claim that for most Tanzanian cities excluding the more dynamic Dar es Salaam and Arusha, peri-urban and rural households have similar proportions of non-farm income and that their sources of cash are similar – usually informal trading or businesses. The reason they advance for this is that peri-urban households take the opportunity provided by their relative closeness to urban markets to focus on the production of perishable food stuffs like fruit and vegetables, and similarly, rural residents take the opportunity to participate in non-farm activities.

Flynn's (2001) and Ellis and Sumberg's (1998) discussions of urban agriculture shows that those with access to capital are better positioned to compete for land. Formal sector employees therefore supplement their uncertain incomes with urban food production. They are also more likely to be able to buy land or to gain access to land through government connections. The poorest of the urban poor, mostly female headed households, struggle to get access to land since traditional land tenure excludes women. They will also most often lack the necessary labour to produce crops above subsistence levels.

Despite it's location on the sub-continent's largest body of fresh water, the region suffers from severe water shortages, and that water that is available is often of low quality. The Mwanza Urban Water and Sewerage Organization (MWAUWASA) claims to provide coverage for 72% of the urban areas in the region and to provide sewerage for 7% of the area. However, Mushamba (2003) reports that water supply in Mwanza is problematic. Wells dry up in the dry season and tap water is mostly unavailable. People are therefore mostly depended on rainwater run-off.

International health statistics in Tanzania indicate that the country is a high risk zone for water borne diseases like bilharzias, bacterial diarrhea, hepatitis A, typhoid fever and schistosomiasis (CIA 2007). The incidence of these diseases in Mwanza has not been widely studied, however there is some indication that the people are aware of the risk and boil water daily (Lockhart 2002).

The concept of *desakota* is defined in relation to a number of characteristics, which are found to varying degrees along the rural-urban continuum. The Mwanza Municipality has been administratively divided into rural, urban and mixed wards, but unequal economic growth, urban deterioration, rural economic collapse and increasing population growth (birth rates as well as domestic and international migration), have led to an increasing blurr between these categorical distinctions. While some areas may appear more urban, and others more rural, the distribution of economic activities, concentration of the population in pockets through the region, and the increasingly diverse nature of livelihood strategies, particularly of the poor, suggest that the region would be better described as a *Desakota* zone, with different wards falling into different points along the *Desakota* bell curve. This is not to imply that there are not important differences between wards classified as rural, and those classified as urban, just that using the traditional rural-urban dichotomy is no longer adequate to understand the increasingly complex nature of the region. Characteristics such as mixed livelihoods and landuse patterns, increased transport connectivity, the commodification of the local economy, increased engagement with the global economy, changing land and resource rights and administration, the modernization of production and processing technology, and a decline in local, informal institutions and collective action, permeate throughout the region, varying in scale, intensity and nature, from downtown urban shopping centres to remote subsistence plots. In this way, Mwanza presents a microcosm of the range of activities found along the shores of Lake Victoria and highlights the importance of utilizing the *Desakota* framework in exploring areas which increasingly deviate from categorical norms.

Perch and People – an Illustrative Example

One of the most heavily cited, and widely studied issues affecting the Lake Victoria's ecosystem and the livelihoods dependent on it, is the controversy surrounding the introduction of the invasive fish species, the Nile Perch, to the lake. Ecologically, the introduction of the perch has been cited as a disaster, but economically it has been seen as a huge success, generating much needed revenue and employment for all three countries in the Lake's catchment. The reality, however, if viewed through a *desakota* lens that takes into consideration a range of socio-economic, political and ecological processes, is far more complex, and not as easy to understand as many authors imply. Such an approach allows a range of issues to be brought together, highlighting complexity rather than drawing strong conclusions.

The economic and ecological issues relating to the presence of the Nile Perch in Lake Victoria have been widely explored and written about (Goldschmidt et al 1993, Kitchell et al 1997, Wilson 1998, Medard et al 2002, Mshandete 2004), but these investigations have largely been one sided, either focusing on the scientific effects of the perch, or the socio-economic effects of the perch on the formal sector fishing industry. Few studies have been done which examine both scientific and the socio-economic factors in relation to each other, and none have been done in the context of the *Desakota* characteristics observed in the region. Understandably, many contradictory conclusions have been reached, each driven by the particular lens of analysis through which the issue was examined.

In an attempt to move away from the 'economy' versus 'environment' dichotomy that has been set up in much of the literature, and towards a more complex understanding of the issues at hand, this paper re-examines some the key economic and environmental issues surrounding the Nile Perch in relation to a broad range of socio-economic and ecological concerns, highlighting the dynamic interlinkages between seemingly unrelated issues. In particular, broader environmental degradation concerns relating to

population increases, lack of proper infrastructure, the increasing incidence of drought and the introduction of other invasive species, such as the water hyacinth, are examined in relation to broader socio-economic concerns relating to the increasing poverty in the region. The mixed effects of trade liberalization and the booming perch industry, are also examined. In this way the paper illustrates the extent to which even seemingly clear cut issues like the perch, which superficially present clear relationships between water based ecosystem goods and services and poverty alleviation, are in fact far more complex than explorations of isolated issues may suggest. Unless explored in relation to the interlinkages between a range of socio-economic and ecological issues, in this case those highlighted in the Desakota framework, the complexities on the ground will continue to go unnoticed in the literature, and relevant policies and development interventions targeting the increasing environmental degradation and poverty in the region will continue to fail to have lasting effects. The focus of this paper is on highlighting the interlinkages, and cross cutting themes weave throughout, but for analytical clarity issues are explored under five broad Desakota themes – the informal economy, urbanization, human induced environmental degradation, invasive species and environmental management.

Economic Boom and the Informal Economy

The introduction of the Nile perch caused a fishing boom in the region. Perch fillets are exported to the European Union, generating valuable foreign reserves for Tanzania. Kitchell et al. (1997) reports that approximately 19 000 fishing canoes and 100 000 fisherman operate on the Lake and that an additional 250 000 people are employed in marketing and distributing the fish. Annually, between 400_10⁶ kg and 500_10⁶ kg's of fish are harvested from the lake, the export of which contributes an estimated combined annual income of US\$ 250 000 – 500 000 to the GDPs of Kenya, Tanzania and Uganda (Ntiba et al 2001). The Nile perch is estimated to have created 150 000 new jobs in the region.¹ However studies of the involvement and economic importance of the fishing industry in Mwanza specifically is lacking (Kadonya 2002).

The boom in the perch industry coincided with the opening up of Tanzania's markets and the enforcement of structural adjustment policies, which had its own set of knock on effects on poverty in the region. Structural adjustment policies instituted price changing and deflationary policies, and removed basic commodity subsidies, which impacted on poverty and unemployment rates and led to an increase in the dependence of the poor on informal activities and natural resources to subsidize their diets and sources of revenue (Jamal 2001:25). The flooding of the perch markets by international investors and fishing firms is directly proportional to the increase of exports, exponentially increasing government returns from taxes on the industry and the country's GDP – creating an artificial sense of poverty alleviation.

Despite comprising one of the largest urban areas in Tanzania, Mwanza's economies – formal and informal – are driven by natural resource extraction and agricultural activities. Both sectors are dominated by small holder agriculture, commercial fishing, mining and cotton related industries. Most businesses are unregulated and fall below the registration and tax radar, generating little or no revenues for the government. The commercial fishing, mining and cotton industries are driven by international companies and while there are many informal fishing, mining and cotton operations in the region, they are unable to compete economically with the infrastructure and capital driving formal industries.

¹ Kitchell, p. 654.655.

There are thus relatively few formal sector wage earning job opportunities in the Mwanza region, and despite the fishing related economic boom, urban and rural real incomes have declined significantly over the last thirty years (Potts 1995). The city is described as the industrial headquarter of North West Tanzania, however these industries are concentrated in only two wards of Mwanza. Few studies provide statistical information about the distribution of the regions' labour force, but Kadonya (2002) reports that the fishing industry employs only 1% of the population in Mwanza and that most of the region's labour force are employed in the informal sector. In a burgeoning metropolis such as Mwanza City, with one of the highest urbanization rates in the region, the lack of formal employment opportunities and the collapse of small scale formal industry, the informal economy has boomed and the municipalities business economy is currently dominated, in terms of scale if not profits, by informal business activities (Murphy 2002).

The informal economy in Mwanza, despite playing a vital role in maintaining livelihoods in the region, does little to contribute to the fiscal or service concerns of local government. As a result they are seldom regarded in relation to the development of business related legislation, and are often targeted by municipal authorities. There have been several attempts to remove informal and small scale manufacturers from the Central Business District (CBD), forcing them to relocate to peri-urban and rural locations where they are further disadvantaged by the debilitating effects of crumbling transport and communications infrastructure. The failure of many of these small manufacturers to register and pay tax, has led to further conflict with municipal authorities, who regularly close them down in the name of stopping tax evasion.

Increasing disparity and conflict between formal and informal fishing industries provide a good example of the increasing tensions between formal and informal institutions in the competition for control over and access to natural resources in the region. Informal fishermen have little or no bargaining power with international traders and government regulators and little knowledge of international fish markets, they are therefore paid very little for their catches, and are disadvantaged by regulations favouring formalized fishing industries. As a result many have to engage in subsistence agriculture to survive (Madula:2003).

The government increasingly support international fishing companies, as they gain income through the granting of fishing licenses. Informal fishermen are therefore being squeezed out of the industry. Both informal and formal fishing activities are environmentally destructive, but everything from the fishing season, to catch sizes and quota's are determined by policies aimed at promoting the catching of adult Perch, and do not necessarily suite the needs of informal fishermen and women who focus on catching smaller fish in the shallows near the shore (Medard et al 2002).

Over fishing is believed to be threatening this industry as catches peaked in 1985-1990 (Kitchell et al. 1997). However the impact of over fishing has mixed benefits as it reduced Nile perch predation on indigenous species and caused them to recover in certain locales. Kitchell et al. (1997) propose that government policy should focus on prohibiting fishing from beaches with cast nets and weirs and to prohibit small mesh gill nets. They suggest that beach- and small mesh net fishing practices cause a large proportion of juvenile perch to be caught and so reduce the fish population and fishing yields of the region. Adult fish are more likely to prey on indigenous fish species and provide for better yield. It would therefore be more sustainable for the fishing industry to focus on adult fish. While this may seem like a sustainable solution for perch related ecological concerns, it also provides an excellent example of the

ways in which perch related governmental policies adversely affect the marginalized fishermen and women dependent on beach and small mesh net fishing of smaller species of fish.

Fishing in Tanzania falls under the authority of the Fisheries Division. Structural adjustment policies, however, have left the FD understaffed and underfunded. To save cost and increase local community participation, enforcement of fishing regulations were developed to elected Beach Management Units (BMU). Informal dagaa fishermen who supply smaller fish to the local and regional informal fish markets are not considered in environmental regulations aimed at perch related concerns, and yet have been made part of the BMU's intended to govern local fishing practices. This has negative consequences for both the fishermen trying to negotiate their livelihoods in relation to formal industries, and for the ecosystems which they utilize - whose interests are not always protected in the perch based legislation. A case study from Kabanjaga, a small fishing village on the edge of the city, illustrates how this has led to increasing tensions between local dagaa fishermen, international perch fishing companies and government agencies. In this area government attempts to implement so called 'community-based' environmental management practices to deal with over fishing have led to dagaa fishermen participating in governance activities that do not suite their fishing schedules and requirements (Medard et al 2002).

The combination of socio-economic and political drivers behind the resettlements caused by the villagisation process in the 1970's and structural adjustment programs of the 1980's have left the poor in Mwanza particularly vulnerable to economic and environmental shocks. Little opportunity for urban waged employment, and a failing rural economy of increasingly high population density, has left the majority of the population dependent on livelihoods made up of various combinations of subsistence agriculture, natural resource harvesting, informal trading and informal wage employment. The particular combinations, and the extent to which people are able to make a decent living from them, varies across the rural-urban continuum, dependent on environmental, economic and infrastructural factors and government processes.

The greater penetration of the cash economy, and the decline of exchange and reciprocity mechanisms caused by resettlement process and the liberalization of the economy, has led to an increasing penetration of global market forces into local markets. This had a direct impact on the expansion of cash based natural resource use activities, particularly in the mining, fishing, cotton and agricultural sectors. It has also negatively affected social institutions built around reciprocity and the exchange of natural resources. Portions of fish catches, for example, were traditionally made freely available to the poor and marginalized as a means of informal social support, but increasing pressure to generate cash incomes and changes in fishing practices has led to a decline in this practice, and increased vulnerability of those formerly dependent on these practices, particularly female headed households (Tenga 1996). The increased pressure on ecosystems has also resulted in a decrease in the number of primary resources available to those unable to capitalize on the new markets – mostly the poor and marginalized.

This highlights the prevailing economic climate, as well as some of the increasing tensions between informal business, government attempts to generate tax revenue, and formal business interests. The largely unregulated nature of the burgeoning informal economy has pushed government favour strongly towards the formal sector, particularly those sectors that attract foreign direct investment and generate exportable goods. In relation to the perch industry, these trends complicate any attempt at economic analysis of the benefits of the industry to poverty alleviation in the region. While there can be no doubt that the industry has generated important revenue for the region, it is not clear whether the industries have

truly benefited the poor and marginalized who depend on the informal economy and smaller fish related industries, or further disadvantaged them by isolating them from government support and forcing them to compete with international interests. Rather than attempting to support, regulate, and thus tax, the informal economy, local and national government policies are increasingly attempting to squash the informal economic activity. This, argues Murphy (2007), is driven by ideological and fiscal concerns, both a by-product of structural adjustment economics.

Urbanization

The economic and ecological effects of the boom in the perch industry should also be assessed in relation to the increased rate of urbanization and the increases in local, national and international migration which coincided with the turn in the fishing economy. These demographic changes were partly driven by the opening up of economic opportunities in the region, and partly by the crashing rural economy, but remain largely unexplored as a serious driver of change in the region in the literature.

Madula (2003) suggests that the increasing number of migrants to the region are attracted to the fishing and mining industries. Although the international fish processing plants and international mining companies are headquartered in Mwanza City, there is no indication in the literature on how these industries interact with the local economy or if it draws migrants to the city (Murphy 2002). Mining and fishing migrants to the region are more likely to settle in neighbouring rural wards, where informal regulation of land and access to natural resources buffer against the costs of living closer to urban settlements while still providing access to urban markets.

Medard et al (2002) provide an example relating to the dagaa fishermen who are reported to have left Lake Tanganyika and travelled to Mwanza by rail with their fishing equipment in search of better catches and access to better markets in 1989. Villages such as Kabangaja, with its proximity to the city and informal property regulations, provided a good location for the migrants, who set up informal huts between the existing settlements and the water. This placed immense pressure on the already stressed wetlands around the Lake, and what remained of the reed beds are now almost completely gone.

The fishermen work as seasonal migrants catching dagaa fish to supply local subsistence needs as well as an extensive sub-regional fish market network. Many return home when the fishing season closes, although some have brought their families with them and made more permanent settlements. The immigrant fishermen belong to the Ha ethnic group, and they draw on different cultural and religious practices to the resident agro-pastoralists, who identify with the Sukuuma ethnic group.

Kabanjaga has also recently become home to an Italian Feed company, Polo Amadoli Italia, who built a processing plant near the Ha settlements in 1994. Their intention was to capitalize on the dagaa supplies in the area and use them to stock their animal feed factories. Initially they bought fish from the local Ha fishermen, and provided jobs to locals, but their wholesale purchase prices were below the expected price of dagaa, and the fishermen were not keen to sell at reduced rates when their catches could still be sold to regional markets. The company, unwilling to raise its prices quickly switched to using perch and perch fishermen from neighbouring areas capitalized on the lack of perch fishing in the village by bringing in their equipment whenever possible.

The formerly sparsely populated lakeside village, has, in the last 19 years, become an increasingly densely populated area, with settlements encroaching onto beaches and into wetlands. Increasing pressure on wetlands, increasing pollutants from residents, fishermen and the factory have all contributed to an increasingly degraded environment, and an increase in tensions over access to land, markets, the price of fish, and the regulation of the fishing industry. Latent ethnic tensions between the Sukuma and the Ha ethnic groups have flared up, and there is increasing tension between all residents of the area and government attempts to assert control over the beaches.

This trend is being observed across the region, coupled with dramatic increases in the number of urban dwellers living in unplanned settlements. This is of direct significance for the health of the Lake, as pollution levels have increased dramatically, but it is also significant for those people unable to compete with formal companies for access to, and rights over, water resources and water treatment (Kessler and Van Dorp:1998). People living on the urban fringe and in unplanned settlements on open land throughout the region where most industries are located, and where the incidence of unregulated discharge is the highest, are amongst the most vulnerable.

Mixed Livelihoods and Human Induced Environmental Degradation

Structural adjustment policies also led to a rationalization of government bureaucracies – including the downsizing of environmental management, sanitation, infrastructure and public service departments, leaving a service delivery and regulatory vacuum in the face of a rapid increases in population density, natural resource extraction and pollution. Understaffed municipal bureaucracies, lack of proper infrastructure and high rates of urbanization have left sanitation infrastructure in the region largely non-existent, with the majority of people relying on pit latrines. A study of sanitation in informal settlements illustrated that 83% make use of pit latrines, 3% septic tanks and soak pits, and 14% have no toilet systems at all (Mwanza Squatter Settlement Situation Report 1994 in Rwabigene 2002:2). Due to the shallow sands and high ground water table, most of the sewage either runs into the lake indirectly through storm water drains, natural springs or rivers; or, during the rainy season many latrines overflow and sewage flows directly into the lake (Rwabigene 2002).

The wetland ecosystems surrounding the lake play an important role in providing provisioning and buffering services for both human and ecological populations, and play a key role in determining the health of the lake, particularly in buffering it from nutrient run-off and sedimentation. Unfortunately, however, the wetlands surrounding Mwanza are under extreme stress. The increases in population size and density, and the influx of people and livestock into the area, are putting enormous pressure on their ability to draw nutrients and sediments from the increasingly polluted runoff or provide the fuel and forage so many agro-pastoralists depend on.

An increase in the incidence of drought, due to climate change and environmental degradation, as well as the lengthening of the dry season have also contributed to the increases in population size and density, as many inland pastoralists have shifted closer and closer to the lake in search of water and the wide range of forage and subsistence services offered by the wetlands.

Increased population density and reliance on supplementary livelihood activities has led to intensified agricultural activity in the Lake's catchment area. In rural wards 85% of the population are reportedly involved in some form of agriculture, from small home gardens to larger scale commercial farming, and

while the proportion of the population involved in urban agriculture is also not clear (reports range from 15% (Kadonya 2002) to 41% (Flynn 2001) what is clear is that a significant portion of the population are engaged in agricultural activity. The increased use of artificial fertilizers and increased population density have caused unprecedented levels of nutrient run-off in the form of phosphates and nitrates, and increased sedimentation, in the lake (Kitchell 1997). These developments are not only the result of the economic and governance changes driven by the perch fishing industry, but also to the increased reliance of people on small scale agricultural activities on previously non-agricultural land (urban areas and wetlands) linked to broader changes in economic and governmental policy.

Internationalization of the fishing, mining and agricultural sectors led to the introduction of modern production and resource extractive technologies, but in the absence of sufficient regulatory infrastructure the effects of these technologies on water-based ecosystem goods and services in the area has been mixed. These technologies have led to an increase in resource extraction, as well as an increase in pollutants from industrial and intensified extraction activities. For those able to capitalize on the new technologies the relationship has been positive, but increased environmental degradation is a serious concern.

The increases in industrial effluent, human waste and atmospheric pollution dissolving in rain have led to heavy metal concentrations being of increasing concern. Samples taken from Mwanza City showing higher concentrations than anywhere else in the Mwanza Gulf (Kishe & Machiwa 2003, Kishe 2003). Despite being the most intensely industrial area in North Western Tanzania, and small holder farming being the primary activity of most residents in the Region, the combined pollutants from Industry and Agriculture are, with the exception of ammonium and chrome, noted as being less than those coming from residential areas.

Mwanza	BOD	COD	Nitrate -N	Phosphate - N	Copper	Chrome	Ammonium - N
Industry	163,4	1700	17,37	3,44	6,9	4,9	18,93
Agriculture	33,7	558	0,89	1,50	3,5	172,9	28,22
Residents	275,4	2182	33,54	4,44	42,0	10,8	0,48

Table X: Discharge of pollutants from Mwanza Municipality into Lake Victoria May – June 1993 (National Environmental Management Council 1994)

As such, changes in settlement patterns and the increasing population density in the region – related to but not solely the product of the booming perch industry – are important pieces in the ecological puzzle surrounding the degradation of the lake’s ecosystems and the resultant loss of biodiversity, and the socio-economic puzzle surrounding the increasing levels of poverty in the region.

Invasive Species

The introduction of the Nile perch and Nile tilapia into the Lake are presented as having caused an ecological disaster for the Lake’s biodiversity (Kitchell 1997). Authors are uncertain precisely when the perch were introduced with some dating it to the 1950s and others to the 1960s. The omnivorous Nile tilapia is the perch’s natural prey, however the tilapia had evolved to a high level of resistance to perch predation, making the indigenous haplochromine species the perch’s preferred prey (Kitchell 1997). Since the late 1970s the perch population has boomed, and has been blamed for causing the extinction of

between 150 and 200 of the 400 haplochromine species endemic to Lake Victoria, dangerously disturbing the Lakes' ecosystem in the process. Currently the system is very simplified and lacks biodiversity reserves.

These indigenous fish species are small bodied and did not support high profit catches. By the time of introduction of the perch, their populations were already under pressure from local fishing practices, but no baseline data examining the extent of this is available. The impact of the eutrophication and sedimentation of the Lake on the haplochromines has not been widely studied, and it is not known how this has contributed to the extinction of the species. This section will briefly examine the ecological effects of the water hyacinth on the loss of biodiversity attributed to the perch.

The explosive growth rate of the water hyacinth has had unprecedented impacts on the Lake's ecosystems, economies and transport routes. Large matts form, blocking transport routes, and preventing sunlight from entering water. The dissolved oxygen content of the water is noted to decrease from open water into the center of matts, where it approaches anoxia (Masifwa, Twongo, Denny 2001). On the edge of the hyacinth matts plant and animal life flourish, but this does not compensate for increasingly large 'dead zones' under cover of thick matts. As yet these matts have not been blamed for the lakes loss of biodiversity (ie species extinction), but they have been noted to significantly decrease the availability of areas in which healthy ecosystems can flourish, putting immense pressure on plant and animal populations. Some progress has been made in ridding the lake of the weed, but only a dent in a massive problem stretching the length and breadth of the lake.

The Lake's increased nutrient loading is causing an increase in the growth of algae and the invasive alien water hyacinth. The resultant eutrophication (i.e. decrease in oxygen concentrations) is of significant concern for the health of the lake (Machiwa 2003).

Date	Dissolved Oxygen	Phosphates	Nitrates/Nitrogen
1961	4 mg/l	5 µg/l	10 µg/l
1998	2 mg/l	100 µg/l	110 µg/l

Table x: Changes in chemical composition of the first 60m depth of Lake Victoria between 1961 and 1998 (Hongo & Masikini 2003:1001)

The perch boom therefore occurred in the ecological context of an already over-fished, eutrophying lake, in which the smaller, less profitable catches of dagaa and haplochromines, played an important role in supporting a local and regional fish trade. There is no exact record of how perch populations developed between their introduction in the 1950's, and the boom in the fishing industry, nor on the level of pressure the haplochromines were already facing at the time of introduction.

Management Issues

Due to its size, and the number of nations found along its shore, the management of Lake Victoria has proven endlessly difficult. Government response to both the issue of water quality and fishing in the Lake is problematized by the fact that the Lake's catchment is shared by three governments and all policies have to be coordinated between them. Agreements between Tanzania, Kenya and Uganda exist to improve the Lake's water quality and regulate fishing. Each country on its shoreline has their own laws and

regulations governing the Lake, and traditionally there has been little or no overlap between management strategies and regulations governing the use of, and protection of, the lakes resources. Whilst some international treaties have been signed in the past, a renewed effort to co-ordinate international management strategies is underway. The Lake Victoria Fisheries Organization (LVFO) is one such institution in the process of being established, but whether or not it will be able to co-ordinate divergent interests and implement its resolutions still remains to be seen. The institution aims to address the enforcement of legislation and regulations governing fisheries, and engage with land use management, catchment forestation, invasive species control, the treatment of effluent and municipal waste.

The LVEMP (Lake Victoria Environment Management Project), jointly run by the governments of Kenya, Tanzania and Uganda, has been active in gathering data on the Lake's environment and proposing interventions to improve community awareness about pollution. But the LVEMP is under funded, they have few water testing stations and their successes have been modest (Machiwa 2003). Due to lack of coordination and funding, comprehensive up to date information on the fishing populations in the Lake is also not available. This lack of information constrains effective policy making (Kitchell 1997).

Conclusions

Through an exploration of some of the complexities associated with the perch fishing industry in the Mwanza region of Lake Victoria, this case study has attempted to illustrate that drawing together disparate bodies of knowledge illuminates previously unexplored interlinkages and insights in our understanding of the relationship between water-based ecosystem goods and services and poverty alleviation. The examples presented from the Kabangaja case (Medard et al 2002) highlight the multiple ways in which economic, demographic, ecological and governance issues interact in a desakota context, highlighting the significant gaps in our understanding of how increasingly complex social and ecological systems interact with their broader contexts. The move away from traditional dichotomies between natural and social sciences, and urban and rural spaces, has allowed previously unexplored complexities – such as the relationship between the booming perch industry and the informal economy, or migration patterns and the eutrophication of the lake – to emerge. The trends observed in these seemingly disparate but inherently interconnected processes point to the fact that these factors play an important role in determining the social and ecological context, but the lack of available data or literature which actually tracks these interactions makes it difficult to do more than just point to their importance. In order for concrete conclusions and recommendations to be made, research aimed at filling in data gaps and bringing together different bodies of social and ecological knowledge is needed.

Drawing on the Desakota framework in the investigation of the perch issue has highlighted the importance of understanding not only whether the GDP increases, but how such economic changes affect people's access to markets, natural resources, infrastructure and appropriate governance institutions. The increasing conflict between formal and informal traders and governance structures is of vital importance to our understanding of how effective management institutions can be developed. In desakota contexts, over simplified notions of 'community' are increasingly redundant in the rapidly changing demographic context and, as seen in Kabangaja, unless more conceptual frameworks that adequately reflect the complexity on the ground are developed, management interventions are likely to exacerbate problems and further alienate resource users from sustainable harvesting methods.

In a Desakota context the reliance on diversified livelihoods offers some protection against economic and environmental shocks, but a heavy reliance on the import of most commodity goods means most people are more vulnerable to changes in global commodity and fuel prices than before. Living in marginalized areas, often on steep sandy slopes, rocky shores or in wetlands, has left the poorest of the poor increasingly vulnerable to environmental shocks, decreasing water quality and soaring food prices. Similarly, burgeoning informal markets sometimes act as a buffer against dropping real incomes, but the lack of rights and regulations protecting and regulating such informal activity leaves people vulnerable to government discrimination and increasing conflict with the formal sector.

The importance of seemingly unrelated processes, such as structural adjustment, to the current manifestations of poverty in the region point to a need to ground socio-economic and ecological research in historical processes. Without such perspective assumptions regarding poverty and environmental degradation are often reached which are not properly situated in a relevant understanding of the context. Understanding internal migration trends, for example, or the development of the informal economy and its increasing role in determining people's use of ecosystem goods and services, may be the key links missing from current interpretations of the effects of the perch fishing industry on poverty in the region.

In order to design appropriate management interventions, a deeper understanding of how access and governance issues manifest across the formal – informal divide is needed. This has been shown to be of particular importance in understanding how the perch industry has affected the poor and marginalized in Mwanza, highlighting a further gap in current socio-ecological research into poverty and water issues in the region.

There is a need for integrated studies on the ecosystem functioning of Lake Victoria (Bootsma and Hecky, 2003). A better understanding of lake function will enable a more accurate interpretation of impacts of climate change and anthropogenic activity. This region remains one of the least-studied areas in terms of ecosystem dynamics and climate variability (Hely et al., 2006). There is a need for a better understanding of how vegetation will respond to climate change and how this may affect hydrological processes. Groundwater dynamics need further study, with an emphasis on likely changes induced by climate and vegetation change. In this context shallow groundwater along seasonal water courses, lake shores and within wetlands are crucial to ecosystem services and are also highly susceptible to relatively small hydrological changes.

Invasive species, such as the water hyacinth, threaten Lake Victoria and many other waterbodies. Limited understanding of the ecology of these species hinders the development of effective management strategies.

The area is very sensitive to El Nino events, which are predicted to increase in frequency and intensity. A better understanding of this phenomenon would aid forecasting and the development of appropriate responses.

This brief analysis of some of the complex interlinkages between water-based ecosystem goods and services and poverty in Mwanza highlights the importance of drawing on a new framework which welcomes such complexity, rather than shies away from it. The Desakota framework, which moves away from over-simplified notions of spatial, economic and ecological processes is exactly the kind of framework which could assist us in moving towards a more nuanced understanding of what is going on in

rapidly changing social and ecological contexts across the sub-continent. Not only do areas showing Desakota characteristics present a unique set of problems, which conventional paradigms are unable to deal with, but the framework itself presents a new lens with which to examine old problems in search of innovative solutions.

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Annex: Sub-Saharan Africa Case Study: Exploring the links between water-based ecosystem goods and services and poverty alleviation in Mwanza, Tanzania

Desakota Criteria	Water-based Ecosystem Services	Poverty
<p>1. Greater Connectivity— physical, electronic and cultural.</p>	<ul style="list-style-type: none"> • Villigisation processes resulting in nucleated settlements along transport routes led to increases in connectivity to markets and employment opportunities as well as increased stress on ecosystem services in and around settlements. • Introduction of alien species into Lake: <ul style="list-style-type: none"> ○ Water Hyacinth – blocking sunlight and causing serious eutrophication in the Lake and decreasing available habitat for indigenous fauna and flora ○ Nile Perch – predatory species decimating local fish stocks (an estimated 200 of 400 endemic species lost since introduction of perch to the lake) • Migration of inland agro-pastoralists closer to the Lake in search of better grazing and water accessibility <ul style="list-style-type: none"> ○ Over usage of sensitive wetlands for grazing and watering of livestock leading to the destruction of wetlands and the loss of their filtering and regulating capacity. ○ Encroachment of settlements onto beaches and into wetland areas due to a shortage of land, leading to increased pollution of wetlands and lakes, overuse of wetland and shoreline goods and services and the further destruction of water-based ecosystem goods and services in the area, ○ increased pressure on water-based ecosystem goods and services for both productive and reproductive uses, 	<ul style="list-style-type: none"> • Villigisation processes resulting in nucleated settlements along transport routes with increases in connectivity to markets and employment opportunities, but also increased: <ul style="list-style-type: none"> ○ insecurity of land tenure, ○ vulnerability to political and environmental shocks, ○ rural-urban migration, ○ food insecurity • Introduction of alien species into Lake: <ul style="list-style-type: none"> ○ Water Hyacinth - thick mats on Lake surface have blocked transport routes and damaged many boats, but clearing projects have also created local job opportunities having some positive spin offs ○ Nile Perch – boom in export orientated fishing industry but marked decline in local fishing industries and availability of cheap fish sources for local people and regional markets • Greater connectivity to urban markets through improved road infrastructure and proximity to Mwanza City leading to settlement of immigrant fishermen and international industries (in this case an Italian fish processing plant) along lake shore. This has led to: <ul style="list-style-type: none"> ○ increased competition over access to resources and increasing natural resource access related tensions.
<p>2. Greater penetration of cash economy, with remnants of</p>	<ul style="list-style-type: none"> • Structural Adjustment policies and other fiscal and political reforms have led to trade liberalization and the increasing penetration of global market forces into local markets. This has had a direct impact on the expansion of cash based 	<ul style="list-style-type: none"> • Structural Adjustment policies and other fiscal and political drivers leading to trade liberalization and the increasing penetration of global market forces having a direct impact on state spending on social services

<p>exchange and reciprocity mechanisms on the decline.</p>	<p>natural resource use activities, particularly in the mining, fishing, cotton and agricultural sectors, leading to:</p> <ul style="list-style-type: none"> ○ increased intensity of resource extraction for productive purposes and a strong focus on primary product exports ○ increased nutrient runoff into lake, ○ destruction of wetlands, ○ increased pollution from industries and resultant settlements ○ increased pressure on fish stocks due to cash returns in fishing industry ○ increased use of fertilizers in agriculture and more intensive use of land ○ the introduction on new cash crops, such as rice ○ increased disturbance of sensitive top soil through agricultural and mining activities, leading to increased run-off and sedimentation of wetlands and the Lake 	<p>and urban and rural real incomes. This has led to:</p> <ul style="list-style-type: none"> ○ removal of basic commodity subsidies and increased vulnerability to global commodity price changes ○ pouring in of cheap foreign goods ○ decrease in regulatory capacity of the state ○ deflation of currency ○ decreases in real incomes and increased dependence on informal markets ○ increase in GDP due to increased exports, but simultaneous increase in poverty due to broader economic decline <ul style="list-style-type: none"> ● Internationalization of fishing industry and preference for Nile Perch has lead to the commercialization of formerly subsistence and informal fishing economy, leading to: <ul style="list-style-type: none"> ○ increased GDP due to increase in export of perch products ○ increase in income gap due to inability of informal traders and subsistence fishermen to capitalize on new perch related industries ○ loss of endemic fish stocks has had negative effects on Dagaa and Cichlid fishing industries – negatively affecting marginal fishermen and people dependent on cheap fish supplies ● Increasing dominance of cash based resource extraction activities has negatively affected social institutions built around the reciprocity and exchange of natural resources. Portions of fish catches, for example, were traditionally made freely available to the poor and marginalized as a means of informal social support, but increasing pressure to generate cash incomes and changes in fishing practices has led to a decline in this practice, and increased vulnerability of those formerly dependent on these practices, particularly female headed households.
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<p>3. Mixed livelihoods drawing upon local as well as non-local service, and manufacturing sector opportunities.</p>	<ul style="list-style-type: none"> • Increased mixing of land use practices, from informal agriculture to industrial production is placing increasing stress on water-based ecosystem goods and services and increasing health hazards to people dependent on these resources. Unregulated run-off from fish processing plants in formerly rural areas, for example, is directly affecting water quality and exposure risks for local residents. • Increased urban and peri-urban agriculture, dependent on waste water and rainwater runoff in areas where water is exposed to industrial and domestic effluents is increasing health related risks while simultaneously increasing access to fresh produce and alternative income sources. 	<ul style="list-style-type: none"> • Increased internationalization of markets and penetration of cash economy together with rising poverty and declines in urban and rural real incomes has led to an increased reliance on multiple livelihood activities. In urban areas this has led to: <ul style="list-style-type: none"> ○ increase in informal urban and peri-urban agriculture to substitute declining wages and job opportunities, In rural areas this has led to: <ul style="list-style-type: none"> ○ an increased reliance on informal trading and waged labour in an effort to buffer against droughts and declines in the rural economy.
<p>4. Greater diffusion of modern production and resource extractive technologies.</p>	<p>Internationalization of the fishing, mining and agricultural sectors has led to the introduction of modern production and resource extractive technologies, but in the absence of sufficient regulatory infrastructure the effects of these technologies on water-based ecosystem goods and services in the area has been mixed. These technologies have led to an increase in resource extraction, as well as an increase in pollutants from industrial and intensified extraction activities. For those able to capitalize on the new technologies the relationship has been positive, but increased environmental degradation is a serious concern.</p>	
<p>5. Greater penetration of formal institutions existing in a transformational tension with traditional informal institutions.</p>	<ul style="list-style-type: none"> • Attempts to develop international and national environmental management frameworks to manage the lakes sensitive ecosystems have made some headway in extending rational scientific knowledge into environmental management practices from the national to the local level. However, insufficient attention to local custom and knowledge has brought these attempts into direct tension with local concepts and efforts regarding the ownership and management of the Lakes resources. The introduction of ‘Beach Management Teams’, for example, was a rational attempt to improve local participatory management practices, but it’s failure to take into consideration ethnically and culturally heterogeneous rural communities resulted in an increase in ethnic tension and resource vigilantism between resident agro pastoralists and immigrant fishermen. 	<ul style="list-style-type: none"> • Greater penetration of state policies into rural areas has led to increased tensions between existing traditional institutions and new legislation. Tensions further exacerbated by parochial concepts of ‘community’ which are no longer applicable in increasingly heterogeneous rural and urban communities. • greater penetration of informal markets and institutions across desakota spectrum has led to increased tension with formal regulatory environment and government attempts to control markets and resource extraction.