Part II A

Desakota:
Reinterpreting the Urban-Rural Continuum

Marcus Moench & Dipak Gyawali

March 2008

Desakota: Reinterpreting the Urban-Rural Continuum

Conceptual foundations for understanding the role ecosystem services play in the livelihoods of the poor in regions undergoing rapid change

Contents

Desakota: Reinterpreting the Urban-Rural Continuum

Conceptual foundations for understanding the role ecosystem services play in the livelihoods of the poor in regions undergoing rapid change

Introduction

Over coming decades, two already entrained forces will exert tremendous influence on the nature of ecosystems services and the central role they play as a foundation for livelihood systems across South Asia:

(1) *Technological and economic globalization*. These processes are intensifying and, in combination with demographic growth, drive increased consumption and changes in the role ecosystems services play in livelihood systems and the pressures on such services.

(2) *Environmental change, particularly the combined local impacts of global climate change and other processes of environmental degradation.* Such processes undermine the ability of coupled ecological and social systems to provide critical services.

In combination, the above forces are reshaping the livelihoods of vulnerable populations, particularly the poor who are often the most directly most dependent on ecosystem services. They are also reshaping the manner in which ecosystem services can contribute to major social goals such as poverty alleviation. These forces and the change processes they drive are poorly understood. Understanding is, however, essential in order to identify points of entry for poverty alleviation and the maintenance of basic ecosystem services.

About the study and its methodology

The purpose of this study is to increase understanding of the relationships between major patterns of global economic and demographic changes, the nature of ecosystems services, and the role such services play in increasingly interlinked urban/rural livelihood systems, particularly those of the poor. More specifically, we seek to analyze key elements in the relationship between: (1) major change processes (specifically economic globalization, urbanization and climate change); (2) the condition of basic water resource systems and the wider ecosystem services they support; and (3) the changing role ecosystems services play in the livelihoods across the urban-rural continuum. Our objective is to identify critical knowledge and experience gaps where research and related activities could catalyze new, more effective, strategies for poverty alleviation and environmental maintenance. The study focuses on water-based ecosystem services in regions facing the rapid growth of mixed/interlinked urban-rural economic and livelihood systems; a phenomenon known as desakota that increasingly blurs distinctions between rural and urban. The implications of this phenomenon for the poverty-ecosystem service relationship are also examined in relation to the pressures now emerging as a consequence of global climate and other ecosystem change processes. The methodology used is two-pronged:

1. Literature reviews that are both global (and formal, peer-reviewed) and local (mostly grey);

2. Focus group discussions in field case areas along desakota transects (e.g. across the mixed economy regions that extend from urban centers outward toward regions that have traditionally been viewed as purely "rural") .

The purpose underlying this methodology is both conceptual and applied. On the conceptual level, the approach enables exploration of data sociology and politics as well as the severe methodological problems that give rise to gap between scientific studies and policy action. The data collected by external actors (whether governments or academics) often fail to reflect the dynamic change processes that continuously reshape society and its relationship with the natural environment. Part of this is sociological: we all come with pre-conceived notions and definitions (such as the distinction between "urban" and "rural" areas) and collect data that reflects such concepts. As a result, major change processes that don't fit with pre-conceived frameworks are often missed. By looking at ecosystem service and poverty issues through the desakota lens, we intend to catalyze new insights on familiar challenges. Part is political: data and the manner in which situations are framed are central to the exercise of power within society. As a result, formal reports and the published literature often reflect underlying political positions – they are bounded by what we and others call the "sanctioned dialogue." By combining formal literature reviews with field based "case studies" involving focus group discussions along desakota transects we hope to introduce a wide set of voices that cut across the boundaries of the sanctioned dialogue.

The above conceptual methodology relates directly to the practical applied level: points of entry for catalyzing action to address major poverty or environmental problems can only be identified if they reflect "how things actually work" – that is the opportunities and constraints people face within communities and at higher levels as change occurs and power is exercised within society. The sociology and politics of data and research contribute, we believe, very substantially to the gaps between research, policy and action. Practical applied solutions will only emerge through methodologies that explicitly acknowledge and seek to bridge the gaps created by data sociology and politics.

The concept of desakota

The environment is being stressed differentially across varied geographies by the processes of technology-led economic globalization, which in turn have brought about rapid social responses of livelihood transformations in the form of migration and more market-dependent activities. While environmental stress has reached, and often passed, the stage of insult in many Southern metropolitan regions, it is still in early stages of disturbance in deeper rural hinterlands. It is the region in between, captured by the Bhasha Indonesia term desakota (meaning village-town), where the trends in ecosystem stress can best be observed. These regions are linked to major urban centres by cheap transport axes where much more intense commercial agricultural and non-agricultural economic activities take place than in purely rural areas (McGee 1991). The desakota phenomenon encompasses more than the term "peri-urban." It refers to closely interlinked rural/urban livelihoods, communication, transport and economic systems. Desakota systems occupy, and radiate out from a spectrum of conditions that have purely urban and purely rural as the two extreme ends. In this emerging system, large sections of the population operate a mixed household economy that straddles the urban and the rural, as well as the formal and informal sectors. See Figure 1.

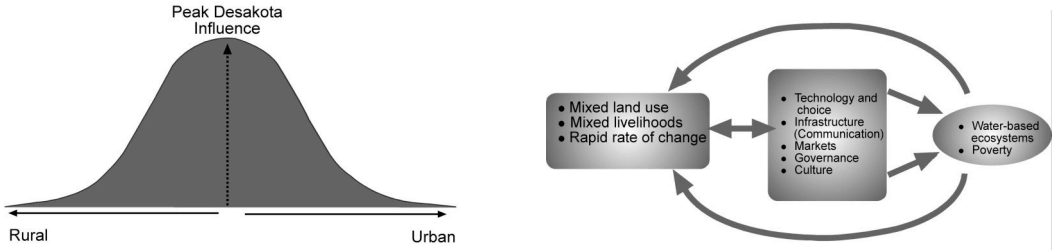

Figure 1: Rural-Urban Desakota Bell Curve (a) and processes of influence in Desakota (b)

Such a mix changes the relationship between livelihoods, ecosystems services necessary for their upkeep, and methods of managing the environment. Where, for example, rural livelihoods once depended primarily on access to irrigation or the reliability of precipitation for agricultural activities, now livelihood demands for water may be shaped as much by requirements for manufacturing. Environmental services that were rarely a concern in rural livelihood systems now are becoming of critical importance – air and water quality, for example, have implications for crop production as well as health. These may also be linked to poverty in very different ways than has been traditionally conceived of in rural areas.

In rural regions, the link between poverty and ecosystems services has generally been conceptualized in terms of access to resources (Cooper et al. 2005, Allen et al. 2006a, Borner et al. 2007). Access to forests or common lands, for example, entitles individuals to ecosystem products such as fuel, fodder, drinking water, and so on. These are direct economic inputs to household and community economies. If the condition of the ecosystem declines, then access to provisions declines and poverty will logically increase. In desakota regions, however, the link between ecosystem services and poverty may be very different – but perhaps even more fundamental. Take the example of water quality. The ability of upstream ecosystems to regulate water quality influences access to clean drinking water and thus the health status of recipient populations (Allen et al. 2006a, Sajor and Ongaskul 2007). Health, in turn, influences the ability to work, income levels and ultimately the distribution of poverty. Similarly, changes in the regulating function of forests or trees on air quality may change the degree of exposure to toxics. This can increase health problems and, as a result, have similar impacts as those described above in the case of water quality on poverty. Other links may also occur – changing land use systems in desakota areas and declines in the ability of ecosystems to regulate river flows could increase flooding (through, for example, blockage of drainages and increases in impermeable areas). This can cause direct asset losses (disaster losses are known to be a major factor contributing to poverty) and can also have major impacts through health and other loss vectors. Overall, the growth of desakota and more urban economic characteristics may shift the relationship between ecosystems services and poverty away from access to provisions to more systemic, but equally important, impacts on health, disasters and so on.

The growth of desakota regions also changes the nature of pressures on ecosystems and the incentive structures underlying institutions for their management. As the economic pull of urban centres reaches further into peri-urban and rural socio-ecological systems, ecosystems are placed under growing stress. Indeed the ecological services they provide are subject to interlinked – and often competing – urban and rural demands (for example over drinking vs. irrigation water or fuel-wood). Since labour now commands a market price, the degree of voluntarism that is required to maintain participatory resource management in the

villages, whether of irrigation and drinking water systems or forest commons, is no longer readily available.

Changes in incentive structures for contributing to the management of common or joint resources may, in fact, have far deeper social roots than change in the price for labour. As diverse economic opportunities and new technologies penetrate rural areas, the degree of interdependency within social and livelihood systems often declines. Where once, for example, a joint-family system was essential in order to complete agricultural operations, now individual or nuclear family units are often able to function as economic entities on their own. Similarly, at a village level, a variety of livelihood system elements on which people's survival depended (from large-scale crop rotation systems to irrigation tanks, village forests, etc…) could not be maintained in an individualistic manner. Individuals, households and communities were, in a very tangible way, interdependent. Emergence of the desakota or more urbanized economy decreases and changes the nature of interdependency. Forms of interdependency are now no longer defined by geographic location or as much by the scale of the family system. Instead they may become more network based – related to, for example, relationships within product or labour markets. Such changes in interdependency affect institutions ranging from the joint family system (which has declined dramatically in South Asia) to institutions for resource management.

Desakota phenomenon now dominates most of South Asia and many other parts of the less industrialized world. Recognition of this reality is essential to understanding the critical role ecosystems services will play over coming decades in livelihood systems, particularly those of the poor. Recognition is also central to understanding the changing incentives that underpin institutions for resource management. The desakota approach brings to center stage the desakota household whose income basket consists of flows from both the "rural" and "urban" ends of the spectrum and, thus, the new mix of dependencies on ecosystem services (McGranahan et al. 2004, McGregor et al. 2006). Environmental services and stresses can no longer be understood in relation to historical notions of rural (agricultural) development or urban planning. Instead, the increasingly interlinked nature of "urban" and "rural" economic and other systems will give rise to new sets of socio-economic, institutional and environmental service issues in many developing countries.

Desakota *Criteria*

In order to determine what is a desakota region, or more precisely how close is it to the peak in Figure 1, a few parameters needs to be defined. They are tentatively identified as the following:

a) It is connected to a major metropolitan centre by at least some cheap transportation axes, viz. a dirt road plying some form of publicly accessible modern transport such as mini-buses or residents commute using mechanized two wheelers etc. More "advanced" transport systems (e.g. air or rail links) can also play an important role in the desakota phenomena. This transport access can be recent or well established. In parts of Asia, transport axes and the inexpensive vehicles to utilize them have often come into place within the last 15 or so years, i.e. within a generation, allowing for commuting to and from urban centers within a day. In much of Europe and North America too, this phenomenon has occurred but over a much longer time span with lower level of global competition, allowing more time for both social and environmental adaptation: in the less industrialized South, the stress has had to be absorbed within a generation.

b) There is a daily labour market available, i.e. people (especially women) can earn some income in the vicinity without having to spend the night away from home. Labour activities are weighted in favour of daily, weekly or seasonal migrations for jobs rather than long-term, multi-year migrations.
c) Information of the outside world (and hence knowledge of opportunities therein) is actively available, i.e. not just through passive means such as newspapers and radio etc., but in the more active forms such as widely accessible cell phones and in some locations the internet.
d) It consists primarily of households where working members are engaged in both rural agriculture as well as jobs, services, retail and manufacturing activities that have historically been seen as more "urban" occupations. As a result, income baskets contain of a mix of rural and urban characteristics.
e) Traditional rural self-help groups and voluntary activities including those for forest, water or other natural resource management are either breaking down or under stress. People find less time to engage in non-market based activities or, because of changing technologies, new labour relationships or declines in interdependency, they have less incentive to contribute to institutions and functions that operate at a community level.
f) Modern technologies (i.e. diesel or electric pump for accessing water rather than wells; chaff cutters for fodder preparation rather than labour-intensive hand-cutting tools etc.) are gaining predominance over conventional and traditional means of resource harvesting or harnessing.
g) While cash income is gaining or has substantially achieved predominance over exchange and reciprocity mechanisms, much of it is in the informal sector rather than the formal. This actually measures how far (or near) the region is to central government regulation through taxation and other means. The informal economy occupies a greater portion of the Southern urban economy than it does in the North, and deep rural hinterlands are sometimes wholly in the subsistence mode. However, as with the bell curve in Fig.1, a significant portion of the income basket of desakota households comes from informal rights over ecosystem services (e.g., fodder and fuel from nearby forests etc. rather than kerosene and LPG from the market) which progressively declines as one moves towards the urban end of the spectrum.
h) Institutionally, desakota regions are often characterized by a poorly linked mix of formal institutions operating within defined enclaves (agricultural estates, corporate industrial estates, forest reserves, parks, etc…), declining or evolving traditional institutions and emergent informal institutions filling the gaps and often encroaching across enclave boundaries. This is frequently a source of tension and makes traditional and more formalized land tenure issues of particularly sensitivity.
i) Another axis of differentiation is the degree of engagement or linkages at global or local levels. It can be hypothesized that global economic fluctuations (such as oil price shocks, major technological shifts etc.) translate into impacts much sooner and more pervasively at the urban end of the spectrum than the rural. This above statement however raises a question: In the peak desakota region, given less infrastructure "locked-ness", can one expect the region to function as a shock absorber with livelihoods and economic activities shifting during such times towards the more rural end of the spectrum?

Institutional Desakota

As transitional environments, the concepts that underpin most approaches to the development of institutions for ecosystem management may not apply in the desakota region. Community-

based approaches, one of the centrepieces of development strategies in most rural regions (Ostrom and Gardner 1993, Ostrom 1999, 2000, Meinzen-Dick et al. 2002), are heavily challenged when communities are no longer strongly interdependent and geographically defined. Mobility, the diversification of livelihood and income options, changing social relationships – all these factors raise major questions regarding the viability of community-based approaches (Agrawal and Gibson 1999). More urban (modernist?) approaches to the development of institutions for ecosystems management also don't really apply in the desakota context. Formalized "modern" management organizations (municipal authorities, water districts, forest and park departments, business groups, utilities, etc.) are generally either weakly established or function as "enclave" institutions – structures that function in physical or social isolation from the realities of daily life for the populations living in the region. Instead, desakota environments are characterized by highly mobile informal institutions – such as informal water markets – that focus on provisioning services (such as supplying water) but probably not on management of the ecosystem or resource base itself.

The institutional challenge for ecosystem management illustrated above is further complicated by the locational disjuncture between the "ecosystem" itself and the services it provides. In some cases this takes the classic upstream-downstream set of relationships (hill areas supplying water that downstream *desokota* regions depend on) -- but the reverse may also be true. The transmission of pollutants from desakota regions to downstream rural or urban areas may be regulated by riverine ecosystems that decompose or sequester contaminants. Also, the nature of ecosystem services often changes as desakota characteristics grow. In the case of forests, for example, in rural areas forests may provide provisioning services (fuel, fodder, lumber, etc. for local use). As the desakota characteristics of a region increase, however, the benefits from forests may shift away from provisioning toward regulating (filtering of pollutants, noise reduction, temperature mitigation, etc.) or cultural (esthetic) values (Stoian 2005, Twyman and Slater 2005). Such shifts have major implications for the relationship between ecosystems services and poverty. They also have very major implications for the incentives different groups may (or may not) face to manage ecosystems or to pay for ecosystems services. As a result, the whole question of institutions for ecosystem management is much more conceptually and practically complicated than in either rural (traditional) or urban (modern) contexts.

On a conceptual level, many development models for the management of forests, water resources and other ecosystem elements begin by assuming some form of direct connection between users and the resource base. This is, for example, the core assumption underlying:

1. Ostrom and the work of the larger "commons" community (conceptual and applied)
2. Debates and applied projects on community-based management (forestry, irrigation, grasslands, etc.); and
3. Much of the work on adaptive management

The above concepts lead to institutional models for resource management through communities of generally local actors. The models assume that those benefiting from the resource have a stake in its management and in its sustainability. They also often assume some level of interdependency between users – none of them may be able to function economically or even survive unless they contribute to group management and maintenance of the system or resource. The "operational" model that follows involves the creation or building of management institutions that formally link input to management with benefits from management. In the desakota and rapidly urbanizing regions, the linkages between management and benefit are several steps removed. An urban resident receiving drinking water is several layers removed (physically, economically, perceptually and socially) from conditions in the watershed. In addition, the level of interdependency is much less immediate

– individuals don't need to "contribute" to maintenance of a watershed in order to receive domestic water through tanker markets.

Even in "rural" areas, the entry of diverse non-farm livelihood options creates very different relationships and sets of incentives between individuals and ecosystem services. For some, the traditional direct links with land/water based livelihood elements remain, for others those are all but absent. Furthermore, local and non-local demands are increasingly placed on the resource through both formal and informal systems – formal water transfers (through, for example, a municipal water utility) are often occurring from the same area that is also being tapped by informal water markets supplying adjacent town centers and by local irrigation users. As a result, the mix of needs, incentives, uses, etc. all tapping the same ecosystem explodes (Turner 1999). In such contexts, the "operational" model assumed for the commons or community management is less likely to work. There are too many diverse communities, incentives are different, and ecosystem service demands are different and so on.

Changes in the tank systems of South India with the spread of mechanized pumping technologies illustrate the manner in which changes in interdependency affect institutions. Much of South India was traditionally irrigated through interlinked tank (pond) systems that were constructed, operated and maintained at the community level. The introduction and rapid spread of mechanized pumping technologies fundamentally changed incentives for maintenance of tanks and the irrigation systems they supported (Janakarajan 1994, 1999, Janakarajan and Moench 2002). With a well and pump, individual farmers were able to access water at the time and in the amount they required without having to wait for their share of canal deliveries. Furthermore, once the well and pump were in place, individual farmers had little incentive to contribute to joint maintenance of the tank system. Yes, in theory the tanks contribute to groundwater recharge in ways that ultimately benefit well owners. But the link is far from direct and often difficult to prove even through detailed scientific studies (COMMAN 2004). Now, in many parts of South India the "rural" economy has diversified and the incentives to contribute to the management of tank systems have further declined.

In much of the industrialized world, society attempts to deal with the above through formal management institutions. The approaches tend to involve the creation of regulatory or line implementation departments at a range of scales – from large government departments (Environment and forestry) to local parks. Municipal utilities also often manage the source area for key resources, such as water. The operational model preferred is very governmental – "stakeholders" are linked to management through taxes. Everyone gets taxed, society uses those taxes to hire people for management functions. Direct community or stakeholder involvement with the resource or ecosystem is minimized. The private sector often delivers key services (thinning timber, operating municipal water supply or waste treatment plants, etc.) on a for-profit basis but under jurisdiction of the regulators. Replication of this model in many developing country contexts has resulted in the creation of the "enclave" institutions mentioned before. These institutions often exist in direct competition and conflict with remnant "traditional" and other community-based resource management institutions and with the informal (often market) institutions that have emerged to meet water supply or similar needs. They generally serve the interests and respond to the perspectives of wealthy sections of society that are separated both geographically and economically from the populations directly living within a region.

Communities of "interest" do form around key issues – the environmental NGOs advocate for specific objectives and, in some cases, play a direct role in management (the Nature Conservancy for example). These communities of interest often exist through support

from members (dues are paid in lieu of taxes), individuals are hired for key work and much other work is supported on a volunteer basis. This type of model could be seen as one in which "downstream" areas (those separated by several social as well as physical layers from direct contact with the resource base) pay upstream users (locals are often hired by forest departments for management) to deliver key functions. The model is somewhat different from the "payment for ecosystems services" model in which beneficiaries directly pay communities in upstream producing regions for the management of ecosystems on which specific benefits depend (Noordwijk et al. 2007, Scherr et al. 2007, Swallow et al. 2007a, Swallow et al. 2007b). At the same time, the essence is much the same – beneficiaries pay for services through contributions (the equivalent of taxes or fees) and a separate entity (either a formal management organization or upstream communities) is paid for management of the ecosystem. The problem with this model from a poverty perspective is that, although local populations may play a role, it tends to create enclaves, much like the governmental institutions discussed above, that separate local populations from direct access to water, fuel and other ecosystem services. The operational viability of such models is in addition, often open to question in developing country contexts. It requires the ability to enforce boundaries and use regulations, an ability that is often lacking when very large sections of society operate in the informal sector.

The above types of systems function, at least to some extent, in parts of the world where social institutional systems at all levels (from the local police and municipal authorities upward) are fairly robust. In the chaotic areas undergoing rapid change processes such models often do not function at all. Creation of operational institutions enabling more direct payment to local populations for ecosystem services (a mechanism that could address the enclave issue) is complicated by the nature of such services. While people are often willing to pay directly for some types of provisioning services (clean domestic water supply or fuel) many regulating services (clean air, clean rivers, sound reduction, aesthetics) are joint or public goods. As a result, except through general taxation it is extremely difficult to accumulate the financial resources to pay for management. This is a particular challenge in desakota regions because many institutions and much of the economy are informal in nature and have network structures making the collection of taxes or fees difficult. Private sector organizations managing large land areas of relevance to the provision of ecosystem services (such as forest products, plantations & estates or commercial agricultural entities) do exist and often function throughout desakota zones. The primary objective of such organizations, however, focuses on their own commercial interests. Whether or not ecosystem services of relevance to poor populations are maintained is generally not their concern. As with many areas protected by governments, they generally manage ecosystems within the enclaves under their control to provide services of distant clients, in this case the customers for food, forest, water and other products.

One of the core global ecosystem service challenges is thinking through the incentives and institutional alternatives in desakota regions. The "community-based" commons models often don't work nor, in most cases, do the western tax-based or community-of-interest models of regions with greater institutional depth. Private sector organizations exist and manage large areas relevant to the production of ecosystem services – but their objectives often have little to do with the well-being of local populations or the ecosystems *per se*. They also tend to create enclaves that deny local inhabitants access to fuel, water and other products found within them. This may not be negative if the economy has shifted to the point where the need for regulating services (water filtration, flood control, etc…) dominate over provisioning – but it is likely to have the largest impact on the poor. Modern tax-based models have additional disadvantages. Organizations such as forestry and irrigation departments, for example, are often extremely ponderous. They take time to evolve and are

often busy responding to conditions that may have existed several decades ago. They are incapable of responding to the rapidly evolving context in desakota regions or that may emerge as climate change proceeds. In addition, they aren't able to capture or respond to the informal sector – the water markets and other spontaneous institutions that are often at the lead edge of supplying key ecosystem-derived products to diverse users. Finally, they aren't able to respond to pulsed change – the sudden impact of extreme events that change both physical and social conditions and that can create windows of opportunity for new approaches to enter. This is where many of the institutional challenges lie. Formal, institutions for ecosystem management are often created and evolve slowly. As a result, they tend to be structured and operate in ways that reflect historical rather than current conditions.

Probably the most common and robust form of institution in desakota regions are those relating to markets. They form networks of buyers and sellers involved in the production, transport and marketing of goods. In some cases these exist as formal associations; dairy cooperatives, mother's groups, vegetable grower associations, business groups, etc… In others people are linked through the daily interactions necessary to support their livelihoods and they may not even be aware of the chain of relationships within which they exist. The associations are generally structured around functional activities related to livelihoods or economic activities rather than locations or specific places. They often lack any centralized structure and, at the moment, rarely play a direct role in ecosystem management. They are, however, often the main entities directly delivering the produce (firewood, water, food, etc..) harvested from ecosystems.

Overall, the institutional challenge in desakota regions can be seen as emerging from the following:

1. The decline of geographically defined and geographically dependent communities and, accompanying this, the decline of traditional resource management institutions: People, activities and products are increasingly mobile and separated from the condition of local ecosystems.
2. The growth of informal, market-based, institutions for delivering ecosystem products (water, fuel and fodder markets, etc…) that lack the organizational structure necessary to engage in ecosystem management. In most cases even the primary institutional structures (clear tenure, frameworks for registering legal entities, etc…) necessary to enable the creation of organizations for management don't even exist.
3. The separation of formal institutions (private agricultural or industrial estates, areas managed by forest or park departments, town and city municipal corporations) into functional enclaves where little or no incentive exists to maintain the flow of ecosystem services to the poor.

Challenges such as the above represent important dynamics – but may not be fundamental. In some locations institutions for resource and ecosystem management have emerged:

- In Tamil Nadu, farmer groups have been working with representatives from the tannery industry to identify viable mechanisms for reducing pollution (Janakarajan 2002).
- In Yemen, an "association of local projects" financed through remittances in the Tai'iz area (Al Hima) provides an array of water services that include attempts to regulate groundwater extraction (Ubels and Wevers 1996, Mohieldeen 1999).

- In Nepal, community forest management activities continue to expand despite the last decade of war and extensive outmigration of the youth, particularly young men (Dixit et al. 2007).

The above examples, a very small selection among many that could be found, suggest that institutions for ecosystem management can be formed or encouraged to emerge despite the major changes occurring as economies diversify and communities become increasingly defined on the basis of social networks and less on the basis of geography or physical proximity. Understanding how, where and why such institutions for management might emerge and contribute to the maintenance of ecosystems and ecosystem services represents a major social science challenge. This increased understanding of desakota institutions needs to be accompanied by increased understanding of ecosystems in desakota regions. "Desakota science" is, as a result, a key point of entry.

Desakota *Science*

What kind of science is needed to understand the relationship between ecosystem stress and livelihoods in the desakota regions? We begin with the definition provided by Millennium Ecosystem Assessment but try and move, through this research, to deepen it:

Ecosystem services are benefits that people obtain from ecosystems that include

- **Provisioning Services** such as food and water
- **Regulating Services** such as regulation of floods, droughts, land degradation and diseases as well as climate regulation
- **Socio-cultural Services** such as aesthetic, spiritual, religious, recreational and other non-material benefits.

All these services are held in place by the **Supporting Services** of ecosystems such as soil formation and nutrient recycling, mitigation of climate change through floodplain inland water bodies storage, mangrove buffering etc. (See Figure 2)

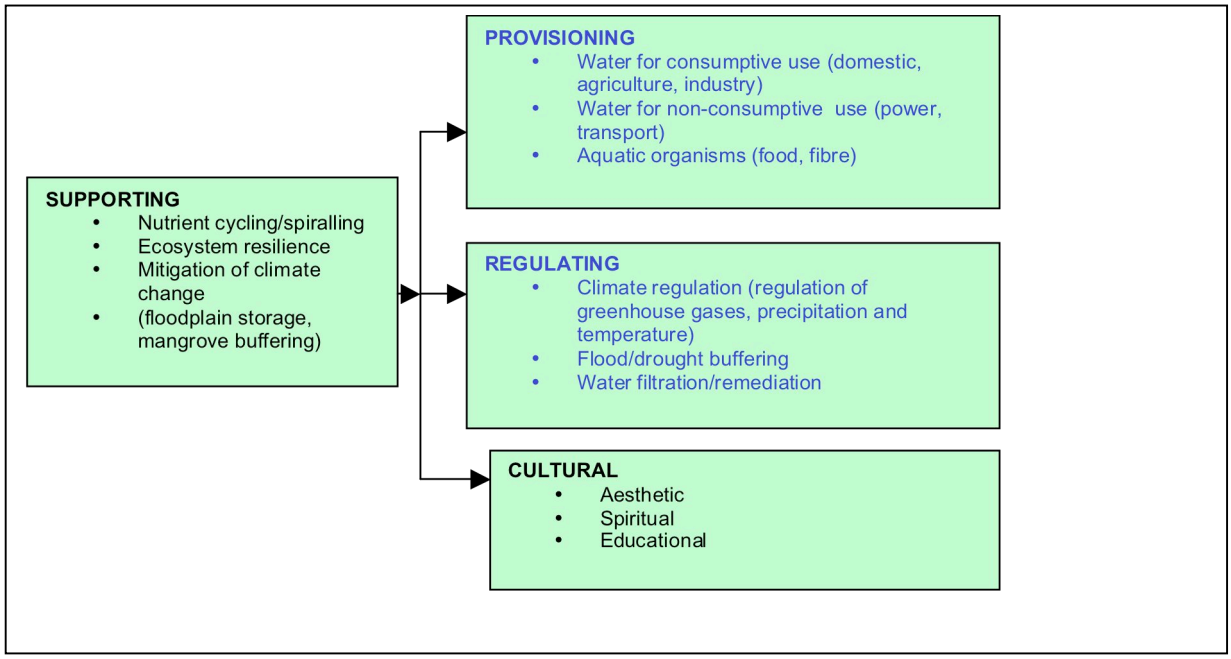

Figure 2 Water Related Ecosystem Services

The key scientific question is: how resilient is the system and in which way is its capacity for resilience heading? Is it heading towards depletion or enhancement within the desakota dynamics of mixed land use, mixed livelihoods and rapid rate of change or both? While much of the literature on ecosystems points toward declining resilience as urban economic elements increase, in some locations the reverse may be true. In the middle hills of Uttaranchal and Nepal, for example, increasing access to non-farm labour markets appears to have "pulled" populations out of farming on marginal hill lands encouraging, in the process, the re-growth of forests. A similar process enabled the re-growth of forest throughout northern New England over the last century. Resilience and the ability of upstream regions to provide regulating services may as a result have increased in these specific cases. In other cases, however, the development of desakota systems has clearly increased pressure on environmental systems and the services they provide.

From a social science perspective, understanding the systemic factors that encourage maintenance or destruction of ecosystems in desakota regions is, as the institutional section above discusses, a major gap. Such gaps are also present where the natural sciences are concerned. In the natural sciences, gaps in understanding at macro, meso and micro levels are major. The manner in which riverine ecosystems change as drainage patterns are altered at local, regional and basin scales remains poorly understood. Flood control, for example, is still largely conceptualized as regulation of river flows. In many desakota regions, however, it may be more an issue of changing landuse patterns eliminating the buffering capacity of wetland ecosystems and constraining drainage. Similarly, while the IPCC AR4 conclusions of global climate change are fairly robust at the global macro scale, they begin to lose robustness as they go down the scale. This is best captured in the fact that the entire meso-scale Himalaya-Hindu Kush region is a 'scientific gap' in the IPCC AR4. Gaps in scientific understanding become even bigger as one approaches the micro scale. The dynamics of natural science/social science inter-linkages is captured in the following diagram. (See Fig 3)

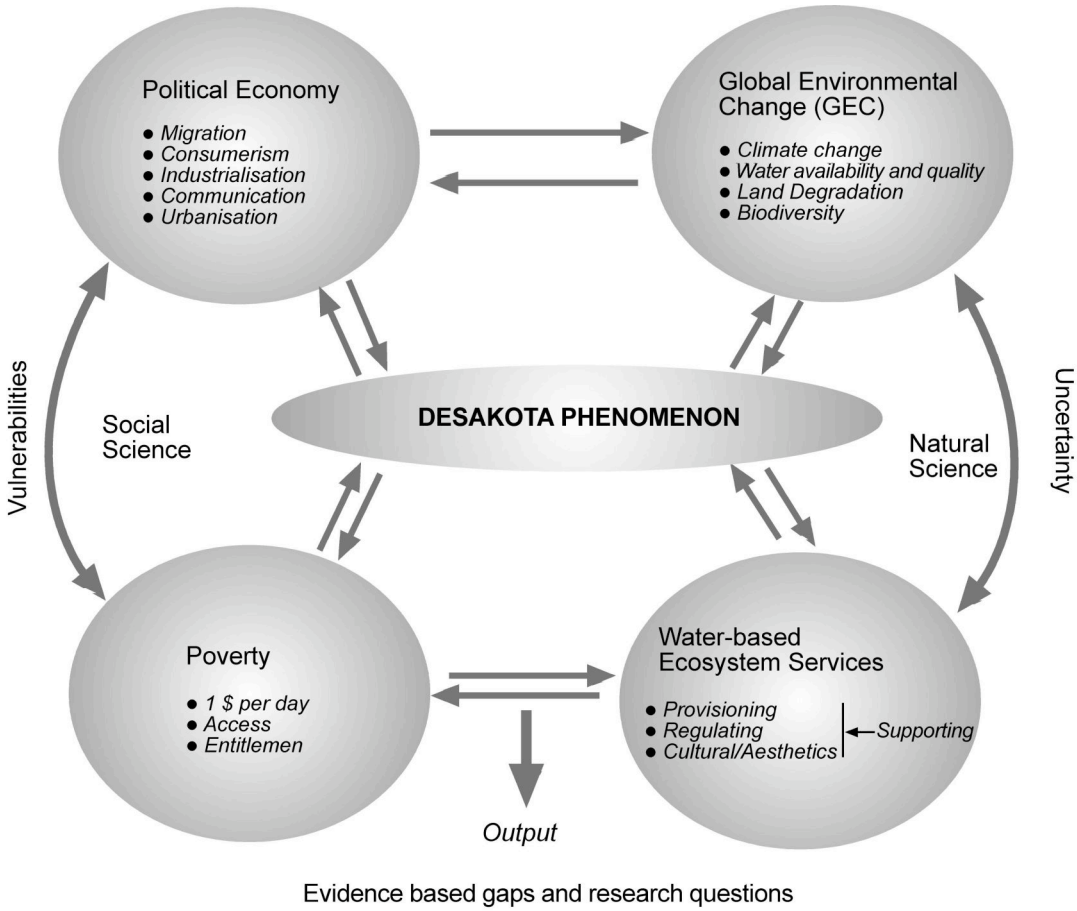

Figure-3 Conceptual Framework of Interlinkages in the Desakota Phenomenon

The desakota region, for the purpose of our study, can be conceived of as surrounded by four areas of interlinked rapid change: the overall political economy characterized by migration, urbanization, consumerism, industrialization and communication; global environmental change in climate, water availability and quality, land degradation and loss of biodiversity; water-based ecosystem services that, under global environmental change are unable to provide the benefits outlined above; and finally poverty in absolute as well as access and entitlement terms that are heavily influenced by the dominant political economy.

The natural science/social science tasks lie in examining the linkages between the last two (poverty and ecosystem services) within the context of the political economy and global change.

Regional Differences and their Conceptual Implications

Major differences may exist in applying desakota concepts to China, Latin America, Africa and South Asia. Desakota concepts initially emerged in the Asian context. While urbanization processes (which are closely linked to desakota phenomena) are strong trends across most parts of the world, they have progressed in different ways and at different speeds in different regions. Latin America has experienced a higher degree of urbanization much earlier than, for example, either Africa or South Asia. China's urbanization process and the change in its economy have been much more abrupt.

The above regional differences may have significant implications for the nature of desakota systems and the role of ecosystem services play within them. In Latin America, for

example, conditions may fall more at the urban end of the spectrum with issues such as flooding and the regulating services of ecosystems playing a much larger role in comparison to the provisioning services that probably dominate more rural desakota regions of Africa. At the same time, there may be very large parallels between all regions with regard to the institutional disjuncture discussed above and the role of informal institutions. The role of informal water markets has, for example, been a very sensitive issue in both Latin America and South Asia despite their greatly differing level of urbanization.

Differences such as the above may require substantial refinement of desakota concepts if this becomes a major focus within research programs. Ultimately such differences are likely to translate into significant differences in the applied research issues of relevance within different regions. At the same time, however, comparisons between regions may lead to the identification of social and natural scientific commonalities that can serve as a foundation for the development of strategies that respond to fundamental elements of social behaviour and ecosystem dynamics.

The Ecosystem context and relationship to desakota

The processes driving the growth of desakota economic structures and those both contributing to and mitigating ecosystem degradation intersect in fundamental ways.

The growth of desakota systems is, in many ways, equivalent to the growth of energy-intensive livelihood systems. Increases in mobility are an inherent feature of desakota systems. Rather than depending on local resources as the primary basis for local livelihoods, people in desakota systems migrate or commute to work, produce and consume products for and from distant markets and often engage in relatively high energy intensity forms of production whether in agriculture or manufacturing. A recent article in the International Herald Tribune on the spread of inexpensive Chinese motorcycles across Asia illustrates the change well. Whether people are transporting themselves to work or vegetables, milk and products from small industries, the paved road and motorcycle are enabling features in the transformation of entire regions (Fuller 2007). Overall, diversification, intensification and mobility…key features of the desakota system….all depend on or are enabled by access to energy.

The intensification of energy-based livelihoods has clear implications for greenhouse gas (GHG) emissions and thus for climate change. Transport and the growth of manufacturing are obvious areas where this occurs since most systems depend on fossil fuels. It also is, however, present in other elements of the economy. In India, for example, expansion of groundwater irrigation, the foundation of much agricultural intensification, represents a huge increase in the energy intensity of agriculture and contributes directly to increases in GHG emissions. According to a modeling study by the Indian Institute of Management (Shukla et al. 2003):

> "Under the present condition, every meter change in the ground water table will mean a change of 4.374% in GHG emission for Haryana and 6% for Andhra Pradesh considering all other variables remaining constant.
>
> "For every percentage increase in cropping the GHG emission increased by 2.2%. The cropped irrigated area has increased by CAGR 3 % per annum in 1990s and hence the total impact of cropped area under irrigation on the GHG emission is 6.6% per annum.
>
> The GHG emission increases by 2.2% for every percent increase in the share of ground water irrigation."

Perversely, many of the courses of action that increase the energy intensity of livelihoods in desakota regions are also central elements in the courses of action individuals, households and communities take to adapt to climate change. As a set of field studies undertaken by ISET and our partners in the Gangetic basin documented, the first three factors contributing to the ability of communities to adapt to floods and droughts involved:

1. Diversification of livelihood systems;
2. Increases in commuting and migration;
3. The ability of information, goods and services to flow in and out of regions (Moench and Dixit 2004).

Conceptually at least, the impacts anticipated as a consequence of climate change are likely to intensify the evolution of desakota dynamics and, unless the energy requirements of desakota systems can be derived from "green" sources, the reverse will be true as well – the growth of desakota systems will increase energy demand and exacerbate climate change processes. The dynamics go well beyond diversification, mobility and transport. Returns to scale may, for example, intensify the desakota process as climate change proceeds. If climatic variability increases, small farmers who lack the "deep pockets" to absorb short-term losses are likely to be driven out of business. This is likely to contribute to increased urbanization and dependency on non-agricultural activities for basic livelihoods of the poor. It may also encourage the growth of large diversified agribusinesses and the enclave institutions they are associated with. Large organizations, particularly ones that are able to operate in multiple parts of the world and grow multiple crops, would have comparative advantages due to their ability to reduce exposure to location specific climate risks and disaster losses.

Overall, the growth of desakota types of economic systems is likely to serve a dual role in relation to climate change. The diversified livelihood options they represent could serve as a major pressure-release valve enabling populations to adapt (Start and Johnson 2004). At the same time, unless the energy required to "run" such systems can be provided in ways that don't depend on fossil fuels, the desakota process will tend to increase GHG emissions and thus exacerbate climate change concerns. As a result, major challenge for research is to identify ways in which the underlying systems enabling adaptation can meet the needs of affected populations, particularly the poor, without increases in fossil fuel use.

The dualistic nature of desakota systems is also likely to be present in relation to other environmental resources and the ecosystems on which they depend. On one hand, as previously argued, populations having access to the mixed livelihood baskets, resources and mobility, present in desakota regions often have tremendous advantages. Access to non-farm systems can pull pressure off marginal lands enabling greater production of provisioning, regulating and esthetic services. This appears to have occurred in parts of the Himalayan region in India and Nepal where marginal agricultural lands have returned to forest as populations obtain access to better sources of income and reduce their dependency on wood as a primary energy source. In this case, populations including the poor may have both better access to the ecosystem services on which livelihoods traditionally depended (e.g. forest products, clean water, etc…) and access to income opportunities and other goods from more urban elements of the economy. In such systems, the mixed nature of the system can buffer problems that emerge from either the "urban" or "rural" elements of the livelihood basket.

At the same time, the growth of desakota systems can concentrate pressures on ecosystems and the services they provide. Water resources in many peri-urban or mixed economy areas are subject to severe pressure from a combination of agricultural, local non-

farm and urban demands. This pressure stems from increasing demand for water from all sectors, increasing pollution from all sectors and alteration of the landscape (Bradford et al. 2003, Douglas 2004, McGranahan et al. 2004, Allen et al. 2006a). The combination of pressures often results in the creation of highly polluted and areas that face high levels of exposure to floods and droughts. As has been widely documented, vulnerable populations are often concentrated in such areas.

Overall, as a result, the relationship between desakota systems and ecosystem condition depends heavily on the relative balance of pressures created. This could be seen as another "location specific" issue. Commonalities may, however, exist that determine whether or not the evolution of desakota systems represents a net increase or net decrease of pressure on ecosystems. In the energy case, for example, this balance is heavily influenced by the availability, economics and overall access to alternatives to fossil fuels. In the forestry case, it probably depends heavily on the economic value of marginal lands under non-forest uses and the ability to develop institutions for forest protection that are compatible with inherent incentives in the desakota environment. Where water is concerned, the balance of pressures may depend heavily on the nature of institutions and whether or not those are able to mitigate and respond rapidly to changing conditions.

Globally, for example, water development in urban areas tends to follow a similar pattern. Initially urban areas depend on local sources, streams, springs and groundwater. This dependency often increases to the point where pressures become clearly unsustainable – at which point urban areas generally invest in transporting supplies from distant areas. Once this is done, local water resources, including groundwater, often recover (Foster et al. 1998). The relative balance in this case is heavily influenced by the presence or absence of an effective urban administration that can coordinate the large projects essential to "bring water in." In most desakota regions, such formal institutions don't exist, most institutions are informal and strategies for responding to the dualistic nature of such regions must recognize and, where possible, build off the informal institutions present (Ahmed and Sohail 2003, Allen et al. 2006b). As a result, it is important to understand the nature of the informal institutional world.

The Informal world

The desakota region is characterized by a mix of the formal and the informal economic activities, with – as this section will argue – a larger degree of informal than in the purely urban areas but less than in the purely rural end of the spectrum with its predominantly natural resource based (in some cases subsistence) economy (Tacoli 2002, Aberra and King 2005, Thanh et al. 2005). It is important to emphasize this in connection with both the understanding of poverty as well as the management of natural resources. Too often, the conceptual debates around poverty alleviation have concentrated on "economic growth" assuring its actualization (Cooper et al. 2005). While it is undoubtedly true that economic growth is necessary to generate and sustain the flow of resources necessary for poverty alleviation, it alone, without the requisite institutional vehicles, will not assure that the well-meaning measures will even reach the poor. The role of the state, which work along the formal system, as well as other institutional instruments – self-help groups, clan networks etc. – that rely on more informal arrangements, are crucial to the understanding of how actual economies work in the clumsy space called desakota. Focusing only on the formal can mean bypassing the poor who often have to make do in their everyday living within the informal system.

The informal economy, it is argued, is the socio-political response of the poor to their economic vulnerability in the face of national and global pressures over which they have little

say. It predominates over South Asia and its size is a subject of an unresolved debate. This is all the more so when there are increasingly frequent questions being asked about the size and nature even of the formal economy. Some speculate that the informal sector is much larger than the formal economy, maybe even as high as 90% of the total economic activity in a predominantly rural country like Nepal. But it all depends upon how and what one counts. Even in a more measurable sector such as finance, informal credit to by indigenous bankers accounts for one-twelfth to one-half of all credit to different categories of industrial units (Chandavarkar 1987).

Jagannathan (1987) uses the concept of informal property rights to describe the informal economic processes. His basic distinction is between property rights protected by the formal legal system, and informal property rights protected by self-policed contracts which are used to appropriate incomes from either existing assets and tangible resources or intangible property rights and social assets. He estimates that this sector would cover economic transactions anywhere between 30% and 70% of a country's gross national product. It covers the bridge between most rural markets and the rapidly growing chaotic urban transactions from those of slum dwellers to family firms where perceived economic opportunities are seized upon by the poor to earn their livelihood. These opportunities are utilized through voluntary agreements that are remarkably stable and serve as effective substitutes for many institutional deficiencies in the formal sector.

Smith (1989) defines the informal sector as one that produces goods and services, some of which are marketed, but which for various reasons escape enumeration, regulation, or other type of public monitoring or auditing. It covers all activities in which people engage to augment deficiencies in income or consumption opportunities in the formal sector, from underpaid civil servants moonlighting or soliciting "grease money" to rural migrants to the city who must attempt to market what skills they have and find jobs where they can, whether they are legal or not. It also includes pastoralists suddenly finding their transhumant movements impossible because of new international or administrative borders. This last example is significant in Nepal's case (and perhaps for Pakistan and India as well): with the advent of Chinese control over Tibet in 1950, the transhumants of northern Nepal suddenly found that, in Smith's general phrasing also applicable to Nepal, "a traditional move from summer to winter pasturage became an illegal border crossing; gifts and other exchange items became contraband". Such pastoralists from Manang and Mustang in the north, finding their subsistence survival at stake, were the first to exploit any economic opening they could discern: instead of bringing in salt on yak backs from Tibet, in the 1970s they were able to bring consumer items from Hong Kong on Boeings to cater to the large demand in Nepal and eventually India.

Thomas (1992) sees several types of informal economic activities all of which have the common characteristic that none of them are fully recorded in the national economic accounts, but differ in whether they involve market transactions and whether their output as well as distribution are legal or illegal. The household sector activities are legal but involve no market transaction and are excluded from national accounting. The informal sector production (involving small scale, often self-employed, producers in commerce, transport and cottage industry) also do not break any laws but the output enters market transaction. The irregular sector activities have outputs that are legal (such as redecorating a house through an informal builder), but the production and distribution of these goods and services involve some illegality (such as tax evasion). There is finally the criminal sector where significant market transactions take place but both the product (e.g. drugs) and its production and distribution are illegal.

What these definitions do is re-define the boundary of our understanding of economic activities to include the vast reality of coping with everyday living that the majority of the population in developing countries indulge in, but which has yet to see academic insights, policy foresights or legal hindsights. Managers of the formal national economies have a tendency to classify these extensive set of activities as illegal or heavily dutiable; but even when they are so classified it is nearly impossible to do anything about them. In the example of the Manangi Hong Kong traders mentioned above, all attempts to control the import of luxury items in personal baggage only ended up increasing the rent-seeking value of a customs posting at Tribhuban International Airport without making a dent on the volume of items imported. That reduction only occurred when India began liberalizing under the tutelage of Narsimha Rao and Manmohan Singh, making large volume imports for subsequent disbursement in India unfeasible.

In resource management, perhaps the best example of the formal forgetting the informal reality to the detriment of both is the irrigation sector. Of the total cultivated area, 52% is non-irrigable, and of what remains, in the hills, most of the irrigable area is already under some form of irrigation developed by farmers through the ages. Only a very small portion has resulted from decades of government intervention. The former are generally referred to as "farmer managed irrigation systems (FMIS)" and the latter "agency managed schemes" through central government intervention. The story repeats itself in the Tarai, with some increase in agency developed large irrigation schemes. These FMIS are basically in the informal system, despite attempts by the state to bring them under classification and registration.

One difficulty in estimating how much irrigation there is in Nepal lies with the very definition of irrigation. There has been a tendency to count as irrigation only that which has been under some form of formal agency intervention with modern cement technology. The small FMIS irrigation systems often employ simple but effective "brush wood" dams on small streams which are economic enough to build and fall within the farmer's capacity to rebuild after they are washed away by floods, while the state-constructed massive concrete structures are not, given the extreme and violent nature of Himalayan hydro-geology. Such irrigation systems have not been properly inventoried and the state is only dimly aware of their existence. This transfer of risk resilience capacity from village to state has been the hallmark of much of state-led development intervention in the field of irrigation, and the transition from the informal to the formal. It has a direct bearing on the understanding of poverty and its alleviation.

Estimates of the area of land under irrigation could, in principle, be arrived at from land taxation records; but in reality this is not easy. In the past, there did exist a classification system that differentiated land as per its productive potential. For taxation purpose, the state classified land as *abal, doyem, sim* and *chahar. Abal*, the highest quality land, was land that could comfortably grow two crops of rice and hence was in all probability well irrigated. This classification is still valid for the revenue agencies but has not been internalized by the irrigation department whether in its engineering or financial planning. Even within revenue agencies, there has not been a systematic effort to monitor and refine land classification, especially land that is falsely classified as of lower category to take advantage on taxes. A joint effort by the revenue, the irrigation and the agriculture departments – together with empowered local bodies – may have succeeded in finding out how much land is under farmer managed irrigation systems and of these how much need civil engineering upgrading if at all; but these agencies do not talk to each other as there exists no underlying political imperative to do so.

The failure to consider taxation as an institutional tool which, besides raising revenue, assures that assets be maintained at optimal productivity to successfully offset the tax burden and thus leads to better returns has been the bane of land management in Nepal. Land tax is negligible: although agriculture is said to contribute 60% to the GDP, land revenue provides less than 1% to the state's revenue. The inability to integrate state level irrigation intervention with attempts to reclassify irrigated or irrigable land through a sensible tax frame is one more indicator of the divorce of state irrigation activities from farming and their sequestering into a pure civil engineering effort. In the process, the real farmers were slowly edged out of the formal into the informal economy, many of them pushed into informal tenancy. A similar "data mismatch" occurs in forestry and the use of forest products by the informal economy (Gyawali, 2004).

A question is often asked: why should the informal ("primitive" to some of the modernists) not be brought under the formal as quickly as possible? Is not allowing the informal to remain that way a romanticizing of the "noble savage" and against the very ethos of modernization and development?

The answer is simple: given the imperatives and stress of change no structure, formal or informal, will "remain that way". The real question is: how is the change to be effected, by whom, how fast, with what proportion of winners and losers, and with what degree of participation by those whose lives are being changed sometimes so violently? When phrased this way, the history of marginalization of the poor is seen in sharper context, with ethnically or geographically vulnerable groups being the first to pay the price of losing their social and physical assets. And the real answer is to be found in the process by which this change occurs. In the formal procedures for subsuming the informal under it, the process of marginalization of the poor moves forward at an accelerated pace as the example of irrigation management in Nepal show.

To borrow another example from across the world, an experiment was conducted by Hernando de Soto and his Institute for Liberty and Democracy in Lima, Peru which showed that officially registering a small business, whose workshop consisted of nothing more than two sewing machines, took 289 working days, the equivalent of 32 months' income at the minimal wage (Plattner 1991). Experience indicates that, if grassroots NGOs repeated this experiment in South Asia, they would arrive at similar results. This is another common instance of a rent-seeking state creating very high transaction costs of operating in the formal sector, the very costs that are at the root of a dynamics of marginalization and vulnerability of the poor.

At the root of the desakota lies the social resilience in adapting to new circumstances. It is often forgotten that the formal or informal institutions in these areas are under the stress of change, and the decisions that are daily taken within them are often an expression of underlying political relationships that involve hedging bets and making compromises. The degree of decentralization (the reach of central decisions) is reflected in the capacity of political manoeuvrability of the local political institutions (Jarvela, 2007). The market driven, decision making processes of the informal economy are enmeshed in these processes.

The issue of institutional reach

The large role played by the informal economy and informal institutions in desakota systems has, as argued at various points above, major implications for the ability to manage ecosystems in ways that maintain key services. Within desakota contexts, many of the

institutions on which resource management systems are founded in both "traditional" rural areas and "modern" generally more urban zones have a limited reach. This is illustrated in the accompanying diagram

The reach and influence of traditional rural institutions decline as one gets further away from the rural heartlands towards the metropolitan areas. Similarly the reach of formal markets as well as central governmental institutions (aside from those that create and operate within enclaves) diminish as one heads towards the rural hinterlands as distance from the generally urban power centers increase (McGregor et al. 2006). The fuzzy region in the center where the hegemony of both is minimum is the desakota region. The power of traditional forums for governance, such as the Indian village Panchayat or the farmer organization for managing irrigation systems has generally decayed – but it has not been replaced by strong formal institutions. The "reach" of municipal corporations or similar "strong" urban institutions that often engage in resource management extends only to their borders or to enclaves of particular importance to the urban area (such as the location of a dam for water supply).

The desakota region itself is characterized by an institutional "clumsiness." Traditional informal, emergent market and weak formal institutions all often exist in parallel. The strongest institutions in such regions are probably the market and banking networks that allow goods and finances to flow in and out of regions. Such network institutions have historically not been viewed as playing a key role in the management of ecosystems or access to ecosystem services. This said, they clearly do play such a role. Tanker markets, for example, are the core mechanism via which people in some desakota regions obtain access to water for domestic and other uses (Ahmed and Sohail 2003, Llorente and Zerah 2003). Remittance income flows, another characteristic of desakota regions, occasionally are used to finance the creation of major semi-formal institutions that deliver services, including ecosystem management, to local populations. This is, for example, the case with the Gurkha Welfare Trust in Nepal. Given their internal diversity and the reduced role played by both traditional and formal government institutions, desakota regions may provide space for the incubation of new institutional possibilities. Catalysts that enable such "possibilities" to emerge as "realities" will, however, be essential. Identifying catalytic points where catalytic change can be achieved that result in the protection of ecosystems and ensures the poor access to critical services is a major challenge. The starting point toward this is, we believe, to recognize and build off "what people actually do" – that is the relationships and institutional structures that are emerging within desakota regions as people go about their daily lives. There are good reasons why the institutional reach of both traditional forms of organization and "modern" centrally structured management organizations is poor in desakota regions. Other points of entry, possibly targeted at strengthening and enabling the associations people create as part of their livelihoods, need to be explored.

Desakota Poverty and Ecosystems Services

Defining poverty is a complex task. Economic measures, such as the $1/day income standard, don't capture the multiple factors that influence whether or not people see themselves as "poor" and are only weakly related to the factors that enable or constrain the ability of individuals and households to move out of poverty (Narain et al. 2005). For this reason, in the case studies that form a core part of this review, descriptions of poverty emphasize how people within communities see themselves and others. This self-definition of poverty is much more closely related to the causes of poverty than abstract income measures. Why people are viewed or view themselves as "poor" can often be tangibly related to specific causes that may range from household structure to education or access to common lands or

common institutions. As a result, this perspective on poverty may assist in identifying avenues for poverty alleviation that are only partially related to increases in income *per se*.

The literature on ecosystems services and poverty has two well-established strands:

1. What might be called the "provisioning" strand: This focuses on the role of common lands, forests and water resources as income sources for the poor. Much of the literature here emphasizes the role common grazing lands, forests, etc…play as direct income sources in the livelihoods of the poor, particularly in rural areas. Fodder, fuel, minor forest products, and so on are central elements supporting the livelihoods of most "rural" livelihoods and some more urbanized ones (Vedeld et al. 2004, Gregory 2005, Borner et al. 2007). Much of the literature from this strand has found that the fraction of total income derived from common-pool resources decreases with income and thus, that strategies for improving ecosystem condition will particularly benefit the poor. More recent analyses, however, suggest that the relationship between use of common-pool resources and income is much more complex with relatively more wealthy households also having increased reliance on common-pool resources for income (Narayan et al. 2000). Overall, however, studies have found that improvements in ecosystems, i.e. general biomass availability, directly benefit rural livelihoods.
2. What might be called the "exposure" strand: This focuses on the concentration of poor populations in locations that have a high exposure to hazards such as flooding and locations where human activities (such as waste disposal) contribute directly to the degradation of the environment. Cause and effect are intertwined in this strand: poor populations are located in flood prone locations because property values are lower (no one else is willing to settle there) and it is the only location they can afford; poor populations are exposed to pollution loads because they lack the political power to prevent disposal of toxic substances and waste where they live. As with the provisioning strand, the association between vulnerable populations and vulnerable locations is not absolute. As the high death toll among wealthy tourists during the Asian Tsunami in 2004 demonstrated, rich populations often chose to enter high-risk locations for reasons that range from esthetics to lack of knowledge (Moench and Stapleton 2007).

A third line of analysis that hasn't been widely articulated in the ecosystems services – poverty literature, but that has been relatively widely explored in the literature on urban water supply focuses on the delivery of services through markets and formal institutions such as utilities. In the case of water markets, for example, the poor generally pay more for water services than the rich first because they aren't served by public systems and second because they are unable to purchase bulk supplies – the per liter cost of a full 6000-12000 liter tanker load of water is generally a fraction of the amount charged when water is purchased in 1-10 liter increments. This set of relationships may be particularly important in desakota regions where populations no longer have direct access to ecosystem services and need to rely on intermediary organizations (water, fuel, fodder, etc… markets and organizations) to deliver those services.

What does all this mean for the relationship between poverty – whether defined on the basis of pure economic criteria or the relative perceptions of local populations – and ecosystem services within desakota systems? It means that the link, while likely to be strong, is heavily mediated by the nature of intermediary organizations and systems. The link is likely to have the following elements:

1. Second order linkages are likely to increase and be mediated through market institutions that create a price for food, water, etc… (mostly provisioning). This will

reflect the growth of secondary or tertiary market institutions for provisioning – e.g. reliance on water markets, imported food, fuel, fodder, etc… where production depends on ecosystems that may be relatively proximate or quite distant but where most users don't have day to day access. In this case, the question of equitable and affordable access by the poor to provisioning institutions will be central to the ecosystem service-poverty linkage.

2. Continued first order dependency for many groups, both the "poor" and the relatively "wealthy" on ecosystem services for provisioning: fuelwood, fodder, food (particularly the high value fresh produce and meat elements that tend to be produced locally), water, etc… as core inputs to livelihoods. The nature of this dependency will be mediated by the diverse "clumsy" mix of traditional, formal and emergent institutions in desakota regions. Here the mediating role may be primarily influenced by factors that constrain or enable the ability to organize.
3. First order linkages between poverty and ecosystem services probably increasing in relation to health (more exposure to pollution, etc…) and disaster risks. There is likely to be growing (or more evident) dependence on the regulating functions of ecosystems for marginal communities. Increases in flooding, for example, affecting those living in the flood plain. In many cases this will be linked with the question of waste disposal – flood plains are often selected as the site for municipal and other waste disposal. This increases both water pollution and flood hazards resulting in a double health and disaster risk impact on local communities. Here again possibilities for mediating this linkage may be primarily influenced by factors that constrain or enable the ability to organize.
4. Second order linkages probably increasing in relation to land, location and possibly technology access, again primarily through market mechanisms. Where flooding is an issue, for example, houses and assets of the wealthy tend to be clustered in high locations – raised villages or in major urban centres (such as Dhaka) upper story apartments. This is true as well where air and water pollution are concerned – the wealthy often buying assets in less polluted locations. The primary mediating institutions in this case are the market and land tenure systems.

Points of entry for change: Where does the conceptual lead?

Where do conceptual frameworks for understanding desakota systems and the linkages between poverty and ecosystem services within them lead? The core motivation for this review is to identify mechanisms or practical points of entry for alleviating poverty and maintaining the basic ecosystems that supply key services on which livelihoods either directly or indirectly depend. The current gap review is a first step where the immediate purpose is to identify lines of inquiry, research, capacity building and experimentation that will contribute to that larger objective.

The conceptual review above points toward at least two lines of inquiry where it may be possible to catalyze major changes that address the complex interlinkage between ecosystem services and poverty in desakota environments. The first of these relates primarily to institutions of the desakota: specifically avenues for working with the complex, clumsy, informal structures that characterize this zone. The second, perhaps surprisingly, focuses on interlinked technological and institutional systems.

Institutional Entry Points

As argued above, the most common institutional frameworks for ecosystem management, (community-based and more centralized governmental structures) face tremendous challenges in desakota regions. Their "institutional reach" into such regions is weak and, as a result, they have limited ability to address the inherent challenges in managing ecosystems. Community institutions are often declining as the nature of communities shifts from being geographically defined to associations based on networks of activity that often span long distances. At the same time centralized governmental structures for managing ecosystems have a difficult time "pushing their way down" and responding to the dynamic complexities inherent in desakota contexts. Like rainclouds in the desert, they appear formidable from a distance…but the rain often evaporates before it hits the ground. They can be effective in establishing enclaves (protected areas) but such enclaves rarely benefit the poor.

Avenues of inquiry for addressing the ecosystem services – poverty equation that move beyond community-based and more hierarchical governmental management strategies have not been widely investigated. Potential points of entry within the institutions of the desakota do, however, exist. In specific, rather than attempting to manage ecosystems through centralized or community-based organizations, enabling frameworks could be created that would encourage organizations to form by building on existing networked patterns of association. With support, such organizations could begin to address many of the ecosystem issues that contribute to poverty in the areas where they exist. In some ways the "bottom-up" enabling philosophy here is similar to that underlying recent work on community-based institutions – but the focus would be on networks and associations (communities of interest) rather than on geographically defined groups (villages, etc…).

As described above the potential we see in this approach is highly abstract. A practical example from Tamil Nadu may help to illustrate it. In a major desakota region of Tamil Nadu, growth of the tanning industry (primarily through small-scale entrepreneurs) has created very major water pollution and availability problems that have a very direct impact on irrigation and domestic water supply availability for farmers (Janakarajan and Moench 2002, Janakarajan 2003). In this region, organizing activities assisted by researchers from the Madras Institute of Development Studies assisted local farmers in the formation of an association and the initiation of dialogue with representatives from the tannery industry. This dialogue resulted in the identification of practical mechanisms for reducing pollution loads (in specific, freezing rather than salting hides). The interaction between these two groups was enabled by:

1. The catalytic inputs from MIDS researchers in helping dispersed sets of farmers and factory owners (each group linked in their daily activities but not through a formal structure) to organize and initiate a dialogue process. The groups were, in essence, created by catalyzing organization within groups associated by common activities rather than location;
2. The presence of regulatory standards established by the state. These water quality and pollution standards weren't enforced (the state lacked the resources or will to police them) but their existence gave farmers a "hook" that was widely recognized by all including the tannery owners.

To return from the example to the guiding concepts; the creation of organizations for responding to environmental management needs in desakota regions may be possible by building off existing patterns of association. These are generally based on shared forms of work (as in the Tamil Nadu example) or shared activities. Where shared activities are concerned, opportunities may exist in relation to other networks that create tangible,

functional relationships between people. Specific opportunities could, for example, exist in association with:

1. Financial and banking systems: Self-help groups and other associations that through the shared banking function, have a core set of on-going tangible activities and potential source of revenue could represent a nodal point for organization;
2. Energy (particularly electricity distribution) and similar networked physical systems such as those for irrigation and domestic water supply delivery: In the case of Nepal, for example, regulations enabling any form of user group (mothers groups, dairy cooperatives, etc..), to purchase power in bulk from the electricity network and distribute it to their members have catalyzed the formation of hundreds of such groups. Many of these groups are based around functional patterns of association (e.g. farmers, dairy, etc…) rather than "village communities." Many undertake a variety of activities in addition to power distribution.
3. Industry, farm and other sector-specific associations. In India, for example, the associations of dairy cooperatives that operate across some states have become actively involved in basic resource issues that affect their membership. This is particularly true in Gujarat where the cooperatives have been active on groundwater overdraft issues since the early 1990s.

In all of the above cases, the initial reason for organization was related to tangible activities that link groups with common needs or work areas. In all of the cases, the activities also have an underlying business model related to their function that gives them access to revenue and an organizational structure. The ability to create proactive organizations utilizing on patterns of association in networked institutions that actively address ecosystem and poverty concerns would be assisted by:

- The presence of catalysts that first encourage such organizations to form and second assist them in recognizing and beginning to address ecosystem and poverty issues;
- Legal frameworks that enable organizations to form, raise resources, and take action;
- Higher level regulatory or other standards that, even if not widely enforced by the state, can provide a "hook" or point of leverage;
- Lowering the barriers of entry for access to existing formal institutions (i.e. making access to the courts and other institutions for regulation and management as easy as possible, making the formation of an organization as simple as possible).

Overall, the core idea here would be to explore enabling frameworks that encourage new forms of organization to emerge by building off existing, generally networked, forms of market or function-based association in desakota regions. These new forms of organization could actively mediate the relationship between ecosystem conditions and poverty if they were designed or catalyzed in ways gave ensured poor and vulnerable communities both voice and lowered the barriers of access to power. Isolated cases of this type of institution exist – but their potential has not been widely explored. The potential, however, could be quite high.

The structure of technologies and how those relate to institutions is also important to recognize. Network technologies, such as electric power, financial and water systems, can serve as structures enabling organizations to form around communities of interest or functional activities such as those common in desakota areas. Organization transforms what were once individual actors working within a networked market, into an organized structure that can raise resources and could, at least in theory, contribute either directly or indirectly to the maintenance of ecosystems and the services they provide.

The argument underlying this is important to recognize. Given the chaotic institutional nature of most desakota regions and the "lack of reach" for both modern and traditional institutional forms, catalyzing any form of organized structure is an essential first step toward ecosystem management. Using power and other similar networked systems as a structure for catalyzing the formation of institutions begins to address the question of institutional "reach."

Technology and Institutions

As argued above, many of the core features of the desakota environment are catalyzed and enabled by technologies. Communications (particularly the cell phone), energy and transport systems are the "rails" enabling emergence of desakota dynamics. Energy and transport are the basis for most non-farm and intensified farming activities. Along with high quality communication systems they are also the foundation that enables market and other network institutions to operate. Unfortunately, even for communication systems they are also the main sources of pollution and many of the most destructive impacts on ecosystems (Carroll 2008). At the same time, improving access to communications, energy and transport – which then enables access to higher income and more diversified livelihood strategies – may represent a powerful mechanism for poverty alleviation, income diversification and generally increasing the resilience of society in relation to climatic change and other sources of variability.

Given the above, encouraging the development and penetration of "environmentally benign" energy and transport systems into desakota regions may represent a key avenue for both alleviating poverty and mitigating some types of negative impacts on ecosystems and the services they provide. The rapid spread of inexpensive motorcycles has, on one side, been widely criticized in relation to their environmental impacts and, on the other side, been recognized as contributing to the evolution of markets and income opportunities. Mobility and flexibility, both of which are enabled by transport and communication systems, are central to the ability of populations to adapt to climate change, settle in low hazard risk areas, build institutions, and diversify/intensify livelihood activities. Achieving this without exacerbating climate change and other ecosystem concerns depends, at least in part, on access to and penetration of low impact technologies.

As argued in the preceding section, the relationship between technology, environmental services and institutions extends beyond the first order question of access to "green" technologies. As suggested by analyses of change following natural disasters, the strength of underlying systems that enable adaption and contribute to the resilience of livelihoods may have far more impact on risks than more target "risk-specific" courses of action (Moench and Dixit 2007). This may also the case in desakota regions where the relationship between ecosystem services and poverty is concerned. Research, experience and capacity in relation to this is, however, severely limited.

Bibliography

Jagannathan, N. Vijay, 1987. Informal Markets in Developing Countries. Oxford University Press.

Smith, M. Estellie, 1989. The Informal Economy. In Plattner, S. (ed) Economic Anthropology. Stanford University Press.

Thomas, J. J. 1992, Informal Economic Activity. London School of Economics handbook in economics. Harvester Wheasheaf, UK.

De Soto, Hernando, 2000. The Mystery of Capital – why capitalism triumphs in the West and fails everywhere else. Basic Books, New York.

Aberra, E., and R. King. 2005. Additional Knowledge of Livelihoods in the Kumasi Peri-Urban Interface (KPUI), Ashanti Region, Ghana. Development Planning Unit University College London, London.

Agrawal, A., and C. C. Gibson. 1999. Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation. World Development **27**:629-649.

Ahmed, N., and M. Sohail. 2003. Alternate water supply arrangements in peri-urban localities: awami (people's) tanks in Orangi township, Karachi. Environment and Urbanization **15**:33-42.

Allen, A., J. D. Davila, and P. Hofmann. 2006a. Governance of Water and Sanitation Services for the Peri-urban Poor: A Framework for Understanding and Action in Metropolitan Regions. Development Planning Unit, University College London, London.

Allen, A., J. D. Davila, and P. Hofmann. 2006b. The peri-urban water poor: citizens or consumers? Environment and Urbanization **18**:333-351.

Borner, J., A. Mendoza, and S. A. Vosti. 2007. Ecosystem services, agriculture, and rural poverty in the Eastern Brazilian Amazon: Interrelationships and policy prescriptions. Ecological Economics **64**:356-373.

Bradford, A., R. M. Brook, and C. S. Hunshal. 2003. Wastewater irrigation in Hubli-Dharwad, India: implications for health and livelihoods. Environment and Urbanization **15**:157-170.

Carroll, C. 2008. High Tech Trash: Will your discarded TV end up in a ditch in Ghana? *in* National Geographic.

COMMAN. 2004. Community Management of Groundwater Resources in Rural India. Commissioned Report CR/04/155N, British Geological Survey, Wallingford.

Cooper, E., P. Ghazi, K. Holmes, K. Kichnak, Y. Kura, A. LaVina, D. Prager, P. Steele, W. Vanasselt, and J. Virdin. 2005. World Resources 2005: The Wealth of the Poor—Managing Ecosystems to Fight Poverty. World Resources Institute in collaboration with United Nations Development Programme, United Nations Environment Programme, and World Bank, Washington DC.

Dixit, A., M. Upadhya, A. Pokhrel, K. M. Dixit, D. R. Rai, and M. Devkota. 2007. Flood Disaster Impacts and Responses in Nepal Tarai's Marginalised Basins. Pages 119-157 *in* M. Moench and A. Dixit, editors. Working with the Winds of Change: Toward Strategies for Responding to the Risks Associated with Climate Change and other Hazards. Institute for Social and Environmental Transition-International Institute for Social and Environmental Transition-Nepal ProVention Consortium, Kathmandu.

Douglas, I. 2004. Environmental Change in Peri-Urban Areas: Report and Recommendations. Pages 7 *in* Environmental Change in Peri-Urban Areas -A Scope Project- PUECH: Fifth regional meeting, Beirut, Lebanon.

Foster, S., A. Lawrence, and B. Morris. 1998. Groundwater in Urban Development: Assessing Management Needs and Formulating Policy Strategies. World Bank, Washington, D.C.

Fuller, T. 2007. Chinese goods transform life in Southeast Asia Pages 2 *in* International Herald Tribune.

Gregory, P. 2005. A Synthesis of Peri-Urban Research of Kumasi, Hubli-Dharwad and Kolkata Peri-Urban Interfaces. Development Planning Unit, University College London, Tregaron.

Janakarajan, S. 1994. Trading In Groundwater: A Source of Power and Accumulation. Pages 47-58 *in* M. Moench, editor. Selling Water: Conceptual and Policy Debates over Groundwater Markets in India. VIKSAT, Ahmedabad.

Janakarajan, S. 1999. Conflicts over the invisible resource in Tamil Nadu: Is there a way out. Pages 123-160 *in* E. C. Marcus Moench, Ajaya Dixit, editor. Rethinking the Mosaic: Investigations into Local Water Management. ISET and NWCF, Kathmandu.

Janakarajan, S. 2002. Issues relating to official data base on groundwater resource in Tamil Nadu. Pages 23 *in*, Chennai.

Janakarajan, S., editor. 2003. Avala Nilayil Thamizhaga Arugal (Water scarcity and pollution in river basins of Tamilnadu) , first edition October 2003, printed 1500 copies, price Rs.95, Pages: 272+viii, ISBN 81-87477-59-8 -. Kalachuvadu.

Janakarajan, S., and M. Moench. 2002. Wells and Illfare: Conditions and Characteristics of Groundwater Irrigation in Tamil Nadu. *in* M. Moench and A. Dixit, editors. Understanding the Mosaic. Draft Manuscript, Delhi.

Llorente, M., and M. H. Zerah. 2003. The urban water sector: Formal versus Informal Suppliers in India. Urban India **12**.

McGee, T. G. 1991. The Emergence of 'Desakota' Regions in Asia: Expanding a Hypothesis. Pages 3-26 *in* N. Ginsberg, editor. The Extended Metropolis: Settlement Transition in Asia. University of Hawaii Press, Honolulu.

McGranahan, G., D. Satterhwaite, and C. Tacoli. 2004. Rural-urban change, boundary problems and environmental burdens. International Insitute for Environment and Development, London.

McGregor, D., D. Simon, and D. Thompson, editors. 2006. The Peri-Urban Interface: Approaches to Sustainable Natural and Human Resource Use. Earthscan, London.

Meinzen-Dick, R., K. V. Raju, and A. Gulati. 2002. What Affects Organization and Collective Action for Managing Resources? Evidence from Canal Irrigation Systems in India. World Development **30**:649-666.

Moench, M., and A. Dixit, editors. 2004. Adaptive Capacity and Livelihood Resilience: Adaptive Strategies for Responding to Floods and Droughts in South Asia. Institute for Social and Environmental Transition, Boulder, Kathmandu.

Moench, M., and A. Dixit, editors. 2007. Working with the Winds of Change: Toward Strategies for Responding to the Risks Associated with Climate Change and other Hazards. ISET and ISET-Nepal, Kathmandu.

Moench, M., and S. Stapleton. 2007. Water, Climate Risk and Adaptation. Institute for Social and Environmental Transition, Co-operative Programme on Water and Climate, Newater, Delft, Nederlands.

Mohieldeen, Y. 1999. Responses to Water Scarcity: Social Adaptive Capacity and the Role of Environmental Information. A Case Study from Taiz, Yemen. Water Issues Study Group, School of Oriental and Africal Studies, University of London, London.

Narain, U., S. Gupta, and K. van 't Veld. 2005. Poverty and the Environment: Exploring the Relationship between Household Incomes, Private Assets, and Natural Assets. Discussion Paper 05-18. Resources for the Future, Washington DC.

Narayan, D., R. Patel, K. Schafft, A. Rademacher, and S. Koch-Schulte. 2000. Voices of the Poor: Can Anyone Hear Us? . Published for the World Bank, Oxford University Press., New York, N.Y.

Noordwijk, M. v., B. Leimona, L. Emerton, T. P. Tomich, S. J. Velarde, M. Kallesoe, M. Sekher, and B. Swallow. 2007. Criteria and indicators for environmental service compensation and reward mechanisms: realistic, voluntary, conditional and pro-poor. World Agroforestry Centre, Nairobi.

Ostrom, E. 1999. Coping with Tragedies of the Commons. Annual Review of Political Science **2**:493-535.

Ostrom, E. 2000. Collective Action and the Evolution of Social Norms. The Journal of Economic Perspectives **14**:137-158.

Ostrom, E., and R. Gardner. 1993. Coping with Asymmetries in the Commons: Self-Governing Irrigation Systems Can Work. The Journal of Economic Perspectives **7**:93-112.
Plattner, S. 1991. Review: [untitled]. American Anthropologist **93**:959-960.
Sajor, E. E., and R. Ongaskul. 2007. Mixed Land Use and Equity in Water Governance in Peri-Urban Bangkok. International Journal of Urban and Regional Research **31**:782-801.
Scherr, S., J. C. Milder, and C. Bracer. 2007. How important will different types of Compensation and Reward Mechanisms be in shaping poverty and ecosystem services across Africa, Asia and Latin America over the next two decades? World Agroforestry Centre, Nairobi.
Shukla, P. R., R. Nair, M. Kapshe, A. Garg, S. Balasubramaniam, D. Menon, and K. K. Sharma. 2003. Development and Climate: An Assessment for India. Indian Institute of Management, Ahmedabad
UNECP Collaborating Centre on Energy and Environment, Ahmedabad, India.
Start, D., and C. Johnson. 2004. Livelihood Options? The Political Economy of Access, Opportunity and Diversification. Overseas Development Institute, London.
Stoian, D. 2005. Making the Best of Two Worlds: Rural and Peri-Urban Livelihood Options Sustained by Nontimber Forest Products from the Bolivian Amazon. World Development **33**:1473-1490.
Swallow, B., M. Kallesoe, U. Iftikhar, M. v. Noordwijk, C. Bracer, S. Scherr, K. V. Raju, S. Poats, A. Duraiappah, B. Ochieng, H. Mallee, and R. Rumley. 2007a. Compensation and Rewards for Environmental Services in the Developing World: Framing Pan-Tropical Analysis and Comparison. International Development Research Centre
World Agroforestry Centre, Nairobi.
Swallow, B., B. Leimona, T. Yatich, S. J. Velarde, and S. Puttaswamaiah. 2007b. The Conditions for Effective Mechanisms of Compensation and Rewards for Environmental Services. World Agroforestry Centre, Nairobi.
Tacoli, C. 2002. Changing rural-urban interactions in sub-Saharan Africa and their impact on livelihoods: a summary. International Institute for Environment and Development, London.
Thanh, H. X., D. N. Anh, and C. Tacoli. 2005. Livelihood diversification and rural-urban linkages in Vietnam's Red River Delta. International Institute for Environment and Development.
Turner, M. D. 1999. Conflict, Environmental Change, and Social Institutions in Dryland Africa: Limitations of the Community Resource Management Approach. Society and Natural Resources **12**:643-657.
Twyman, C., and R. Slater. 2005. Hidden livelihoods? Natural resource-dependent livelihoods and urban development policy. Progress in Development Studies **5**:1-15.
Ubels, J., and A. Wevers. 1996. Assistance to Capacity Building for Integrated Water Management:
a comparison of Netherlands support to water sectors in six countries. Working Group No. 4, Paper No. 8, Organisation for Economic Co-operation and Development Development Assistance Committee.
Vedeld, P., A. Angelsen, E. Sjaastad, and G. Kobugabe Berg. 2004. Counting on the Environment Forest Incomes and the Rural Poor. 98, Environmental Economic Series (informal) of the World Bank, Washington D.C.