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SEA GRANT PROJECT SUMMARY FORM (90-2)

INSTITUTION: University of Illinois at Urbana-Champaign
ICODE:
TITLE: An Illinois Green Infrastructure and Ecosystem Services Valuation Tool
KEYWORDS: Ecosystem Services, Green Infrastructure
PROJECT NUMBER:
REVISION DATE:
PROJECT STATUS:
INITIATION DATE: October 1, 2009
COMPLETION DATE: September 30, 2010

SUB PROGRAM:
PRINCIPAL INVESTIGATOR: Dr. Brian Deal **EFFORT:** 1 Month
AFFILIATION: University of Illinois at Urbana-Champaign, Urban and Regional Planning
AFFILIATION CODE:
ASSOCIATE INVESTIGATOR: Mr. Tom Heavisides **EFFORT:** 1 Month
AFFILIATION: Illinois Department of Natural Resources
AFFILIATION CODE:
ASSOCIATE INVESTIGATOR (S): Mr. Robert Boyer **EFFORT:** 2.4 Months
AFFILIATION: University of Illinois at Urbana Champaign
AFFILIATION CODE:
SEA GRANT FUNDS: $
STATE MATCHING FUNDS: $

LAST YEAR'S SEA GRANT FUNDS: $
LAST YEAR'S MATCHING FUNDS: $
PASS-THROUGH FUNDS: $
LAST YEAR'S PASS-THROUGH FUNDS: $

RELATED PROJECTS:
PARENT PROJECTS:
SEA GRANT STRATEGIC PLAN CLASSIFICATION:

PROBLEM & IMPACT: It has been argued that improving the quality of life for Illinois residents is one of the least costly and most viable economic development strategies for the state (IDNR, 2005). Traditionally, efforts to foster improved quality of life tend to be focused on a strict understanding of what constitutes economic resources and/or physical infrastructure. As a consequence much of the investments made to help improve the life of the state's residents have been focused on the physical, built infrastructure. This traditional approach however, has had detrimental effects not only on the environment, but on the very issues the investments were designed to help improve – the characteristics that define a high quality of life. For example, infrastructure investments intended increase mobility and reduce travel times by increasing road capacity have instead lead to sprawling patterns of development, longer commutes and increases in vehicle miles traveled across the state. Likewise, an increasing concern for issues like climate change and urban water and run-off has traced some of their root causes to conventional infrastructure and related urban planning decisions.

Achieving more sustainable future development decisions necessitates a departure from the traditional approach to decision making to take into account the long-term impacts of planning and infrastructure investment decisions in social, economic and environmental terms. Assessing important planning decisions in these terms however, requires three important abilities- the ability to forecast potential future changes to our cities, the ability to identify important, existing resources and services, and the ability to understand how these future changes will affect these service areas. Therefore, identifying and understanding existing green infrastructures, the related ecosystem services they provide and the effect that our planning decisions may have on their ability to provide these valuable services into the future are important components for long-term sustainable development planning.

Informational Uncertainty: Theoretical definitions provide a basis for understanding green infrastructure, there is still a gap in gaining relevancy in the planning realm, i.e. integrating the concept with land-use decisions. The literature on the valuation of ecosystem services offers an avenue for initiating dialogue on the green infrastructure relevancy issue. It uses socio-economic valuation techniques to define the role of ecosystem services in clearly understandable – dollar/unit terms. However, due to the difficulty of incorporating opaque valuation structures in public decision making processes, ecosystems services discussions are often missing from policy debate. In addition, it is important to be able to disaggregate what can often be spatially unspecific valuation data to very local information and data if the goal is to understand ecosystems and their context from a decision point perspective.

The current literature on ecosystem services valuation has primarily focused on the "supply" or the "source" side of the equation – i.e. how much of a critical resource is available, and at what cost. A key link to integrating the concepts of green infrastructure and ecosystem services in practice is the identification of the "demand" side. It answers questions of not only how much, but how quickly will it will be used. Disaggregated valuation information that is localized and spatially specific also addresses questions of 'where' the resources are, and where the demand is coming from. When linked to spatially defined green infrastructure data, the relationship between the values and the local costs of physical replacement becomes clear – and avoidable.

METHODS:

This draft working paper aims to provide relevant ecosystem services and green infrastructure information at varying scales to leverage land-use decision-making at different political levels. The data would demonstrate the long-term implications of development in socio-economic and environmental terms across the state of Illinois, some specific regions in the state, the counties that make up the regions, and the municipalities that reside within those counties. The information would be presented in economic terms to better guide management decisions about land acquisition, conservation and restoration efforts especially as they implicate green infrastructure resources. The information can be applied for proactive decision-making to arrive at the best planning alternative as it steps down from the state to regional hubs and further to local jurisdictions to facilitate dialogue (figure 1).

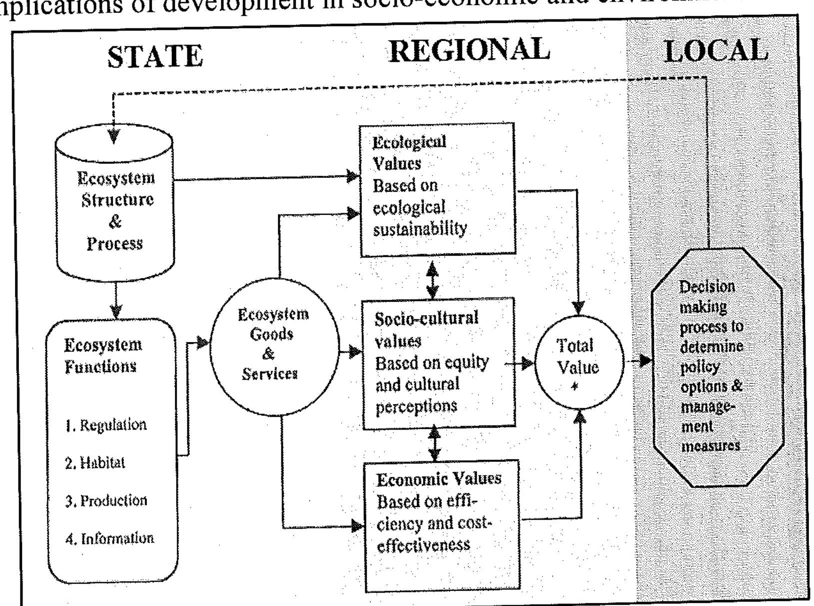

Fig 1. The hierarchical green infrastructure identification and valuation process.

Therefore the initial vision is a pragmatic first step to ensure that spatial models can indeed be linked to ecosystem valuation models, beneficiaries-based approach in particular. Essentially this first phase of the research is to develop a successful linkage between models, (and the attached budget page reflects that effort.) Figure 1 presents the conceptual process to be explored by this initial phase. The longer term vision is to provide relevant ecosystem services and green infrastructure information at varying scales to leverage land-use decision-making at different political levels. The longer term application vision is discussed next.

The following steps outline the sequence in which our research will be carried out.

1. *Spatial Identification of Green Infrastructure*: The project begins by mapping the green-infrastructure of the state of Illinois and subsequently uses existing data and research to assign a value to the ecosystem services the network provides. Considerable work has been done by the Land Use Evolution and Impact Assessment Model (LEAM) in the state of Illinois. Data on existing natural resources can be consolidated at each 30m X 30m grid/ cell to provide a basis for estimating the total value of the ecosystem services and the interconnections between the source and sink regions. Generalized Source-Sink Models (GSSMs) and ARtificial Intelligence for Ecosystem Services (ARIES) are other models that would help in identification of the causal relationships between the cells. Figure 2 shows the regions of high impervious surface and areas of dense canopy cover. Both these factors are indicators of sink and source areas respectively, and causal relationships may be drawn between them with further research.

2. *Classification and valuation of the ecosystem services*: Classification of ecosystem services can have multiple approaches. Considerable literature exists on the classification and subsequent valuation of these. Since the focus of the project is including the concept of ecosystem services in planning practice, a beneficiaries-based approach to ecosystem services will be pursued. Collaboration with other research groups who have a similar approach will help determine the beneficiaries and assign a value as per the cost of the services paid by them. The approach takes into account the socio-cultural and economic values of different regions to arrive at the total community value of the ecosystem service. Such a demand-based method takes into account the increase in the value of an ecosystem/ habitat even though it may provide lesser quantity of services due to degradation. This translation of the services in direct economic cost terms makes the process more transparent and allows clearer communication between the stakeholders and decision makers.

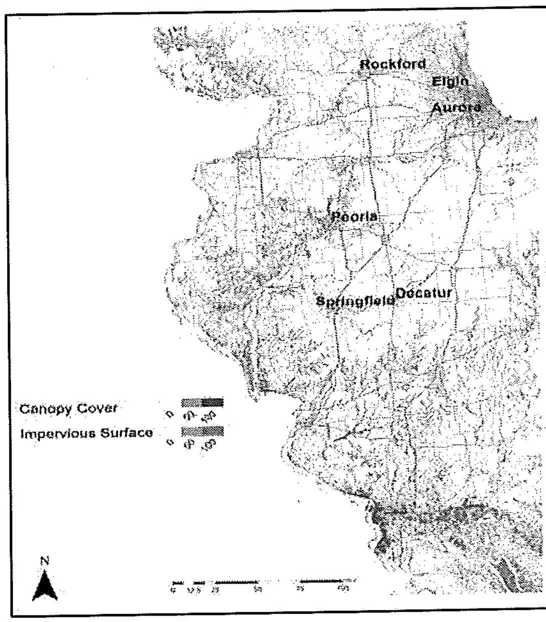

Fig. 2: IL Canopy Cover & Impervious Surfaces

Regional variations in the demand and use of the ecosystem services will be accounted for in this method as well. To illustrate, the same service may be valued more in the Chicago metro region as compared to metro-regions in Central Illinois. Similarly, the implications of ecosystem degradation would be more pronounced in the Chicago region than the latter. It should be noted that the source-sink connections identified are likely to be beyond the jurisdictional boundaries of different planning agencies thus facilitating inter-agency dialogue.

3. *Incorporation of ecosystem valuation into resource protection and management*: Having quantified the ecosystem services as per the demand and also spatially located the beneficiaries, the direct implications of ecosystem degradation can be demonstrated in the context of a particular region within the state. LEAM outputs for different future growth scenarios would

generate a probability of change in land-use. The level and type of development in each cell would be the basis for estimating future resource demand. The resulting change in ecosystem services and cost for the beneficiaries would help evaluate different growth scenarios. It should be understood that this change in ecosystem service value may not always be depreciation. This is because the base value for the ecosystem service will change as the beneficiaries based approach assigns a higher value to the same supply due to demand side changes. Table 2(a) illustrates a dummy scenario, with existing ecosystem service valuation and LEAM probability runs. The Reference Scenario shows a reduction in the total ecosystem service for the region.

Table 2(a): Reference Growth Scenario

ES (Existing)					Probability as/ LEAM				Change is ES				ES (Reference Scenario)			
5.00	7.00	8.00	10.0		0.05	0.01	0.03	0.05	0.25	0.07	0.24	0.50	4.75	6.93	7.76	9.50
13.0	15.0	10.0	12.0		0.03	0.05	0.10	0.07	0.39	0.75	1.00	0.84	2.61	14.25	9.00	11.16
12.0	10.0	14.0	15.0	X	0.04	0.06	0.15	0.08	0.48	0.60	2.10	1.20	1.52	9.40	11.90	13.80
6.00	9.00	7.00	10.0		0.06	0.09	0.20	0.10	0.36	0.81	1.40	1.00	5.64	8.19	5.60	9.00

Alternative scenarios can be tested to measure the effectiveness of conservation and restoration policies. Table 2(b) shows the conservation easement scenario where no growth is permitted in the 2nd and 3rd rows.

Table 2(b): Conservation Easement Scenario

Ecosystem Service (Existing)					Probability as/ LEAM				Change is ES				ES(Conservation Easement)			
5.00	7.00	8.00	10.0		0.07	0.05	0.09	0.08	0.35	0.35	0.72	0.8	4.65	6.65	7.28	9.20
13.00	15.00	10.00	12.0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	**17.00**	**20.0**	**15.0**	**14.0**
12.00	10.00	14.00	15.0	X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	**17.00**	**15.0**	**20.0**	**17.0**
6.00	9.00	7.00	10.0		0.10	0.20	0.20	0.15	0.60	1.80	1.40	1.5	5.40	7.20	5.60	8.50

As a result, the probability of growth in adjacent cells may increase, thus increasing the value of the ecosystem resources and services in the cells that lie within the easement (note that the ES value in conservation easement scenario increases). The total ecosystem service value for the region increases under this scenario and may be preferred against the reference scenario. Figure 3 summarizes the 3 scenarios.

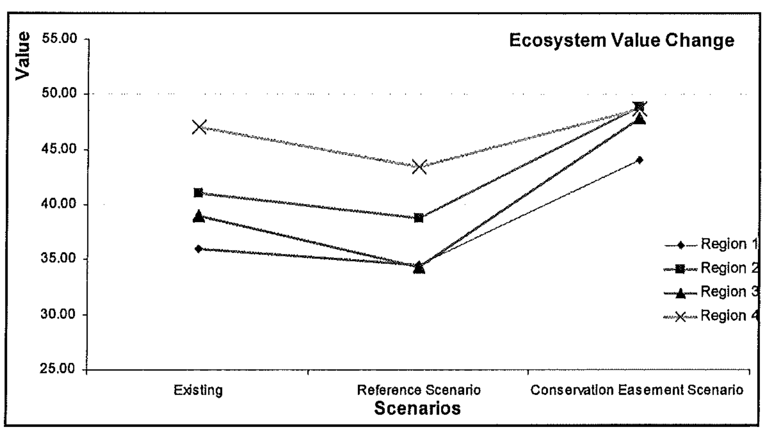

Fig. 3: Test Results of Model Integration

EXPECTED RESULTS: The data can be aggregated and/or disaggregated at a relevant scale to initiate dialogue in planning practice. An important aspect of this method is that it breaks down information to the most-relevant scale of planning, thus allowing for both top-down and bottom-up discussions.

Demonstration with a pilot area would establish the applicability of the research in planning practice. An online tool would further aid in a participatory process, and make the derivation through the model clearer. The long-term, large scale implications of development decisions in the pilot region would be demonstrated clearly through the tool to include the ecosystem service dialogue for planning, not only in the pilot region, but also other stakeholder regions. The value change in the source will clearly demonstrate the implications on beneficiaries through the services flows and facilitate pro-active planning. Comparison of different scenarios and the subsequent ecosystem service value change would help arrive at the best possible alternative.

Another important part of this tool is that it makes decision making transparent- not only to participating agencies, but also to public. The information is provided in a simple online interface that makes usability and searchability easy. LEAM has been using PLONE, an open source content management system (CMS) to develop GeoPortals for a number of projects. Given the easy access and methodical organization that PLONE offers, the online portal will make information easily available to non-technical users. The online platform also provides an interactive forum for discussion, collective working and comments. Different levels of access can be given to different participants in the portal, while maintaining a common working area for all. Also, information can be made open to public to make the reasoning behind the planning decision clear. The portal removes overlaps in information and helps in maintaining an open and collaborative process.

Easy access and direct comparative analysis of different growth scenarios for regions incorporates ecosystem services in planning practice. It also facilitates inter-region dialogue since growth in one area/ jurisdiction may affect the ecosystems of another region. Since the impact on the beneficiaries is also demonstrated through the tool, the conservation and restoration actions can be coordinated between the affected areas. The decisions regarding the management and conservation of resources will be made at the local level, with information about the long-term, statewide implications of the actions. The tool helps in providing the relevant information to facilitate dialogue not only between planning agencies, but also makes the process participatory by engaging the public.

BUDGET JUSTIFICATION:

Funding from Illinois-Indiana Sea Grant will support initial research to link the two primary models for application in a pilot area. The research would involve one part-time researcher for the project duration. In kind support will be in hours spent on the project (Deal, UIUC and Heavisides, IDNR). The SeaGrant funds will be distributed as follows:

- PhD student (Robby Boyer) support, 2-3 months at 50% time
- Travel to Springfield for coordination meetings with the IDNR ($83)

ESTIMATED BUDGET

TITLE:An Illinois Green Infrastructure and Ecosystem Services Valuation Tool

PROJECT PERIOD: 10/1/2009 - 9/30/2010

INVESTIGATOR: Brian Deal

An Illinois Green Infrastructure and Ecosystem Services Valuation Tool

I. DIRECT COSTS	**Rate/mo.**	**MO.**	**$'s**	
A. SALARIES & WAGES				
* Full Professor	$0	0.0	$ -	
* Associate Professor	$0	0.0	$ -	
*Assistant Professor	$0	0.0	$ -	
*Research Specialist	$0	0.0	$ -	
*Project Manager	$0	0.0	$ -	
*Project Coordinator	$0	0.0	$ -	
TOTAL SENIOR PERSONNEL		0.0	**$0**	
GRADUATE ASSISTANTS				
MASTER'S STUDENT, MUP2	$0	0	$ -	
PhD STUDENT, PhD2, 50%	$1,833	2.4	$ 4,453	
TOTAL GRADUATE ASSTS			$4,453	211100
TOTAL SALARIES			**$4,453**	
B. FRINGE BENEFITS	Rate, %			
RETIREMENT, % OF * ITEMS	0.000%		$0	
HEALTH INS., % OF * ITEMS	0.000%		$0	
MEDICARE, % OF * ITEMS	0.000%		$0	
TERMINAL BENEFITS, % OF * ITEMS	0.000%		$0	
WORKER'S COMP., % OF ALL ITEMS	0.140%		$6	
Grad Health Benefit, UIUC	4.350%		$194	
TOTAL FRINGE BENEFITS	4.49%		$200	219000
TOTAL SALARIES & FRINGE BEN.			**$4,652**	
EXPENSES (non-personnel costs)				
C. Telecom - Long distance, faxes	$0	0.00	$0	
D. Travel	$83	1	$83	132000
E. Computing Services (rate/hr)	$0	0	$0	
F. Printing	0	0	$0	
G. Tuition remission	56%		$ 2,493	
H. Other - subawards	$0	0.00	$ -	
TOTAL EXPENSES			$2,576	
TOTAL DIRECT COSTS			**$7,229**	
TDC base, exclude tuition remission			$4,735	
Fac/Admin. Costs: 58.5% TDC	58.50%		**$2,770**	
TOTAL PROJECT COSTS			**$9,999**	