IIRA
Illinois Institute for Rural Affairs

Policy Brief

January 2014

The Illinois Institute for Rural Affairs (IIRA) works to improve the quality of life for rural residents by partnering with public and private agencies on local development and enhancement efforts.

www.IIRA.org

WESTERN ILLINOIS UNIVERSITY

Economic Impacts of the 2008 Mississippi River Flooding in Southeast Iowa and West-central Illinois

Adee Athiyaman, Timothy Collins, and Chris Merrett[1],
Illinois Institute for Rural Affairs

Introduction

In June 2008, the Midwest suffered its worst flooding in 15 years, causing widespread damage to towns and crops. Twenty six people died and thousands were displaced from their homes (http://usatoday30.usatoday.com/weather/floods/2008-06-24-flood_N.htm). A number of studies have addressed these flood-related losses with varying degrees of comprehensiveness (for example, Long Term Recovery Council, 2010; Casagrande and McIlvaine-Newsad, 2010). However, none has assessed flood impacts on both sides of the Mississippi River spanning Illinois and Iowa. And none (in our view) adequately explain to local leaders and stakeholders how a flood impact study can help. This study bridges this gap in knowledge by exploring flood-induced economic losses in six counties in southeastern Iowa (Des Moines, Henry, Lee, and Louisa counties) and west central Illinois (Hancock and Henderson counties).

What is Flood Damage?

"Flood damage" refers to all types of harm caused by flooding, including direct and indirect damages (Greenberg, Lahr, and Mantell, 2007). *Direct flood damage* is caused by the physical contact of flood water, including damage to buildings, crops and cropland, and health impacts. *Indirect flood damage* is caused by disruption to physical and economic linkages, including monetary losses (*tangible damages*), or non-monetary losses (*intangible damages*), such as the inconvenience of post-flood recovery assessed using residents' perceptions about quality of life. Whether it is direct or indirect, tangible or intangible, measurement of flood damage is difficult. For example, to assess damages to buildings (a direct, tangible measure) we could use market-value measures from taxation databases. But these values often overestimate the actual damage. Underestimation could happen too. Historic buildings may have value far greater than their repair and replacement costs. A multi-method approach to gathering valid, direct-damage data can improve data collection. For example,

[1] Athiyaman is a professor at the Illinois Institute for Rural Affairs, Collins is assistant director of the Institute. Merrett is the director.

a post-event field survey of residents and interviews with area Realtors could be used to develop more accurate information on direct flood damages.

In the case of indirect, tangible measures, even field surveys become difficult to implement. For example, consider a scenario where a producer had to stop production because of flooding in the manufacturing facility. This would economically impact not only the producer, but also raw material suppliers and final consumers. Raw material suppliers need to seek other purchasers, and consumers need to find alternative sources. To assess these losses, we need to trace all of the producer's backward (suppliers) and forward (customers) connections or linkages. Depending on the number of supplier and customer linkages, the task of tracing them can become extremely difficult and time intensive.

One solution for this difficulty in data gathering is to focus on the macro-economic impact of the disaster, such as the recommendations of the European Community's FLOODsite report (2007). For example, the salient component(s) of the Gross Regional Product (GRP)2 in each disaster county could be analyzed for changes during the flood year. This entails cross-classification of GRP changes by industry to infer flood-impacts on specific industries and the larger economy. As an illustration, if the retail industry contributed 2% less to the economy during the flood year than the previous year, then we could attribute this negative shift to floods. But since changes to GRP could be caused by a number of other events, we use statistical approaches to gain insights into the impact of "shocks," if any, to the economy during the flood year. This approach is employed in this paper.

Profile of the Counties (Setting the Context)

We begin with the region's population in 2010 and explore its growth rate before and after the flooding. Then, we assess the region's GRP during 2010, highlight the economic strength of the counties, and explore changes to GRP during the flood year compared to the previous year. Finally, we investigate changes in one of GRP's major determinants, the labor force.

Population

The population of the six-county region in 2010 was 134,154. After the flood, population growth was negative in five counties, and positive in Des Moines (Table 1). In general, the severity of the post-flood population loss is more pronounced in smaller economies. Henderson County, IL, the smallest of the six economies, had a five-fold increase in population loss during 2008-2009 compared to the previous periods. In contrast, the largest economy, Des Moines, experienced a slight population increase.

[2] GRP is composed of personal consumption expenditures, investments, exports, imports, etc. (Leontif, 1951).

Table 1. Region and Counties Population

Region	2010 Population	Population Growth Rate (ACGR) 1969-2007	2008-2009
Six-County Region	134,154	-.003	-.005
Hancock County, IL	19,104	-.006	-.011
Henderson County, IL	7,331	-.003	-.015
Des Moines County, IA	40,325	-.004	.006
Henry County, IA	20,145	.003	-.007
Lee County, IA	35,862	-.005	-.001
Louisa County, IA	11,387	.002	-.039

Note: ACGR = Annual Compound Growth Rate
Source: www.factfinder2.census.gov; BEA's Regional Economic Accounts

Gross Regional Product by Industry

In 2010, the six-county region had a GRP of $ 5.47 billion. Manufacturing (24%) made the largest contribution. Other significant contributors were Government & Government Enterprises (19%), Healthcare & Social Assistance (11%), Farming (10%), and Retail Trade (7%). Table 2 shows county changes to GRP during the 2008 flood year. Manufacturing sector and farming show declines across the counties.

Table 2. Percentage Changes to County Gross Regional Product: 2007 to 2008

Industry	Hancock	Henderson	All IL	Des Moines	Henry	Lee	Louisa	All IA
Farm earnings	-7%	-24%	-24%	-6%	-39%	-19%	-17%	-11%
Forestry, fishing, and related activities	0	0	9	0	0	0	0	8
Mining	0	0	-9	0	0	0	0	0
Utilities	28	10	3	0	0	7	0	5
Construction	-13	0	-13	-2	-14	-13	-20	-11
Manufacturing	-27	-100	-7	-2	-4	-3	2	-5
Wholesale trade	17	44	-2	0	5	6	-22	1
Retail trade	10	10	-2	4	-1	5	6	3
Transportation and warehousing	11	16	-2	-4	5	-3	0	0
Information	3	0	-3	-4	64	3	4	0
Finance and insurance	8	0	-3	5	5	6	2	3
Real estate and rental and leasing	4	0	-2	5	-12	-1	0	2
Professional, scientific, and technical services	15	0	-1	-4	8	2	0	4
Management of companies and enterprises	0	0	2	8	15	29	0	2
Administrative and waste management services	16	4	-8	10	-4	-13	-10	1
Educational services	0	0	11	8	3	-10	0	8
Health care and social assistance	0	22	8	8	6	9	11	7
Arts, entertainment, and recreation	-100	0	0	5	9	-2	-8	-1
Accommodation and food services	-100	0	1	2	1	5	-3	2
Other services, except public administration	15	0	2	5	0	-1	3	4
Government and government enterprises	24	19	8	10	5	9	10	8
GRP 2008 ($ mil)	726	279	631,970	1,680	741	1,337	443	136,062

Note: GRP (Gross Regional Product) was estimated based on personal income distribution in the region.

Source: GDP by industry data table: GDP by Ind VA_NAICS (http://www.bea.gov/industry/gdpbyind_data.htm)

Labor Force

The estimated number of employed and unemployed persons in the six-county region during 2010 was 67,514. Losses in the counties' employment numbers after the flood, ranged from -3% to -1%, with the largest number of unemployed in the large Iowa counties of Des Moines, and Lee (Table 3).

Table 3. Labor Force: Number of Employed and Unemployed Persons

County	2010	2007	2008	Change in employment: 2007-2008	Change in unemployment: 2007-2008
Hancock	9,915	9,939	9,878	-1%	21%
Henderson	3,843	4,041	3,918	-3%	27%
Des Moines	21,048	21,113	20,906	-1%	33%
Henry	9,431	10,337	10,173	-2%	15%
Lee	17,354	17,376	17,489	1%	17%
Louisa	5,923	6,446	6,381	-1%	32%
Total	67,514	69,252	68,745	-1%	23%

Source: Bureau of Labor Statistics (http://www.bls.gov/cew/)

Combined with the population numbers (Table 1), Table 3 suggests that during tough economic times, people seek refuge and employment in larger population centers.

In summary, the six-county region is faced with decreasing population. One-quarter of its $5.47 billion economy relies on the manufacturing industry. A comparison of the region's 2007 and 2008 GRP clearly shows that farm earnings and manufacturing posted negative growth. The next two sections explore the role of the 2008 floods in these declines.

Modeling the Economic Impact

Table 4 shows the "final demand" components of the Input-Output (IO) transaction table for each of the six counties. Final demand shows sales of the counties' producing industries to various final users. Since the personal consumption expenditure is the salient component for all of the counties, we model the expenditure to assess the economic impact of flooding in the counties.

Table 4. Final Demand Components for the Counties: 2010 IO Table Estimates

	% of GRP				
County	Consumption Expenditure	Government Expenditure	Investments	Exports	GRP ($Mil)
Hancock, IL	77	12	15	-4	749
Henderson, IL	79	11	13	-3	287
Des Moines, IA	72	15	18	-5	1,798
Henry, IA	73	14	17	-4	777
Lee, IA	74	14	17	-5	1,402
Louisa, IA	75	13	16	-4	465

Results of Model Estimation

Table 5 shows the results of the modeling exercise. The flood-year lowered personal consumption expenditure in Henderson, Des Moines, Henry, and Lee counties. It is interesting to note that for Louisa, IA, personal consumption expenditure changed little during the flood year, but the pace of consumption changed. Put another way, the population of Louisa did not consume at the same pace or speed during the flood year, compared with "normal" years.

Table 5. Parameter Estimates: Results of First-Difference, County-Level Regressions

County	$\hat{\beta}$	γ_1 Change in Consumption	R^2
Hancock, IL	0.74	4636.14	.55
	(4.84)	(0.33)	
Henderson, IL	0.81	-17927.45	.65
	(5.37)	(-2.78)	
Des Moines, IA	1.21	-69715.89	.52
	(3.7)	(-2.14)	
Henry, IA	0.85	-40347.9	.48
	(3.29)	(-2.61)	
Lee, IA	0.8	-76270.27	.40
	(2.45)	(-2.57)	
Louisa, IA	0.98	-10902.41	.70
	(6.17)	(-1.7)	

Note: $\gamma 1$ is the indicator variable that measures parallel shifts in the intercepts during flood years. Figures in parentheses are *t* ratios, an assessment of the variable's relevance for the model. R^2 is the proportion of variance explained by the model.

Figure 1 shows the flood-induced reduction in personal consumption expenditure in the six-county region. We estimate the total reduction to be around $468 million, about 9% of the region's GRP. While reduction in dollar-based consumption expenditure is more pronounced in the larger counties – Des Moines and Lee – it is the smaller community of Henderson, IL, that suffered the highest percentage GRP reduction.

Figure 1. Flood-Related Reductions in Personal Consumption Expenditure: Monetary Value and as a Percentage of GRP

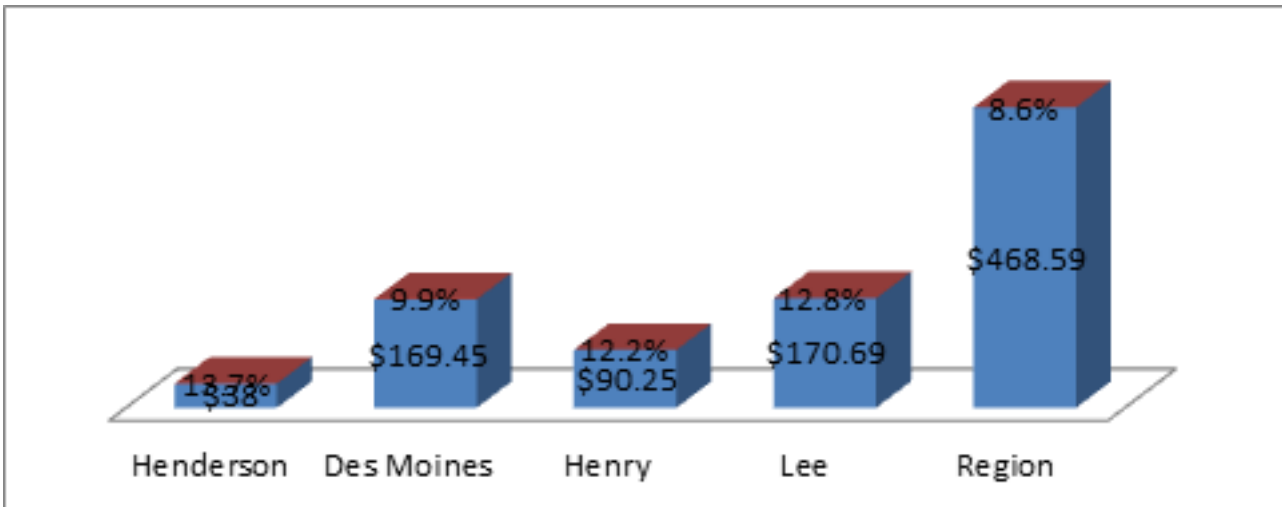

Table 6 shows the industry-wise economic impact of reduction in personal consumption expenditure in the six-county region. Note that the Table lists probable values and the point estimate. This is to minimize errors involved with a single, point estimate. The agricultural sector contracted by $3.89 million to $24.18 million. Overall, the total economic impact of flooding for the region's industry was reduction in outputs to a tune of $864.67 million; the manufacturing industry absorbed around 20% of this reduction.

Table 6. Economic Impact Assessments: The Six-County Region ($ mil)

	Point and Interval Estimates		
	Point	**Best**	**Worst**
Agriculture, forestry, fishing & hunting	-14.0185	-3.88714	-24.1828
Mining	-29.0436	-8.0534	-50.1021
Utilities	-20.2325	-5.61021	-34.9024
Construction	-5.46955	-1.51663	-9.43532
Manufacturing	-184.499	-51.1592	-318.273
Wholesale trade	-35.5959	-9.87026	-61.4052
Retail trade	-47.7883	-13.251	-82.4378
Transportation & warehouse	-26.2026	-7.26563	-45.2012
Information	-37.4871	-10.3947	-64.6676
Finance, insurance, real estate & leasing	-199.878	-55.4233	-344.802
Professional services	-80.603	-22.3501	-139.045
Educational services	-94.9643	-26.3323	-163.819
Arts & entertainment	-44.9792	-12.4721	-77.5919
Other services	-30.5846	-8.4807	-52.7605
Government	-13.328	-3.69568	-22.9917

Total Impact	**-864.67**	**-239.76**	**-1491.6**

Alternative Models: Analysis of Employment Data

The monthly employment data for 2001 to 2010 show weakness for Iowa and a decline for Illinois. As a result, employment growth in the six-county region is negative. In other words, these counties have been experiencing declining employment for the last 10 years. However, further statistical analyses reveal that Lee County, IA, lost 621 jobs during the flood. In contrast, Des Moines had little or no immediate job loss. This is no surprise since the ability to sustain immediate shocks or disasters is correlated with the wealth of the region (Figure 2).

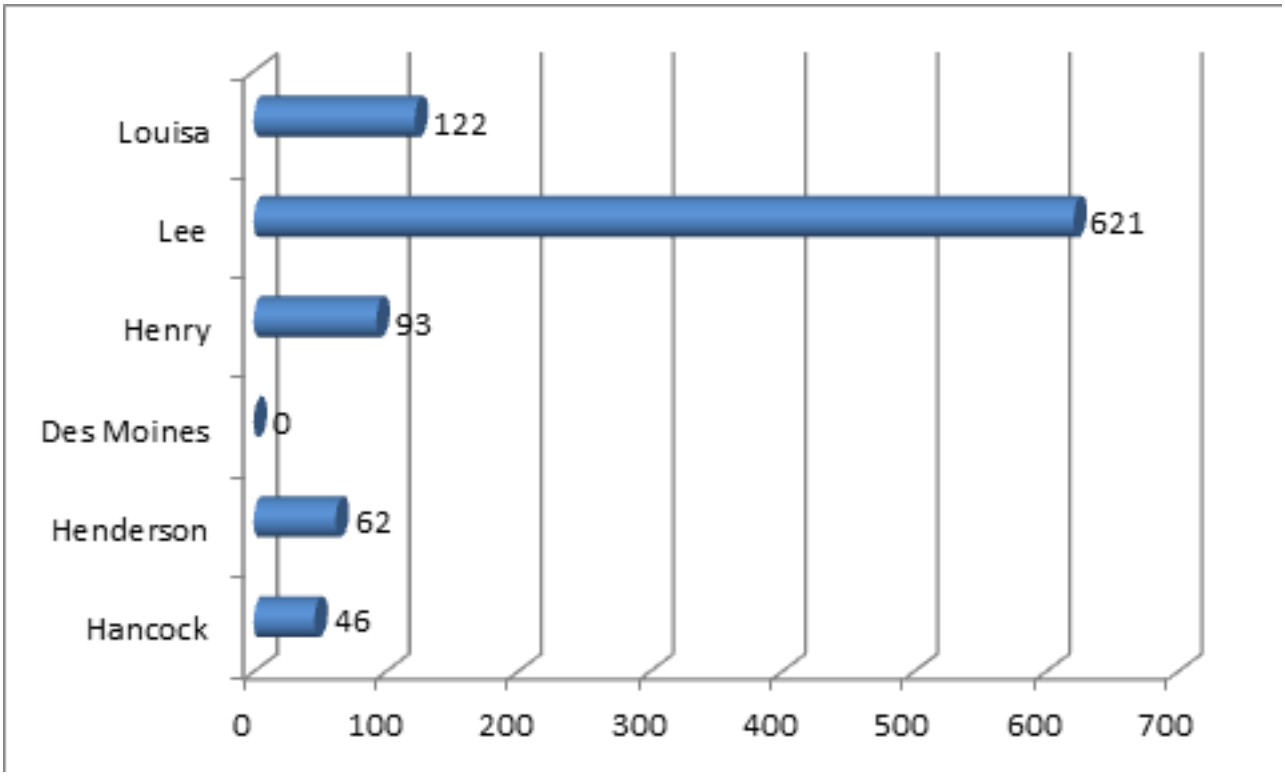

Figure 2. Immediate Impacts of Floods: Number of Job Losses

Regarding long-term job losses due to flooding, counties with significant, permanent reduction in employment include: Hancock, IL with 150 positions, Des Moines, IA with 239 positions, and Louisa, IA, with 8 job losses. Henderson, IL and Henry, IA do not show any permanent effects.

Summary and Conclusion

This study focused on the macro-economic impact of 2008 Mississippi River flooding on a six-county region in southeastern Iowa (Des Moines, Henry, Lee, and Louisa counties) and west central Illinois (Hancock and Henderson counties). Personal consumption expenditure, a salient component of the area's Gross Regional Product, was analyzed for changes during the flood year. Statistical approaches used to gain insights into flood impact include econometric models and time-series techniques.

The results of statistical analyses indicate:

1. The flood-induced reduction in personal consumption expenditure in the six-county region is around $468 million, about 9% of the region's GRP.
2. While on a dollar basis the reduction in consumption expenditure is more pronounced in the larger counties of Des Moines, and Lee, the smaller county of Henderson, IL, suffered the highest percentage GRP reduction, about 14%.
3. For Louisa, IA, although there was little or no change in personal consumption expenditure during the flood year, the pace or speed of consumption changed.
4. Population migration numbers were not affected by the floods. This is not surprising since all of the counties have experienced out migration for the last five to 20 years.
5. The number of immediate, flood-related job losses ranges from 46 to 620 jobs.
6. Flooding also caused permanent reduction in employment in Hancock, IL (150 jobs), Des Moines, IA (239 jobs), and Louisa, IA (8 jobs). Henderson, IL, and Henry, IA, do not show any permanent job losses.
7. The total direct and indirect economic impact of the 2008 floods is $864.67 million; the average multiplier is 1.8723.

Research is of two, broad types: (i) phenomenological: where we collect specimens (for example, human work-related behavior) and classify them into groups (for example, white-collar job, blue-collar work, etc.), and (ii) enumerative: we measure the frequency of occurrence of phenomena within a certain population so that we can act upon these phenomena. In this paper, we enumerated flood-induced losses for a six-county region. A vital question is how we make the inferential leap from "approximate" data about the past to wise action in the future.

Most businessmen and public policymakers are theorists. They are forced to have theories in order to decide how to act … and act they must. Because most events in business and public policy are unique and transitory, the decision maker must try to identify reasonably analogous situations from earlier tested actions, theorize about the mechanisms involved, and act.

Here is a "meta-analysis" or integrations of available actions to deal with flood-induced losses in a community:

1. Educate citizens about where water flows during a flood event. Specifically, educate the community about floodplains. Floodplains are defined based on the "100-year flood" or the "500-year flood". Technically, 100-year flood zone means that the area's elevation has a 1% chance of flooding each year. In contrast, the 500-year flood zone has a lower chance of flooding. This is the method that the National Flood Insurance Program uses to determine insurance costs. More information on flood maps can be accessed from http://www.floodsmart.gov/floodsmart/.

2. Make citizens aware about the Federal Emergency Management Agency's online resources on disaster management (http://www.fema.gov/). Also, it is crucial that elementary, middle, and high schools train their students on emergency management procedures.

3. This is what businesses want as recovery assistance, in order of importance:

    a. Tax breaks (75% + businesses see this as essential);

    a. Business-recovery helpline (66% see this as a required help), and

    a. Low-interest loans (1 in 2 businesses express this need).

In conclusion, this study highlights "structural shifts" in the economy of the study region during 2008. These largely negative shifts can be attributed to the June 2008 floods.

It is possible that the parameters in our econometric model vary over time because of other influences such as recession and governmental policy variables. Lack of data prevents us from analyzing these determinants. However, the convergence of findings on employment losses and reduction in personal consumption expenditure add strength to our argument that the 2008 floods caused negative economic impacts in the six-county region.

References

Box, G.E.P., and Jenkins, G. M. (1970). T*ime Series Analysis: Forecasting and Control,* Holden Day: San Francisco.

Casagrande, D., and McIlvaine-Newsad. (2010). *Slow Road to Recovery: Small Rural Community Resilience in Illinois after the Mississippi River Floods of 2008.* Macomb, IL. Available online: http://faculty.wiu.edu/DG-Casgrande/literature/Flooding2008Report.pdf.

Chow, G. C. (1960). Tests of equality between subset of coefficients in two linear regressions, *Econometrica,* 591-605.

Darby, M. R. (1974). The permanent income theory of consumption: A restatement, *Quarterly Journal of Economics,* 88(2), 228-250.

FLOODsite. (2007). Evaluating flood damages: Guidance and recommendations on principles and methods, Report Number T09-06-01. Available online at www.floodsite.net

Granger, C.W.J., and Newbold, P. (1974). Spurious regression in econometrics, *Journal of Econometrics,* 2, 111-120.

Greenberg, M. R., Lahr, M., and Mantell, N. (2007). Understanding the economic costs and benefits of catastrophes and their aftermath: A review and suggestions for the U.S. Federal government, *Risk Analysis,* 27(1), 83-96.

Leontief, W. (1951). The Structure of the American Economy, 1919-1939. Oxford University Press, Oxford.

Long Term Recovery Council. (2010). *Final Report to Governor Pat Quinn and the People of Illinois: Aftermath of the Floods of June 2008 and Recommendations for Long Term Economic Recovery.* Champaign, IL: University of Illinois, Office of Sustainability.

Merz, B., Kreibich, H., Schwarze, R., and Thieken, A. (2010). Assessment of economic flood damage, *Natural Hazards Earth Systems Science,* 10, 1697–1724

Theil, H. (1966). *Applied Economic Forecasting,* Rand McNally: New York.