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Outlook for Grain and Oilseed Export Shipments from the Upper Mississippi River Basin

Abstract

In response to a request by Senator Tom Harkin, the Food and Agricultural Policy Research Institute (FAPRI) has evaluated a number of issues related to the lock and dam system on the Upper Mississippi and Illinois Rivers. One critical issue is how future demand for agricultural exports will affect the demand for river transportation services. This paper sketches a theoretical framework for economic decision-making regarding the upgrade of the lock and dam system of the Upper Mississippi River and then compares export projections underlying analyses by the U.S. Army Corps of Engineers (USACE) with recent projections by FAPRI and the International Food Policy Research Institute (IFPRI).

Disciplines

Agricultural and Resource Economics | Agricultural Economics | Economics

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OUTLOOK FOR GRAIN AND OILSEED EXPORT SHIPMENTS FROM THE UPPER MISSISSIPPI RIVER BASIN

SENATOR TOM HARKIN asked the Food and Agricultural Policy Research Institute (FAPRI) to evaluate a number of issues related to the lock and dam system on the Upper Mississippi and Illinois Rivers. One critical issue is how future demand for agricultural exports will affect the demand for river transportation services. This briefing paper will sketch a theoretical framework on economic decisionmaking regarding the upgrade of the lock and dam system of the Upper Mississippi River and then will compare export projections underlying analyses by the U.S. Army Corps of Engineers (USACE) with recent projections by FAPRI and the International Food Policy Research Institute (IFPRI).

Decision Framework

THE DECISION WHETHER to upgrade the lock dam system on the Upper Mississippi River should be based on the costs and benefits associated with the upgrade or lack thereof. Because of the large uncertainties involved in estimating costs and benefits and the long lead and lag times between a decision and implementation of the project, the framework used to make the decision should be based on the present (i.e., discounted) value of future costs and benefits and should explicitly account for our lack of knowledge concerning what these future costs and benefits will be.

A simple one-period, two states-of-the-world framework can be used to describe the approach. Implementation of a real assessment of the costs and benefits should consider several lock and dam upgrade options and should include many more states-of-the-world, rather than only two as presented here.

Consider two alternative states-of-the-world (high demand or low demand for transportation on the Mississippi River) and the decision to be made (upgrade, or do not upgrade). For each decision and each state-of-the-world there is an associate net gain, G_{ij} , for decision j under state of the world i .

If demand turns out to be low and if the decision is to not upgrade, then the net gain $G_{ld, nU}$ is relatively high because the decision was correct (in an *ex post* sense). If demand turns out to be high, however, and the decision is to not upgrade, then the net gain $G_{hd, nU}$ is relatively low.

Each state-of-the-world (low demand, high demand) has a certain probability of occurrence. Let p_{ld} be the probability that future demand for grain export services is low. Thus $(1 - p_{ld})$ is the probability that future demand is high. This probability allows us to calculate the expected (or

Net gain from upgrade decision conditional on realization of future demand.

	Upgrade	Do Not Upgrade
Low demand	$G_{ld,U}$	$G_{ld,nU}$
High demand	$G_{hd,U}$	$G_{hd,nU}$

average) net gain of each decision simply by weighting the net gain in each state-of-the-world by its associated probability. We can then compare the expected net gains to see which gives the highest payoff.

Often, though, it is difficult to assign a probability to a state of the world that will occur far into the future. In this case it might be useful to consider the consequences of the potential downside of making a wrong decision. For example, what is the magnitude of the forgone benefits if demand turns out to be high, but we do not upgrade? Or, what costs are involved if we upgrade but demand turns out to be low? This type of scenario analysis can be quite useful. For example, if the forgone benefits of not upgrading when demand is high are relatively modest compared with the magnitude of the costs involved from upgrading when demand turns out to be low, then policymakers might find it useful to not upgrade.

Net Gain Function

The gain function is the present value of the sum of the benefits less the sum of the costs associated with the decision to upgrade the lock and dam system. Costs to be considered include the direct cost of construction, the indirect costs of increased river congestion during construction, and any gross loss in recreational value of the Mississippi River. The benefits of construction would be the gains to exporters obtained through

increased ability to meet foreign demand for products, the gain from lower transportation costs of products to downstream domestic users, and any gross increase in recreation value of the Mississippi River. And, of course, the gains to consumers from increased integration of U.S. production regions with world markets should be included.

The distributional impacts on the various users of grains and oilseeds also should be estimated. For example, upgrading the lock and dam system will lower the cost of exporting corn, wheat, and soybeans. This has a positive net effect on the price of these commodities, which hurts other users, i.e., livestock producers, ethanol manufacturers, food processors, and other domestic users.

Uncertainties

There are many uncertainties involved in determining valid descriptions of alternative states-of-the-world and assigning probabilities. One uncertainty is export demand. The trade and agricultural policies of countries that import U.S. products and export competing products have a dramatic impact of the composition of U.S. agricultural trade. With regard to the export demand for U.S. corn, soybeans, and wheat, key factors include foreign exchange rates and the macro environment in foreign markets as well as whether importing countries will emphasize domestic production of meat or importation of meat. For example, the recent outbreaks of foot-and-mouth

disease (FMD) in Taiwan and Korea will decrease the demand for U.S. feed grains and increase the demand for U.S. meat products.

A second uncertainty is export supply. Our residual supply of commodities available for exports (total domestic supply minus domestic demand) is affected by U.S. farm programs, and energy policy, as well as whether states continue to emphasize the importance of adding value to agricultural products before they leave the state in which they are produced. Supply-increasing agricultural policies, such as the current loan deficiency payments (LDP) policy, increase export supply whereas an energy policy that is ethanol friendly will decrease export supply. A recent trend indicates a growing percentage of feed grain exported from the United States is exported in the form of meat. If this trend continues, then the export supply of feed grains will continue to shrink in relative importance.

Grain and Oilseed Exports on the Mississippi River

It is useful to explain briefly how the USACE constructed its forecast of grain and oilseed exports shipped through the Mississippi River and the Gulf: USACE started from a national forecast of the demand for these commodities (exports and domestic use) and then forecast the allocation of the national exports to various port areas. We follow this procedure to evaluate our grain and oilseed outlook relative to the USACE forecast. We believe the methodology followed by the USACE in its 1997 study to project U.S. grain exports is sound, but that the year from which they started is too late.

Trends in USACE projections are qualitatively similar to trends exhibited in FAPRI and IFPRI forecasts of U.S. grains and oilseed exports.

A Long-Term Projection of Corn, Soybean, and Wheat Exports

In order to formulate a timely response to Senator Harkin's request, FAPRI took the following specific steps.

- Using historical data, the 2000 FAPRI World and U.S. Agricultural Outlooks, and the most recent IFPRI projections, FAPRI evaluated the 1995-2025 export projections used by the USACE in its "Waterway Traffic Forecasts for the Upper Mississippi River Basin," report for the three major crops transported on the Upper Mississippi River (corn, soybeans, and wheat).
- Using historical data and the same projections from FAPRI and IFPRI, FAPRI evaluated USACE projections of domestic use (feed, food, and other uses) for the same time period. These two comparisons combined allowed us to compare alternative projections of total demand (export demand and domestic use).
- Using data from the Federal Grain Inspection Service, FAPRI compared the USACE 1995/96-1998/99 forecast of the share of total exports for corn, soybeans, and wheat going through the Gulf with actual data on these shares.

This information is presented in Tables 1-3. Table 1 shows the USACE forecast and our combined projections (history + FAPRI outlook + IFPRI projec-

tions) for national exports of wheat, soybeans, and corn. As shown in the table and in corresponding Figure 1, the USACE forecast indicates greater exports of wheat and corn, and lower soybean exports, compared with the FAPRI and IFPRI projections. In 2025, USACE wheat and corn export estimates exceed those of IFPRI by 21 and 39 percent, respectively. The USACE estimate of 2025 soybean exports is 4 percent lower than the IFPRI projection.

Using the USACE-estimated share of these total exports going through the Gulf (70.7 percent of corn, 23 percent of wheat, and 77.1 percent of soybeans), we find that the USACE forecast for the total tonnage of these three commodities moving through the Gulf is systematically higher than our combined projections. According to the USACE forecast, in 2025, the grain and oilseed export traffic on the Mississippi River is 25 percent higher than the traffic implied by the IFPRI projection. For the historical period 1995/96-1998/99, the USACE study overpredicted the actual combined traffic of corn, wheat, and soybeans by 11 percent.

The USACE study appears to use a reasonable estimate of the share of total exports going through the Gulf. We did not find any systematic difference between the USACE forecast for 1995/96-1998/99 and the actual data. As shown in Table 2, the actual shares during that period were 71.8 percent for corn, 22.1 percent for wheat, and 77.7 percent for soybeans. Hence, we cannot detect any bias in the USACE assumptions regarding the share of total exports being transported on the Mississippi River. The departure between the USACE forecast of tonnage and our projection comes from

different projections of national exports but not from the spatial allocation of these exports to the various ports.

Looking at the domestic demand forecast presented in Table 3, one can see a mixed picture. Over the historical period 1995/96-1998/99, the USACE forecast is 4 percent lower than the actual levels for wheat, 8 percent lower for soybeans, and 1 percent higher for corn. Over the next decade, the USACE forecast indicates lower levels of soybean domestic use and higher levels of wheat domestic use than the FAPRI projections. Corn use projections for the next 10 years are essentially identical in the FAPRI and USACE projections. Compared with the longer-run projections by IFPRI, the USACE forecasts of domestic corn and wheat use are greater, but the USACE forecasts of domestic soybean use are lower than those of IFPRI. These patterns are best seen in Figure 2.

Finally, one should note that these projections are best guesses or “point estimates” of export flows. It is difficult to put error bands on these central projections because so many sources of uncertainty are present. In recent history, the coefficients of variation (variation per unit of mean exports) for agricultural exports on the Mississippi River and at the national level have been very similar and relatively small (see Table 2). These coefficients are about 10 percent for wheat, 4.6 percent for soybeans, and 15 percent for corn.

A Word about Long-Term Projections

To assess the value of changes to the lock and dam system requires a long-term view of the demand for exports and, thus, the demand for river services. Unfortunately,

making very long-term projections of export demand is difficult at best. FAPRI projections extend only over the next 10 years because it is our judgment that longer-term projections depend on many factors that are essentially unknowable. Although we have no major disagreements with IFPRI's 25-year projections, it is important to emphasize just how sensitive such projections are to a wide variety of assumptions.

Even FAPRI's 10-year outlook is not a "forecast" in the sense of it being a prediction of what we expect to occur over the next 10 years. Instead, it is a projection conditional on a number of assumptions, some of which may not hold. For example, FAPRI's baseline assumes that current policies remain in place indefinitely, even though one might reasonably expect changes in U.S. policies, an expansion of the European Union (EU), and a new World Trade Organization (WTO) agreement all to occur sometime in the next 10 years. In any given year, the assumption of "average" weather will prove incorrect, resulting in significant variation in annual export levels. This weather-induced variation in export demand may be almost as important in determining the value of river transportation, as is the average level of exports.

No attempt will be made here to catalog all the reasons that longer-term projections could miss the mark. A new WTO agreement could further liberalize and expand trade. Income growth could result in even more rapid growth in demand for meat and dairy products than implied in the FAPRI and IFPRI projections. If this demand is met in large part by locally produced meat and dairy products, then U.S. exports of grains and oilseeds

could grow more rapidly to feed growing livestock herds. On the other hand, if the demand is met by importing meat, U.S. grain and oilseed exports could actually fall, as feed is diverted to support an expanding U.S. livestock sector. Foreign crop yields could grow more rapidly or slowly than projected. Countries such as

China have demonstrated an ability to constantly surprise analysts. It is worth noting that total U.S. exports of wheat, corn, and soybeans are lower now than they were 20 years ago, contrary to what almost anyone would have expected in 1980.

Implications for a Forecast of Waterway Traffic

The USACE estimates higher levels of agricultural exports going through the Gulf compared with historical data for 1995/96-1998/99, and compared with both FAPRI and IFPRI projections. Before concluding that this implies that USACE has overestimated the likely demand for transportation services on the upper Mississippi and Illinois Rivers, it is important to assess the assumptions underlying the export projections and other factors affecting river transportation.

We can only provide this qualitative assessment in the absence of a sophisticated spatial model of livestock and crop production, consumption, and trade. The USACE grain and waterway traffic forecast study cited here took over two years to complete. FAPRI is redirecting resources to increase its ability to progressively address spatial issues, but such an effort will take time to bear fruit.

Table 1. National exports: Comparison of USACE and FAPRI and IFPRI projections (million bushels)

	1995/96	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009/10	2020	2025
USACE Wheat	1,319	1,125	1,420	1,425	1,440	1,465	1,546	1,519	1,540	1,560	1,581	1,598	1,618	1,638	1,659	1,879	1,981
History and FAPRI+IFPRI Wheat* difference	1,241	1,002	1,040	1,042	1,107	1,128	1,155	1,168	1,200	1,197	1,210	1,219	1,229	1,239	1,249	1,592	1,642
	6%	12%	37%	37%	30%	30%	34%	30%	28%	30%	31%	31%	32%	32%	33%	18%	21%
USACE Soybean	761	770	710	720	725	755	755	766	799	816	845	853	864	876	888	1,012	1,070
History and FAPRI+ IFPRI Soybean difference	851	882	870	812	865	989	1,045	1,018	995	1,002	1,011	1,027	1,037	1,055	1,067	1,088	1,111
	-11%	-13%	-18%	-11%	-16%	-24%	-28%	-25%	-20%	-19%	-16%	-17%	-17%	-17%	-17%	-7%	-4%
USACE Corn	2,175	2,200	2,200	2,250	2,375	2,575	2,676	2,732	2,785	2,822	2,860	2,907	2,951	2,994	3,036	3,452	3,644
History and FAPRI+ IFPRI Corn difference	2,228	1,797	1,504	1,981	1,901	1,983	2,022	2,047	2,093	2,164	2,217	2,274	2,353	2,435	2,517	2,576	2,613
	-2%	22%	46%	14%	25%	30%	32%	33%	33%	30%	29%	28%	25%	23%	21%	34%	39%
Gulf Export Overstatement	-4%	10%	23%	9%	13%	13%	13%	15%	17%	16%	16%	15%	14%	12%	11%	21%	25%

*History refers to actual data 1995-98, FAPRI to FAPRI Outlook 1999-2009, and IFPRI to IFPRI Outlook 2020 and 2025

Table 2. Recent historical data on Mississippi River exports

	1995/96	1996	1997	1998
Export shipments on Mississippi River (Million Bushels)				
Corn	1,562	1,232	1,119	1,467
Wheat	264	251	211	226
Soybean	630	677	699	648
CV for US levels 1995-1998 and 1995-1999				
wheat			10.00%	8.68%
soybean			3.59%	3.15%
corn			16.26%	14.06%
CV for Mississippi exports (1995-1998)				
			10.06%	4.58%
				15.23%
CV=std deviation/sample mean				
Historical shares of total exports on Mississippi River (percent)				
1995	70.1%	68.6%	74.4%	74.1%
1996	21.3%	25.1%	20.3%	21.7%
1997	74.1%	76.7%	80.3%	79.8%
1998				
average 1995-98				71.8%
USACE projected shares				
1999				70.7%
2000				23.0%
2001				77.1%

Table 3. Domestic use: Comparison of FAPRI, IFPRI and USACE projections (million bushels)

	1995/96	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009/10	2020	2025
USACE Wheat	1,175	1,176	1,211	1,267	1,288	1,310	1,322	1,335	1,347	1,359	1,372	1,384	1,397	1,410	1,422	1,568	1,632
History + FAPRI + IFPRI Wheat* difference (usace-fapri)	1,140	1,301	1,257	1,385	1,302	1,309	1,283	1,286	1,286	1,309	1,312	1,322	1,333	1,343	1,356	1,475	1,536
	3%	-10%	-4%	-9%	-1%	0%	3%	4%	5%	4%	5%	5%	5%	5%	5%	6%	6%
USACE Soybean	1,490	1,500	1,524	1,550	1,566	1,578	1,595	1,613	1,630	1,647	1,665	1,683	1,701	1,719	1,737	1,946	2,041
History + FAPRI + IFPRI Soybean difference (usace-fapri)	1,479	1,559	1,756	1,785	1,766	1,870	1,907	1,925	1,967	1,999	2,042	2,072	2,113	2,147	2,190	2,128	2,259
	1%	-4%	-13%	-13%	-11%	-16%	-16%	-16%	-17%	-18%	-18%	-19%	-19%	-20%	-21%	-9%	-10%
USACE Corn	6,585	7,075	7,250	7,425	7,550	7,625	7,721	7,817	7,914	8,011	8,109	8,209	8,310	8,411	8,512	9,693	10,235
History + FAPRI + IFPRI Corn difference (usace-fapri)	6,320	6,991	7,287	7,311	7,535	7,558	7,651	7,852	7,916	8,025	8,116	8,250	8,335	8,433	8,520	8,824	9,173
	4%	1%	-1%	2%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	10%	12%

*History refers to actual data 1995-98, FAPRI to FAPRI Outlook 1999-2009, and IFPRI to IFPRI Outlook 2020 and 2025

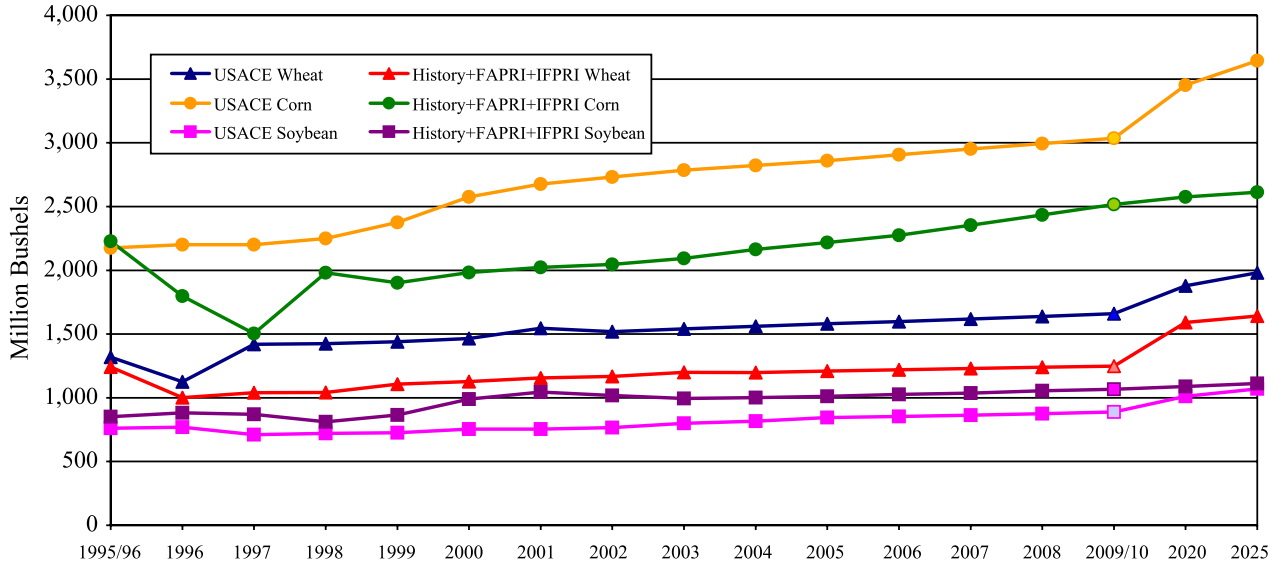


Figure 1. U.S. Exports Forecast.

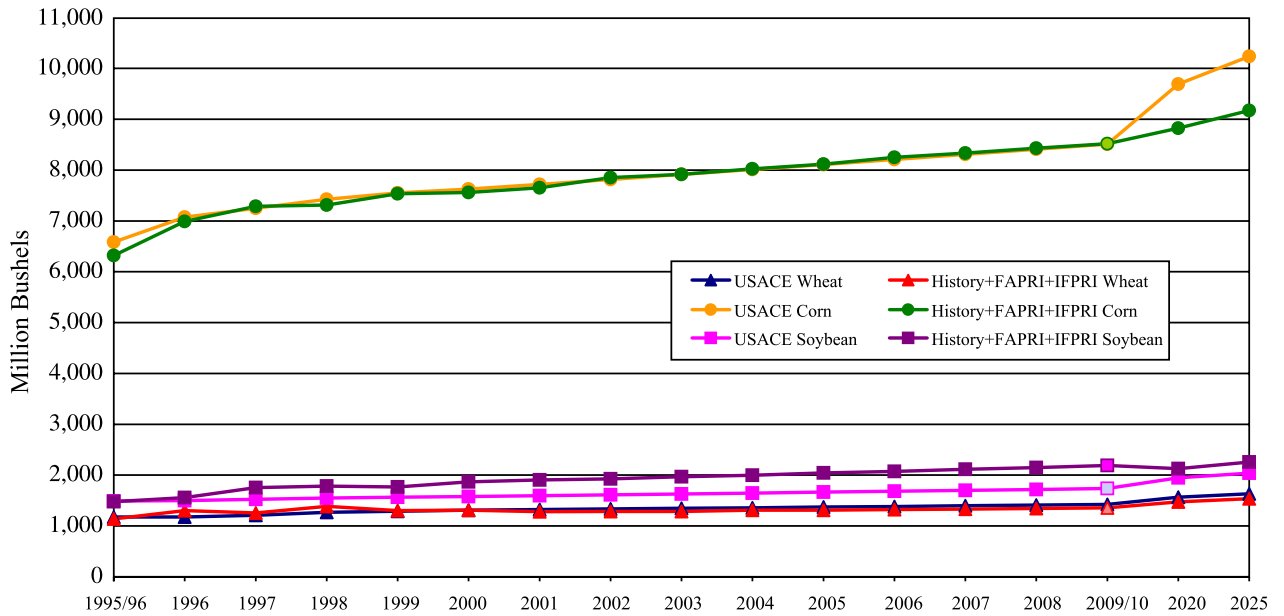


Figure 2. U.S. Domestic Use.

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