SYNOPSIS

Project Number: C-04 Start: 09/98
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Title: Evaluating Water Policy Affecting Fish Habitat, Hydrology and Irrigated Agriculture in the Snake River Basin

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Congressional District: 5th Washington

Focus Category: HYDROL, IG, ECON

Descriptors: Ground and Surface Water Hydrology, Irrigation, Economics, Fish Habitat

Problem and research objectives:
Changes in water management policies for the Snake River are required as a consequence of the Salmon River Sockeye and the Spring and Summer Chinook Salmon stocks being listed as endangered. The Snake River is heavily appropriated for irrigation and hydroelectric power production, resulting in problems relating to water quantity and quality in Idaho, Oregon and Washington. Further, surface water and groundwater are highly interdependent in the region. Consequently, changes in water policy to assist salmon recovery may dramatically affect the hydrology and the agricultural economy of the region.

The overall objective of this research is to evaluate alternative water policy choices for salmon recovery in the Snake River basin for effects on quantity and quality of stream flow, groundwater recharge and discharge, irrigated agricultural production, hydroelectric production, and the region's economy.

Methodology:
Research objectives will be accomplished by integrating models of individual and regional crop production, irrigation uniformity, ground and surface water hydrology, and regional economic impacts. The research goal for the second year of this research was to finish development and calibration each of the individual models, to run some water policy scenarios, and to assess the economic impacts of alternative policies. Attention was given to the need for the models to be consistent for the ease of integration.

Principal findings and significance:
Progress to date consists primarily of data gathering, individual model development, model calibration, and preliminary efforts of model integration. There are six individual models to be integrated: SPRINKS, a model of irrigation efficiency and uniformity; CropSyst, a crop production model; SRAM, a regional agricultural production model; a groundwater hydrology

model; MODSIM, a surface water allocation model; and IMPLAN, a regional economic impact model. Crop/water production functions are being developed by integrating SPRINKS and CropSyst. The groundwater hydrology model is being used to develop response functions to incorporate groundwater interactions into MODISM, which models surface water storage and allocation. SRAM and MODSIM will be iterated for each policy alternative. Results from SRAM will input to IMPLAN to estimate the regional economic impact of the alternatives.

Crop production functions were developed for zones in the upper Snake River basin represented by climatic conditions at Fort Hall and Twin Fall, Idaho. For surrounding areas, county level yields were obtained, which were used as references to adjust some of the crop parameters in CropSyst so as to improve yield simulation of the different crops involved. Complete weather records were obtained and modified for in CropSyst. In addition, soil data for each area was identified and input files were prepared. Model calibration for alfalfa, corn, spring wheat, sugar beets, dry beans and potatoes under full irrigation were prepared. A reasonable agreement with observed yields was obtained. Simulations for 0 to 100 percent irrigation in increments of 10 percent were prepared. These yields can be used to accommodate any depth of field water application as predicted by SPRINKS for different irrigation uniformity and efficiency scenarios. Additional data analysis will determine patterns of relative yield with respect to relative water supply. Results from these runs will be used to estimate crop production functions for use in SRAM.

SRAM has been developed to estimate the change in crop production at the regional level due to changes in water allocation. Data on water deliveries, crop acreage, irrigation efficiencies, crop water use and crop input and output prices were gathered for model development. SRAM was calibrated and tested using the policy scenario of government purchases of one million acre-feet of water to augment in-stream flow. Results from the SRAM model have been compared to the results obtained in the Million Acre Feet study that was separately conducted by the Bureau of Reclamation. In general the SRAM results were relatively consistent with results from the Million Acre Feet study lending some credibility to the SRAM exercise.

The SRAM model has been used to examine two alternative million acre-feet scenarios. In alternative one the impact on recreation was minimized at the expense of irrigated agriculture. In alternative two the impact on irrigated agriculture was minimized at the expense of recreation. In each scenario, the water transfer from each region was determined by using MODSIM and those transfers were fed into the SRAM model. The advantage of this approach is that MODSIM does take account of water rights and the hydrology of return flows. The disadvantage of the approach is that MODSIM is unable to account for the relative value of the water in each of the regions along the Snake River. So water is being taken out some regions were it is relatively valuable when other regions where water is less valuable are not transferring as much water.

Work is currently underway to use the SRAM model to determine the region from which the water will be transferred from agriculture. Here the water transfer will be determined so that the shadow price of water in the SRAM models is equal across all regions. In this way the economic impact across the entire region can be minimized. The water transfers from the SRAM model will then be fed into MODSIM to determine how the hydrology of return flows modifies the results obtained from SRAM.

Work is also underway using SRAM to vary the level of assumed water purchases from the Bureau of Reclamation's one million acre-feet scenario and examine the predicted impact on regional crop production and regional economic impact. In addition, the consequence of dry year versus average year scenarios is also being investigated.

Work on MODSIM has focused on two goals. First, enhance our ability of manipulating and interfacing with the MODSIM computer program. Second, develop an understanding of MODSIM as developed by the Bureau of Reclamation model of the upper Snake River basin, from Wyoming to Brownlee Dam on the Idaho-Oregon border. The model is being enhanced to better incorporate ground water interactions, thus being more capable of evaluating effects of land use changes on river flow. The most significant groundwater contributions to the river are in the eastern Snake River Plain, above King Hill. The changes to incorporate groundwater hydrology take the form of new attributes in the model, as opposed to changes in model code. Preliminary groundwater response functions have been used in the Snake River program of MODSIM with good success. Refining these functions will continue throughout the project.

So far all of the economic impact analysis using SRAM has been built on output coming from MODSIM. Work is now being conducted where the Regional input-output models were constructed to cover the economy of southern Idaho. Three separate models were constructed representing the eastern region (Idaho Falls), the central region (Twin Falls) and the southwestern region (Boise). Idaho Falls, Twin Falls and Boise make up the three functional economic regions in southern Idaho and represent appropriate regional units on which to conduct economic impact analysis of the kind required by this project. The input-output models have been standardized in terms of reporting format to facilitate translation of model results to spreadsheet and word processor formats. Estimates of regional agricultural impact from SRAM are being fed into the input-output models to estimate the likely regional economic impact of leasing different amounts of water from agriculture for salmon recovery.

Publications

Hamilton, J.R. G. Green and D. Holland "Modeling the Reallocation of Snake River Water for Endangered Salmon." *Amer. J. Agr. Econ.* 81 (5):1253-1256. 1999.

Engle, Paula, and David Holland. "Water Leasing For River Flow Augmentation and Uncompensated Job Loss: A Case Study of South Central Idaho." A.E 99-3., Dept. Ag. Econ., Wash. St. U., Pullman. 1999.

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