AN ANALYSIS OF THE FEASIBILITY OF IRRIGATION DISTRICT TRANSFER IN HONDURAS

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Introduction

User participation in the management of irrigation systems has been touted as a means to establish incentives for proper operation and management, decrease distortionary governmental subsidies, and increase water-use efficiency. User managed irrigation systems should be more responsive to farmers' needs. Local managers can better maintain systems when budgets are controlled locally and not reliant upon central government transfers. And irrigation management transfer has been recommended under structural adjustment programs as a means to reduce government expenditure. Often this transfer has been supported by development banks and donor assistance (Johnson, 1997; Vermillion, 1998; Gorriz et al, 1995). However, it is often difficult to withdraw subsidies, to reduce the bureaucracy dedicated to public irrigation systems, to train farmers in system management, and to instill a sense of group responsibility for common assets.

The Government of Honduras has been in a process of rehabilitating and transferring management responsibility of the Flores irrigation districts to farmers. This decentralization of management has progressed slowly because of the unenthusiastic response of the irrigators and the need for system rehabilitation. There remains uncertainty about the economic viability of the irrigation systems, the users' acceptance of increased responsibility for system operation and maintenance, and the sustainability of these systems. Despite the advantages of irrigation, especially in Honduras' five-six month dry season, basic grains remain the major crops in the district. Poor soils inhibit the change to higher valued crops. Farmers' lack of formal education and training might restrict their capacity to effectively manage the system. And water scarcity and conflicts over water-use might reduce the availability of irrigation water.

This research assesses three key potential constraints to a successful user managed irrigation system transfer process: 1) farmers' preferences towards the privatization process and acceptance of new responsibilities; 2) the security of water resources to sustain irrigation; and 3) farmers' capacity to accept financial responsibility for the systems and cover the capital costs of the rehabilitation. The research intends to support the ongoing transfer process by identifying constraints and proposing improved strategies. The second part of this paper will provide background on the irrigation system and the transfer process. The third part of the paper will present an analysis of farmers' preferences to the transfer process. The fourth part of the paper will discuss conflicts for water and environmental management. The fifth part of the paper will present an analysis of farmers' capacity to accept financial responsibility for the district. The paper will conclude with a discussion of compliance with criteria for successful management transfer.

The Flores Irrigation District and the Transfer Process

The Flores irrigation district, with 3600 hectares of irrigated land, is located in the Comayagua Valley, one of Honduras' most productive agricultural areas with an altitude between 600 and 670 masl. Prolonged dry periods restrict productivity without effective irrigation. The dry season lasts from November though April and averages 11 mm of precipitation per month. The rainy season starts in May and lasts through October with an average of 96 mm/month of rain (CONASH, 1999). Notably most of the soil is noted well suited for irrigated agriculture. A 1990 study assessed that only 10% of the district's area is highly suited for irrigated agriculture, 20% is moderately suited for irrigated crop production, 40% is poorly or conditionally suited for irrigated crops, 20% is inadequate

for irrigation. Nearly 10% of the districts land area is used for residences, roads, or waterways (JICA, 1990).

In 2001, there were 496 irrigators in the district. Most of these are farming their own land, although there are a few renters and share croppers. Almost half of the farmers had plots less than or equal to 5 hectares, which represents less than 15% of the total irrigated area. Over 40% of the farmers had plots between 5 and 20 hectares, representing 48% of irrigated land. And 8% of farmers had farms greater than 20 hectares, representing 37% of the district's land. Principle crops include rice, beans, maize, papaya, and pasture, which are grown in both the rainy and dry seasons. Some vegetable crops and tobacco are grown in the dry season. And some farmers use irrigation water to maintain fish ponds.

The district has been in operation since 1954, originally managed by the government and supported as a means to assist peasant farmers. During the 1990s the Honduran government adopted a policy of privatization and decentralization that included the eventual transfer of irrigation systems to users. In 1993 the Irrigators Association was formed as a first step in the transfer process. This association has an official charter as a tax-exempt, non-profit organization. The Association is organized with a General Assembly, Board of Directors, and committees in charge of secondary and tertiary canals. Currently, the irrigators are responsible for the management, operation, and administration of the system under guidance from the Secretariat of Agriculture's (SAG), Directorate of Irrigation and Drainage (DGRD). The DGRD currently supports the district with a manager, social promoter, and a cashier, which is 17% of the total operations cost of the district. The DGRD also provides technical assistance in terms of

training courses as well as some material support. The association collects fees by selling tickets for irrigation turns based upon the area irrigated, which is under certain assumptions akin to a volumetric fee. In 2001 this fee, was equivalent to $1.23 per hectare to the association, with an additional $0.12 per hectare as a traditional water use fee for the state[2].

The ongoing privatization process should culminate in the transfer of canal infrastructure, and the district's office and property to the irrigators in form of a permanent concession. As of 2001, much of the legal work needed to accomplish this transfer was ongoing and still subject to approval of the Honduran Congress. The government has supported the transfer process by maintaining the manager and other functionaries, but there has been little help in terms of training irrigators in system management.

A 1996-2002, $21 million rehabilitation project has restored principal canals, the Coyolar Dam and reservoir, and a small hydroelectric generator. The reservoir also supplies domestic water for 8,700 residents of two small communities, villa de San Antonio and Flores. The hydroelectric generator is administered separately from the irrigation district. But the dam is supposed to be managed for the irrigation districts and hydroelectric generation should occur when the irrigation district requires water. This rehabilitation project, supported by the Government of Kuwait, has temporarily reduced irrigated area, but full production is expected to be restored in 2005. Because of the rehabilitation, the capacity of the farmers to fully accept the financial responsibility for system operations and maintenance has not been adequately tested.

[2] The actual amount of the water *canon* is approximately $0.00015/m^3.

Farmers' Attitudes Towards Management Transfer

A 2001 workshop of members of the Board of Directors, government agents, and selected farmers from the Flores and nearby Selguapa Irrigation Districts addressed strategies for sustainable district management. A number of problems with the Flores District were identified, including: 1) lack of volunteers to serve on the Board of Directors or other District functions; 2) lack of training and technical assistance for District leaders; 3) poor capitalization; and 4) poor management of Coyolar Dam. Strategies for address these problems included training, continued governmental assistance, a preseason payment dependent on crop, and strict rules for dam management. This workshop also served to assist in the development of a survey instrument to assess farmers' attitudes towards the privatization process.

A sample of 195 farmers were interviewed when they purchased tickets for irrigation turns. There is no recent census of district farmers, but this sample contained 86% owner farmers, 12% renters, and 12% share farmers. Sixty-one % of respondents had primary education, 27% had secondary or superior education, and 12% of respondents had no formal education. Thirty % of farmers were less than 40 years old and 22% of farmers were greater than sixty years old. Ten percent of respondents were females.

The sample revealed that 66% are in favor of accepting control of the district. Training and distance from the principle canal were significant factors in the probability of being in favor. Only 43% of respondents would accept a position in the District's Board, with training a significant factor in a positive response and age a significant factor in a negative response. Maximum likelihood results of a logistic regression model to

assess willingness to be a Board Member are presented in Table 1. These results support the strategy of continued training that was proposed at the leaders' workshop.

The survey was also used to assess preferences for alternative systems of water fees. Farmers have been required to buy tickets before each irrigation turn based upon the area to be irrigated. The implied assumption is that each hectare requires a uniform volume of water. Alternative fee systems were proposed. A system where farmers are charged different rates per crop was proposed. This alternative would charge higher rates for crops which are more profitable. A modified version of this system is used in the nearby Selguapa Irrigation District, where a differentiated preseason fee is charged for each crop, and this is used to provide the district with preseason liquidity. In Selguapa a area based fee is also used during the irrigation season. A third alternative, a strict volumetric system was also proposed. The most favored result was the current system of are charges with 46% of responses. Thirty % of respondents favored crop charges, and 25 % favored volume charges. Results of a multinomial logit model showing the marginal probabilities of selecting three alternative irrigation fee systems are shown in Table 2.

Conflicts for Water and Environmental Management

The recent reconstruction of the Coyolar Dam has greatly reduced concerns about water availability. Although water in the basin eventually flows into the Humuya River and the large El Cajon hydroelectric plant there is little concern within the district, the community, nor the documents that supported the rehabilitation project about the quantity of water that flows downstream from the district. The principle users of the water in the Coyolar Basin are the irrigation district and the local population. Using data of river

average monthly flows from 1990 -1996 and subtracting estimated monthly water requirements for the irrigation system and household water requirements of 150 liters/person/day projections for the projected 2030 population of 19,200 residents, a 1999 study showed that river flows would exceed the necessary 16.5 liter per second continuous flow for ecological purposes in all but of 72 months.

Evidence of conflicts over water use is ambiguous. Sixty two percent of survey respondents in the Flores District stated that there was no water conflicts between users in the District. The leaders' workshop did reveal concern about the coordination between the mini hydroelectric plant at the Coyolar Dam and the irrigation district concerning the timing of discharges. However the engineer in charge of the rehabilitation project stated that dam and discharge management at the Coyolar Dam was subject to the needs of the irrigation district.

Efforts to maintain forest cover in the 19,000 hectare watershed area above the Coyolar Dam are considered to be critical because of concerns for sedimentation in the reservoir. The large proportion of this land is forested and nearly half is national or municipal property. The El Cajon dam project has maintained some watershed protection projects in the Coyolar watershed, and AFE-COHDEFOR, the state forestry corporation has developed a new watershed protection plan with the aim of stabilizing runoff and hillside soils, conserving ecosystems and biodiversity, and multiple use forest management.

Capacity of Farmers to Cover Costs of Irrigation System

The capacity of farmers to fully cover the costs of the irrigation system management and the rehabilitation project was assessed using crop budgets and local

estimates of net returns per hectare. A wide variety of crop budgets were gathered from local development projects, government agencies, and the agricultural bank, these accounted for the variability in technologies, inputs and output prices, and soil conditions found in the district. Net returns per acre were also solicited from local experts, including the district manager, and from farmers during the survey. These local estimates were accounted for by including an average over a wide variety of crop budgets and prices. After accounting for direct costs, net benefits were divided into returns for management, capital, land, and water, according to subjective weights solicited from producers and experts. The value of irrigation water in the rainy season was further adjusted by the contribution of rain water to the crop. Per hectare returns for irrigation were summed across the proposed crop plans in order to estimate the total value of irrigation water in agricultural production.

Results of this analysis are presented in Table 3. Note that the value of a cubic meter of water in irrigation varies widely across crops, with highest returns to tomatoes, onions, and watermelons. This could reflect the different levels of human capital required to produce different crops, or the differentiated soils that occur in the district. Water remains much more valuable in the dry season than the rainy season, although there are only a limited number of irrigations that are applied in the rainy season.

In order to completely cover the full cost of water, the irrigators would need to pay for:1) the costs of operating and maintaining the irrigation system and administering the Irrigation Association; 2) the cost of maintaining the upper watershed; and 3) the cost of the rehabilitation project. Projected budgets for the irrigation district were obtained from district management. Current investments in protection of the upper watershed,

including the costs of a forestry plantation and labor to plant trees in the upper watershed, were used to assess future costs. The total investment in the rehabilitation of the Coyolar Reservoir was divided between the consumptive water users, the irrigation district and the communities, and the hydroelectric station according estimated benefits. The cost of the reservoir and the principle canals should be divided between the irrigation district and the communities on the basis of the water used

The total cost of water service including financing irrigation district's share of the cost of the $21 million rehabilitation project is 0.023 $/$m^3$. The value of water in irrigation is not sufficient to cover this cost. However the value of water in irrigation in the district, $0.0073 is sufficient to cover the combine costs of: 1) the operation and maintenance of the irrigation system; 2) contributions to watershed conservation efforts; and 3) the national water use fee.

Conditions for Irrigation Management Transfer

Based upon field work and interviews conducted in the district in 2001, an assessment of the transfer process was conducted. Criteria were adapted from Vermillion (1994). Results are presented in Table 4. Over all the transfer process is meeting most of the criteria. The irrigation association is clearly established, financially autonomous, and experienced in collecting fees for water-use and managing funds. Clearly the donor financed investment in the rehabilitation of the reservoir and storage dam supports the success of the transfer process. The eventual role of the state and the final approval of the Congress in the privatization of the canal system is still ambiguous.

Conclusion

Much of the preliminary steps for a successful towards management transfer have been successfully completed. Many of the legal and institutional requirements for a successful water user association have been established, although the DGRD has yet to determine its ultimate role. In general the farmers are in favor of taking control of the system. Further training of young potential leaders is recommended. Although farmers have the financial capacity to cover the variable costs of the irrigation system, they will not be able to pay for the rehabilitation project. Poor soil quality in the district and the continued reliance on basic grains restricts farmers' income generation.

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Table 1: Maximum Likelihood Estimates of the Logistic Regression

Model Pr[Y(Yes, I would accept to be a member of the Board of Directors)]

"Yes" = 84; "No" = 111 Likelihood Ratio test ($Pr > \chi^2 = 0.0036$)

	Parameter Estimate	Standard Error	$Pr > \chi^2$
Intercept	-0.0426	0.4478	0.9242
Age	-0.1856	0.1174	0.1141
Training	0.3519	0.1250	0.0049

Table 2: Marginal Effects of the Probabilities Model Pr[Y = payment method]

"Area" = 88; "Crop" = 57; "Volume" = 47

Variables	Payment by Area Cultivated	Payment by Crop and Area Cultivated	Payment by Volume
Constant	0.03829	0.1803*	-0.2186*
Age	0.0467*	-0.0495*	0.00278
Training	-0.10460	0.04406	0.0605*
Education	-0.01921	0.01411	0.00510
Irrigated Area	0.05010	-0.07691	0.02681

* significant at the 0.15 level

Table 3: Net Returns to Water in Irrigation: Flores Irrigation District					
Crop	Net Returns $/Hectare	Hectares Cultivated	Net Returns Attributed to Irrigation %	Number of Irrigations	Value of Irrigation water $/m^3
Dry Season Crops					
maize	90.69	601	33.86	12	0.0015
beans	168.99	200	32.14	9	0.0035
tomato	1473.31	475	32.29	16	0.0173
chili peppers	728.81	175	32.29	16	0.0086
cucumber	625.80	426	31.71	16	0.0072
onion	987.00	175	30.14	16	0.0108
tobacco	512.61	100	32.00	24	0.0040
watermelon	975.95	251	31.57	15	0.0120
permanent crops[3]	731.15	171	28.52	24	0.0051
pasture	167.12	80	35.57	10	0.0035
SUBTOTAL		**2653**			**0.0083**
Rainy Season Crops					
maize	90.69	601	5.07	3	0.0009
rice	261.40	1101	3.79	3	0.0019
soybeans	188.70	351	6.25	3	0.0023
tomato	1473.31	175	3.86	3	0.0111
chili peppers	728.81	175	3.86	3	0.0055
permanent crops[2]	731.15	171	2.20	3	0.0031
pasture	167.12	80	5.23	3	0.0017
SUBTOTAL		**2653**			**0.0026**
TOTAL		**2653**			**0.0073**

[3] Net returns are weighted averages for papaya, mango, avocado, oranges, and coffee.

Table 4: Compliance with Criteria for Successful Management Transfer	
Criteria	**Compliance**
1. Political and economic pressure for state to transfer management	State incentive to reduce cost. Users have a passive attitude towards transfer.
2. New roles for state agencies developed. Transfer policies clearly established.	No clearly defined new roles for state agencies defeined. Transfer process remains unclear.
3. Financially autonomous irrigation associations.	Irrigation association is financially autonomous and experienced.
4. Ideological commitment on part of irrigators to remain autonomous.	Majority of farmers support transfer. Some are not fully committed.
5. Irrigation association has rights and obligations clearly defined.	Signed agreement between irrigation association and government.
6. The transfer process strengthens the irrigation association and the ability of users to make decisions.	The irrigation association is legally chartered, and is strengthened by the transfer process.