



# The Economic Impact of Mariculture on a Small Regional Economy

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**Summary.** — This case study of southern Honduras explores whether new exports act as staples or promote enclave development. Aquaculture exhibits low backward and strong forward linkages. However, reliance on imported inputs is likely to increase as vertical integration, disease and quality concerns grow. In addition, there are only minor fiscal linkages through municipality taxes, and the region has received a minor share of the surpluses generated. Shrimp farmers have tended to use reinvestment to deepen, rather than widen, their activities. Any moderate consumption linkages remain dependent upon the ecological health of the export sector itself.

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*Key words* — linkages, economic impact, staples, coastal aquaculture, Honduras, Central America

The South is an emporium of unexploited riches. . . (Choluteca businessman, *El Heraldo* newspaper, Tegucigalpa, Honduras, June 26, 1993).

Non-traditional exports have changed the South from a zone of poverty to a growth attraction area. (Shrimp farming representative, presentation at the AAAS Meetings, March 15, 1999).

Honduras' southern region. . . presents a classic, well-documented case of both failed and contested export development. (Boyer & Pell, 1999).

the country's total exports and 3.5% of the country's total GDP. The shrimp sector, like most agroexports, helps the country pay its foreign debt—44% of the total sales figure remains in the country as local salaries, profits, and indirect taxes (BCH, 1998). Moreover, this trade expansion has provided additional resources for national growth; business leaders estimate the industry attracted about \$230 million worth of investment during 1985–95 (*El Heraldo*, 1996).

The regional impacts of the exports may not mirror these macroeconomic trends. Industry officials claim that unemployed labor and surplus lands are being put to good use as the

## 1. INTRODUCTION

The development impact of natural resource-based nontraditional exports in Central America remains an issue of contentious debate. Nontraditional agricultural exports (NTAX) are those that traditionally comprise no more than 1% of a country's export revenues (Andrade & Lee, 1990). In Honduras, exports make up 30–35% of the country's GDP (IDB INTAL Database, 2001), with nontraditional products rising to 22% of agricultural exports in 1996 (RUTA, 1999).

In numerical terms, farm-raised shrimp appears as Honduras' most successful NTAX. Shrimp exports (both capture and farm-raised) generated \$75 million foreign exchange in 1996. Over the last decade the figure grew steadily and peaked in 1997 (UN, 2001); shrimp now ranks as the country's third largest export.<sup>1</sup> These figures generally represent about 10% of

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countries move away from import-substitution industrialization patterns. Indeed, the department of Choluteca, Honduras has been characterized as a “growth pole” and development hub (Lara, 1997). On the other hand, critics charge that the new activities provide few employment opportunities, lead to more skewed land distribution patterns, and produce negative environmental impacts (Conroy, Murray, & Rossett, 1996).

Clarification of the nature and magnitude of regional impacts is important as leaders consider continuing subsidies and financial incentives to support the export-led development strategy. The focus here is primarily on the regional economic (rather than environmental) impacts, with concluding comments on the interdependence of ecology and regional growth patterns.<sup>2</sup> This paper focuses on shrimp farming in southern Honduras to test whether new natural resource-based exports are fomenting a growth pole or enclave regional development pattern by determining whether strong or weak linkage and multiplier effects are present.<sup>3</sup> According to classical growth theory, a region appears as a growth pole if location-specific investment creates additional activity and employment in further geographic areas, while an enclave pattern is associated with few spillover effects and low retained values from export revenues (Perroux, 1955; Richardson, 1978).

Given the absence of precise local interindustry matrices and regional GDP statistics in many developing countries, the paper relies on household surveys, firm interview data, enterprise budgets, and coefficients provided by the national accounts calculations of the Honduran Central Bank.<sup>4</sup> The household survey data are part of the Permanent Multiple Household Survey project (EPHM) of the Honduran Statistical Office, the Inter-American Development Bank and the United Nations Economic Commission on Latin America.<sup>5</sup> This project provides the only regional data to analyze work and earnings patterns by industrial classification, but since the data are based on survey sampling, then must be analyzed with caution. Most of the data focus on 1996–97 when migration remittance information was included in these surveys and prior to the devastation of Hurricane Mitch.

Section 2 of the paper discusses the historical debate around natural resource exports and regional development processes. Section 3 reviews the quantitative and qualitative indica-

tors to assess multiplier and linkage effects. Section 4 first provides an overview of the Southern Honduras region, incentives for nontraditional exports such as coastal aquaculture, and the recent export growth process. Section 5 calculates technical linkage coefficients for coastal aquaculture and a variety of agroexports in the zone and explores other multiplier effects of the farm-raised shrimp industry.

Initial findings suggest that the regional economy is fairly diversified with a wide range of export activities, including the export of labor services and the return of remittance income playing a larger role than previously discussed. Coastal aquaculture has relatively low backward linkages and high forward linkages, and it is not easily classified into historical categories. Country size, increasing disease problems, and government incentives offered to exporters of nontraditional products may be contributing to a production pattern dependent on imported inputs associated with enclave development.

## 2. AN INTRODUCTION TO STAPLES EXPORTS

There is a long-standing debate over whether natural resource-based export industries make a positive contribution to local economies. Specifically, “staple” export crops and natural resource extraction activities—i.e., furs, timber, and wheat—may have driven regional and national growth in Canada, Australia and the United States.<sup>6</sup> A region in the extremes of underdevelopment may have surplus labor, land and capital resources that remain unexploited until the stimulus of foreign export markets arrives to stimulate a “vent-for-surplus” (Myint, 1958). Export businesses then create positive spillovers and foment further economic activity. Hirschman developed statistical measures of such business interdependence linkages and induced economic growth (Hirschman, 1958).<sup>7</sup> Industries with high “linkage” effects are associated with the appearance of growth poles. Porter (1990) has recently suggested some forms of global (cross-country) production could foment linkages since local suppliers of inputs should have a competitive advantage over foreign suppliers.

Historians analyzing the pattern of mining, banana plantation crops, and other primary

products in Central America argue, however, that a different pattern of “enclave development” often occurs (Amaya Amador, 1950; Lainez & Meza, 1985).<sup>8</sup> The export industry makes little contribution to a region apart from the employment of local unskilled, low-waged labor. Skilled technical labor is brought in from outside so most salaries are not spent on the consumption of local goods. Inputs are imported, surpluses are remitted to a head office, the firm pays few taxes, and the firm establishes few secondary links with interests in the community. The exports provide few linkages and low retained value.

The more recent literature on specific staples exports presents a mixed picture of the exports’ contribution to local economies. Barham and Coomes (1994) show that the Brazilian state captured much of the surplus from the Amazon rubber boom through taxation, even though few technical backward and forward linkages were present due to the nature of wild extraction in an isolated area. The industry’s high sunk costs and continued investment deepening made the local economy vulnerable to a bust after rubber prices fell, however. Roberts (1995) assesses the trickle-down effect of mining in Brazil by focusing on consumption linkages, possibly generated through the spending and saving of employee salaries. He demonstrates that few salaries remained as funds for the local banking system. In addition, most consumer goods and production inputs are imported into the study region so that an enclave pattern is being repeated.

Twentieth century nonstaple export industries such as cotton, cattle, and garments also have been associated with limited regional development and negative environmental consequences. The cattle boom is often labeled a worse-case scenario in which a new industry may cause a net labor expulsion when the number of workers displaced from traditional activities far outpaces the level of new job creation (Williams, 1986; Howard, 1987). There is a new line of literature emerging around the development impacts of manufacturing products from less-developed countries. Many observers contend that export-based manufactures produced in “maquillas” may be replicating the enclave pattern in the sense of purchasing few local inputs and providing few skilled labor opportunities (Warr, 1987; Brannon, James, & Lucker, 1994). In the Sri Lanka garment case, few local suppliers were able to meet the requirements of international de-

mands through purchasing agreements and the sunk costs associated with some types of input production (Kelegama & Foley, 1999).

There have been few such analyses of new “nontraditional” natural resource-based exports such as farm-raised shrimp products.<sup>9</sup> Aquaculture products provide about 26% of fish volume and sales worldwide, and are expected to dominate fisheries by the year 2030 (FAO, 2000). Aquaculture is an important example of a nontraditional export product for Ecuador, Honduras, and many Southeast Asian countries. Farm-raised shrimp is a variation of the classic bulky staple-type export. This type of aquaculture is capital, skill and land-intensive, and it requires new farm construction and machinery, as well as training in new techniques, yet it has a high unit value.

There are debates over whether shrimp can be grown economically on small-scale farms in less-developed countries; generally some economies of scale are assumed with 100–300 ha being the minimum efficient size for semi-intensive and intensive operations (Lee & Wiggins, 1992; Shang, 1990).<sup>10</sup> Aquaculture enterprises are increasingly operating as vertically integrated complexes rather than traditional fishpond activities.<sup>11</sup> Industrial spokespeople have presented reports suggesting the creation of tens of thousands of jobs in each country where exports have begun. Catfish, a common US aquaculture venture, supposedly creates a high local value-added with numerous development spillovers (Allen, 1986). Critics respond that artisanal fishing families have been displaced from coastal wetlands and labor absorption by the industry is low, with mostly temporary jobs created (Bailey, 1997).

### 3. METHODOLOGY TO ASSESS EMPIRICALLY THE NATURE OF EXPORT-LED GROWTH

Regional economic base theory uses the assumption of classical economists that exports provide the primary stimulus to growth of employment and domestic product (Baldwin, 1956; Caves, 1965; Innis, 1956; North, 1955; Tiebout, 1956; Watkins, 1963). So a local economy can be divided into two components—basic and nonbasic—with the basic sector being that related to exogenous demands while nonbasic activities (such as services and wholesale/retail shops and hotels/restaurants)

support the economic production in the basic sector. Economic base techniques allow the calculation of the general employment and income multiplier effects of export industries as a group (Hoover & Giarrantani, 1984; Tiebout, 1962). Total regional economic activity  $T_i$  (either in terms of employment or resident income) is broken into occupational categories and then assigned to either the "export base"  $B_i$  or the "nonbase"  $N_i$ . A base economic impact multiplier is then calculated as the total economic activity level divided by that associated with the base ( $T_i/B_i$ ) (Vias & Mulligan, 1997). A large base multiplier—akin to a large multiplier from the inversion of an input-output matrix under certain conditions (Hinojosa & Pigozzi, 1988; Merrifield, 1987)—indicates strong direct and indirect spillover effect so that a natural resource-based export could be promoting a regional growth pole, rather than enclave-type development. Evidence about the growth of basic and supporting nonbasic sectors also is available in business expansion records (Schurman, 1993).

Calculation of the base multiplier using employment as the economic activity suggests that for every new job in a Honduran export activity approximately three other jobs will be created,

primarily in the service sectors of the economy.<sup>12</sup> Regional resident income might offer a more accurate measure of economic activity. The export and nonexport sectors often pay different salary rates, and residents receive non-earnings income transfers.<sup>13</sup> Using the resident income figures provides a smaller base multiplier of two. These income multipliers are similar to those reported in other rural economy studies using base methods (i.e., Garrison, 1975; Gibson & Worden, 1981).

Not all export activities contribute equally to the economic base multiplier. For instance, "nonemployment incomes" (such as migration remittances) often have a higher multiplier effect on regional services and commerce than does basic employment (Kendall & Pigozzi, 1994). In addition, the multiplier effects of traditional and nontraditional natural resource-based exports may vary.

The Hirschman-type linkages and business impacts of Table 1 can illustrate the export production dynamics underlying the base multiplier. The analysis here concentrates on the technical, consumption, investment and fiscal linkage effects of the coastal aquaculture industry in southern Honduras, with some comparison to other agroexports. The first entry of

Table 1. *Assessment of business impact on a local economy (Barrow & Hall, 1995)*

	Growth pole multipliers	Enclave-type development
(1) Primary linkages:		
—Backward linkages and the purchase of input supplies	Large backward linkages (local input use)	Small backward linkages (high imported input content)
—Forward linkages and the composition of demand	Large forward linkages (local processing)	Small forward linkages (export or consume primary product)
(2) Fiscal links	Sector pays substantial taxes to local and national government	Sector exonerated from taxes or exhibits tax avoidance
(3) Consumption links	Sector's payroll is well-distributed to allow spending by lower-skilled employees on locally made goods	Sector's payroll is concentrated among high-skilled, professional employees who purchase imported consumer goods
(4) Investment spillovers	Majority of shareholders local, majority of profits/dividends reinvested locally	Investment funds raised internationally, with profits remitted outside the region
(5) Employment skill spillovers	A range of employment opportunities available with extensive training in skills transferable to other sectors	Skilled labor imported to the region and most employment opportunities offered in unskilled, or highly specialized, positions
(6) Secondary links	Sector interested in the broad development of the host economy; political participation and assistance to community in education, health efforts	Sector has little interest in community; staff establish few residency/political ties and provide few donations to community development efforts

Table 1, technical linkage coefficients, represent the partial multiplier effects of a new production activity's demands for labor, services, and inputs in a zone.<sup>14</sup> These downstream and upstream effects create concentric circles of additional employment (Reardon *et al.*, 2000). Linkages give a ranking measure of the stimulus one industry gives to another since there is a correlation between high linkage effects and high employment and income multipliers.

Backward linkages represent the input purchases from other local industries by a sector, while forward linkages are the amount of total sales other local industries purchase from a sector.<sup>15</sup> For instance, a new berry contract farming operation may stimulate local box companies to supply cartons for harvesting while a new jam business may appear since it could acquire cheap berries as its input. Following Thirwall (1994), the "primary" linkage effects of industry "j" in a zone are expressed as

$$\mathbf{L}_b^j = \Sigma_i X_{ij} / X_j$$

= purchased (regional) intermediate inputs/  
total value sales

$$\mathbf{L}_f^j = \Sigma_j X_{ij} / X_j$$

= local interindustry demands/total value sales

$$0 < \mathbf{L}_b^j, \mathbf{L}_f^j < 1$$

Linkages are often derived from the Leontief matrix constructed from input-output tables. The operational definition of backward linkages is the sum of all  $a_{ij}$  row coefficients in a  $j$  column of the technological A matrix in an input-output table. Forward linkages are the sum of all  $X_{ij}$  interindustry sales of final demand.

The other growth pole/enclave hypotheses of Table 1 can be found in interviews with business sector representatives, business incorporation documents including the nature of investor composition, and payroll records. Additional positive spillovers occur when the industry provides employment across a range of skill levels, has local shareholders, and pays taxes to a local government. Consumption linkages follow when export industry employees spend their salaries on locally made food, housing, and durable and nondurable goods. But it is often assumed that the most-skilled, and highest paid, employees tend to buy imported consumer goods (Barrow & Hall, 1995). Thus only a salary distribution favoring lower-skilled employees would be associated with

large consumption linkages.<sup>16</sup> Moreover, having regional businesspersons participate in exports is usually associated with higher investment spillovers. This is because residents are more likely to use their profits from exports to start new local business concerns, whereas foreign investors could repatriate profits as a "leakage" effect (Barrow & Hall, 1995). High fiscal linkages occur when an export industry pays large tax revenues that are recycled into broader government expenditures. Next, training employees receive in export industries may generate positive externalities if other local industries later hire these skilled workers; interviews with these potential future employers are used to qualitatively measure this aspect.

#### 4. THE SOUTHERN ECONOMY AND THE ROLE OF NATURAL-RESOURCE BASED EXPORTS

##### (a) *Population and economy in the southern region*

The dry area of southern Honduras includes low foothills, a coastal plain, and mangrove swamps and estuaries along the Pan-American Highway. Cattle and cotton were the main export activities throughout the post-WWII period, with salt and sugar farms serving the national market. Coastal communities also relied on gathering and fishing activities (Stonich, 1991). Light manufacturing began in the 1960s with the establishment of wire fencing production, leather processing, and block manufacturing. Nontraditional exports arrived in the late 1970s.

The region has been one of the most densely settled and poor areas of the country. In the mid-1980s more than 70% of the families in the region lived on less than \$20 per month (CPSE/OEA, cited in Stonich, 1991), and this trend has continued with a low Human Development Index of 0.55 for Choluteca, which is below the national average (UNDP, 1998). The largely rural population historically has relied on basic grains production for home consumption and the sending of migrants to the central and northern regions of Honduras (Polanco, 1992).

##### (b) *National policy incentives*

Honduras' expansion into new export activities in the 1980s came about both through

private sector initiatives and conscious policy decisions. The idea that exports could serve as an engine of growth gained new popularity with the trend of economic liberalization throughout Latin America and the developing world. For instance, the US Caribbean Basin Recovery Act (CGERA), passed in 1983 and later extended, provides duty-free entry of nontraditional exports and funds for agricultural infrastructure development and diversification projects in 22 Caribbean and Central American countries (Clark, 1997).

Central American governments also have undertaken "selective" trade liberalization and promotion. Nontraditional producers in particular were provided tax exonerations on intermediate inputs and profits, customs benefits, special technical extension programs and semi-subsidized loans through international lines of credit, and other support akin to export subsidies (Hoffmaister, 1992). Producers of traditional exports do not enjoy these measures. Other specific laws and decrees aimed at promoting the nontraditional sector include the Temporary Import Tax Exemption of 1984, the Industrial Processing Zone Regime of 1987, the Export Promotion Law of 1987, and the Structural Adjustment Decree of 1990. In general the measures have resulted in nontraditional exporters being exempt from paying the common national sales and profit taxes, market-value property rates, import duties, and most export taxes. As discussed below, however, some firms still pay municipal taxes.

### (c) Regional export trends

The direct impact of the incentives described above may be seen in the regional growth of agro-industries during 1988–96 in Table 2. Salt, sugar, and cattle production continue to occupy a large amount of arable land and labor. Melon production has peaked at nearly 7,500 ha under production. The main nontraditional export, shrimp, blossomed a bit later and now occupies some 27,000 ha, of which 14,000 ha were under production in 1996 (Green, 2000).

An initial view of how the local economy has expanded alongside the southern export growth appears in Table 3 from a review of new business licenses and tax registers of selected municipality offices. The data highlight how the departmental city of Choluteca has grown more than the rural municipality of Namasigue during the last decade. The rural Namasigue area is where much agroexport production is physically located, but few spillover businesses have started there. But new business start-ups in Choluteca have outpaced the population growth rate, with the largest increase has occurred in the retail trade and services sectors. Few manufacturing concerns have emerged to diversify the base of the economy.

The EPHM provide a similar picture. Occupational employment trends in Table 4 show that over time the share of agriculture has decreased somewhat, possibly due to outmigration. Employment increases have occurred in food processing, cattle slaughter, bakeries,

Table 2. *Agroindustrial expansion in Southern Honduras*

	Area under production	Number of firms	Farm-level employment	Value regional production 1996	National export level 96/97
Cashew	600 ha 1990 1,448 ha 1996	50 producers 200 producers	500 people 1,700 people	\$300,000	\$8.3 mn. \$0.1 mn.
Sugar	12,675 ha stable	850 farms, two refineries	Approx. 7,500 FTE <sup>a</sup>	\$4,071,750	National sales
Melons	6,000 ha 1990 7,500 ha 1996	2 coops, five large farms 78 farms	Approx. 7,000 FTE	\$3,480,000	\$16.1 mn. \$11.7 mn
Shrimp	5,500 ha 1990 13,780 ha 1996	147 producers 223 producers	Approx. 4,800 FTE	\$63,750,000	\$57.5 mn. \$75.4 mn.
Cattle (dairy & beef)	160,000 ha stable	13,974 farms	Approx. 13,500 FTE	\$19,337,500	\$10.7 mn. \$5.3 mn. (beef)
Coffee	2,154 ha stable	677 farms	Approx. 1,300 FTE	\$28,270,000	\$238 mn \$322 mn

Sources: Agrarian Census of 1988, 1990 and 1993 (SECPLAN); FPX (1993); Howard (1987); UN Commodity Trade Statistics.

<sup>a</sup> FTE = full-time equivalent at 300 days per year.

Table 3. *Patterns of municipality expansion*

	Small municipality			Large municipality		
	17,810 (1988 Census)	24,119 (SECPLAN) 1998	35% % Increase	88,812 (1988 Census) 1990	116,492 (SECPLAN) 1998	32% % Increase
Population						
Number Firms	1990	1998	% Increase	1990	1998	% Increase
<i>Primary agriculture</i>						
Shrimp, sugar, cashew	5	8		0	9	225%
Wood cutting	0	0	15%	4	4	
Cattle	15	15				
<i>Manufacturing</i>						
Brickmaking	5	6	20%	1	9	
Cement production				1	4	
Food processing				5	11	200%
Icemaking/metalwork				5	7	
Art-gloves manufacture				1	2	
Lime processing				2	3	
<i>Construction</i>						
Machine/tractor rentals	0	0		4	13	225%
<i>Wholesale trade</i>						
Beverage distribution	0	0		3	4	196%
Grain wholesale				19	64	
<i>Retail trade</i>						
Agricultural inputs				4	20	
Bakeries	0	1	85%	5	14	
Cheese-food sales	8	13		119	492	
Car and machine parts				10	46	
Hardware & electric goods				9	34	306%
Furniture & plastics				1	10	
Gasoline				3	11	
General and paper goods	0	1		34	122	
Purified water				0	4	
<i>Services</i>						
Banks				6	16	
Beauty salons				5	23	
Bicycle & car repair	1	2	50%	8	52	236%
Carpentry & painters				4	14	
Courier services				1	3	
Electric goods-repair				22	73	
Fumigation services				0	2	
Funeral parlors				2	4	
Real estate & insurance				2	5	
Jewelry-gun repair				8	14	
Medical clinics/pharmacies				27	51	
Pawnshops-mortgage				2	11	
Photography & printers				6	19	
Radio-TV-cinemas				4	6	
Private schools				1	4	
Secretarial & engineering				1	2	
Security services				0	6	
Tailors				1	6	
Travel agencies				1	2	
Transportation	1	1		9	13	
<i>Restaurants, hotels, liquor establishments</i>	37	53	43%	31	125	503%

Table 4. *Pattern of occupational distribution, 1989-96*

	1989 Reported observations	Percentage of total workforce (%)	1996 Reported observations	Percentage of total workforce (%)
<i>Choluteca department</i>				
01 Agriculture	44,933	49.8	60,191	46.6
02 Mining	292	0.3	2,272	1.8
03 Manufacturing (food processing 031)	9,376 (5,217)	10.4 (5.8)	19,803 (12,283)	15.3 (9.5)
04 Utilities	178	0.2	135	0.1
05 Construction	7,947	8.8	6,911	5.3
06 Commerce/hotels	11,675	12.9	14,646	11.3
07 Transport	1,431	1.6	3,807	2.9
08 Banks/finance	469	0.5	339	0.3
09 Service	12,914	14.3	21,124	16.3
<i>Valle department</i>				
01 Agriculture	16,934	50.7	16,890	33.6
02 Mining	392	1.2	424	0.8
03 Manufacturing (food processing 031)	4,575 (1,601)	13.7 (4.8)	12,721 (3,347)	25.3 (6.7)
04 Utilities	0	0	234	0.5
05 Construction	1,420	4.3	3,089	6.1
06 Commerce/hotels	4,362	13.1	8,999	17.9
07 Transport	762	2.3	1,187	2.4
08 Banks/finance	178	0.5	389	0.8
09 Service	4,741	14.2	6,388	12.7

Source: Data from Encuesta Permanente de Hogares de Honduras (EPHM), various years.

sugar refineries, and light manufacturing of clothing, furniture, and ceramics. Most important, the region is not wholly dependent on shrimp employment, in contrast to some districts in Asia (Goss, Burch, & Rickson, 2000). Finally, it appears the region has experienced some economic growth, but it does not stand out as a clear "growth pole." Both average rural and urban incomes have risen some 300% in nominal terms from 1989 to 1996 in the southern departments, but the levels and increases are less than the national averages.<sup>17</sup>

## 5. LINKAGE EFFECTS AND BUSINESS IMPACTS OF NATURAL-RESOURCE BASED EXPORTS

### (a) *Export sector overview*

Honduran farm-raised shrimp production began in 1973; however, most of the expansion occurred in the late 1980s in response to generous incentives and attractive export markets. Technicians from Ecuador, Panama and the United States played an important role in transferring ideas to the Honduran industry, although national specialists are increasingly leading dissemination efforts. The area under

production has expanded to some 13,600 ha in ponds, operated by 66 firms and 157 family operations in late 1997 (Green, 2000). The sector contains both small family firms using extensive (low-input) techniques and medium and large-sized multi-shareholder companies using moderate input ("semi-intensive") techniques. Many larger operations involve joint ventures between Honduran and international investors. Yet the Honduran sector is not among the largest world producers, so that farmers are price takers in global markets.

Post-larval shrimp (seed) is stocked in growout ponds for four months during which time feeds are added and the water is circulated through pumping or the natural tide. Harvest then occurs by pond draining. Pond productivity peaked in 1993 at 2,292 lbs/ha across two cycles. Current yields from Honduran semi-intensive operations are about 1,500 lbs/ha (Green, 2000), which is low compared to Asian farms and some South American operations.

At least 12,000 direct on-farm and 30,000 indirect employment positions (with a multiplier of 2.5 jobs/production ha) are commonly attributed to the shrimp industry (FPX, 1993). The industry tends to follow the gendered division-of-labor described in other agroindustry studies (Goss *et al.*, 2000). It is commonly as-

sumed that the region holds large (unskilled) labor reserves so this new job creation would be a clear vent-for-surplus growth benefit. But some of the coastal aquaculture positions require skilled labor, more often transferred from other zones; a common trend is the recruitment of agronomists from the urban and northern areas of the country. Interviews with shrimp processing plant managers and seed buyers reveal that many of the young women and men holding the packing and gathering positions are new entrants to the regional labor force; thus the net impact of the industry on regional unemployment rates remains unclear. The indirect employment created by the industry through its multiplier effects is discussed below.

(b) *Technical linkages in Southern Honduras*

Are the described regional trends in Section 4 derived from new agricultural export products such as farm-raised shrimp or from the region's historical exports? The linkage analysis can help address this question. Data from interviews with farm managers were used to determine the source of input supply (local, national or imported), production cost structures, and typical sales levels. For comparison, they were analyzed against farm enterprise budgets and industry cost structure compositions of other agroexports derived from the Honduran Central Bank's National Accounts unit.

Figure 1 shows the flow chart of the typical commodity flow of medium and large-sized producers' shrimp exports in southern Honduras.<sup>18</sup> The figure demonstrates some reliance on national inputs with significant local processing activities. The production chains for melons and cattle demonstrate a similar pattern. Until 1996, the coastal aquaculture operations relied on local larva seed for about 70% of the ponds stocked. This includes both wild seed (captured by fisherpeople) and seed produced in regional hatchery facilities. Other locally purchased inputs for shrimp include ice (for post-harvest) and transportation services. These spillover businesses represent genuine linkages in that managers indicated the majority of their sales were to shrimp farms. Lime, some chemicals, and packing materials are acquired from national sources and occasionally sold through a local distributor. Feeds are brought from the northern city of San Pedro Sula or imported from Guatemala.

Since 1997 groups of four-five shrimp farms have united into partially vertically integrated operational chains in which the farm investors now have ownership of on-farm ice production, a hatchery and a packing plant, as well as an international broker office. One production group also sponsors an internal research unit. Two production groups engage in rental and management contracts with small independent farmers. But feed operations remain outside of

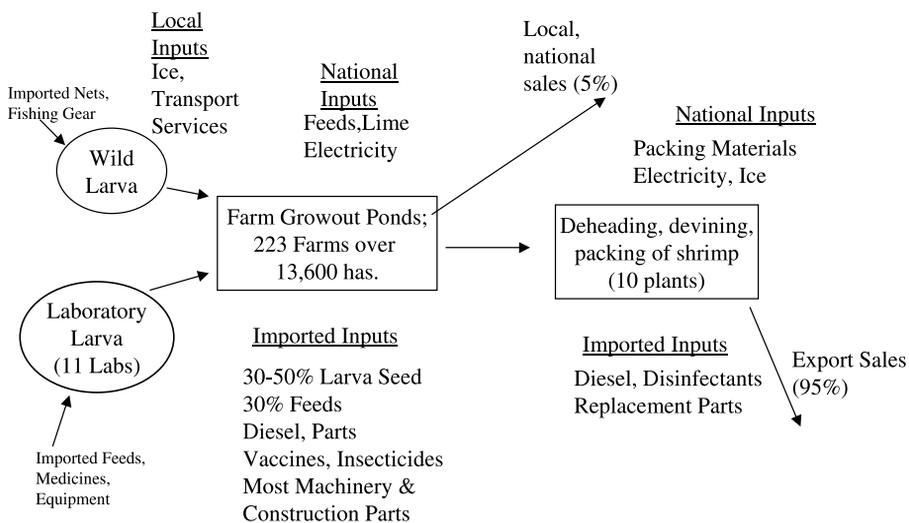


Figure 1. *Shrimp production interindustry flow of main expenses.*

each group's domain, and there have been few attempts at developing domestic market links. Thus the level of this (partial) vertical integration in Central America is much less complete than that observed in Asian shrimp farming and the Charoen Pokphand group in particular (Goss *et al.*, 2000).

Table 5 demonstrates the backward and forward linkages, and indirect job creation, from the farm production level. The first column of the table shows the expenditure on Honduran material inputs by sectors based on the Central Bank cost structure coefficients. Ranking this and the other columns shows that ranching has the highest local cost component and backward linkages. This matches the findings of prior linkage studies.<sup>19</sup> The low-input cattle system requires locally produced fencing, services and transport with few imported inputs.

Interestingly, it is the newer nontraditional melon and shrimp exports that appear to require the largest share of imported inputs, apart from the artisanal fishing sector relying on

suppliers in neighboring El Salvador. Melons require large quantities of imported fertilizers and pesticides. Most export producers interviewed said that local seeds and chemicals are not available or of low quality, and post-larval seed quality is an issue of increasing concern to shrimp farmers.<sup>20</sup> Growing disease problems (such as Taura, whitespot, and yellowhead viruses; Jory, 1999) are forcing the industry to rely on imported virus-resistant seeds and medicines, thus reducing the backward linkage effects. One firm has internalized the production of the larva input through supplies from its laboratory in the United States.<sup>21</sup> Trends of trade liberalization and the RIT (Temporary Import Regime) allowing the duty-free entry of necessary inputs may be reinforcing this trend.

With the recent integration trends backward-linked larva gathering operations and ice plants are slowly disappearing as the firms produce their own intermediate inputs. It remains uncertain whether such "internalization" of input production will have a positive or negative effect on local employment. Generally there are

Table 5. *Important linkage effects of agroindustries in Honduras (primary production stage)*

	Local expenditure (%)	Backward linkages	Forward linkages	Import coefficient: Percentage of imported inputs per sales unit
	(National, regional)	$L_b^1 =$ regional, $L_b^2 =$ national	$L_f =$ regional	
Cattle (beef & milk)	55 36	$L_b^1 = 0.08$ beef $L_b^1 = 0.11$ dairy $L_b^2 = 0.28$ dairy	0.70 intermediate demands by slaughterhouse, cheese plants	2
Melons	30 14	$L_b^1 = 0.14$ $L_b^2 = 0.16$	0.95 intermediate demands by export packers	29
Cashew		$L_b^1 = 0.03$ $L_b^2 = 0.04$	0.96 intermediate demands by nut processors	14
Sugar	33 26	$L_b^1 = 0.22$ $L_b^2 = 0.24$	0.95 intermediate demands by sugar refineries	17
Salt		$L_b^1 = 0.18$ $L_b^2 = 0.38$	0.95 intermediate demands by salt processors	4
Basic grains	33 12	$L_b^1 = 0.13$ $L_b^2 = 0.21$	0.30 intermediate demands by local processors (drink)	Corn: 11.5
Artisanal fishing	27 18	$L_b^1 = 0.05$ $L_b^2 = 0.11$	0.40 in-home processors and shrimp packing	37
Farm-raised shrimp	38 27	$L_b^1 = 0.09$ $L_b^2 = 0.23$	0.95 intermediate demands by packing plants	21

Sources: Farm enterprise budgets from firm-level interviews, Honduran Central Bank cost structure and value-added components based on business receipts by sector.

fewer jobs created for direct-employee larva gatherers paid high efficiency wages than for gatherers operating under indirect spot market contracts who are paid piece-rates (Stanley, 1999). Moreover, the formation of production groups has led to the reduction of some redundant administrative and technical staff. Currently, farm-raised shrimp ranks in the middle of the export industry continuum.

Agroindustrial forward linkages have created additional processing employment and incomes in the zone. For comparison, the sugar, cattle, and melon-packing plants all depend on local clients to provide the low-cost raw material. The long history of dairy and beef ranching in the zone has spurred forward-linked activities such as leather industries, cheese and meat-packing. Aquaculture's forward linkages have been high since the shrimp is deheaded, de-ined, and packed locally before export. Shrimp production has stimulated the opening of 10 packing plants in the region. Like the melon-packing houses, these operations demand locally produced ice, boxes and bags from other departments in Honduras. But the shrimp industry has not yet established forward linkages to other feed and livestock industries; for instance, low-quality shrimp are not used as an input in any processed food project.<sup>22</sup> Of course, this comparison across industries may

evolve over time; the older cattle ranching industry developed linkages over a 50-year history. As the nontraditional sector reaches a steady state and becomes a more permanent fixture in the economy, the number of linkages may rise.

Together these backward and forward linkages provide some indicator of the shrimp industry's current employment multipliers. The previously cited multiplier of 2.5 jobs per pond hectare is probably overly high since other coastal aquaculture case studies have lower multipliers even when complete grain farm and feed mills exist in the region (French, Cotsapas, & Hayes, 1991). Table 6 suggests that perhaps one-half additional (full-time) job per pond hectare is a more reasonable figure for a total of 10,000 jobs associated with the industry. This level of job creation can reduce, but not solve, the region's labor problems, as at least 50,000 persons estimated unemployed in the mid-1990s.<sup>23</sup> In addition, the shrimp farming work offered is highly seasonal in nature. Survey data suggest the direct employment creation potential of semi-intensive shrimp farming is probably less than one-half *full-time* job per hectare (Stanley, 1996). Actual nontraditional export employment multipliers may be higher; the figure omits any second-round employment effects associated with consumption spending.

Table 6. *Mariculture employment generation in Honduras*

Sector profile	About 265 farms producing 20–22 million lbs. of tail-on shrimp across 13,600 ha of ponds
Direct farm employment	Approximately 4,500–6,500 full-time equivalents; Between 0.33 and 0.50 FTE <sup>a</sup> per pond ha/year
<i>Indirect employment</i>	
A. Regional backward linked	
(1) Larva seed	
50% wild gatherer	1,700 FTE
50% laboratory	150 FTE
(2) Ice: four plants	120 FTE
(3) Transportation and construction services related mainly to mariculture	40 FTE
(4) Industry supply stores	10 FTE
(5) Large farm perimeter food provision services/stands	10 FTE, 40 FTE
(6) Initial farm construction	100 FTE
B. Regional forward linked	
10 small packing plants	500 FT, 742 FTE = 1,242 FTE
Total indirect:	3,412 FTE
Grand total	8,000–10,000 FTE

Sources: CCID (1996), Howard (1987), BCH (1998), Daberkow (1993).

<sup>a</sup> FTE = full-time equivalent at 300 days per year.

(c) *Consumption and fiscal linkages of the farm-raised shrimp subsector*

The other spillover effects such as consumption and fiscal linkages may be equally relevant in understanding the relative economic impact of coastal aquaculture. Proponents claim that employee salaries have generated adequate demands to stimulate local consumer goods industries. Indeed, the business data in Table 3 show expansion of clothing and food stores, bakeries, restaurants and bars in the zone. But given the presence of traditional exports and the increasing importance of international remittances in southern Honduras, it is clear that any "consumption boom" in the region cannot be attributed just to the growth of the shrimp industry.

The poor are incorporated in the shrimp boom mainly through employment opportunities. Unfortunately there is no recent consumption survey data available in Honduras from which to calculate how the marginal propensity to consume varies across income class. Data on the distribution of skilled and unskilled jobs and payroll shares can serve as a proxy indicator. In this regard it appears that Honduran coastal aquaculture's unskilled workers, while representing the largest share of employees, receive the smallest share of earned incomes. Stonich (1991) uses data from investment studies to calculate that 75% of the jobs on large farm operations are unskilled, yet unskilled workers receive only 19.5% of the total wage payments; a similar unequal pattern is observed across farm size. Other farm budgets demonstrate that over 60% of the total yearly wage payments accrue to the 30% best-paid skilled employees in administrative and technical positions (Dickinson *et al.*, 1988).

For comparison, a traditional local agro-industry, sugar, has a relatively well-distributed salary pattern. Over half of one refinery's raw sugar input is acquired through smallholder contracts rather than own production. Nearly 66% of the yearly salary payments in its directly-farmed area accrue to the 2000 temporary (maintenance and cane-cutting) workers while the 200 administrative and permanent workers receive 33% (Cruz, 1999; CCIC, 1966).

Large flows of international remittance income into this region further complicate the picture of consumption linkages in this region. Nationally the export of labor services has been estimated to include some 500,000 migrants

remitting \$100 million yearly in 1998 (BCH-Central Bank of Honduras, 1998). National accounts data do not provide a breakdown of the areas receiving remittances across the country. But, interviews with employees of the main courier companies operating in Honduras, Western Union, and banks receiving wire transfers suggest the level of remittances to the southern region generated \$10 million in 1996.<sup>24</sup> This level nearly equals that attributed to coastal aquaculture salary payments that year (BCH, 1998).<sup>25</sup>

Regarding *fiscal linkages*, the national impact of the new coastal aquaculture industry is low given the tax exemptions inherent as investment incentives. The temporary import regime exonerating nontraditional producers of import duties is one of the more costly incentives to the Honduran government. Estimates from the Ministry of Economics demonstrate that annually the shrimp industry imports approximately \$11 million in raw materials and \$6.3 million in machinery and parts for a yearly \$270,000 fiscal benefit through the exemption of tariffs and import duties (Mendez, 1999). Export tax collection has been sporadic and exempted for NTAX in most years; the shrimp export revenue foregone (assessed at 1% of FOB) would range between \$0.5 and \$1 million. The government's foregone profit tax revenues and administrative fees are difficult to calculate given the variability of average profit levels by year, shrimp cycle, and farm size. Producers also enjoy a subsidized rate on the lease of national coastal lands. Rentals are approximately \$5/ha per year, well below the opportunity cost of the land and the rate for (black-market) swapping of leaseholds (Stanley, 1996). The wetland concession area includes at least 6,774 ha managed by the National Fisheries Directorate and 18,327 ha administered by the Honduran Tourism Institute (Currie, 1995).

Perhaps more relevant for regional development is the trend in municipality-level tax collection. Efforts toward state decentralization led to the passage of the Honduran Law of Municipalities (Dec. 134-90) in 1990. Article 116 of the 1990 law exonerates nontraditional export producers from the sales tax on exports product. All firms, however, are required to pay the payroll taxes. Municipality officials could not pinpoint the exact incidence of tax evasion and collection rates across firms, but there was a general consensus that larger firms (particularly those with foreign investors) have paid the local taxes.<sup>26</sup>

(d) *Investment spillovers*

The residency of investors and the use of production surpluses remain contentious issues around the Honduran and worldwide shrimp farm expansion. Understanding the scale and factor bias of any agroindustry is crucial to predicting investment profiles and multiplier outcomes (Reardon *et al.*, 2000). Commonly urban-consumed or exported foods subject to grades and standards operate with some economies of scale and capital and land-intensive production patterns (Schejtman, 1997 cited in Reardon *et al.*, 2000). Additional factors, such as the land concession program, high fixed costs and differential credit access, appear to have fostered a segmented investment pattern in shrimp farming.

Honduran coastal aquaculture is characterized by a bimodal distribution of land holdings (and area under production). A large number of artisanal producers operate a small amount of area and contribute a small proportion of the export volume while the concentrated modern sector of about 20 firms holds most of the area and contributes the majority of exports. Calculations from 1991 concession figures demonstrate that 84% of the small farms held 13% of the area while 8% of the farms held 72% of the area (Stanley, 1996). An analysis of the 1995 area under production demonstrates that the largest 7% of the firms (farm pond area over 500 ha each) control 67% of the area.<sup>27</sup>

The skewed production distribution pattern means most of the profits generated through shrimp exports accrue to investors in the large farm segment. Furthermore, many large farm investors are not local residents. A review of the list of semi-intensive coastal aquaculture firms with three informants and records from the Honduran Business Registry suggests that about 40% of the area under production was financed by foreign capital, 38% involves national investors residing outside the region, and about 20% of the area is financed primarily by local residents.<sup>28</sup> Assuming constant profit levels by size, this would imply that nearly 80% of the surplus generated from shrimp lands accrues to nonresidents.<sup>29</sup> In this regard coastal aquaculture resembles some of the traditional export crops of the zone; for example, local investors supplied only 15% of the capital financing the two largest sugar processors in 1996 (Cruz, 1999).

The half-dozen small-scale shrimp farmers interviewed by this author have tended to put

any profits received from shrimp into their side salt pond business. Owners of medium-scale operations were divided in their use of profits. Most said they reinvest in the operation, yet in two instances the owners have used about 50% of the profits to diversify their businesses into dairy cattle and sugar cane activities. Managers of large-scale operations interviewed planned to reinvest 60–100% of profits in coastal aquaculture, either through expanding into new areas, adding other fish species, or intensifying production. Some firms have a system of profit sharing with employees, distributing about 5–10% of the surplus in this manner. One manager admitted to the firm's rule of distributing 60% of the profits to shareholders from Asia and northern Honduras. Few showed an interest in starting local businesses unrelated to coastal aquaculture. Trends toward vertical integration may lead to further investment specialization within the industry and profit repatriation outside of the region, both of which reduce investment spillovers.

Thus coastal aquaculture's impact on the local economy in terms of its use of revenues may be more akin to an enclave pattern. The strong presence of outside investment in the large-scale operations of the sector was probably necessary for the rapid generation of the region's export production; yet this ownership pattern has yet to contribute to a broad diversification of the region's economy. The industry has deepened investments in the fisheries sector rather than stimulate manufacturing or new activities in the zone.

(e) *Employment spillovers*

The most concrete indicator of the qualitative economic impact of coastal aquaculture may center on employee training, a so-called human capital linkage. Farm manager interviews suggest the 20–30% of total employees engaged in permanent, on-farm activities receive specialized training in aquaculture management and animal husbandry skills; others perform traditional technical roles (carpentry, automobile repair, etc.). A large segment of employees (mainly female) work in shrimp processing and packing. Whether these skills are transferable to other activities is an important issue not yet discussed in the employment analysis.

To begin exploring this question, I questioned 18 representatives from other sectors of the southern economy (i.e., salt, sugar,

manufacturing, mining, commerce, and service activities) about their willingness to hire persons with experience in coastal aquaculture. Eight would not hire an employee from a shrimp farm due to the specialized needs of a given sector (i.e., utility generation). But the majority stated that coastal aquaculture on-farm and processing skills are transferable to work in salt pond operations and melon packing activities. In addition, Chamber of Commerce representatives who are keen to attract maquila operations to the zone highlighted the shrimp packing skills learned by young girls would be directly transferable to this new sector. Thus training remains one of the most positive aspects of the industry's regional presence.

(f) *Secondary links*

Other business impacts in the region, namely involvement in the community and charity activities, are difficult to quantify. The National Association of Aquaculturalists (ANDAH) has played a leading role in the local Chamber of Commerce and provided financial support to some public events and fairs in the larger cities. The Association has started a regional aquaculture training program. A regular public relations newsletter outlines the association's views of the positive impact coastal aquaculture plays in national development. Most efforts of ANDAH, however, center on technical seminars for its members. In the rural areas located alongside the farms, some of the larger firms have provided occasional donations to school projects and road building. Yet in other areas tension remains between community members who feel a farm's charity activities remain inadequate to "compensate" for its role in re-

duced wetland access. Marches by community organizations, and counterprotest marches by shrimp farm employees, remain common.

## 6. COASTAL AQUACULTURE AND THE REGIONAL IMPACT OF NONTRADITIONALS

The impact of natural resource-based exports on regional development has not been as positive as expected, given the large financial support of the sector. A case study export does not follow the precise pattern of growth pole or enclave development associated with plantation and mineral activities. The export promotion has allowed the country to partially achieve its national goals of debt repayment and the attraction of foreign direct investment. But at the regional level it is doubtful if a complete "vent-for-surplus" process of growth has occurred. The new industry offers very moderate, and highly vulnerable, linkages. Aquaculture prices and demands are predicted to remain stable in the upcoming years.<sup>30</sup> (FAO, 2000; USDA/Harvey, 2002), so that international factors may not produce a local "bust." Producers dealt with increasing costs in the mid-1990s through a form of industrial restructuring. Yet ecologically based shocks could affect production levels in Honduras.

Table 7 summarizes the assessment using the common regional development criteria. Aquaculture's technical linkages and job creation rank it in the middle of a spectrum of other agroexport industries. Similar to the findings of other studies, the traditional cattle exports perhaps offer greater linkage effects. The industry's indirect job creation has been limited by the lack of a feed complex in the region,

Table 7. *Mariculture impacts in Southern Honduras*

Item	Probable score	Comments
(1) Primary linkages	0	Strong forward, moderate backward, but declining over time and ecologically vulnerable
(2) Fiscal linkages	0	Strong national tax exonerated pattern, some municipal taxes concentrated in urban areas
(3) Consumption linkages	-	Some consumption purchases by employees, but salary pattern unequally distributed and inseparable from remittances
(4) Investment spillovers	-	75-80% of profits accrue to nonresidents; little business diversification
(5) Employment spillovers	+	Many skills transferable
(6) Secondary linkages	0	Community projection, but significant opposition

vertical integration, and the growing reliance on hatchery seed. Coastal aquaculture and other nontraditionals' dependence on imported inputs is likely to increase as disease and product quality concerns raise the level of technical sophistication. The new exports may have generated some consumption multipliers and the start of new retail and service businesses, but this pattern seems as likely to be driven by the region's remittance income. In addition, the central government has foregone substantial fiscal revenues to promote nontraditional exports such as shrimp. The lost tax receipts total at least \$1–\$1.5 million annually. Minor fiscal linkages occur through taxes paid to the urban municipality, and some businesses are involved in the cultural activities of the zone. The poor of the region have received a minor share of the surpluses generated from shrimp farming as shrimp farmers have tended to use profits to deepen their activities.

Overall these linkages of nontraditionals remain inherently fragile and dependent upon the health of the export sector itself. Specialization and deepening of the industry is not necessarily bad, unless ecological limitations or disease problems bring about a bust. Indeed, as Bunker (1989) points out, resource depletion is a long-term limitation to the extraction of staples such as minerals. Schurman (1996) also mentions the vulnerability of consumer goods production and other multiplier effects in regional growth since most fisheries investments are sunk costs which are not transferable to other activities should the sector collapse. This general lesson appears relevant to Honduran shrimp farming as recent disease outbreaks and drought conditions reduced farm-raised shrimp output in early 2001, resulting in some lay-offs in packing plants and other forward-linked industries (World Catch, 2001).

Ecological sustainability issues thus will affect the ultimate economic impact of coastal aquaculture and other nontraditionals. Currently a heated debate exists in the environmental management literature around the sustainability of "industrial" shrimp farming (Stanley, 1998; also summarized in Clay, 1997; see also Flaherty, Vandergeest, & Miller, 1999 and citations within). The debate turns on reports of mangrove deforestation, overfishing of shrimp larva by-catch, salt loadings and water pollutants associated with shrimp farms in some developing countries. The skewed distri-

bution of the economic surplus from coastal aquaculture, as demonstrated in the Honduran investment profile above, may be related to poor environmental outcomes. In particular, the method of land concession allocation has forced small operators to farm in marginal mangrove areas (Dewalt *et al.*, 1996). Research based on 1995–96 data has warned that future Honduran farm development (and water pollutant concentration loadings) along several estuaries would press the carrying capacity of the region's ecosystem (Ward, Green, & Teichert-Coddington, 1999).

On the other hand, earlier ambitious farm expansion plans to 31,000 ha, well beyond the region's carrying capacity, may be limited through a recently approved protected-areas legislation. The trend to (partial) vertical integration of production may be a stimulus toward better environmental management. Industry public relations presentations claim that farms within the production groups in Honduras have adopted best-management practices such as reduced water exchange and sedimentation ponds (GMSB, 2001). Whether industry leaders are able to promote a broad adoption of these practices and manage industrial expansion within the carrying capacity of the region's ecosystem will determine whether the (limited) linkage effects discussed in this paper remain as permanent spillovers to the regional economy.

In addition, how coastal aquaculture is articulated in a local economy may vary across the developing world. In the present case the multiplier impacts of farm-raised shrimp exports remain constrained by the small size of the Honduran economy, its traditional dependence on imported inputs, and the generous nontraditional export incentives. Different trends are apparent in countries such as Ecuador, where a larger coastal aquaculture sector has stimulated the creation of 15 feed plants and a wide range of input-supplying industries (Pintado, 1990). Chile's natural resource-based exports now appear to have generated wide-ranging production complexes of supporting industries (Schurman, 2001). Regional integration in Central America may change the pattern of linkages and regional development around export industries. Thus a comparative approach integrating the technological demands of a sector and the policy environment conditioning production is needed in future research.

## NOTES

1. The Honduran Central Bank reports much higher dollar figures for farm-raised shrimp exports (for instance \$125 million in 1996), while the NOAA Database of the US Department of Commerce tracking US imports of Honduran shrimp shows a figure of \$70 million; in each case a peak in 1997 appears.
2. A description of the environmental problems of this region, and the role of mariculture, can be found in Dewalt, Vergne, and Hardin (1996).
3. A standard neoclassical cost-benefit welfare analysis of nontraditional exports was avoided since strong debates remain about the feasibility and value of alternative wetland uses and the shadow value of inputs. Commonly the net-present value of assigning wetlands to shrimp farming is compared to putting the area into sustainable shellfish harvesting (Gammage, 1997), and there is little attempt to assess the indirect impacts of new export production. Such ecological economics studies of wetland value ranges from \$60–\$2,400 per hectare per year and remain highly controversial (Dixon, 1989). In general, it is doubtful that the Honduran wetlands were “surplus lands;” but their actual marginal productivity is disputed. Moreover, it is unclear whether keeping wetlands as low-revenue, traditional, use reserves for local consumption was ever considered as a feasible option given broader Honduran export and policy incentives to support a transition to high-value crops.
4. This methodology emerged since at this point no meaningful input–output tables exist for the Honduran economy beyond the level of a one-digit industrial classification, and there are no regional tables. The last input–output matrix of Honduras in 1993 included 10 categories at the national level (UDAPE, 1996). But it focuses on agroexport activities not present in the southern zone, so the national coefficients were not regionalized. Instead, Central Bank representatives and 2–5 representative firm managers from each industrial subcategory were interviewed to prepare enterprise budgets. Survey instruments are available upon request.
5. The EPHM datasets are twice-yearly surveys of Honduran households, using population census data as a sampling frame (CEPAL, 1995). They provide representative data on household demographics, income, and work trends stratified by department and classified by urban and rural residence, although the coverage of municipalities and hamlets is incomplete.
6. Although difficult to generalize, staples often are referred to as bulky commodities based on natural resources that are produced in agriculture or extracted in mining. They often possess certain physical and spatial characteristics such as a low ratio of production weight–volume to the weight–volume of the extraction and processing stages, and high capital and transportation needs.
7. In the interest of tractability, this paper focuses more on the growth pole or enclave nature of exports rather than their spatial, geographical or demographic impacts.
8. Several factors contributed to banana exports becoming an enclave on the Honduran North coast. Although local processing created some forward linkages, the high reliance on imported inputs limited backward spillovers. State land concessions (for instance, the exchange of 500 ha of land for every kilometer of railway built) reduced fiscal linkages. Given the skewed income distribution pattern, low-wage workers only demanded dietary staples; these consumption linkages were limited even more by the company-store phenomenon. But, other analyses (Euraque, 1996) suggest that the banana industry may have provided some linkages which fomented the growth of ethnic businesses and political dynamism in the northern part of the country.
9. Exceptions include Schurman’s (1996) study of Chilean export fisheries and Schurman (2001).
10. Farming intensity refers to the level of inputs and associated output per pond area. Semi-intensive operations rely on moderate to high levels of post-larval seed, pumped water intake and supplementary feeds and chemicals with yields between 1,000 and 5,000 kg/ha/year.
11. For a review of this pattern of integration of agroindustries in Latin America, see Reardon, Rello, Schejtman, and Stamoulis (2000).
12. Tables for the sources of basic employment and resident income patterns in southern Honduras, organized by SIC categories, are available from the author on request.
13. Indeed employers in export industries are required to pay daily wages above the agricultural norm. Legislative Decree No. 001-97 (like previous annual decrees) set the daily salary of export industry workers at 39.65 (about \$3.30) lempiras while workers in small agricultural operations were to receive 25 lempiras (about \$2.08) daily.

14. They cannot serve as complete multipliers to forecast labor or input requirements for a change in final demand of one of the export industries. These technical linkages represent the direct (first-round) effects of an industry's purchases and sales without the second and later rounds of spending or consumption multipliers derivable from the inversion of the Leontief matrix. Yotopolous and Nugent (1973) present a total linkage multiplier for a specific (*j*th) sector as:

$$L_T = \Sigma_i a_{ij}^* \text{ where } a_{ij}^* = (I - a_{ij})^{-1}$$

Later analyses, however, suggest this multiplier captures the full effects on supplier industries, rather than user industries (Jones, 1976).

15. "Local" may be defined as businesses in a given region, treating all other national and international activities as outside; more commonly for developing countries "local" includes all national businesses.

16. Some early analysis suggested that incomes received by wealthier landowners would generate greater consumption linkages (see Hart, 1993 for a review of the consumption linkage debate). Most analysts of Latin America however now argue that a skewed land and rural income distribution pattern tends to reduce the influence of consumption linkages (Sadoulet & de-Janvry, 1995).

17. EPHM data calculations show Choluteca rural monthly incomes rose from 36 to 181 lempiras (approximately \$9-\$15) while urban incomes increased from 114 to 346 lempiras (\$12-\$28), while the national rural average rose from 56 to 289 lempiras (\$14-\$24) and the urban average from 169 to 684 lempiras (\$42-\$57).

18. Small producers often enter into interlinked input-sales contract arrangements with a local processor.

19. Mohamed and Hassan (1994) suggest certain agroindustries provide a greater stimulus to growth than others. Based on a full-SAM model of Sudan they conclude that cotton and wheat crops of the irrigated agricultural subsector have weak linkages, while sugarcane, oil seeds, and livestock generate particularly strong multipliers effects.

20. This concern has been voiced in other linkage studies; see, for instance, UNIDO (1974) and the discussion of specialized inputs for agroindustry in Key and Runsten (1999).

21. For a similar account of how food safety requirements and other quality concerns change the form of input provision see Reardon *et al.* (2000) and Key and Runsten (1999).

22. Shrimp heads waste, and aquaculture effluents, are possible feed inputs, yet only one large feed producing plant in northern Honduras has started to buy packing plant waste.

23. Unemployment rates in Honduras have been cited between 25% and 29% (including underemployment levels) (IBRD, 1987). The 1988 Census data counts 119, 141 persons as economically-active of the total 415, 450 population while there were approximately 171, 110 persons economically active of the region's 518, 516 total population in 1996.

24. Data provided by couriers, banks and transfer companies are available from on the author on request.

25. Salary payments at the farm and processing stage were calculated to be 119 million lempiras, while in 1996, \$1 = 12 lempiras.

26. Some local news coverage has focused on tax evasion by small and medium-sized firms.

27. It is worth noting, though, that this skewed pattern is not uncommon to agroexport production in the region or Central America in general. According to the 1993 Agrarian Census, 35% of the melon producers in Choluteca were smallholders (<100 ha) who cultivated 4% of the area. The three largest producers with extensions over 1,000 ha cultivated 59% of the area. And the smallest 26% of the cattle operations (under 2 ha of pasture) held only 5% of the total animals. The largest 2% of the ranches with over 200 ha in pasture controlled 40% of cattle. Dairy operations tend to be smaller-scale.

28. The analysis focuses on semi-intensive operations operated by private firms. Mixed salt-shrimp farms using low-profit extensive technologies were excluded as well as the 15 cooperative firms which operate irregularly. The area of analysis included 37 farms operating 12,509 ha in 1995; to calculate the land surplus each farm's area under production was weighted by its approximate ownership residency pattern.

29. Early US Agency for International Development reports suggested around 85% of the investment capital was North American (Maugle, 1987).

30. The FAO's State of World Fisheries and Aquaculture Report predicts "no insurmountable obstacles to the continued growth of aquaculture," particularly if producers emphasize higher-value finished products, a trend which is underway among several of the production groups in Honduras. The USDA Aquaculture

Outlook suggests developed country markets will continue to rely on imported shrimp products; price trends received by many countries fell in 2001 could vary but remain fairly stable depending on offsetting factors such as recessions and exchange rates in buying countries.

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