UNIVERSITI PUTRA MALAYSIA

ECONOMICS OF TECHNOLOGY ADOPTION: THE CASE OF BRACKISHWATER AQUACULTURE IN BULACAN, PHILIPPINES

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ECONOMICS OF TECHNOLOGY ADOPTION: THE CASE OF BRACKISHWATER AQUACULTURE IN BULACAN, PHILIPPINES

by

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ECONOMICS OF TECHNOLOGY ADOPTION:

THE CASE OF BRACKISHWATER AQUACULTURE

IN BULACAN, PHILIPPINES

by

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Faculty : Resource Economics and Agribusiness

Brackishwater fishponds are traditionally devoted to milkfish culture. However, for the past three to four years, brackishwater milkfish operators in Bulacan, Philippines have been culturing tilapia in addition to their milkfish crops. Owing to the dearth of primary data on this aspect, reasons advanced by researchers on the emergence of such practice were based on secondary information.

The purpose of this study was to provide information on the circumstances surrounding the phenomenon of culturing tilapia in traditional milkfish systems. The underlying reasons for the shifting to tilapia culture were investigated. Another objective was to identify and measure factors which tend to encourage or

restrain the adoption and extent of adoption of such practice. The analytical tools included costs and returns analysis in addition to models specified in the context of innovation adoption. Information for the study was obtained from a sample survey of fishfarmers in Bulacan, Philippines. The survey covered 1983-84 crop year. Additional data from a previous survey in the study area reporting 1979 crop year were also included in the study.

Between 1979 and 1983-84 crop years, milkfish producers were caught in a cost-price squeeze as input costs rose more rapidly than output prices. As a result, milkfish culture profitability declined considerably and some milkfish farmers shifted to other species particularly, tilapia. These farmers (adopters) were found to be the marginal and less efficient milkfish growers and the culture of tilapia provided higher returns than the old practice. Net return accruing from tilapia culture amounted to 1,125 pesos per cropping per hectare which was three times more than profit realized in milkfish culture. This was due to the fact that tilapia required less material inputs than milkfish.

Using logistic regression technique, seven technical and socioeconomic variables were hypothesized to explain the decision to adopt the new practice. Significant variables were perception on profitability and capital requirements of the innovation, extension contact, milkfish culture experience and market accessibility. The intensity or extent of adoption model was specified in semi-logarithmic form with essentially the same set of explanatory variables as in the adoption model. Four variables were significant, namely: tilapia culture experience, distance of pond from coastline, and the perception variables on the innovation (profitability and capital requirement).

From the foregoing results, it was concluded that the shift by milkfish farmers to other species, particularly tilapia was profit-motivated. Farmers' perceptions of the innovation were related to adoption behaviour actually taken. Moreover, management ability was an important determinant in innovation adoption and in the quantity of innovation to secure. At the same time, consideration of physical factors such as salinity of pond water was imperative in the frequency of tilapia cropping. Extension contact and access to printed materials on aquaculture significantly influenced adoption decision.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi dari keperluan untuk Ijazah Master Sains

EKONOMI PENERIMAAN TEKNOLOGI:

KES AKUAKULTURA AIR PAYAU

DI BULACAN, FILIPINA

oleh

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Mengikut tradisi, kolam air payau lebih banyak ditumpukan kepada kultur "milkfish". Walau bagaimanapun selama tiga empat tahun terakhir ini, pengusaha "milkfish" air payau di Bulacan, Filipina telah mengkultur tilapia sebagai tambahan kepada hasil "milkfish" mereka. Oleh kerana amalan ini bermula baru-baru ini, tidak ada data primer yang wujud mengenai aspek ini. Oleh itu, alasan-alasan yang dikemukakan oleh penyelidik-penyelidik mengenai kemunculan amalan sedimikian adalah berasaskan maklumat sekunder.

Tujuan kajian ini ialah memberi maklumat mengenai situasi di sekitar fenomena mengkultur tilapia dalam sistem "milkfish". Alasan-alasan yang menjadi dasar peralihan kepada kultur tilapia

telah disiasat. Di samping itu kajian ini cuba mengenalpasti dan mengukur faktor-faktor yang boleh menggalak atau menghalang penerimaan amalan di atas dan setakat manakah amalan berkenaan diterima. Di antara kaedah-kaedah analisis kos-pulangan di samping model-model khusus yang digunakan dalam konteks penerimaan inovasi. Maklukmat untuk kajian telah diperolehi daripada satu tinjauan sampel ke atas 60 penternak ikan di Bulacan, Filipina, yang meliputi tahun hasil 1983-84. Data tambahan daripada satu tinjauan sebelumnya dalam kawasan kajian tersebut yang melapurkan tahun hasil 1979 telah juga dimasukan dalam kajian.

Di antara tahun hasil 1979 dan 1983-84, penghasil-penghasil "milkfish" terperangkap dalam tekanan harga kos dengan kos input menengkat lebih cepat daripada harga output. Akibatnya, keberuntungan kultur "milkfish" banyak merosot dan setengah-setengah penternak "milkfish" beralih kepada jenis lain, khususnya tilapia. Adalah didapati petani-petani yang menerima peralihan merupukan penternak-penternak "milkfish" yang marginal dan kurang cekap, dan kultur tilapia telah memberikan pelangan yang lebih tinggi dibandingkan dengan amalan lama. Pulangan bersih yang didapati daripada kultur tilapia adalah sebanyak 1,125 peso sehektar semusim merupakan tiga kali ganda daripada keuntungan yang didapati daripada kultur "milkfish". Ini adalah kerana tilapia memerlukan bahan-bahan input yang kurang daripada "milkfish".

Dengan menggunakan teknik regresi logistik, tujuh pembolehubah sosioekonomi telah dihipotesiskan untuk menerangkan keputusan untuk menerima amalan yang baru ini. Pembolehubah-pembolehubah yang bererti adalah seperti persepsi mengenai keberuntungan dan keperluan modal bagi inovasi berkenaan, hubungan pengembangan, pengalaman mengkultur "milkfish" dan kebolehdapatan pasaran. Model keamatan atau setakat manakah penerimaan inovasi telah ditentukan dalam bentuk semi-logaritma dengan pembolehbubah-pembolehubah yang sama seperti yang terdapat dalam penerimaan di atas. Empat pembolehubah adalah didapati bererti, iaitu pengalaman mengkultur tilapia, jarak kolam daripada garispantai dan pembolehubah persepsi terhadap inovasi (keuntungan dan keperluan modal).

Daripada keputusan yang awal itu, telah disimpulkan bahawa peralihan oleh petani "milkfish" kepada mengkultur ikan jenis-jenis lain, khususnya tilapia adalah bermotivasikan keuntungan. Persepsi petani terhadap inovasi adalah berkaitan dengan tingkahlaku penerimaan yang sebenarnya dibuat. Lagipun, kebolehan mengurus adalah penentu yang penting dalam penerimaan inovasi dan dalam kuantiti inovasi yang hendak diperolehi. Pada masa yang sama pertimbangan faktor-faktor fizikal seperti kemasinan air kolam adalah penting dalam keamatan penghasilan tilapia. Hubungan pengembangan dan kedapatan bahan-bahan bercetak atau risalah-risalah mengenai akuakultura banyak mempengaruhi keputusan penerimaan.

CHAPTER 1

INTRODUCTION

1.1 Background

Since aquaculture was first practised in the Philippines in 1920, brackishwater ponds have been devoted mostly to the culture of Chanos chanos (milkfish). In 1981, total fish production from 176,000 hectares of these ponds reached 170,000 metric tons (BFAR, 1982). Of this, an estimated 90 percent was milkfish (Smith and Chong, 1983). In their assessment of the economic status and future prospects of the Southeast Asian milkfish industry, Smith and Chong (1983) noted that, while milkfish production in the Philippines continued to grow, its share to total fish production was leveling off. Using price data, they attributed this apparent trend to declining profitability of milkfish monoculture. Producers were being caught in a cost-price squeeze as input costs rose more rapidly than milkfish retail prices. Comparing costs and returns in 1974 and 1978 crop years, nominal receipts increased 108 percent while expenses were up 133 percent (Librero et al, 1977; Chong et al, 1982).

Several factors contributed to the decline in profits of brackishwater milkfish producers . First, there was an increased supply of lower-priced milkfish and other substitute species from freshwater pens and cages of Laguna de Bay. This resulted in a decline in milkfish retail prices (in real terms) in Metro

Manila with spillover effects on outlying provinces which originally supplied part of the metropolis' requirement. In fact, yearly average retail prices of milkfish in Metro Manila markets went down by 21 percent in real terms for the period 1974-1983, although in nominal terms, these was an increase of 90 percent in the same period (Table 1.1). As corresponding farm gate or fish landing site prices are not available, the extent by which fishfarmers were affected by the declining prices is not known.

The second factor was related to consumers' buying power and preferences. Declining real wages and inflation reduced per capita fish consumption from 38 kilograms (kg) to slightly over 20 kg in 1980 (NEDA, 1982). As demand for fish is more elastic at lower incomes (Smith and Chong, 1983), continuous fall in real per capita income brought about by the present economic crisis has led to an even greater diminution in the demand for fish. Consumers turned to lower-priced substitutes and demand for milkfish has been most affected. Moreover, changing preferences of consumers toward other species, particularly tilapia had further aggravated the situation for milkfish producers.

Entrepreneurs adjust to economic conditions. Thus, in response to the declining profitability of milkfish culture, producers have made short-run adjustments in their farms: adopting new technologies through complete or periodic shifting to the culture of other species or polyculture with the milkfish crop. These phenomena have been reported not only in brackishwater ponds but

TABLE 1.1

YEARLY AVERAGE RETAIL PRICES OF MILKFISH (PESOS/KG) IN METRO MANILA, PHILIPPINES, 1974-1983

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Percent change 1974-1983
Current Pesos	6.45	7.14	7.26	8.97	8.84	11.46	11.98	12.90	12.92	12.25	+90
Constant pesos	6.45	6.60	6.32	7.24	6.68	7.23	6.42	6.39	5.58	5.09	-21
Consumer retail price index (1972 = 100)	152.2	164.6	174.8	188.6	202.9	241.1	284.1	335.2	352.2	366.2	

1

Constant peso price = current peso price deflated by the consumer price index (see row 3) for all items n(1972 = 100).

2

January - June only.

3

Average for first 6 months of the year.

Source: 1974-1977: Bureau of Agricultural Economics
1978-1983: Philippine Fish Marketing Authority

Note: Table was lifted from Smith and Chong (1983).

also in freshwater pens. However, the most significant shifting has been occuring in brackishwater systems. These have given rise to a significant development in aquaculture. A sort of multiple cropping has evolved comparable to those existing in rice-based farms. The shifting from one species to another at certain times of the year, or the culture of two or more species simultaneously in different compartments or in the same pond, has created a distinctive cropping pattern. Among the species which has caught the interest of fishfarmers is tilapia.

1.2 Tilapia culture in the Philippines

Tilapia was first cultured in the country in 1950 with the introduction of the Mozambique tilapia, (Oreochromis mossambicus) from Thailand. The growing of O. mossambicus in those years did not fluorish because of improper management. The fish bred in an early age that ponds were filled with tiny, almost useless fish. This outcome hindered commercial tilapia farming. Worse, the fish invaded brackishwater ponds and became a scourge to milkfish farmers for sometime as it competed with the main crop for food and space. The introduction of Nile tilapia, O niloticus, in 1972, however, renewed interest in tilapia culture. The new species was better accepted by farmers and consumers alike because of its faster growth and lighter colour. Several species were subsequently introduced (Table 1.2).

Tilapias are considered euryhaline species; they can survive, grow and some species, O. mossambicus, O. aureus, and

TABLE 1.2

TILAPIA INTRODUCTION
IN THE PHILIPPINES (1950-1982)

Species	Year	Origin
Oreochromis mossambicus	1950	Thailand
O. hornorum X *O. mossambicus*	1971	Singapore
O. niloticus (Uganda)	1972	Israel
O. niloticus (Egypt	1972	Thailand
Tilapia zillii	n.a.	n.a.
O. aureus	1977	U.S.A.
O. niloticus (Ghana)	1977	Israel
O. niloticus (Ghana)	1977	Singapore
O. aureus (Israel)	1977	Singapore
O. aureus (Israel)	1978	Singapore
O. niloticus (Ghana)	1978	Singapore
Red tilapia (hybrid)	1979	Taiwan
Red tilapia	1981	Taiwan
O. aureus (Israel)	1982	Israel
O. niloticus (Ghana)	1982	Israel
Red tilapia	1982	Taiwan

n.a. = not ascertained

Source: Guererro (1983)

Tilapia zillii, can even reproduce in sea water of up to 40 parts per thousand (ppt) salinity (Chervinski, 1982). The most common habitat of tilapia, however, is freshwater. Since commercial tilapia fry is produced in freshwater hatcheries, proper acclimation must be done if these are to be cultured in brackishwater ponds to achieve higher survival rates. It has been observed that Nile tilapia fry is adversely affected by salinities higher than 15 ppt; however, with proper acclimation, growth and survival of tilapia fry are not affected (Guerrero, 1983).

While there are no statistics available, it is strongly felt by some researchers that the volume of tilapia produced in inland waters is quite substantial. In 1981, estimates of annual production in the country were placed at about 50,000 metric tons (Table 1.3)(Guerrero, 1983; Smith and Pullin, 1984).

Nile tilapia is the most common species raised in freshwater ponds and cages/pens. The culture of these species contributed to higher productivity in these systems. On the other hand, low production in brackishwater ponds can be traced to the fact that tilapia is just a fortuitous harvest, particularly O. mossambicus which invades ponds during water flashing activities, survives pest eradication by farmers and is eventually harvested together with the main crop.

Periodic and total shifting to tilapia in brackishwater ponds have been practised in Bulacan and Pampanga for the last 2 or 3 years. Tilapia production practices are in many ways similar to milkfish farming, but tilapia culture requires proper

TABLE 1.3

ESTIMATES OF TILAPIA PRODUCTION FROM PHILIPPINE WATERS, 1981

Production system	Area (ha)	Yield (kg/ha/yr)	Annual harvest (metric tons)
Aquaculture			
Brackishwater ponds	176,000*	100	17,600
Freshwater ponds	12,000	1,000	12,000
Cages/pens	1,000	10,000	10,000
Open-water fishing			
Lakes and reservoirs	200,000	50	10,000
	Total		49,600

* This was changed from 182,000 to 176,000 to conform with BFAR data.

Source: Guererro (1983)

scheduling of the production process to avoid highly-saline water intrusion which causes shock and stress to the growing fish. Gradually, producers are learning the proper culture of tilapia and the practice is gaining momentum on a wider scale.

Several factors contributed to the growth of tilapia industry (Guerrero, 1983; Smith and Pullin, 1984). One significant factor was the energy crisis in the early seventies that shifted emphasis from marine fishing to aquaculture. Technological breakthroughs by researchers for the improved management of tilapia encouraged fishfarm operators to take a second look at the fish. Also, increased acceptability of the fish by consumers favoured widespread enthusiasm for tilapia production and a subsequent boom in production. The initiative of the Filipino fishfarmer for venturing into ingenious culture techniques in tilapia culture (cage, pen and pond culture) was also a major contributor.

Tilapia can be mass-produced from eggs or intensively farmed in "batteries" unlike milkfish fry which has to be caught in the wild. Tilapia can also convert plant products into animal protein at a very efficient and economical two-to-one ratio (Maclean, 1984). Thus, it produces cheap animal protein in backyards or high-technology enterprises.

1.3 Statement of the problem

In some respects, the shift to the culture of tilapia in