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Milkfish Production Dualism in the Philippines: A Multidisciplinary Perspective on Continuous Low Yields and Constraints to Aquaculture Development

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Cover: Rounding up milkfish for harvest in a large Philippine pond. Photo by Kee Chai Chong.

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Abstract

Philippine milkfish ponds are generally underutilized. Perennial low milkfish yields from underutilized brackishwater ponds are primarily the result of the difference between fertilizer application rates followed by most milkfish farmers and those higher rates which would duplicate the results achieved on experimental farms and also on a small number of private farms.

The purpose of this study was to determine and measure the constraints to the adoption of more intensive fertilizer application rates among milkfish farmers in the Philippines. The analytical model specified for this study was placed in the context of various theories of agricultural stagnation and growth. Fifty-six explanatory variables, categorized into socioeconomic, institutional, physical and bio-technical parameters, were hypothesized to explain variations in fertilizer use. The study focused on farmers' perceptions of constraints. Data were collected from 447 milkfish farmers in seven provinces. Additional data from a previous survey involving 324 farmers from seven provinces were also included in this study.

Using multiple regression techniques, eight of these 56 explanatory variables explained 73% of the variation in fertilizer expenditure. Each had the expected sign. The high R^2 and F-value imply that the model as specified was appropriate.

The four explanatory variables which were statistically significant at the 1% level were: ratio of milkfish price to organic fertilizer price, ratio of milkfish price to inorganic fertilizer price, interest in working on other milkfish farms and belief in the effect of fertilizers on the taste of milkfish. The other four variables, significant at the 5% level were: salinity of pond soil sample, interest in seeking consultation, family size and farmers' estimates of a "fair" collateral requirement for loans.

Based on these results it was concluded that milkfish farmers are responsive to relative prices of inputs and output and will adjust their fertilizer expenditure accordingly. However, high costs of credit and of organic fertilizers in some locations coupled with declining real prices of milkfish inhibit many farmers from increasing fertilizer use.

One major reason why milkfish farmers were not applying more fertilizers was because they claimed not to have the necessary financial means to obtain them. A dual-pricing fertilizer subsidy scheme to encourage more intensive use of fertilizers merits an evaluation by the government to determine its practicality. Increased credit for operating capital, in contrast to credit for investment capital, should also be considered. Along with dual pricing for fertilizers and increased credit for production, there is also a clear need for the government to strengthen and increase the mobility of its information dissemination and extension service. Level of contact between farmers and extension workers was low and few, if any, farmers had published materials which would explain the advantages of intensified fertilizer use.

While the milkfish industry as a whole appeared to be undergoing transformation to higher average yields and not stagnating, the study concluded that strengthened institutional support (e.g., credit, extension and information dissemination) is necessary to accelerate development of the industry.

Introduction

BACKGROUND INFORMATION

This study was commissioned by the Food and Agriculture Organization of the United Nations (FAO) under the Bureau of Fisheries and Aquatic Resources (BFAR) Brackishwater Aquaculture Development and Training Project (BADTP), funded jointly by the Government of the Philippines and the United Nations Development Programme.

The principal author of this report was seconded to FAO by the International Center for Living Aquatic Resources Management (ICLARM) to design and organize the study under the general direction of the BADTP project leaders. The United Nations Development Programme and the National Economic and Development Authority of the Philippines supported the precepts set forth to the extent of providing additional funds for an extended project which included training of BFAR personnel.

The study, which has both research and training phases, was implemented jointly by ICLARM, BFAR and the Bureau of Agricultural Economics (BAEcon). The research phase, which culminated in a separate full report, was concerned with the identification and measurement of socioeconomic, institutional, bio-technical and physical constraints to the adoption by milkfish farmers of more intensive use of supplementary inputs, namely, fertilizers. Of particular concern was an assessment of producers' attitudes and perceptions regarding input use.

The second phase involved the development of training materials to be used at the four Brackishwater Aquaculture Development and Training Centers. These teaching materials are used in the training programs of BFAR extension personnel and technical appraisers and planning officers from BFAR, the Development Bank of the Philippines and provincial government offices.

The research phase was based primarily upon a 1981 survey of 447 milkfish producers in seven selected provinces in the immediate vicinity of the four Brackishwater Aquaculture Development and Training Centers. This report sets out the results of the survey and includes considerable discussion of producers' attitudes regarding constraints. Many of their comments center upon the availability of credit and contact with extension officers.

This report is an evaluation of government programs; however, producer attitudes toward government programs are presented and discussed in a constructive mode in the belief that an appreciation for these attitudes is an important ingredient in the development process.

PAST GOVERNMENT PROGRAMS

For the past two decades, milkfish farmers in the Philippines have been the expected beneficiaries of government efforts to bridge the output gap between potential and actual yield per ha of local milkfish ponds. Potential yield is as high as 2 t/ha/year yet the average productivity of milkfish farms is approximately 800 kg/ha/year. Many farms produce far less and are thus underutilized (Tang 1967; Shang 1976; Librero et al. 1977; Chong et al. 1982). The Philippine Government is rightly concerned over the low yield per ha of many milkfish ponds because it is interested in boosting production of fish from aquaculture systems, particularly in light of the expected levelling off of fish supply from capture fisheries.

Over the past few decades, the government has tried numerous approaches to change the status quo in the milkfish industry. These approaches, which included credit for capital investment and extension activities, attempted to shift subsistence milkfish farming to a more commercial status, often by encouraging more intensive use of supplementary inputs.[1]

Prior to the mid-1970s, government attempts to increase milkfish production and yield per ha tended to be ad hoc in nature. For example, the major activity to spur adoption of more intensive supplementary input use during the 1960s seems to have been a series of lectures and intensive consultations by a very small number of individuals with a limited number of milkfish producers (Tang 1967). While certainly extremely valuable for those producers fortunate enough to partake of these consultations and seminars, the majority of producers, particularly those still using very limited supplementary inputs, apparently benefited only marginally if at all.

The second avenue through which production increases were sought was the provision of substantial capital investment credit. These funds, most of which were made available through the Development Bank of the Philippines (DBP), were restricted to pond development and construction costs. Substantial areas of coastal swamplands and mangroves were converted to brackishwater milkfish ponds. Area under production increased 37% from approximately 123,000 ha in 1960 to 168,000 ha in 1970 (Table 1). Coupled with an 18% increase in yield per ha, total milkfish production increased by 60% during this decade.

[1] Defined as inputs over and above land, labor and stocking materials. In this study, the primary supplementary inputs considered are organic and inorganic fertilizers.

Table 1. Total area and production of milkfish in the Philippines, 1952-1980.

	Area (ha)	Production (tonnes)	Average yield/ha/yr (kg)
1952	88,681	31,038	350
1953	95,633	33,472	350
1954	100,097	35,034	350
1955	104,952	36,734	350
1956	109,799	38,480	350
1957	112,611	39,414	350
1958	116,546	59,624	512
1959	119,582	58,090	486
1960	123,252	60,119	488
1961	125,810	60,825	484
1962	129,062	61,436	476
1963	131,850	62,044	471
1964	134,242	62,680	467
1965	137,251	63,198	461
1966	138,968	63,654	458
1967	140,055	63,912	456
1968	162,807	86,711	533
1969	164,414	94,573	575
1970	168,118	96,461	574
1971	171,446	97,915	571
1972	174,101	98,922	568
1973	176,032	99,600	566
1974	176,032	113,195	643
1975	176,032	106,461	605
1976	176,230	112,761	640
1977	176,230	115,756	657
1978	176,230	118,682	674
1979	176,230	133,595	758
1980	176,230	135,951	771

Source: BFAR Fisheries Statistics, 1981.

Area expansion has slowed considerably since 1970, however, due to increased concern for the rapidly dwindling mangrove area and possible negative impacts on marine fisheries and coastal ecology of converting more of this coastal resource to brackishwater ponds. Between 1970 and 1980, yield per ha increased by 34%, while total area increased by only 5%. Consideration has been given to a moratorium on use of mangrove areas for milkfish ponds, but conversion still continues in certain parts of the country, especially in the Visayas and Mindanao. Moreover, DBP continues to provide the bulk of its milkfish credit for pond development, thus tacitly encouraging a continued emphasis on expansion of area rather than intensification of production methods on existing areas.

There are encouraging signs, however, that the potential for increasing production through increased yield per ha has been receiving attention since the mid-1970s. The major current activity of the Bureau of Fisheries and Aquatic Resources (BFAR) in this direction is the establishment of four Brackishwater Aquaculture Development and Training Centers, one in each climatic zone of the Philippines. These centers have a combined demonstration and training function, with an emphasis on the latter. To date, about 365 extension workers, 15 technical appraisers and 20 planning officers from the BFAR, DBP and provincial government offices, respectively, have undergone training at these centers.

Practical classroom and field training of these government officials in fishpond engineering, management, economics and post-harvest technology has already been accomplished. Another training component, extension methodology, was also incorporated. The training on extension includes an in-depth discussion on the need to understand the relationship between low producers and fisheries extension officers, which is addressed in this report.

The underlying rationale for the shift in emphasis from expansion of pond area to intensified production from existing areas can be found in the most recent Integrated Fisheries Development Plan (FIDC 1981). The Philippines is heavily dependent upon fisheries products to meet the animal protein requirements of its population. It has been estimated that 24 kg/yr or 54% of *per capita* animal protein consumption in the country is derived from aquatic products (FAO 1973). The population is currently growing at 2.4% per year, and it has become apparent to fisheries planners that population growth is now outstripping the capacity of marine and inland capture fisheries to supply these *per capita* levels of aquatic protein on a continuous basis. Consequently, the most recent Integrated Fisheries Development Plan calls for annual production increases of 20% from the aquaculture sector. Given the limits to expansion of area, much of this increase is expected to be achieved through increased yields from existing areas, thus implying more widespread adoption of intensive production techniques.

The annual 20% increase called for is significantly greater than historical rates of increase. As pointed out earlier, there was a 60% increase in total milkfish production from 1960-1970. During the next decade (1970-1980), there was a further 41% increase in total production (Table 1). Of course, not all of the expected increase in aquaculture production is to be contributed by the milkfish sector, since major advances are also underway in freshwater fish culture, especially of tilapia. Nevertheless, it remains true that an annual 20% increase in milkfish production far surpasses any annual increase achieved by the industry in the past. The challenge facing the Philippine government is thus to find ways to accelerate intensification of input use and increased production.

Before any attempt is made to alter the 'status quo', it is important that a thorough understanding of the existing production situation be obtained. In particular, it is important that the background, perceptions and aspirations of the farmers responsible for production activities be understood, and their decisionmaking process be appreciated. Often, the perceptions and attitudes of farmers are quite different from what observers believe them to be. What may appear 'irrational' to observers may be quite 'rational' to farmers. Individuals committed to promoting increased milkfish yields in the Philippines will hopefully find that this report contributes to an understanding of the constraints to increased input use and yields as perceived by milkfish producers themselves.

DUALISTIC STRUCTURE OF THE MILKFISH INDUSTRY

The Philippine milkfish industry can be characterized as a dualistic system: the two discrete components are the extensively and intensively managed farms. Extensively managed farms are those which do not use any fertilizers. Intensively managed farms are those which use supplementary inputs to some extent. The latter group make up the majority of farms. Although both systems produce milkfish, the two are very different not only in terms of yields per ha but also in their stage of development, levels of capital investment, degree of concentration of output, state of repair and entry barriers (Table 2). In short, the structures of the two components are different.

Table 2. Salient features of the dualistic structure of the milkfish industry (1980 crop year).

Characteristics of farm[1]	Extensive farms[2]	Intensive farms[3]
Weighted average yields (kg/ha/yr)	189	869
Proportion of farms (percent)	10	90
Degree of concentration of output share of top 4% of farmers[4]	27	39
Capital investment	Low	High
Entry barriers	Low	High
State of repair	Bad	Fair

[1] See also Table 6 for other contrasting features.
[2] Defined as using no fertilizers.
[3] Defined as using positive level of supplementary inputs.
[4] By volume of output.

The extensive/intensive distinction aside, the intensively managed component of the industry exhibits a wide range of intensity of supplementary input use and hence of output. In an earlier study, Chong et al. (1982) focused on intensively managed farms and found that the majority of farms in this category still produce less than 500 kg/ha/year (Table 3).

Establishing a line of demarcation between low, medium and high intensity of supplementary input use is somewhat arbitrary. The BADTP through which FAO commissioned this study considers those farms producing approximately 1,200 kg/ha/year as practicing mid-level intensity and those producing over 1,500 kg/ha/year as high level intensity. In this report, those farms that use supplementary inputs but achieve $\leqslant$ 1,000 kg/ha/year are classified to be low level intensity and those producing $>$ 1,000 kg/ha/year to be high level intensity. These distinctions, of course, are measuring intensity relative to the land input and not relative to other scarce inputs such as capital or labor.

Table 3. Percentage of farmers attaining various yield levels in intensively managed milkfish farms in selected provinces, 1978 crop year.

Province	Sample size	Yield (kg/ha/yr) <500	500-1,000	> 1,000
			Percent	
Cagayan	27	63	15	22
Pangasinan	81	51	33	16
Bulacan	52	29	29	42
Masbate	31	90	7	3
Iloilo	53	30	32	38
Bohol	42	88	10	2
Zamboanga del Sur	38	89	8	3
Survey sample	324	60	21	19

It is unnecessary to pursue the debate over which input is the 'most scarce' and hence the most appropriate for measurement of intensity, because an earlier study (Chong et al. 1982) demonstrated that increased profits can be obtained for the 'average' farm through increased use of organic and inorganic fertilizers. The implication of these earlier findings was that the 'average' milkfish farmer would be economically better off and achieve higher yields per unit area if the rate of application of fertilizers were increased. Intensity of fertilizer use and output per unit area are thus reasonable measures of management efficiency.

Based on Tables 2 and 3, it appears that 80-85% of all Philippine milkfish farms produce less than 1,000 kg/ha/year. This large number of low intensity and extensive (no fertilizers used) farms, co-existing with the much smaller group of high intensity farms, is the primary target of government programs and the research focus of this report.

The economic behavior of these co-existing systems has so far not been studied to find out why there is such a range of supplementary input use and yields, when in fact technology has long been available to bridge the output gap. Is this co-existence transitory or is it still evolving? Is the co-existence damaging or beneficial to society? Can the community of milkfish farmers using extensive and low intensity systems benefit from technology and programs designed to improve yields? In short, can or should the unequal development between the two systems within the milkfish industry be corrected?

Lasting and significant change in patterns of production from the traditional extensive methods to a more intensive commercial orientation requires the active cooperation and participation of the farmers being serviced. This change can only be accomplished when the introduction and adoption of the recommended method of production is clearly understood by the farmers and they see a real value in switching from their old and proven methods to one that is not only new but as yet untested by them under field conditions. It is one thing to say that many milkfish farmers have considerable management experience when much of this is with low intensity or extensive methods; it is quite another thing to say that the experience of milkfish farmers is appropriate for more intensive methods when this clearly applies only to a small minority. To sustain the shift of the majority from extensive or low intensity methods up the scale of intensity requires continuous and concerted effort not only by government agencies but also producers themselves.

OBJECTIVES

The overall objective of this study is to identify and quantify the nature of constraints to high yields from Philippine milkfish farms. Once the nature of these constraints is ascertained, it will then be possible to determine whether these constraints can be removed, modified or corrected to accelerate the wider adoption of improved techniques of production and hence increase milkfish production in the country. It is expected that once these constraints are removed, modified or corrected, the milkfish farmers will find the use of inputs economically attractive. Herein lies the keyword: milkfish farmers must find the switch from the less intensive to the more intensive methods of production economically *attractive.*

Within this broad objective, a major thrust is to identify the factors which limit the use of supplementary inputs that can help to increase yields.

Several definitions of yield gaps are possible depending on the bench mark and potential yield adopted for comparison (Fig. 1). In this study, the *potential* yield can be defined as the maximum yield obtained on experimental stations. The *bench mark* yield is the yield obtained by the small group of very high intensity producers. In this study we are only concerned with the gap between actual and bench mark farm yield; that is, yield gap II. Yield gap I can be characterized as non-transferable technology under current conditions; it is caused by site differences, differences in scientific know-how and management skills of farmers and researchers, difficulties in extrapolating to larger farm sizes from relatively small production areas most often used for experiments, and most importantly by the fact that private farmers are more likely to be guided by profit maximizing principles that are experiment stations that seek to maximize production per unit area. The level of input use and output that maximize profits will always be less than the level of inputs that maximizes production. Our primary interest is thus on sources of yield variation among farms rather than between farms and experiment stations.

For the purpose of this study, the bench mark yield is pegged at 2,000 kg/ha/year, a conservative output level widely known as attainable under farmers' field conditions. Much higher output has in fact been reported, but this is probably not a realistic goal for most milkfish farms. The actual yield is estimated to be 800 kg/ha/year, representing approximately the average yield per ha achieved

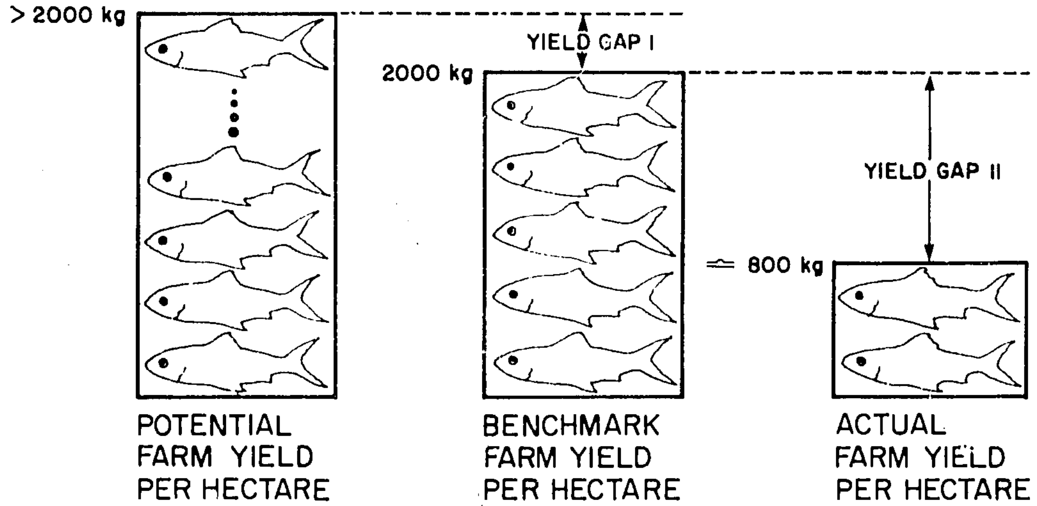

Fig. 1. Definition of yield gaps.

by milkfish farmers. The majority of farms, in fact, still fall below this level. Based on these two definitions, there is a yield gap of about 1,200 kg/ha/year and the bench mark yield is 2.5 times the actual yield.

Given that output increases are achievable with increased use of supplementary inputs, the authors examined the factors that can explain variability in input use, specifically fertilizer use. Management factors such as culture experience, age and educational attainment of producers/managers are also examined. The major possible explanatory factors for this variability are identified and the constraints to adopting increased inputs and 'action steps' that the Philippine government might consider to overcome these constraints are discussed.

DATABASE

This study is based on a 1981 field survey of 447 milkfish farmers in seven provinces representing four different climatic types. The seven provinces and their climatic classifications are as follows: Bulacan (Climate I), Quezon (Climate II), Capiz, Mindoro Oriental, Negros Oriental and Calape, Bohol (Climate III), and Lanao del Norte (Climate IV). These four climate types are defined as follows:

- Type I : two pronounced seasons, dry from November to April and wet during the rest of the year;
- Type II : no dry season, wet, maximum rain period from November to January (pronounced rainfall);
- Type III : seasons not very pronounced, relatively dry from November to April and wet during the rest of the year; and
- Type IV : rainfall evenly distributed throughout the year.

In addition, data from and results of a 1979 survey covering 324 milkfish farmers are also referred to extensively in this report (see Chong et al. 1982 for details, including definitions of climatic types). This earlier survey covered seven provinces in three different climatic zones. They are Pangasinan, Iloilo and Bulacan (Climate I), Cagayan, Masbate and Zamboanga del Sur (Climate III), and Bohol (Climate IV). Between them, the two studies covered 771 producers in 12 different provinces (Fig. 2).

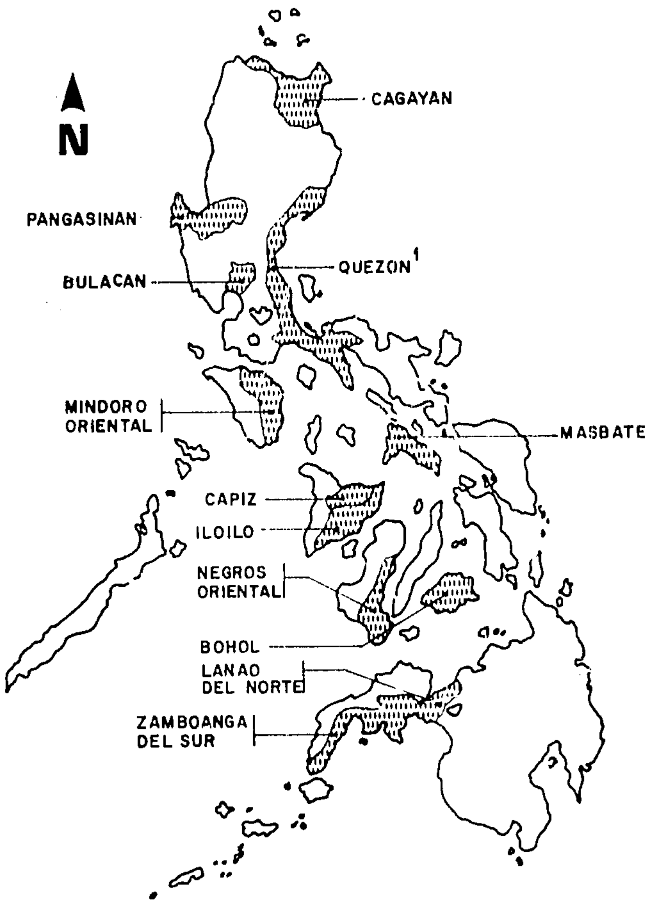

Fig. 2. Map of the Philippines showing the provinces included in the 1979 and 1981 surveys.

[1] All respondents were drawn from southern Quezon.

In both surveys, proportional sampling was used to ensure that sufficient variations in milkfish farming practices and managerial background were present. The 1979 survey covered only those farms using supplementary inputs; the 1981 survey also included extensively managed farms (i.e., those using no supplementary inputs). The sampling frame and unit were stratified according to climatic zone and then by province and *barrio* or village. Proportional sampling was adopted because of the need for farmer cooperation and representativeness. The use of stratified and proportional sampling worked well for the two surveys because the data points exhibit wide variations.

The selection of the survey areas was based on climatic types because milkfish productivity is known to be influenced by natural conditions such as rainfall and hours of sunshine. This is also the reason there is one Brackishwater Aquaculture Demonstration and Training Center (BADTC) in each of the four climatic zones found in the Philippines. Incorporating all climatic types permits separation of the effects of climate from those constraints which are amenable to human intervention.

Although milkfish farm owners were sought out as primary sources of information, this was not always practical because many were absentee owners. As a result, only 60% of our sample in the 1981 survey consists of milkfish farm owners; the rest are either caretakers, fishpond administrators or managers. Our sample thus consists of the 'primary decisionmakers' regarding levels of input use. The total area owned by the 447 milkfish farmers is about 8,500 ha, of which 84% or 7,100 ha were in production and the remainder (1,400 ha or 16%) were not in production during the reference period, 1980 (Table 4). Our survey showed no fully developed farms lying idle in 1980 but an estimated 25% of the milkfish farmers interviewed had underdeveloped areas on their farms. Underdeveloped areas are not fully excavated but were used to grow milkfish.

Table 4. Distribution of developed and undeveloped areas on milkfish farms in the 1980 crop year.

Province	No. of farms	Total Area (ha)	Developed Area (ha)	Developed Percent	Undeveloped Area (ha)	Undeveloped Percent
Bulacan	111	2,555.3	2,492.8	98	62.5	2
Quezon	99	1,589.8	1,233.1	78	356.7	22
Mindoro Oriental	19	344.0	305.3	89	38.8	11
Capiz	64	915.5	802.2	88	113.4	12
Negros Oriental	24	376.5	304.7	81	71.8	19
Bohol	107	1,262.9	797.7	63	465.2	37
Lanao del Norte	23	1,447.1	1,168.1	81	279.0	19
Total	447	8,491.2	7,103.8	84	1,387.4	16

The 1981 sample included milkfish farmers who use supplementary inputs and those who do not. Farmers in both categories were interviewed in 1981 because it was important that the socioeconomic differences between the two types of farmers be recognized. In addition, documentation of the physical differences between the pond systems operated by the two categories of farmers was important. Moreover, differences in the technical knowledge and managerial abilities between the two groups of farmers would also shed some light on the wide yield gap. The two groups of farmers may have different access to or perception of the various government and other institutions with which they deal. It was also important that this aspect be documented.

Additional information on the milkfish industry was sought from non-producers such as input suppliers, officials of financial institutions (rural banks and Development Bank of the Philippines), milkfish brokers, wholesalers and retailers, fry gatherers and distributors, extension agents and government research personnel, and industry leaders. While structured interviews were conducted with primary producers using a 14-page questionnaire (see Appendix), informal question and answer sessions were carried out with the non-producers.

Alternative Theories of Agricultural Change

The following brief overview of alternative theories of agricultural change is presented to highlight and summarize previous research which bears on the issues being examined in this study—constraints to high yields, resistance to change, technology transfer and diffusion of innovations. These topics have been the subject of numerous investigations, mainly in agriculture. This review is by no means an exhaustive one, but is illustrative of the major theories and hypotheses that are applicable to this analysis of aquaculture constraints.

The major theories of agricultural stagnation and transformation can be grouped into those that attempt to explain farmers' behavior through sociocultural perspectives and those that assess their behavior in terms of economic explanations. Under these two general theories, Stevens (1977) summarizes the four major hypotheses that have been expounded to explain the reasons for stagnation of traditional agriculture. These are: (1) small farmers are poor decisionmakers; (2) small farmers lack capital; (3) small farmers would become more productive on larger-scale farms; and (4) small farmers in low-income societies are trapped in a technical and economic equilibrium.

Evidence of the validity for agricultural settings of these alternative sociocultural and economically oriented hypotheses can be found in reports of empirical research studies too numerous to cite here.

Each hypothesis leads to a particular set of 'action steps' or recommendations to transform traditional agriculture. In this particular study the authors have tried to determine which hypotheses best explain the behavior of milkfish farmers in the Philippines and therefrom which 'action steps' are most appropriate to overcome constraints to high yields.

For purposes of this brief overview of the alternative theories, we have categorized Stevens' four hypotheses into two major groups: (1) "small farmers are poor decisionmakers" theory (also known as the subculture of peasantry hypothesis) which puts forward sociocultural explanations for agricultural stagnation; and (2) "small farmers are poor but efficient" theory which favors the economic perspective. Extensions of the latter perspective which include concepts of induced innovation and rural stagnation are also presented in summary form.

'SMALL FARMERS ARE POOR DECISIONMAKERS' THEORY

This hypothesis assumes that more productive or profitable alternative production activities are available to traditional farmers but "they" do not make the right decisions about these new opportunities because they are poor decisionmakers, irrational or even lazy (Stevens 1977). This hypothesis which underlies much of the rationale for community development programs in Pakistan and India in the 1950s suggests that extension services, community development programs and other forms of educational and management assistance have crucial roles to play to improve farmers' production decisions.

Corollary to this view of farmers' poor decisionmaking capabilities, are explanations that focus on the "subculture of peasantry." This viewpoint suggests that agriculture is essentially a cultural characterization of the way particular people live (Rogers 1969; Lewis 1962, 1964). Cultural attributes of farmers and the value system that farmers hold are cited as the major barriers to their increased productivity and transformation. For example, Lewis (1962, 1964) and Rogers (1969) cite such values as (1) strong disposition towards authoritarianism; (2) mutual distrust in interpersonal relations; (3) perceived limited good; (4) lack of innovativeness and resistance to change; (5) fatalism; (6) limited aspirations; (7) limited view of the world; (8) lack of geographic mobility and (9) low empathy as characteristics that prevent farmers from participating in the agricultural transformation or modernization process. For example,

> Peasant communities are characterized by mutual distrust, suspicion and evasiveness in interpersonal relations. Peasants tend to believe in the notion of limited good (that all desirables in life are in fixed supply), and in the related idea that one man's gain is another's loss. Government officials are viewed with both dependence and hostility. Villagers are fatalistic—that is, they subordinate their individual goals to those of the family and the will of a supreme authority. Peasants generally lack innovativeness and have an unfavorable attitude towards change.
>
> Fatalism is the degree to which an individual perceives a lack of ability to control his future. Fatalistic attitudes are widely reported as characteristic of peasants. Social aspirations involved desired future states of being, such as living standards, social status and occupation. A common observation in most studies of peasantry is that the respondents have limited aspiration; they also lack deferred gratification, the postponement of immediate satisfaction in anticipation of future rewards. Peasants are also characterized by a limited view of the world. They are localistic in geographic mobility and in their exposure to mass media and have a limited time perspective. (Rogers 1969)

Proponents of this viewpoint give primary importance to sociocultural attributes as deterrents to the agricultural transformation process. In the Philippines, the cultural values of fatalism, strong disposition to authority, lack of innovativeness and resistance to change have also been cited (e.g., Espiritu et al. 1977; Co 1982). These theorists forward the view that the ethos of possibility that characterizes Filipino farmers' behavior and the sense of resignation with which they view the world is due to the *bahala na* (come what may) syndrome and an authoritarian structure characterized by a patron-client relationship between landowner and tenant.

> The typical Filipino, as we know, is traditionally fatalistic, believing in some mysterious external force that controls all lives and destinies. (Co 1982)
>
> The way important events like...a good or bad harvest are interpreted reveals a belief in the supernatural and a trust in and reliance on a Divine Providence. The farmer prays for rain but is not interested in building irrigation ditches. He carefully follows rituals of planting but is not inclined to experiment on a new type of seed or fertilizer...A poor harvest is not due so much to poor seed or lack of fertilizer or irrigation as to bad luck. The rural folk thus learn to submit to uncertainty, to take a *bahala na* attitude, and to develop traits of patience, endurance and resignation. Moreover, since good is limited, not everyone is expected to enjoy success and happiness at the same time. (Espiritu et al. 1977)

If one accepts the sociocultural point of view, overcoming these attitudes and constraints is primarily possible through education and extension programs.

'SMALL FARMERS ARE POOR BUT EFFICIENT' THEORY

In contrast to the above hypothesis, the second, third and fourth hypotheses in Stevens' summary discount sociocultural explanations in favor of an economic perspective to the agricultural transformation process. These hypotheses (small farmers lack capital; small farmers would become more productive on larger-scale farms; and small farmers in low-income societies are trapped in a technical and economic equilibrium) espouse the belief that agricultural transformation is held back not so much by the farmers' cultural attributes and value systems but by economic factors that make any efforts at increased agricultural productivity non-profitable. This view is strongly endorsed by Schultz (1965) who advocates the concentration on high-payoff new inputs (both materials and human capital) to improve the state of the art of production techniques of farmers. According to Schultz, unless the rate of return to investment in inputs of production is improved, there will always be little or no incentive on the part of the farmers to increase productivity, nor for them to save and invest.

Theorists of this particular school of thought state that small farmers are poor, but efficient. This hypothesis implies that traditional peasant farmers are generally good decisionmakers, given their knowledge and resources, but the scarcity (high price) of capital, and non-access to and unavailability of new agricultural technology have deterred their agricultural transformation. Small farmers are trapped in a technical and economic equilibrium, and any reallocation of their resources would not appreciably increase income because, given prevailing prices of inputs (land, labor, capital), farmers are already efficient in utilizing the production inputs they have at their disposal. For example:

> Traditional agriculture is not capable of contributing cheaply to economic growth because it has exhausted the economic opportunities of the state of the arts on which it is dependent.
>
> The key to this lack in capability, therefore, is not a matter of allocative efficiency. The many efforts to show farmers in traditional agriculture how to use more efficiently the resources which they have are in vain, because they are in this respect essentially efficient. Nor is this lack in capability a matter of *simply* investing more in what they have. Thus, our efforts to induce them to invest more than they are investing in the factors of production available to them are also in vain; the investment opportunities open to them simply do not warrant their doing so. (Schultz 1965)

Empirical support for Schultz's ideas has been found among Nigerian dryland farmers (Norman 1977), small farms in Brazil (Rask 1977) and Thai livestock producers (DeBoer and Welsch 1977) to cite a few. To overcome the low level equilibrium trap, Schultz argues for the introduction of high-payoff new technologies which markedly reduce average costs per kg of production.

Acceptance of the view that small farmers are trapped in a low level equilibrium has led some economists to argue in favor of larger-scale farms to achieve greater productivity by taking advantage of economies of scale. Empirical research however, has indicated that while theoretically possible, there are limited economies of scale in agricultural production in developing nations and that small farms can often compete effectively with medium and large farms or state farms (Takahashi 1970). While evidence accumulates that farm enlargement is not necessarily associated with increased land productivity, others have cautioned that the shift to science-based agriculture and use of technology also pose threats to rural employment and political equilibrium (Sinaga and Collier 1975). According to this view, small farms could be threatened by the introduction of new machines that may displace labor utilization in the area.

INDUCED INNOVATION AND RURAL STAGNATION

Economic viewpoints generally accept that breaking out of the technical and economic equilibrium described by Schultz can not only be achieved by means of the introduction of advanced technology, but also by induced innovation (Hayami and Ruttan 1971; Ruttan 1977). Changes in relative factor prices or output prices and the provision of institutional support such as credit, extension and information dissemination will produce *disequilibrium* to which small farmers will respond positively. According to this viewpoint, technical change and institutional development are entwined.

> The induced technical and institutional innovation perspective does not imply that the progress of agricultural technology can be left to an 'invisible hand'—to the undirected market forces that will direct technology along an 'efficient' pattern determined by 'original' resource endowments or relative factor and product prices. The production of the new knowledge leading to technical change is the result of a process of institutional development. The invention of the public sector agricultural research institute—the socialisation of agricultural research—was one of the great institutional innovations of the 19th century.
>
> Technological change, in turn, represents a powerful source of demand for institutional change. The processes by which new knowledge can be brought to bear to alter the rate and direction of technical change in agriculture is, however, substantially greater than our knowledge of the processes by which resources are brought to bear on the process of institutional innovation and transfer. The developing world is still trying to cope with the debris of non-viable institutional innovations; with extension services with no capacity to extend knowledge or little knowledge to extend; cooperatives that serve to channel resources to village elites; price stabilisation policies that have the effect of amplifying commodity price fluctuations; and rural development programmes that are incapable of expanding the resources available to rural people.
>
> Yet the need for viable institutions capable of supporting more rapid agricultural growth and rural development is even more compelling today than a decade ago. As the technical constraints on growth of agricultural productivity have become less binding there is an increasing need for institutional innovation that will result in a more effective realisation of the new technical potential. The trial and error approaches involved in *ad hoc* production campaigns and rural development programmes have been costly in terms of human resources and have rarely been effective in building rural institutions that have prevailed beyond the enthusiasms of the moment. (Ruttan 1977)

The view that institutions are key to the transformation process is echoed by Bromley (1979). However, he is less optimistic about the rapidity with which institutions will respond. According to Bromley's view, while technology is the engine of economic change, institutions are barriers to the growth in the agricultural sector:

> We have seen decades of investment in new seeds, fertilizer plants, pest control, farmer training, and the like. We cannot say how great the transformation has been, because we do not have an experiment in which we can hold some other things constant. We of course know that some farmers in some countries have indeed made impressive strides in terms of increased production and increased incomes. We also know that there are still millions of subsistence farmers barely able to make a living.

The millions of subsistence farmers left behind who are barely able to make a living give rise to a social phenomenon which Bromley calls "rural stagnation." Rural stagnation, according to Bromley, is caused by the inability of traditional agriculture to generate a sustainable economic surplus in the face of institutional barriers. Similar to the sociocultural explanations of Espiritu (1977) and Co (1982), Bromley hypothesizes that this lack of sustainable surplus is the result of a power-elite manipulating institutional arrangements in order that the economic environment of subsistence farmers be just sufficient to keep the subsistence farmers in production, yet not sufficiently propitious to encourage experimentation.

These various viewpoints to explain rural agricultural stagnation and transformation have been presented above in a necessarily brief summary. However, this discussion serves to raise the various issues that must be dealt with in any serious examination of constraints to high yields from Philippine milkfish farms. The data collected during our two surveys (1979 and 1981) permit examination of the sociocultural, economic and institutional hypotheses outlined above. Since acceptance of any particular hypothesis (or set of hypotheses) is tantamount to identification of constraints to increased yields, the action steps necessary to stimulate Philippine aquaculture will flow naturally therefrom. These alternative hypotheses will be discussed after presentation of survey data, analytical model and results.

Analytical Methodology to Measure Variation in Input Use

Because the output gap between actual and bench mark milkfish yield is thought to be best explained by different levels of supplementary input use, the identification of factors affecting the use of organic and inorganic fertilizers was chosen as the focus of this analysis of constraints to high productivity. In other words, the dependent variable–fertilizer expenditures–is treated as a proxy for yield because fertilizer expenditure in contrast to yield is directly under the farmers' control. Moreover, fertilizers as an input was found to be very significant in explaining yield variations. Organic and inorganic fertilizers were selected for analysis over other supplementary inputs such as pesticides and feeds because the former are technically and economically more important in milkfish production (Chong et al. 1982). Because organic fertilizer is different from inorganic fertilizer in terms of N-P-K content, aggregation of simple physical measures (e.g., kg/ha) of fertilizer application would have been inadequate and misleading. Therefore, the use of organic and inorganic fertilizers is expressed in expenditure terms.

Potential constraints to increased fertilizer expenditure were identified on the basis of existing knowledge of the local milkfish industry. Both primary and secondary sources of information were relied upon to select possible constraints. A model based on multiple regression was chosen to determine the relationships between constraints and level of fertilizer expenditure. Altogether 56 explanatory variables were hypothesized to explain variation in expenditures for fertilizer among Philippine milkfish farmers. One of these 56 explanatory variables was later excluded from the final model due to insufficient data. These potential constraints were categorized as socioeconomic, institutional, bio-technical or physical in nature (Table 5).

Socioeconomic parameters include those related to producers' demographic characteristics and attitudes regarding risk and to prevailing economic conditions faced by the producer (e.g., input and output prices). Institutional parameters consist of external programs and organizations that can be expected to influence the producer's choice of technology. Bio-technical parameters include those related to the production methods actually practiced by the producer and the producer's own attempts to gain additional insights to benefit his fishfarming techniques. Finally, physical parameters are those that relate to farm location, soil conditions and pond design.

The model contains 19 socioeconomic, 5 institutional, 15 bio-technical and 17 physical parameters. Mathematically, the model is expressed as:

$$Z = f(X_1, X_2, \ldots, X_{56})$$

Table 5. Parameters hypothesized to explain variations in expenditure on fertilizers.

A. SOCIOECONOMIC PARAMETERS

1. Ratio of milkfish price to milkfish fry price
2. Ratio of milkfish price to milkfish fingerling price
3. Ratio of milkfish price to organic fertilizer price
4. Ratio of milkfish price to inorganic fertilizer price
5. Ratio of milkfish price to milkfish substitute price
   a) fish
   b) meat
6. Status of respondent
7. Milkfish culture experience of respondent
   a) total number of years
   b) years with supplementary input application
8. Age of respondent
9. Years of formal education of respondent
10. Family size
11. Full-time or part-time occupation
12. Respondent's perception of effect of fertilizers on taste of milkfish
13. Percentage of milkfish and non-milkfish income
14. Risk consideration (collateral)
15. Risk consideration (interest rate)
16. Risk consideration (is use of larger quantities of inputs risky?)
17. Risk consideration (is use of improved technology risky?)

B. PHYSICAL PARAMETERS

1. Farm size
2. Per hectare yield
3. Accessibility of farm
4. Age of pond
5. pH of pond soil
6. Salinity of pond soil
7. Distance of farm to main source of water
8. Depth of pond (water column)
9. Nitrogen level in pond soil
10. Phosphorous level in pond soil
11. Potassium level in pond soil
12. Distance to input market
13. Distance to output market
14. Distance to house
15. Transportation means
16. Availability of inputs
17. Climate type

C. BIO-TECHNICAL PARAMETERS

1. Milkfish fry stocking rate
2. Milkfish fingerling stocking rate
3. Respondent's skills in receiving and decoding technical information
4. Attendance in aqueculture seminar/training
5. Working on other milkfish farmer's farm
6. Being consulted
7. Seek consultation
8. Observe other farmer's production operations
9. Productivity differences between input and non-input use
10. Water change during production (refreshening)
11. Draining and drying after harvest
12. Length of draining and drying
13. Length of crop cycle
14. Number of cropping per year
15. Pravious background in agriculture

D. INSTITUTIONAL PARAMETERS

1. Membership in aquaculture association
2. Contact with extension service
3. Avail of government credit
4. Reliance on local to outside market
5. Contact with government information dissemination system

where Z = expenditure (pesos) on organic and inorganic fertilizers per ha in 1980
X_1 = fry stocking rate per ha per year (pieces)
X_2 = fingerling stocking rate per ha per year (pieces)
X_3 = ratio of marketable milkfish price to fry price (by piece)
X_4 = ratio of marketable milkfish price to fingerling price (by piece)
X_5 = ratio of marketable milkfish price to organic fertilizer price (by kg)
X_6 = ratio of marketable milkfish price to inorganic fertilizer price (by kg)
X_7 = ratio of marketable milkfish price to fish CPI (Consumer Price Index)
X_8 = ratio of marketable milkfish price to meat CPI
X_9 = farm size (total developed area in ha)
X_{10} = yield in 1980 (kg/ha)
X_{11} = tenure status of respondent

a. owner = 1
b. non-owner = 0

X_{12} = accessibility of farm
a. road or combination with road = 1
b. river and/or trail = 0

X_{13} = age of pond (years)
X_{14} = pH of pond soil sample
X_{15} = salinity of pond soil sample
X_{16} = distance to main source of water (m)
X_{17} = depth of ponds (average for all compartments in m)
X_{18} = nitrogen level in pond soil sample
X_{19} = phosphorous level in pond soil sample
X_{20} = potassium level in pond soil sample
X_{21} = milkfish culture experience of respondent (total in years)
X_{22} = milkfish culture experience of respondent (years supplementary inputs used)
X_{23} = age of respondent (years)
X_{24} = formal schooling of respondent (years)
X_{25} = respondent's skill in receiving and decoding technical information
a. skilled = 1
b. unskilled = 0

X_{26} = attendance in aquaculture seminars
a. yes = 1
b. no = 0

X_{27} = interest in working on other farmers' farms
a. yes = 1
b. no = 0

X_{28} = number of times consulted by others during 1980
X_{29} = number of times respondent sought consultation during 1980
X_{30} = observe other farmers' operations
a. yes = 1
b. no = 0

X_{31} = membership in aquaculture association
a. yes = 1
b. no = 0

X_{32} = number of contacts with extension service during 1980
X_{33} = distance from farm to input market (km)
X_{34} = distance from farm to output market (km)
X_{35} = distance from farm to house (km)
X_{36} = family size
X_{37} = percentage of time spent as farm operator
X_{38} = respondent's belief in the effect of fertilizers on milkfish taste
a. bad taste = 1
b. no bad taste = 0

X_{39} = percentage of income from non-milkfish sources
X_{40} = respondent's estimate of productivity differences between input and non-input use (%)
X_{41} = risk assessment--"fair" collateral (%)
X_{42} = respondent's assessment of reasonable interest rate (%)
X_{43} = respondent's assessment of risks associated with increased input use
a. risky = 1

b. not risky = 0

X_{44} = respondent's assessment of risks associated with techniques which give higher output

a. risky = 1

b. not risky = 0

X_{45} = number of water changes during 1980

X_{46} = number of draining and drying cycles during 1980

X_{47} = length of draining and drying cycle—days per year (1980)

X_{48} = average length of crop cycle in 1980 (months)

X_{49} = number of croppings per year (1980)

X_{50} = primary transportation means

a. own vehicle = 1

b. public transport = 0

c. both = 1

X_{51} = respondent's assessment of input availability

a. not difficult = 1

b. difficult = 0

X_{52} = credit use in 1980

a. yes = 1

b. no = 0

X_{53} = ratio of milkfish price in local market to price in outside market

X_{54} = climate types (three dummy variables representing the four climate types)

X_{55} = respondent's assessment of the country's information dissemination system

a. strong = 1

b. weak = 0

X_{56} = farmer's previous background in agriculture

a. yes = 1

b. no = 0

Initially a linear relationship between fertilizer expenditure and the above 56 independent or explanatory variables was estimated but this was later rejected in favor of a log-linear estimation which gave a better fit or higher R^2. The specified relationship therefore took the form:

$$Z = \alpha X_1^{\beta_1} X_2^{\beta_2} \ldots X_{56}^{\beta_{56}} \varepsilon \quad \text{or}$$

$$\log Z = \log \alpha + \beta_1 \log X_1 + \beta_2 \log X_2 + \ldots + \beta_{56} \log X_{56} + \varepsilon$$

where α, β_1's are regression coefficients to be estimated and ε is the error term or residual.

Each of the above 56 explanatory variables represents an hypothesis regarding the effect of the variable in question on variation in supplementary input use which, after estimation, can either be rejected or not rejected as the case may be. Estimating the model in this fashion permits determination of which of these potential explanatory variables are most significant in explaining input use.

Although the above model was the primary means for assessing variation in supplementary input use, additional relevant information were also drawn out of simple tabulations and cross-tabulations of the data collected from the 447 respondents.

Results and Discussion: Low Levels of and Variations in Supplementary Input Use

INTRODUCTION

The data collected during the survey can be presented in a number of different ways. The fact that an analytical model is specified implies that this study is more than simply descriptive. The section which follows therefore mixes description with analysis and discusses the various relationships among variables that are presented.

This section contains five major parts. First, the collected data are presented in summary form, tabulated according to intensity of input use and output levels. The purpose of a presentation in this form is to expand the two categories which characterize the dualistic milkfish industry of the Philippines, as briefly outlined in the introduction to this report. The next part contains a socio-economic profile of milkfish producers in order to highlight certain managerial characteristics and their relationship to output levels. The third part of this section presents the estimated parameters of the input variation model as specified in section 3 of this report. The significant explanatory variables are discussed in detail. Part 4 contains provincial tabulations of those factors that are most amenable to influence by government programs and policy. Variables discussed include a select number for which the lack of significance was probably due to the lack of variation in the explanatory variables in question. The fifth and final part of this section summarizes the results. Conclusions are thus drawn not only from the significance or non-significance of variables but also from cross tabulations of the survey data.

Throughout the discussion in the following 5 parts, the primary focus is upon the producers' own perceptions of their industry, government programs and the processes of technology transfer and adaptation.

SUMMARY AND TABULATION OF SURVEY DATA

In the introduction to this report a distinction was made between those farms producing up to 1,000 kg/ha/year and those producing more. Based on this distinction, the structure of the milkfish industry was characterized as dualistic in nature. When summarizing and presenting the survey data it was found useful to maintain this distinction.

In Table 6, a further distinction is made within the 'up to 1,000 kg/ha/year' category between those farms that use no supplementary inputs (extensive) and those which use such inputs (low intensity).

Table 6. Summary of farm data by output and level of input use (mean and standard deviation on a per farm basis).[1]

	Explanatory variables[2]	Farms producing ⩽ 1,000 kg/ha/yr Extensive (n = 51)	Low intensity (n = 282)	Farms producing > 1,000 kg/ha/yr High intensity (n = 114)	All farms (n = 447)
Z	Fertilizer expenditures/ha/yr	0.00 (0.00)	493.53 (570.04)	1,547.09 (1,758.16)	706.02 (1,119.87)
X_1	Fry stocking rate/ha/yr	1,839.44 (3,173.26)	2,769.89 (2,805.23)	8,009.94 (6,376.33)	4,054.12 (4,718.60)
X_2	Fingerling stocking rate/ha/yr	961.19 (1,914.00)	637.77 (1,380.10)	1,641.00 (3,577.96)	937.42 (2,268.30)

Continued

Table 6 (Continued)

	Explanatory variables[2]	Farms nroducing ≤1,00C kg/ha/yr Extensive (n = 51)	Low intensity (n = 282)	Farms producing >1,000 kg/ha/yr High intensity (n = 114)	All farms (n = 447)
X_3	Milkfish-fry price ratio	18.35 (20.04)	16.64 (13.90)	20.74 (14.79)	17.89 (15.00)
X_4	Milkfish-fingerling price ratio	8.47 (31.11)	2.52 (5.79)	2.06 (4.49)	2.99 (11.11)
X_5	Milkfish-organic fertilizer price ratio	0.00 (0.00)	17.06 (28.05)	31.69 (36.99)	19.32 (30.71)
X_6	Milkfish-inorganic fertilizer price ratio	0.00 (0.00)	3.49 (1.17)	3.63 (1.08)	3.21 (1.50)
X_7	Milkfish-fish price ratio	0.44 (2.97)	0.02 (0.01)	0.22 (0.53)	0.68 (0.99)
X_8	Milkfish-nieat price ratio	0.07 (0.28)	0.03 (0.08)	0.27 (0.67)	0.35 (0.11)
X_9	Farm size (ha)	8.15 (10.03)	21.92 (93.65)	20.09 (26.32)	19.91 (75.79)
X_{10}	Per hectare yield (kg/ha/yr)	331.24 (401.75)	386.14 (248.53)	1,706.24 (616.78)	719.65[3] (701.66)
X_{11}	Tenure status (% privately owned)	0.58 (0.93)	0.39 (0.49)	0.54 (0.50)	0.45 (0.56)
X_{12}	Accessibility of farm (% accessible by road)	0.76 (0.43)	0.61 (0.49)	0.47 (0.50)	0.59 (0.49)
X_{13}	Age of ‹ond (yr)	17.84 (14.87)	20.62 (18.25)	33.18 (25.51)	23.53 (20.81)
X_{14}	pH of pond	5.23 (1.40)	5.66 (2.69)	6.06 (0.91)	5.70 (2.29)
X_{15}	Salinity of pond soil (µmhos/cm)	101.02 (81.38)	73.95 (40.02)	61.86 (44.72)	73.62 (47.69)
X_{16}	Distance to main source of water (m)	4.43 (28.89)	0.46 (3.31)	0.45 (1.96)	0.90 (9.99)
X_{17}	Depth of pond (m)	0.69 (0.37)	0.62 (0.33)	0.53 (0.30)	0.61 (0.33)
X_{18}	Nitrogen level (%)[4]	5.02 (3.27)	4.53 (3.18)	5.34 (10.75)	4.76 (5.79)
X_{19}	Phosphorous level (ppm)	16.72 (12.71)	21.15 (20.07)	56.18 (110.71)	28.44 (56.56)
X_{20}	Potassium level (ppm)	1,278.97 (1,399.89)	1,250.38 (1,077.79)	1,545.93 (1,017.53)	1,319.32 (1,106.37)

Continued

Table 6 (Continued)

	Explanatory variables[2]	Farms producing ≤ 1,000 kg/ha/yr Extensive (n = 51)	Farms producing ≤ 1,000 kg/ha/yr Low intensity (n = 282)	Farms producing > 1,000 kg/ha/yr High intensity (n = 114)	All farms (n = 447)
X_{21}	Total culture experience (yr)	16.88 (12.85)	13.68 (11.31)	17.84 (12.91)	15.11 (12.04)
X_{22}	Culture experience with supplementary inputs (yr)	2.31[5] (5.34)	7.01 (6.53)	11.19 (7.48)	7.54 (7.14)
X_{23}	Age of respondent (yr)	50.37 (15.55)	48.45 (13.61)	47.61 (12.82)	48.45 (13.64)
X_{24}	Years of formal schooling (yr)	7.29 (5.19)	7.36 (4.47)	8.07 (4.76)	7.54 (4.63)
X_{25}	Ability to receive and decode information (%)	0.06 (0.24)	0.66 (0.47)	0.85 (0.36)	0.64 (0.48)
X_{26}	Attendance in aquaculture seminar (%)	0.22 (0.42)	0.29 (0.45)	0.19 (0.40)	0.26 (0.44)
X_{27}	Interest to work on other farmers' farms (%)	0.36 (0.48)	0.42 (0.49)	0.36 (0.48)	0.40 (0.49)
X_{28}	Consulted by others (number of times)	13.78 (55.43)	6.56 (17.73)	22.07 (61.98)	11.39 (39.63)
X_{29}	Sought consultation (number of times)	18.06 (56.65)	9.18 (18.97)	20.04 (61.42)	12.99 (39.68)
X_{30}	Observe other farmers' operations (%)	0.80 (0.40)	0.86 (0.35)	0.82 (0.38)	0.84 (0.36)
X_{31}	Aquaculture association membership (%)	0.25 (0.48)	0.28 (0.45)	0.18 (0.39)	0.25 (0.44)
X_{32}	Contact with extension service (number of times)	1.23 (2.63)	3.31 (10.71)	0.79 (2.67)	2.41 (8.69)
X_{33}	Distance to input market (km)	11.31 (34.71)	26.35 (63.63)	13.96 (30.51)	21.71 (54.78)
X_{34}	Distance to output market (km)	26.02 (46.23)	31.86 (61.48)	20.36 (39.32)	28.23 (55.07)
X_{35}	Distance to house (km)	2.55 (7.26)	4.04 (15.01)	6.48 (21.72)	4.50 (16.41)
X_{36}	Family size	7.88 (6.78)	6.60 (3.14)	7.03 (3.01)	6.85 (3.73)
X_{37}	Percent of time as farm operator	80.53 (30.04)	85.16 (26.24)	85.46 (28.01)	84.70 (27.14)
X_{38}	Belief that fertilizers affect taste (%)	0.38 (0.62)	0.16 (0.37)	0.53 (0.23)	0.15 (0.38)

Continued

Table 6 (Continued)

	Explanatory variables[2]	Farms producing ≤ 1,000 kg/ha/yr Extensive (n = 51)	Low intensity (n = 282)	Farms producing > 1,000 kg/ha/yr High intensity (n = 114)	All farms (n = 447)
X_{39}	Non-milkfish income (%)	40.22 (38.95)	26.72 (32.40)	18.22 (28.87)	25.91 (32.79)
X_{40}	Productivity differences between input and no input use (%)	42.00 (36.13)	81.74 (133.86)	134.70 (202.81)	93.59 (153.33)
X_{41}	Acceptable collateral level (%)	21.17 (26.29)	25.75 (28.10)	26.95 (27.85)	25.57 (27.83)
X_{42}	Acceptable interest rate (%)	30.44 (34.75)	40.13 (57.94)	45.35 (61.06)	40.46 (56.82)
X_{43}	Believed that increased input use is risky (%)	0.40 (0.50)	0.25 (0.43)	0.38 (0.95)	0.30 (0.62)
X_{44}	Believed that improved techniques is risky (%)	0.33 (0.47)	0.24 (0.43)	0.41 (0.49)	0.29 (0.46)
X_{45}	Water change	32.08 (36.04)	37.06 (36.59)	37.45 (34.68)	36.58 (36.02)
X_{46}	Number of draining and drying cycles (times/yr)	1.84 (0.86)	2.60 (1.13)	3.78 (1.41)	2.81 (1.33)
X_{47}	Length of draining and drying cycles (days)	19.88 (13.02)	22.71 (16.98)	25.03 (15.53)	22.98 (16.24)
X_{48}	Length of crop cycle (months)	6.04 (2.58)	4.97 (2.23)	4.11 (1.63)	4.87 (2.20)
X_{49}	Number of croppings/yr	1.84 (0.71)	2.37 (0.98)	3.20 (1.18)	2.52 (1.10)
X_{50}	Percent with own transportation means	0.37 (0.49)	0.49 (0.50)	0.67 (0.47)	0.52 (0.50)
X_{51}	Believed that input availability is not difficult	0.08 (0.28)	0.89 (0.29)	0.71 (0.26)	0.84 (0.28)
X_{52}	Percent using credit	0.06 (0.24)	0.13 (0.33)	0.12 (0.32)	0.12 (0.32)
X_{53}	Ratio of milkfish price in local market to price in outside market	0.81 (0.24)	0.80 (0.19)	0.82 (0.16)	0.80 (0.19)
X_{54}	Climate types	n.a.	n.a.	n.a.	n.a.

Continued

Table 6 (Continued)

	Explanatory variables[2]	Farms producing ≤1,000 kg/ha/yr Extensive (n = 51)	Farms producing ≤1,000 kg/ha/yr Low intensity (n = 282)	Farms producing >1,000 kg/ha/yr High intensity (n = 114)	All farms (n = 447)
X_{55}	Believed that information dissemination system is strong (%)	0.41 (0.50)	0.38 (0.49)	0.28 (0.45)	0.35 (0.48)
X_{56}	Previous agricultural background (%)	0.62 (0.49)	0.46 (0.50)	0.34 (0.48)	0.45 (0.49)

[1]Figures in parentheses are standard deviations. Extensive farms are those with no expenditure on supplementary inputs. All farms producing >1,000 kg/ha/yr are intensive farms.
[2]Refer to the full model for details on explanatory variables.
[3]This yield figure is calculated on the basis of adding the average yields of each farm and dividing by number of farms and not by total area. For weighted average yields, see Tables 2 and 7.
[4]Nitrogen level is reflected through organic matter content (%) of soil sample.
[5]In this case, supplementary inputs include pesticides but not fertilizers.

Fertilizers used in milkfish farming are either organic or inorganic. Examples of organic fertilizers are chicken manure, mud press, and hog manure. Commonly used inorganic fertilizers are "16-20-0" or "18-46-0" or "46-0-0" (N-P-K content). Out of a total sample of 447 milkfish farmers, 397 farmers or 90% reported the use of fertilizers in varying amounts. The remaining 10% did not use any fertilizers at all (Table 7). This is in contrast to the 1978 crop year sample when 21% did not use any fertilizer. The difference in the percent of farmers using fertilizers between 1978 and 1980 crop year is significant. Some yield comparisons between the 1978 and 1980 crop year can be made from the data in Table 8.

Almost all the milkfish farmers in Bulacan and Capiz were found to apply fertilizers; only 5% of the farmers in the two provinces did not apply any fertilizer. This is in contrast to Lanao del Norte and Mindoro Oriental where relatively fewer farmers used fertilizers.

For those farms using organic fertilizers only, the average rate of application was 1,395 kg/ha/year, valued at ₱363 (Fig. 3). The average rate for inorganic fertilizer application was 224 kg/ha/year with a value of ₱467. However, for those farms where both organic and inorganic fertilizers were

Table 7. Number of farmers using supplementary inputs and no supplementary inputs and their corresponding average yields (kg/ha/yr), 1980.

Province	Using inputs Percentage	Using inputs Yields	Using no inputs Percentage	Using no inputs Yields	All farms Yields
Bulacan	94	1,321	6	416	1,275
Quezon	85	507	15	89	468
Mindoro Oriental	79	702	21	153	614
Capiz	97	925	3	450	923
Negros Oriental	100	1,000	0	–	1,000
Bohol	88	513	12	233	439
Lanao del Norte	61	416	39	278	408
Total/average	90	869	10	189	831[1]

[1]This yield figure is a weighted average calculated on the basis of total production divided by total area.

Table 8. Milkfish yields in selected Philippine provinces.

Province	1978 kg/ha/yr	1980 kg/ha/yr
Cagayan	253	–
Pangasinan	589	–
Bulacan	1,066	1,275
Quezon	–	468
Mindoro Oriental	–	614
Masbate	95	–
Iloilo	1,110	–
Capiz	–	923
Negros Oriental	–	1,000
Bohol	308	439
Lanao del Norte	–	408
Zamboanga del Sur	204	–
Sample	761	831

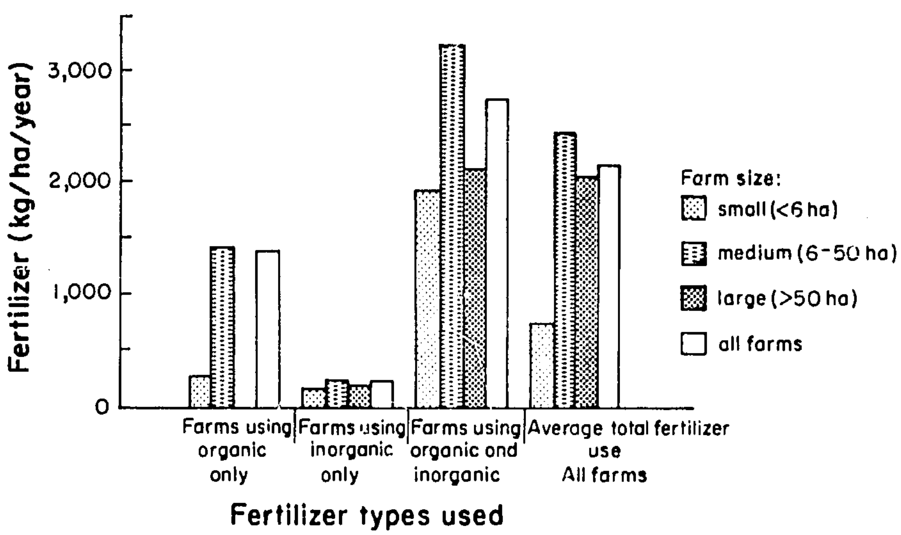

Fig. 3. Types and average quantities of fertilizers used (kg/ha/yr) in milkfish culture by farm size (ha).

applied in combination, the average rate of application was 2,743 kg/ha/year valued at ₱1,297. Combining the fertilizers used for all farms, the average expenditure on fertilizer, irrespective of whether organic or inorganic or both are used, is ₱1,102/ha/year equivalent to 2,165 kg/ha/year. Application rates varied significantly among provinces (Table 9).

In contrast, the 1979 survey of 324 milkfish farmers (Chong et al. 1982) showed that the rate of use of organic fertilizers then was 1,330 kg/ha/year valued at ₱359, and for inorganic fertilizers, an average of 172 kg/ha/year at a cost of ₱286. These results show that there were 5% and 30% increases in the rates of application of organic and inorganic fertilizers, respectively, between the 1978 and 1980 crop years.

In a survey of 1,394 milkfish farmers in 1974, Librero et al. (1977) reported that those farmers who apply fertilizers earned about 46% more than those who did not. According to the same authors, inorganic fertilizers gave the best net profits. These results are consistent with the 1979 survey.

Table 5. Rates of application and expenditures on organic and inorganic fertilizers by province.

Province	Farms applying organic fertilizers only		Farms applying inorganic fertilizers only		Farms applying both organic and inorganic fertilizers	
	kg/ha/yr	value/ha/yr (₱)	kg/ha/yr	value/ha/yr (₱)	kg/ha/yr	value/ha/yr (₱)
Bulacan	543	322	471	989	4,008	1,631
Quezon	1,376	200	165	325	1,462	742
Mindoro Oriental	–	–	173	327	2,724	1,909
Capiz	2,800	700	237	483	2,233	1,063
Negros Oriental	–	–	179	355	4,425	597
Bohol	259	36	315	793	1,819	776
Lanao del Norte	–	–	69	277	767	1,200
Average/sample	1,395	363	224	467	2,743	1,297

Table 6 provides additional evidence of dualism in the milkfish industry. Most obvious is the difference between yield levels of the extensive and intensive farms; marked differences show up between the low-intensity and high-intensity farms also.

MANAGERIAL PROFILE OF MILKFISH FARMERS AND EFFECT ON YIELDS

Because of the nature of milkfish production, productivity of the farm depends to a great extent on the management abilities of the person who tends the farm, that is, the milkfish farmer and/or the caretaker. A working knowledge of the management skills of the milkfish farmers can reveal interesting insights on levels of fertilizer use and yields. The age, educational attainment, milkfish culture experience, attitudes towards risks, and work pattern (whether full- or part-time) of these persons are presented below and discussed in relation to yields per ha. Each of these is a dimension of management ability that warrants further examination.

Age

The age of the farmer has a clear bearing on his decisionmaking process, because managerial ability is commonly assumed to be an inverted U-shaped function of age. [In other words, managerial ability is low at a young age, rises with increasing age to reach a peak at middle age, then declines with increasing age.] In part this pattern is related to the ability to assume risks. The average age of the sample milkfish farmers was 49 years. The oldest farmer interviewed was 93 years old while the youngest was 17 years. About 50% were over 50 years old. Our sample of 447 milkfish farmers clearly revealed a relationship between age of farmers and yield levels (Fig. 4). The curve of yield against age is very consistent with the inverted U-shaped relationship between managerial ability and age.

Educational attainment

About 53% of the milkfish farmers in our second survey had elementary education, 16% completed high school and 25% were college-educated (Table 10). The remaining 6% either completed vocational training or had no schooling at all. Both users and non-users of fertilizer had an average of seven years' education.

The educational attainment of the 447 milkfish farmers suggests that the vast majority should have little difficulty in receiving and decoding technical information in extension bulletins. In fact, there was no clear relationship between milkfish yield and education ($r = 0.06$).

Table 10. Percentage distribution of milkfish farmers with and without education.

Province	1979 Survey No education	1979 Survey Primary education	1979 Survey Secondary education	1979 Survey Tertiary education	1979 Survey Others*	1981 Survey No education	1981 Survey Primary education	1981 Survey Secondary education	1981 Survey Tertiary education	1981 Survey Others*
Cagayan	–	[illegible]	22	41	–	–	–	–	–	–
Pangasinan	2	3	27	20	3	–	–	–	–	–
Bulacan	4	48	19	29	–	5	65	12	17	1
Quezon	–	–	–	–	–	2	63	18	17	–
Mindoro Oriental	–	–	–	–	–	5	53	26	16	–
Masbate	[illegible]	10	39	48	–	–	–	–	–	–
Iloilo		17	19	60	4	–	–	–	–	–
Capiz	–	–	–	–	–	2	42	12	42	2
Negros Oriental	–	–	–	–	–	4	29	29	34	4
Bohol	2	40	10	43	5	10	49	15	24	2
Lanao del Norte	–	–	–	–	–	4	31	17	48	–
Zamboanga del Sur	–	43	26	31	–	–	–	–	–	–
Sample average	2	37	23	37	1	5	53	16	25	1

*"Others" refer to vocational training.

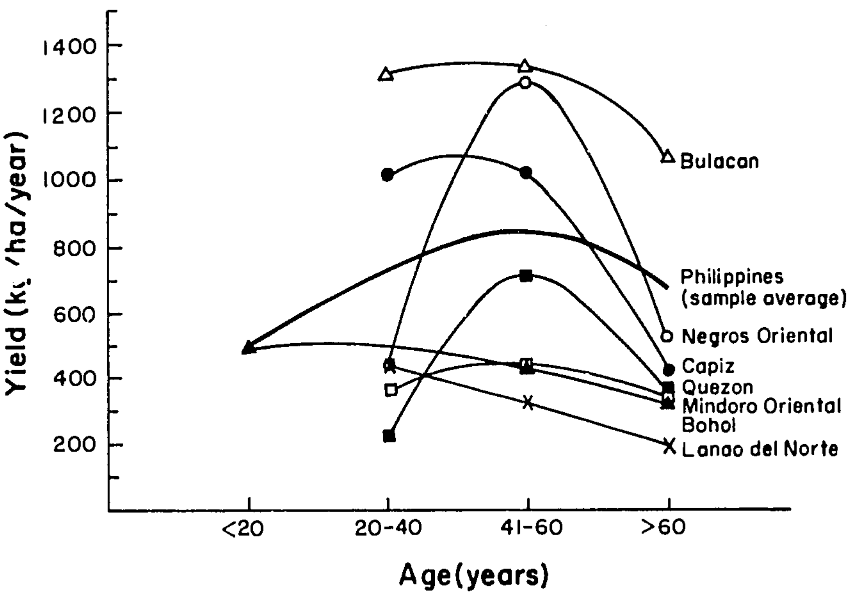

Fig. 4. Milkfish yield as a function of age of farmers.

Milkfish culture experience

Two types of farming experience can be distinguished: total number of years of experience and experience using supplementary inputs. The average number of years of milkfish culture experience was about 15-16 years based on the two surveys (Table 11). Average years of experience using supplementary inputs were less than half this duration. In all the provinces surveyed, there was a marked difference in yield between experienced and inexperienced farmers (Fig. 5). As farmers gained more experience, they were able to improve their yield. This implies that they were making better decisions by learning on the job. It is fair to assume also that a similar increase in yields resulted from added experience with the use of supplementary inputs.

Table 11. Culture experience in years of Philippine milkfish farmers in selected provinces.

Province	1978 Total experience	1980 Total experience	1980 Experience with supplementary inputs
Cagayan	5.0	–	–
Pangasinan	17.6	–	–
Bulacan	21.7	17.8	9.8
Quezon	–	14.0	7.0
Mindoro Oriental	–	16.9	8.0
Masbate	12.1	–	–
Iloilo	19.5	–	–
Capiz	–	16.4	9.3
Negros Oriental	–	13.6	9.3
Bohol	11.7	11.6	4.1
Lanao del Norte	–	20.2	8.3
Zamboanga del Sur	14.1	–	–
Sample average	15.8	15.1	7.6

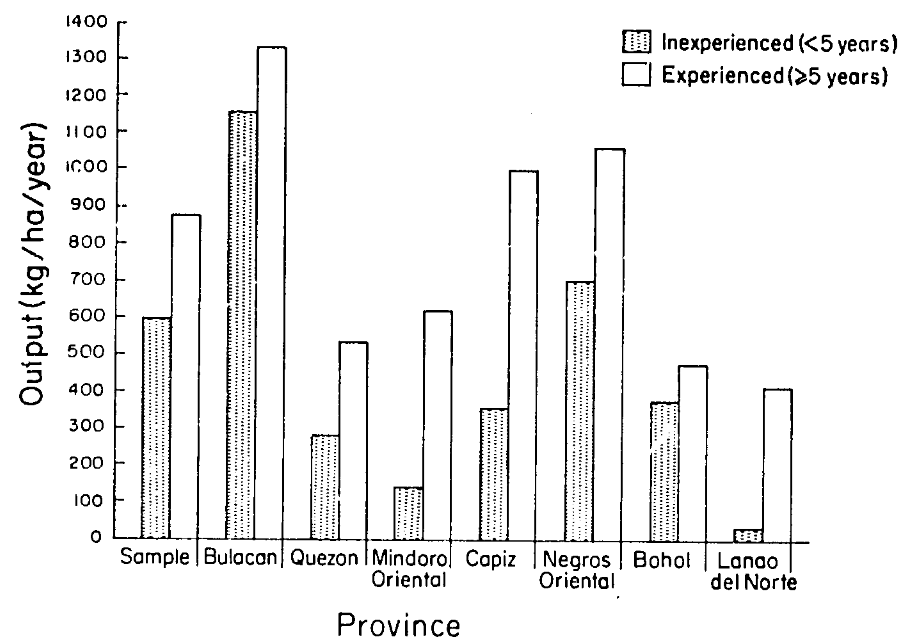

Fig. 5. Average annual per hectare milkfish yield of inexperienced and experienced farmers. (Total culture experience, not only experience using supplementary inputs.)

Work pattern

Among the most successful milkfish farmers, a common maxim is "the best input for a fishpond is the shadow of the milkfish farmer across the pond or the number of footsteps on the dikes." It is clear that personal management is desirable. However, management responsibilities are often relegated to caretakers.

It is not that caretakers cannot do a good job but rather that good and honest caretakers are difficult to hire and retain. Only by inspecting his ponds regularly can the milkfish farmer spot short- or long-term changes in his pond environment. Our survey of 447 milkfish farmers showed that 29% were part-time operators; the rest were full time (Table 12). The difference in average yield between full-time and part-time farmers, unfortunately, is not clear from the data because

Table 12. Percentage distribution of full-time and part-time milkfish farmers in selected provinces in the Philippines.

Province	Full-time	Part-time
Bulacan	85.6	14.4
Quezon	70.7	29.3
Mindoro Oriental	63.2	36.8
Capiz	68.8	31.2
Negros Oriental	29.2	70.8
Bohol	68.2	31.8
Lanao del Norte	69.6	30.4
Sample average	70.9	29.1

caretakers have been included as respondents. However, proportionally more part-time farmers were input users. This would imply that to a small extent part-time farmers substitute supplemental inputs with owner-operator's labor.

Although only 29% claimed to work part-time, about 42% reported non-milkfish sources of income. The survey did not investigate the exact composition of the non-milkfish sources of income in each case, but income such as rental income, spouse's income and children's earnings were included, some of which required no input or capital outlay from the respondent.

The preceding discussion has provided insights into the relationship between yields and certain management related variables such as age, educational attainment, milkfish culture experience, and work pattern. Of these, a clear relationship between yields and age and yields and culture experience emerged. Interestingly, educational attainment and work pattern appear to have no clear impact.

The above discussion focused on output. A more relevant question is the impact of managerial attributes on levels of supplementary input use. The results of the input-variation model estimation, which are reported in the next part, provide a more rigorous assessment of the factors constraining supplementary input use, and hence yields.

ESTIMATION OF THE INPUT VARIATION MODEL

A relationship was hypothesized between levels of input use (expenditure in pesos) and 56 explanatory variables classified into four potential constraint categories: socioeconomic, bio-technical, institutional and physical. The model that was specified was termed an input variation model because it sought to 'explain' variation in expenditures on fertilizers among the 447 milkfish producers in the sample.

The estimated functional model is presented in Table 13. The overall fit of this estimated model is good judging by the R^2 value which is 0.73 (adjusted R^2 = 0.59). Seventy-three percent of the variation in input use is thus explained by this model, which is a satisfactory finding. The F-value is significant also which means the overall explanatory power of the model is good.

Table 13. Input use variation model: regression coefficients and significance levels.

X_i	Explanatory variables	Regression coefficients	Standard errors	t-values
α	Constant	−0.48		
X_1	Fry stocking rate/ha/yr	−0.03	0.10	0.35
X_2	Fingerling stocking rate/ha/yr	0.14	0.14	1.03
X_3	Milkfish-fry price ratio	0.36	0.23	1.56
X_4	Milkfish-fingerling price ratio	−0.04	0.38	0.11
X_5	Milkfish-organic fertilizer price ratio	0.21**	0.07	3.05

Continued

Table 13 (Continued)

X_i	Explanatory variables	Regression coefficients	Standard errors	t-values
X_6	Milkfish-inorganic fertilizer price ratio	1.86**	0.30	6.17
X_7	Milkfish-fish price ratio	0.61	0.67	0.91
X_8	Milkfish-meat price ratio	–0.54	1.00	0.54
X_9	Farm size (ha)	0.01	0.14	0.03
X_{10}	Per hectare yield (kg/ha/yr)	0.15	0 15	1.05
X_{11}	Tenure status (% privately owned)	0.08	0.10	0.77
X_{12}	Accessibility of farm (% accessible by road)	–0.13	0.10	1.34
X_{13}	Age of pond (yr)	–0.03	0.11	0.33
X_{14}	pH of pond soil	0.09	0.78	0.11
X_{15}	Salinity of pond soil (µmhos/cm)	–0.04*	0.20	2.05
X_{16}	Distance to main source of water (m)	0.07	0.11	0.71
X_{17}	Depth of pond (m)	0.12	0.20	0.59
X_{18}	Nitrogen level (%)	0.20	0.22	0.94
X_{19}	Phosphorous level (ppm)	–0.08	0.22	0.34
X_{20}	Potassium level (ppm)	0.15	0.18	0.83
X_{21}	Total culture experience (yr)	–0.10	0.16	0.67
X_{22}	Culture experience with supplementary inputs (yr)	–0.01	0.16	0.09
X_{23}	Age of respondent (yr)	0.17	0.43	0.39
X_{24}	Years of formal schooling (yr)	0.18	0.15	1.21
X_{25}	Ability to receive and decode information (%)	–0.06	0.11	0.60
X_{26}	Attendance in aquaculture seminar (%)	0.17	0.14	1.20
X_{27}	Interest to work on other farmers' farms (%)	–0.27**	0.10	2.72
X_{28}	Consulted by others (number of times)	0.11	0.09	1.16
X_{29}	Sought consultation (number of times)	–0.21*	0.10	2.22
X_{30}	Observe other farmers' operations (%)	0.24	0.16	1.53
X_{31}	Aquaculture association membership (%)	0.09	0.14	0.64
X_{32}	Contact with extension service (number of times)	0.06	0.12	0.49
X_{33}	Distance to input market (km)	–0.13	0.09	1.44
X_{34}	Distance to output market (km)	0.07	0.08	0.83
X_{35}	Distance to house (km)	0.15	0.10	1.60
X_{36}	Family size	0.38*	0.17	2.21
X_{37}	Percent of time as farm operator	0.11	0.22	0.50
X_{38}	Belief that fertilizers affect taste (%)	–0.48**	0.11	4.26
X_{39}	Non-milkfish income (%)	0.06	0.07	0.85
X_{40}	Productivity differences between input and no input use (%)[1]	–	–	–
X_{41}	Acceptable collateral level (%)	–0.22*	0.10	2.08
X_{42}	Acceptable interest rate (%)	0.02	0.11	0.17
X_{43}	Believed that increased input use is risky (%)	–0.19	0.11	1.74
X_{44}	Belived that improved techniques is risky (%)	0.11	0.10	1.16
X_{45}	Water change	–0.01	0.12	0.05
X_{46}	Number of draining and drying cycles (times/yr)	0.55	0.34	1.61
X_{47}	Length of draining and drying cycles (days)	–0.03	0.13	0.20
X_{48}	Length of crop cycle (months)	0.01	0.54	0.00
X_{49}	Number of croppings/yr	0.47	0.51	0.91
X_{50}	Percent with own transportation means	0.10	0.10	1.07
X_{51}	Believed that input availability is not difficult	0.09	0.16	0.54
X_{52}	Percent using credit	0.18	0.14	1.29
X_{53}	Ratio of milkfish price in local market to price in outside market	–1.92	1.52	1.26
X_{54}	Climate types (Type I is base)			
	D1 (Type II)	–0.31	0.20	1.54
	D2 (Type III)	–0.13	0.24	0.57
	D3 (Type IV)	–0.18	0.19	0.95
X_{55}	Believed that information dissemination system is strong (%)	0.06	0.10	0.58
X_{56}	Previous agricultural background (%)	0.13	0.09	1.45

R^2 = 0.73, Adjusted R^2 = 0.59, F-value = 5.04, Durbin-Watson = 2.20

[1] X_{40} is excluded because of insufficient observations.
*Significant at 5% level.
**Significant at 1% level.

SIGNIFICANT VARIABLES

Of the 56 explanatory variables, eight are significant at the 5% confidence level or less. These were:

at the 1% level: X_5 Milkfish/organic fertilizer price ratio
X_6 Milkfish/inorganic fertilizer price ratio
X_{27} Interest to work on other farmers' farms
X_{38} Belief that fertilizers affect taste

at the 5% level: X_{15} Salinity of pond soil
X_{29} Sought consultation
X_{36} Family size
X_{41} Risk assessment–collateral

Five of these variables (X_5, X_6, X_{36}, X_{38} and X_{41}) are socioeconomic parameters; two (X_{27} and X_{29}) are bio-technical parameters; and one (X_{15}) is a physical parameter. Significantly, none of the institutional parameters (which include various government extension, credit and information dissemination programs) had any effect on levels of expenditure on supplementary inputs. Possible reasons for this will be discussed later in this section.

Socioeconomic parameters

First of all, the results show the importance of expected profits as a motivating factor in stimulating input use. Variables X_5 and X_6 represent the ratios of output price to organic and inorganic fertilizer prices, respectively. The output/input price ratios are a proxy for profits, representing the difference between value of output and cost of input. Though not a direct measure of profitability because quantities of output and input and conversion ratios are not explicitly included, these factors are implicit in the mental calculations of fishfarmers when they compare output and input prices and adjust their levels of input expenditure accordingly. The positive signs of the coefficients of these two variables are consistent with theoretical predictions regarding producer behavior in response to changing output or input prices. The higher these ratios, the more likely farmers are to spend more on fertilizers. The lower the ratios, the lower the expenditures on fertilizers.

The importance of these two variables lies in the fact that the inputs they represent are major contributors to variation in milkfish yield. The coefficients of 0.21 and 1.86 of X_5 and X_6, respectively, show that if the output/input price ratios increase by 1%, expenditures on organic and inorganic fertilizer use would increase by 0.21 and 1.86%, respectively. Marginal analysis of Chong et al. (1982) reveals that inorganic fertilizer has a high marginal value product (₱20.20) compared to its cost (₱1.66/kg). In contrast, the marginal value product for organic fertilizer is ₱0.82 compared to its cost of ₱0.29/kg. In both cases, given the relative prices prevailing at that time, it would pay the farmer to increase the rates of application of these two inputs. However, this statement applies to the 'average' fishfarm only; there is significant variation in organic fertilizer availability and price around the country.

Table 14 shows the calculated ratios of milkfish price to organic fertilizer price. Unlike inorganic fertilizers, organic fertilizers such as chicken manure are not necessarily widely available at a uniform price. Their price thus reflects the supply and demand of the raw material in the province in question. This is clearly shown in the average ratios calculated. In provinces where the supply of chicken manure is low and its price high (e.g., in Lanao del Norte and Mindoro Oriental) the ratios are low in comparison to the ratios for Bulacan and Quezon where large poultry farms are present and supply is higher and price lower. These diverse supply and demand conditions produce chicken manure price ranges from ₱0.10 to ₱1.50/kg. In locations where price/kg exceeds ₱0.82, it makes no economic sense for fishfarmers to increase their average application rates of organic fertilizers.

In contrast, with the existence of a reasonably uniform input price, a different pattern of output/input ratios prevails for inorganic fertilizers (Table 14). Theoretically, under conditions of

Table 14. Average output/input price ratios of milkfish to organic and inorganic fertilizers, by province.

Province	Milkfish-organic fertilizer price ratio[1]	Milkfish-inorganic fertilizer price ratio[1]
Bulacan	35.4	4.0
Quezon	46.7	4.2
Mindoro Oriental	15.1	4.3
Capiz	35.9	2.9
Negros Oriental	51.9	3.2
Bohol	41.8	3.1
Lanao del Norte	14.5	3.8
Sample average	38.3	3.6

[1]Read as 35.4:1, 4.0:1 etc.

high factor mobility, a factor of production is attracted into a sector where its opportunity cost or value of marginal productivity in use is the highest. This is especially true of commercial inputs such as inorganic fertilizers which are widely used in agriculture, too. Moreover, these commercial inputs have well-established marketing networks, resulting in greater factor mobility of such inputs. This is in contrast to inputs such as organic fertilizers which not only do not have a well-developed marketing network but are bulky (and therefore costly to transport) and have lower economic value. Thus, in contrast such inputs have considerably restricted mobility and use. Because of the relatively high mobility of inorganic fertilizers, the provincial output/input ratios for milkfish and inorganic fertilizers are fairly close to each other. Because of the fairly uniform price for inorganic fertilizers in the provinces surveyed, the small differences observed actually reflect transportation costs.

The strictly economic marginal analysis indicates that given the prevailing prices farmers on average could increase their profits by increasing supplementary input use. The input variation model, however, implies that input expenditure is determined, in the eyes of the producer, *by the prevailing prices* of output and input and that the ratios would have to be higher to encourage the average producer to increase his supplementary input expenditures. The previous (Chong et al. 1982) study demonstrated the economic benefits to be derived from increased fertilizer use; this study indicates that farmers are either not aware of these potential benefits or that they think the risks associated with achieving them are too high. Both alternatives imply that there is a need for a more active extension and information dissemination network to demonstrate the benefits of technology intensification. The findings also have implication for input pricing policy which are discussed in the concluding section of this report.

The belief of producers that fertilizers impart a bad taste to market-size milkfish (X_{38}) is apparently widespread enough in certain provinces to have a significant impact on levels of fertilizer expenditure. The highly significant coefficient for this variable has a negative sign as expected. For every 1% decline in the number of farmers who hold this perception, expenditures on fertilizers would increase by 0.48%. The belief that fertilizers impart a bad taste to milkfish is especially prevalent in Negros Oriental, Bohol and Lanao del Norte (Table 15). Lanao del Norte and Bohol have the lowest per ha yields of the seven provinces surveyed. Again, a role is indicated for extension and information dissemination to overcome this belief. Of course, it is also possible that the producers' perception is correct; consumer taste tests especially in these three provinces, would provide some indication of where the truth lies and what action should be undertaken.

The model also reveals that milkfish farmers will use additional fertilizers purchased on credit if the collateral requirements of government credit programs and commercial banks (X_{41}) will be lowered. For every 1% decrease in the collateral requirements, expenditures on fertilizers purchased with government credit will increase by 0.22%. Milkfish farmers were very vocal on the collateral

Table 15. Milkfish farmers' belief in the effect of fertilizers on the taste of milkfish.

Province	Percent of farmers believing that fertilizer Produces bad taste	Does not produce bad taste	No idea
Bulacan	5.4	94.6	–
Quezon	14.1	80.8	5.1
Mindoro Oriental	10.5	89.5	–
Capiz	12.5	87.5	–
Negros Oriental	25.0	75.0	–
Bohol	19.6	72.0	8.4
Lanao del Norte	26.1	73.9	–
Sample average	14.1	82.8	3.1

requirements of government lending institutions. They alleged that the collateral the lending institutions require from them often far exceeded the value of the loans approved by the lending institutions. In fact, many milkfish farmers did not bother to apply for government loans because: first, they did not have the necessary collateral or even proper documentation of government leases of the farms they are working; second, they claimed that they are discouraged from dealing with formal lending institutions because of alleged irregularities reported in the local press or by word of mouth. Producer risk considerations are hinted at here.[2]

Fishfarmers believed that stiff collateral requirements were counterproductive. During the interview, farmers were asked what they thought would be a "fair" collateral requirement and their response is reported in Table 16. Approximately 65% believed that collateral requirements should be 20% or less of the loan.

Although milkfish farmers are eligible to apply for loans under the *Biyayang Dagat* program, it is mostly geared towards fishermen. Their common plea is for a credit program patterned after the earlier *Masagana* 99 program for rice farmers, under which no collateral is required. Development banks such as the Development Bank of the Philippines are government-owned and fishfarmers believe that one of their main functions should be to extend credit to farmers at concessional rates. They maintain that these banks should finance farmers' production under circumstances in which private or commercial banks would not normally risk their capital.

[2]The Development Bank of the Philippines is reportedly one of today's biggest land owners in the country through its foreclosures of land (fishpond and agricultural land). Most respondents of the survey claimed to be unhappy with bank lending policies and procedures.

Table 16. Milkfish farmers' view of a "fair" collateral requirement.

Collateral requirement as a percent of loan borrowed	Percentage distribution of responses
0	2.0
< 10	14.3
10	33.1
12 – 20	17.4
25 – 40	6.9
50	9.6
60 – 70	3.8
75 – 80	2.0
100	7.0
No idea/no response	4.0

Since these complaints of fishfarmers imply that they are not being adequately serviced by the development banks of the country, a complete evaluation of the lending practices of these institutions would seem to be in order.

Family size (X_{36}) of the primary decisionmaker of the farm is the final socioeconomic variable shown to be significant in explaining fertilizer expenditures. The positive regression coefficient (0.38) implies that as the size of the family grows, more fertilizers are purchased. It is difficult to provide a logical interpretation for this variable's significance. Perhaps, with more mouths to feed, more income from milkfish farming is needed, and hence the farms of larger families are more intensively farmed. This argument, however, will *not* be followed to its logical conclusion which would be to recommend an increase in average family size so that milkfish farms will on average be more intensively farmed!

Bio-technical parameters

The two significant bio-technical parameters (X_{27} and X_{29}) have to do with acquisition of technical information. X_{27}, which is highly significant, measures the interest of producers to work on others' farms and the coefficient (–0.27) measures the relationship between this interest and current levels of input expenditure. X_{29}, which measures the number of times producers actively sought external consultation in 1980, also has a negative regression coefficient (–0.21). These results imply that those producers who were the most willing to seek advice from other farmers and who most actively sought external advice were those applying fertilizers more efficiently. Supplementary input expenditures actually increased as the seeking of advice declined. These findings simply imply that the more intensive fishfarms were less likely to seek external advice because they already understood the intensive production technology. These results are encouraging because they imply a strong interest among the less intensively operated farms to learn about improved production techniques. Also, as fishfarmers learn improved techniques of milkfish culture, supplementary inputs are more efficiently applied, resulting in less waste. For example, platform method of fertilizer application is more efficient than broadcast method of application.

In fact, the general willingness of fishfarmers to exchange technical and managerial information seems high (Table 17). Eighty-four percent claimed to be consulted by other farmers while 93% claimed to seek advice from their colleagues. Eighty-five percent stated that they observe operations on neighboring milkfish farms, but only 40% were actually willing to work on another farm in order to gain additional technical or managerial exposure. Sixty-five percent of the respondents classified themselves as active information seekers.

Table 17. Information gathering characteristics of milkfish farmers (percent).

Province	Type of information seeker		Interest in working[1] on other farm		Observe other farmer's operation		Percentage being consulted		Percentage seeking consultation	
	Active	Passive	Yes	No	Yes	No	Yes	No	Yes	No
Bulacan	80	20	35	65	84	16	98	2	100	0
Quezon	26	74	36	64	81	19	88	12	100	0
Mindoro Oriental	89	11	58	42	89	11	68	32	79	21
Capiz	69	31	42	58	80	20	84	16	89	11
Negros Oriental	83	17	33	67	83	17	88	12	75	25
Bohol	74	26	41	59	93	7	77	23	90	10
Lanao del Norte	70	30	52	48	83	17	48	52	91	9
Sample average	65	35	40	60	85	15	84	16	93	7

[1] Not as a laborer but rather to see what and how the other farmer is doing and supervising his workers.

Given this level of information exchange among milkfish farmers, the survey team was surprised to learn how little exposure these farmers had to written technical materials on milkfish farming. Out of 447 milkfish farmers interviewed, not one of them possessed a copy of "Philippine Recommends for Bangus", an extension publication available from the Philippine Council for Agriculture and Resources Research and Development (PCARRD). This publication which has most of the basic information on milkfish culture, is currently being revised by PCARRD. Only a small percentage (10%) of the farmers had copies of other written technical information. Most of the farmers reported that they had to make a special effort to obtain these; in other words, expenses are incurred in acquiring them. The extension literature is not handed out to them per se, so there is clearly room here for considerable improvement in the government's information dissemination program. The prevalence of informal information exchange among fishfarmers implies that a major effort to provide extension materials to producers would be worthwhile.

Physical parameters

The sole physical parameter which was significant was the salinity of the pond soil (X_{15}). The regression coefficient is negative (–0.04) which implies that as the salinity of the pond soil increases, the use of fertilizer inputs declined. When milkfish fry first appear along the coast, they seek out freshwater in rivers and estuaries. Milkfish farmers, who observe this behavior, therefore tend to add less fertilizers as pond salinity increases because they believe that fertilizers will add more salt to the pond environment. This they believe would increase the overall salinity of the pond and therefore reduce the rate of milkfish growth. Informal discussions by the senior author with milkfish producers in Taiwan and the Philippines support the contention that milkfish grow faster in freshwater than in brackishwater.

To briefly summarize, eight of 56 explanatory variables were found to be significant in explaining variation in supplementary input (fertilizer) expenditure. The model explains 73% of this variation. Each of the eight significant variables has implications for efforts to increase supplementary input use and hence output on milkfish farms. But before discussing these implications it is instructive to examine a select number of those variables that have insignificant regression coefficients.

NON-SIGNIFICANT VARIABLES

Forty-eight of the 56 explanatory variables in the input variation model have regression coefficients that are not significantly different from zero. A number of these non-significant variables are examined here in more detail because their lack of significance also has implications for government aquaculture development policy. This is particularly true of those institutional variables related to technology transfer.

The following discussion is organized into socioeconomic, bio-technical, physical and institutional categories, similar to the preceding discussion of the eight significant variables.

Socioeconomic parameters

The insignificant socioeconomic parameters can be grouped into three general categories: first, those related to input and output prices; second, demographic factors; and third, pond management factors.

Output/input price ratios for stocking materials (fry [X_3] and fingerling [X_4]) and milkfish output showed no significant relationship to input expenditure. There was quite a range in these ratios, most likely produced by the highly seasonal nature of the prices of stocking materials (Table 18). These output/input ratios are standardized by price per piece. Because the level of supplementary input use by the farmer is more likely to be related to quantities of stocking materials used than to their prices, the effects of seasonal price fluctuations for stocking materials appear to have been covered over by the more standard stocking rates. In other words, it appears that farmers have maintained stocking rates even when fry and fingerling prices have fluctuated.

Table 18. Price ratios of marketable milkfish to milkfish fry and fingerlings estimated by piece.

Province	Marketable milkfish to milkfish fry		Marketable milkfish to milkfish fingerling	
	Ratio[2]	Range	Ratio[2]	Range
Bulacan	25	6 – 60	8	3 – 25
Quezon	21	3 – 60	10	2 – 45
Mindoro Oriental	31	8 – 63	25	11 – 41
Capiz	22	4 – 60	7	2 – 16
Negros Oriental	24	9 – 41	16	–[1]
Bohol	22	3 – 86	17	3 – 33
Lanao del Norte	29	15 – 93	10	4 – 25
Sample average	23		9	

[1]No range is available because only 1 farmer reported the use of fingerlings.
[2]Read as 25:1, 8:1 etc.

The opposite problem occurred with the ratios of milkfish prices to the prices of other fish (X_7) and meat products (X_8). Since prices of other fish and meat products were measured from the consumer price indices (CPI), most producers therefore faced reasonably uniform prices around the country, although there were minor regional differences. The result of this lack of variation in the CPI may have contributed to the insignificant coefficients for these two variables. An indication of the competitive position of milkfish relative to these other products can be obtained from the simple tabulation of the consumer price indices for milkfish, all fish and meat products (Table 19). From this tabulation, one can see that the price of milkfish has been increasing at a significantly lower rate than the prices of other fish that compete with milkfish for the consumer's peso. The prices of meat products have increased at a slower rate than fish prices because they have been under price control while those of fish have not.

Relative to other aquaculture species, the attractiveness of milkfish has declined; in fact, in real terms, the price of milkfish actually declined in the decade 1970-1981. This decline is thought to have been due to changing consumer preferences among the middle and upper classes in the Philippines away from fish towards meat products. Similar shifts have occurred in Taiwan as real per

Table 19. Comparisons of Metro Manila consumer price indices for milkfish, all fish, meat and all items. (1972 = 100)

Year	Milkfish[a]	All fish[b]	All items[b]	Meat[b]
1969	61	54	64	–
1970	63	65	74	71
1971	88	87	89	88
1972	100	100	100	100
1973	107	106	114	113
1974	153	153	157	162
1975	164	170	167	167
1976	173	186	177	169
1977	191	202	190	190
1978	196	222	206	205
1979	233	280	245	245
1980	262	341	284	270
1981	306	355	335	309
1982[c]	306	385	363	330

[a]Source of data: Bureau of Agricultural Economics, based on national moving averages of retail prices.
[b]Source of data: Central Bank of the Philippines. Indices are retail prices in Metro Manila.
[c]Based on first 6 months period.

capita incomes increased during the past decade (Lee 1983). Experience there is instructive for the Philippines because due to this shift in demand, milkfish production area and profitability have been declining. Increased profitability in milkfish farms there that are already intensively farmed is apparently possible only with a shift to an even higher intensity deepwater pond system for which intensive supplementary feeding and major pond reconstruction are required.

Several demographic factors were also found to have no explanatory power for levels of input expenditure. These included age (X_{23}) and years of formal schooling (X_{24}) of respondents. As discussed in the second part of this section (managerial profile), per a yield levels were related to age: yield increasing to middle-age (50 years) then declining thereafter. Presumably input use follows the same pattern. The insignificance of the age regression coefficient in the input variation model is probably due to the fact that it is specified in log-linear form rather than as a quadratic form which gives an inverted U-shape. The results of the education variable, however, are consistent with the management profile which also found no relationship between education levels and per ha yields.

Several pond management factors were also insignificant in explaining variations in input use. As explained in the earlier management profile, milkfish culture experience (X_{21}) is an inadequate measure of management skill because this experience may have been confined entirely to use of traditional extensive or low-intensity methods. Experience with supplementary input use (X_{22}) was expected to show clearer relationship to input expenditures. The fact that the regression results fail to bear this out was because, with experience, fishfarmers become more efficient in their use of fertilizers. Among the more experienced fishfarmers, for example, the survey team noted the prevalence of the platform method of fertilizer application. This method uses a given quantity of input more efficiently than the broadcast method, which is practiced by the less experienced farmers.

Neither tenure status (X_{11}) nor extent of full-time involvement in fishfarming (X_{37}) had any bearing on levels of input expenditure, thus providing evidence to contradict the often-held (though unsubstantiated) point of view that these are significant determinants of input use and hence of yields. Table 20 provides a provincial breakdown of owner and non-owner farmers. Farmers were classified as owners if they were either title-holders of their fishponds or had a combined farm comprising privately-titled and leased fishponds (private or government). On the other hand, non-owners were holders of either private or government-leased fishponds. Non-owners also included

Table 20. Percentage distribution of owner and non-owner milkfish farmer respondents by province.

Province	1979 Survey Owner	1979 Survey Non-owner	1981 Survey Owner	1981 Survey Non-owner
Cagayan	93	7	--	–
Pangasinan	56	44	–	–
Bulacan	48	52	23	77
Quezon	–	–	34	66
Mindoro Oriental	–	–	42	58
Masbate	42	58	–	–
Iloilo	72	28	–	–
Capiz	–	–	58	42
Negros Oriental	–	–	8	92
Bohol	24	76	12	88
Lanao del Norte	–	–	78	22
Zamboanga del Sur	28	72	–	--
Sample average	52	48[1]	31	69[1]

[1]Of this, 15% and 40% are caretakers in the 1979 and 1981 surveys, respectively.

caretakers, managers or administrators of fishponds. Absentee owners were included in the category of non-owner because their caretakers were interviewed. Forty percent of our sample comprised caretakers. Thus the data collected do not accurately reflect the actual ownership pattern, but they are appropriate for our use in this study because they reflect the status of the major decisionmaker for the farm. The mix between owners and caretakers in our sample provides a more balanced view of the constraints to high yields.

Respondents were asked the percentage of their non-milkfish income to determine the contribution of milkfish income to their total income and indirectly the "weight" or attention given to milkfish vis-a-vis non-milkfish activities. In all, 42.3% of milkfish farmers in our 1981 sample reported other sources of income in addition to those from milkfish. Of those who reported non-milkfish sources of income, 89% reported that this source of income exceeded 10% of their total income. The non-milkfish sources of income ranged from less than 10% to 99%. About 14% of those who reported non-milkfish sources of income derived equal share from milkfish and non-milkfish sources. Those receiving more than 50% of their income from non-milkfish sources comprised about 44% of the farmers; 31% received less than 50%. Only 14.5% of all the farmers interviewed relied on milkfish farming as their sole source of income. The rest of the farmers or 43.2% did not wish to discuss other sources of income. One possible implication which can be drawn from this is that they had other sources of revenues. Of the seven provinces surveyed, Negros Oriental, Lanao del Norte and Bohol had the highest percentage of farmers with non-milkfish sources of income. No farmer in Mindoro Oriental depended entirely on milkfish. Where milkfish farming was highly profitable, fewer farmers depended on non-milkfish sources of income (e.g., Bulacan). Despite this variation, however, no significant relationship between dependence on non-milkfish sources and levels of expenditure on supplementary inputs was found.

Finally, in this collection of non-significant socioeconomic parameters are those related to the producers' assessment of risks in milkfish farming. Almost two-thirds of the producers and caretakers interviewed stated that there were no additional risks associated with larger quantities of inputs or with techniques which give higher output (Table 21). Those who regarded the use of larger quantities of inputs as risky reasoned that larger quantities of fertilizers are toxic to the fish. An extension role is thus indicated here. Another group of farmers, about 6% however, clarified that the use of fertilizer must be matched with the size of pond, stocking rate and soil/water conditions. At the same time they were also concerned about the uncertainty in recovering their investment in inputs.

For those 64% who did not regard the use of larger quantities of inputs as risky, the common feeling shared by these farmers was that the fertilizers will increase output of milkfish. Having the necessary know-how and skills in applying the fertilizers can minimize risks. These two factors combined can assure higher returns from the production operations. Many producers within this

Table 21. Milkfish farmers' view on the risks associated with larger quantities of inputs and techniques which give higher output (in percent).

Province	Use of larger quantities of inputs is: Risky	Not risky	No response	Techniques which give higher output are: Risky	Not risky	No response
Bulacan	31.5	65.8	2.7	37.8	59.5	2.7
Quezon	32.3	66.7	1.0	28.3	65.7	6.0
Mindoro Oriental	21.1	47.4	31.5	21.1	47.3	31.6
Capiz	45.3	48.4	6.3	45.3	48.4	6.3
Negros Oriental	20.8	79.2	0.0	16.7	79.2	4.1
Bohol	15.0	75.7	9.3	10.3	86.0	3.7
Lanao del Norte	30.4	39.2	30.4	26.1	69.6	4.3
Sample average	28.6	64.4	6.9	27.7	66.9	5.4

group, however, stated that capital to purchase fertilizers was a more important consideration than risk; they were confident they could manage the risks associated with fertilizer use. To some, no fertilizer was even more risky because fishfood would not grow and harvest would be low (such that cost of fry and labor may not be recovered). Overall, this group of milkfish farmers gave the impression that not only is the use of larger quantities of fertilizers not risky, its use is profitable (advantages outweigh the risks). Why then are not many more milkfish farmers applying fertilizers as well as applying them at a higher rate? According to the respondents, lack of capital is one of the main reasons.

Institutional parameters

Allegations of capital shortages by producers led naturally to discussion of the institutional parameters, none of which had a significant impact on variations in fertilizer expenditure. The major institutional parameters relate to credit (X_{42}, X_{52}), extension and information dissemination (X_{32}, X_{55}) and aquaculture associations (X_{31}) all of which provide institutional support to fish-farmers to a varying degree.

Credit has had little impact on input intensification because so little of the available credit has been used for this purpose. Among the major banking institutions which offer credit to milkfish farmers are the Development Bank of the Philippines (DBP), Philippine National Bank, Land Bank of the Philippines, Central Bank/Rural Bank System, and numerous private or commercial banks. Sources of credit other than banks include individual money lenders, relatives, friends, input suppliers and fish brokers. For loans up to ₱5,000 per borrower from DBP there is no collateral requirement. However, as far as the authors can determine, milkfish farmers are not aware of such a lending policy. In fact, most milkfish farmers cited stiff collateral requirements as one of the main problems of obtaining credit. The great majority of loans reported to the survey team exceed ₱5,000. These loans were used primarily for pond construction, pond improvement and pond repairs (Table 22). Only one of 324 respondents reported using a loan to purchase fertilizers.

Interviewed milkfish farmers viewed credit, rather than risk, as the main constraint in milkfish culture. While 23% of the respondents equated indebtedness with inadequacy, lack of initiative, laziness or extravagance, fully 81% were willing to incur debts for production purposes. Based on

Table 22. Profile of the use of loans, 1978.[1]

	Loan use by farmers as a percentage of the total number of farmers					
	Pond construction	Pond improvement	Pond repairs	Stocking materials	Marketing equipment	Others[2]
Percentage of loan used						
100	12.5	15.4	10.0	25.9	33.3	17.4
90 – 99	5.0	1.5	–	–	–	4.3
80 – 89	20.0	4.6	5.0	3.4	–	8.7
70 – 79	2.5	1.5	2.5	3.4	–	–
60 – 69	5.0	1.5	5.0	3.4	–	–
50 – 59	15.0	30.8	30.0	15.5	–	34.8
40 – 49	2.5	1.5	–	3.4	–	–
30 – 39	10.0	7.7	15.0	10.3	16.7	8.7
20 – 29	12.5	21.5	17.5	17.2	–	13.0
10 – 19	15.0	10.8	10.0	13.8	50.0	4.3
< 10	–	3.1	5.0	3.4	–	8.7
Sample average[3]	24	38	24	34	4	14

[1]Out of 324 milkfish farmers, only 169 farmers or 52% have loans.
[2]Under "Others," only one farmer reported the use of the loan to buy fertilizers.
[3]Percentage figures do not sum up to 100% because some loans are used for more than one purpose and also because of rounding.

our survey data, farms producing more than 1,000 kg/ha/year with average size of about 20 ha, the fertilizer expenditure alone amounts to ₱31,000/year. To a small minority, indebtedness was actually a sign of good character, resourcefulness and prestige, but only if repayment of debt was made. Milkfish farmers had three major complaints about the existing credit system. First, they cited difficulties in obtaining loans for production purposes. Second, as already discussed, they complained of the high collateral requirements. Third, and more ominously, they complained about the high unforeseen additional costs in securing loans from the DBP.

Producers were asked what they regard as 'fair' interest rates, in terms of what interest rate they expected if they deposit money in a bank or if they have money to lend out. The farmers' responses are presented in Table 23. Their responses reflect a combined perception of what they were willing to pay as interest rate to lending institutions and what they expected as reasonable returns on their money as if they were the lenders. Based on their responses, it is obvious that the 1980 interest rates (14-16%) charged by lending institutions were not considered unreasonable. However, when loan processing costs such as service charges and unforeseen additional costs are added, the real rate of interest becomes much higher. Milkfish farmers were extremely discouraged by these unforeseen processing and facilitating costs and complained bitterly about them. Because of these illegal practices, farmers viewed bank borrowing with much skepticism despite their willingness to assume such debts.

Table 23. Milkfish farmer's view of a fair annual rate of return or interest.

Annual rate of return or rate of interest	Percentage distribution of milkfish farmers
< 10	9.8
10	27.1
12 – 20	17.7
21 – 45	8.0
50	11.4
60 – 90	5.8
100	13.2
120 – 500	2.0
No idea/no response	4.9

Note: The "uneven" categorization is made because of the distribution of the raw data.

The results of the input use variation model show that there was no significant relationship between contact with the BFAR extension service and fertilizer expenditure. In part, this finding is due to the fact that 70% of the survey respondents had no contact at all with extension agents during 1980 (Table 24). Only 10% had more than a single contact with an extension agent during

Table 24. Contact with extension agents, by province (percent).

Province	Contact with extension agents		Consultation was useful (% of those who had contact)	
	Yes	No	Yes	No
Bulacan	4	96	25	75
Quezon	25	75	96	4
Mindoro Oriental	16	84	100	0
Capiz	16	84	100	0
Negros Oriental	54	46	85	15
Bohol	62	38	92	8
Lanao del Norte	65	35	100	0
Sample average	30	70	93	7

that year. A further reason for the insignificant regression coefficient can be found on the fact that contact between extension agents and farmers was lowest in that province (Bulacan) with the highest per ha yield and fertilizer use. Those who had contact were not given any extension handouts as reference materials for future use.

A common criticism of the farmers is that they are more knowledgeable than the extension officers. Sixty-three percent of all producers believed that the extension service is weak; 35% that it is strong. Because of this, some milkfish farmers reasoned that the extension officers were reluctant to make farm visits. Low remunerations, limited travel allowances and time-consuming office requirements in terms of filing trip and gasoline requests are other reasons cited by extension officers as inhibiting field work. Lack of visibility of extension workers was repeatedly corroborated by farmers and officials of provincial and municipal governments alike.

During interviews with farmers and caretakers, it also became clear that improved milkfish husbandry techniques are couched or presented most often in a "how" but not "why" orientation. Farmers stated that no rationale is given for a certain improved husbandry practice or why this or that is done. For example, most milkfish farmers were aware of the difference between broadcast method and platform method of fertilizer application but did not understand the rationale. Consequently, many milkfish farmers stated that they do not see real benefits of one method over the other. In fact, however, the platform method of application can save 20-40% on the amount of fertilizer and labor required when compared to the other method of application (PCARR 1976), but this is not generally known by the farmers.

There is a bright side to all of this, however, and this is that 93% of those who did have contact with extension agents viewed the contact as useful. Only in Bulacan, where pond operators are highly experienced, did they generally believe that the extension contact was not useful. Furthermore, in three provinces (Negros Oriental, Bohol and Lanao del Sur) the majority of farmers had contact with extension agents and almost all of these found it worthwhile. Still, there is obvious room for improvement nationwide, and coupled with improved extension materials and manuals, there is hope that the extension service can yet be one of the accelerators of development in the Philippine aquaculture industry. It is our hope that these comments of milkfish farmers will be viewed as constructive criticism. Certainly the BADTC program of BFAR to provide practical training (involving fishpond engineering, fishpond management, fishpond economics, extension methodology and socioeconomics of milkfish farmers) to extension workers is a good step in the right direction.

Finally, no significant relationship was found between membership in aquaculture associations and levels of fertilizer expenditure. In some respects, the existence of an industry association is reflective of the degree of maturity of the industry. Milkfish farming and aquaculture in this country has indeed a long history and tradition. New or infant industries do not normally have the "luxury" of mobilizing their members toward a common goal. The Philippine Federation of Aquaculturists (PFA), first known as the Philippine Federation of Fishpond Producers (PFFP), but renamed PFA in 1981 was first organized in 1964. It is a federation of about 30 associations at the provincial or regional level. The federation claims a membership of 10,000 farmers; its annual convention draws about 500-1,000 participants.

Of the 447 milkfish farmers surveyed only 25% belong to an aquaculture association (Table 25). A common reason given for not belonging to an association was that membership in such an association did not give any benefits and was a waste of time. This point of view was particularly prevalent among the smaller fishpond operators, which is surprising because one might think that they would have the most to gain from membership and interaction with other fishfarmers. Their viewpoint perhaps reflects their uneasiness *(hiya)* or reluctance to display ignorance. However, non-members generally claimed that meetings tend to be more of an occasion to lobby for government attention and assistance than one for the exchange of technical information. It appears that

Table 25. Percentage of milkfish farmers with membership in aquaculture associations.

Province	Members				Non-members (%)
		By farm size			
	Overall	Small <6 ha	Medium 6-50 ha	Large >50 ha	Overall
Bulacan	5	17	66	17	95
Quezon	18	17	77	6	82
Mindoro Oriental	21	25	75	0	79
Capiz	19	17	66	17	81
Negros Oriental	46	18	82	–	54
Bohol	38	50	50	–	62
Lanao del Norte	78	22	72	6	22
Sample average	25	28	64	8	75

most technical information exchange takes place informally among fishfarmers rather than through formal seminars and association meetings.

In summary, none of the institutional parameters are significant in explaining supplementary input expenditure. However, since these findings are due in good measure to (1) lack of loans for production credit, (2) low levels of contact between extension personnel and fishfarmers, and (3) limited membership in associations, they should not be taken as an indication that there is no potential for these facilitating institutions to play a strong role in industry development. The last section of this report outlines some steps that could be considered to improve upon these services.

Bio-technical parameters

The bio-technical parameters relate primarily to the production practices of the fishfarmer and his own initiative in acquiring knowledge of these practices. As it turns out, only two of the 15 explanatory variables grouped in this category were statistically significant. The other 13 relate primarily to the actual production practices of the farmer, and the fact that their regression coefficients are statistically insignificant has major implications for the issue of technology transfer and adoption by milkfish farmers. It appears that in many cases, milkfish farmers did not fully appreciate the interrelationships (well-established by data from experimental farms) among such factors as fertilizer use, stocking rates, water control and number and length of crop cycle, though their knowledge of basic technical methods of pond management appeared adequate.

The basis to determine appropriate stocking rates (X_1 and X_2) was not fully understood by many milkfish farmers. In large number of cases, farmers did not apparently appreciate the relationships between stocking rates and inherent fertility of the ponds, carrying capacity of the pond, types of fishfood available naturally, to be grown or to be added, size of fry at stocking, market size at harvest and most of all the cost of inputs and their added (marginal) value in use. For example, stocking practices as observed during the survey were largely determined by the local availability and price of fry; that is, the number of fry the farmer can buy, given his budget constraints. The appropriate number of fry to stock a given unit of pond area did not appear to be known by many farmers. Wide variations in stocking rates were found (Table 26), although the average stocking rates as estimated by the 1979 and 1981 surveys are not very different from each other. Chong et al. (1982) concluded that "average farm" profits could be increased by increasing stocking rates.

A further indication of the inexperience of producers with a variety of intensive production methods is the fact that only 20% were able to make a concrete estimate of how much higher yield/ha would be when intensive rather than extensive methods are used (X_{40}). This minority group was able to make such estimations only in terms of larger fish size (# pieces/kg) for a given time period, and not in terms of yield and productivity.

Table 26. Average stocking rates of milkfish fry and fingerlings in the Philippines (pieces/hectare/year).

Province	1978 Fry	1978 Fingerlings	1980 Fry	1980 Fingerlings
Cagayan	4,149	764	–	–
Pangasinan	5,985	3,400	–	–
Bulacan	7,561	6,315	8,089	5,044
Quezon	–	–	3,166	1,949
Mindoro Oriental	–	–	2,868	8,000
Masbate	1,730	250	–	–
Iloilo	8,502	6,282	–	–
Capiz	–	–	5,203	3,710
Negros Oriental	–	–	9,485	9,524
Bohol	3,136	–[1]	3,695	1,846
Lanao del Norte	–	–	4,656	1,057
Zamboanga del Sur	1,796	–[1]	–	–
Sample average	5,922[2]	5,892[2]	5,469	4,187

[1]No fingerlings were stocked in 1978.
[2]These fry and fingerling stocking rates are not additive for the average farm; that is, they reflect the averages for those farms stocking fry in the first case and the average for those farms stocking fingerlings in the second case.

There are wide ranges in the practices of the sample fishfarmers with regard to the number of water changes during production (X_{45} and Table 27), draining and drying (X_{46}, X_{47}), number of croppings per year (X_{49}) and length of cropping cycle (X_{48}), indicating the presence of dynamic, not stagnating, processes at work in the industry. It appears that there is a continuous learning process underway.

Table 27. Average number of water changes during production in a year.

Province	Water change: Number of times	Water change: Range
Bulacan	48.5	0 – 192
Quezon	35.3	0 – 240
Mindoro Oriental	37.4	4 – 104
Capiz	36.9	0 – 168
Negros Oriental	33.3	12 – 108
Bohol	29.6	0 – 144
Lanao del Norte	23.7	2 – 72
Sample average	36.7	0 – 240

All basic technical information on acid sulphate soil conditions and the usefulness of draining and drying after each harvest are well described in the "Philippines Recommends for Bangus" (PCARR 1976). Chen (1976) has described the process and benefits in Taiwan and Poernomo and Singh (1982) have analyzed the effect that these soils have upon fertilizer availability to algae in ponds constructed on such soils. Ponds built on these soils have very poor response to fertilizers and due to cumulative toxicity very poor algal and animal growth, but as the ponds age the problem is reduced. Draining and drying after harvests, as practiced by most farmers (Table 28), is viewed by many farmers as means of increasing pond productivity and hastening the aging process.

Milkfish can be grown year-round in the Philippines. Size of fry or fingerlings at stocking and the market size of the fish at harvest have strong bearing on the length of each crop cycle. Furthermore, the use of inputs such as fertilizers and supplementary feeds also can help to shorten the crop

Table 28. Pond draining and drying as practiced by milkfish farmers.

Province	No. of times/yr	Range	Draining and drying Length (days)	Range (days)
Bulacan	3.4	1 – 7	28.2	2 – 90
Quezon	2.3	0 – 6	17.2	0 – 45
Mindoro Oriental	2.4	1 – 6	26.7	7 – 63
Capiz	3.5	1 – 9	22.4	3 – 48
Negros Oriental	3.1	0 – 6	19.3	0 – 44
Bohol	2.3	0 – 5	23.0	0 – 60
Lanao del Norte	2.3	1 – 4	22.9	4 – 60
Sample average	2.8		22.9	

cycle. This relationship was recognized by the milkfish farmers. In general, from one to six crops were grown per year. Table 29 shows the pattern and length of crop cycle. Length of crop cycle by province is shown in Table 30. Milkfish were grown in the ponds from 1 to 12 months; the average length of crop cycle was about 5.6 months. Most farmers (72%), however, kept their milkfish for less than 5 months in their ponds (Table 31). In Pangasinan, some farmers grow their fish for more than a year.

Table 29. Average yield by number of croppings per year.

Number of croppings	Distribution of farmers (%)	Average yield (kg/ha/yr)
1	20	586
2	31	652
3	31	934
4	16	1,182
5	1	1,424
6	1	1,804
Average		833

Table 30. Length of crop cycle by province, 1980.

Province	Average crop cycle (months)	Range of crop cycle (months)	Average yield (kg/ha/yr)
Bulacan	5.6	2 – 12	1,307
Quezon	6.8	3 – 12	468
Mindoro Oriental	5.5	1 – 9	614
Capiz	5.5	1.5 – 12	923
Negros Oriental	5.9	2.5 – 10	1,000
Bohol	6.5	2 – 12	439
Lanao del Norte	6.6	3 – 12	408
Sample average	5.6		833

There was a strong positive correlation between number of croppings and yield/ha/yr (Table 29), but the majority of farmers practiced no more than three croppings per year. By province, only a small percentage of milkfish farmers in Bulacan and Capiz grew only one crop a year (Table 32). This is in contrast to Mindoro Oriental, Quezon, Bohol, Lanao del Norte and Negros Oriental where 21-37% of the farmers practiced only one cropping a year. With the exception of Bulacan, Negros

Table 31. Characteristics of milkfish crop cycle, 1980.

Length of crop cycle (months)	Percent of sampled farmers	Total area in sample (ha)	Average yield (kg/ha/yr)
2	25.2	1,534	1,016
4	34.2	2,229	969
5	12.9	834	746
6	14.1	1,755	618
8	3.9	201	314
10	6.6	337	919
12	3.2	124	398
Total	100.0	7,013	

Table 32. Number of crops/year in Philippine milkfish culture, 1980.

Province	Number of crops/year					
	1	2	3	4	5	6
	Percent of farmers					
Bulacan	7	29	33	28	2	1
Quezon	27	38	24	11	–	–
Mindoro Oriental	37	37	26	–	–	–
Capiz	9	23	33	24	3	8
Negros Oriental	21	8	38	33	–	–
Bohol	27	33	32	7	1	–
Lanao del Norte	26	48	26	–	–	–
Sample average	20	31	31	16	1	1

Oriental and Capiz where sizeable numbers practiced four croppings/yr, a large majority of the farmers interviewed (62-74%) grew two to three crops a year.

As with membership in aquacultural associations, only a minority (26%) of producers had attended aquaculture seminars (X_{26}), which again implies the need for a much improved information dissemination system. Encouragingly, a majority of producers in Negros Oriental and Lanao del Norte had attended such seminars (Table 33). The shortage of seminars and other information dissemination activities for producers has reached a point where the private sector is now taking concrete steps to remedy this situation. A group of successful Iloilo milkfish farmers have put together a team called SHIFTERS, or Staff of Inland Fisheries Technology and Resource Speakers

Table 33. Pattern of attendance at aquaculture seminars by province.

Province	Percent of farmers that have attended	Percent of farmers that have not attended
Bulacan	6	94
Quezon	20	80
Mindoro Oriental	11	89
Capiz	20	80
Negros Oriental	50	50
Bohol	41	59
Lanao del Norte	70	30
Sample average	26	74

whose purpose is to conduct mobile seminars on milkfish production technology in any part of the country, for a fee. However, these fees are high and are definitely prohibitive for many small milkfish farmers.

The adoption of a new idea hinges heavily on the ability of the farmer to receive and decode information (X_{25}). Our survey shows that, first and foremost, Philippine milkfish farmers are familiar with the types of fertilizers and pesticides available in the market. These inputs constitute the yield-increasing and yield-protecting inputs needed to boost output and they are commercially available. They are not new inputs in the sense that only experimental stations have access to them.

During the survey the milkfish farmers were asked whether they were familiar with and if familiar whether they are practicing the following eight concepts deemed essential in aquaculture: acclimatization of stocking materials, fishstock manipulation, draining and refreshening of pond water, soil analysis, pest and predator control, fertilization, supplemental feeding, and finally proper design of pond. They were also asked when they began these practices. Farmers were deemed capable of receiving and decoding technical information if they were familiar with four or more of the concepts and if they were practicing fertilization and pest control.

Our extended interview on this point reveals that 65% of the farmers possessed adequate understanding of the technical concepts posed to them (Table 34). This means that they could implement or translate the concepts into practice if they wanted. This finding implies that ignorance is not a barrier to the use of sound management practices. However, the above eight concepts are relatively straightforward and not as complicated as those related to interrelationships among inputs and the pond environment. Still, these results imply that the basic foundation for intensification of production techniques exists with the majority of farmers.

Table 34. Ability of milkfish farmers to receive and decode technical information.

Province	With ability (Percent)	With no ability (Percent)
Bulacan	74	26
Quezon	57	43
Mindoro Oriental	79	21
Capiz	75	25
Negros Oriental	88	12
Bohol	55	45
Lanao del Norte	48	52
Sample average	65	35

Physical parameters

This category of explanatory variables, in contrast to the three preceding categories, is a little less amenable to influence or control, either from producers or from government or other institutions. Only one of the 17 parameters in this category (soil salinity) was found to be significantly related to variation in supplementary input expenditures. Rather than a variable-by-variable exposition, therefore, the tabular results that indicate provincial differences are shown in Tables 35 to 41, without any lengthy comment.

The major points are worth highlighting, however. Medium-sized farms (6-50 ha) used the highest quantities of fertilizers per ha. This correlates with the earlier findings of Chong et al. (1982) which showed that medium-sized farms had the highest yields per ha. These medium-sized farms made up the majority of all milkfish farms (Table 35). Farm size did not explain variations in supplementary input use because both small and large farms spend less on fertilizers than the medium-sized farms. These results are generally consistent with the allegation that small farms

Table 35. Percentage distribution of small, medium and large farms, 1978 and 1980.

Province	1978 All farms average size	1978 Percent distribution Small <6 ha	1978 Medium 6-50 ha	1978 Large >50 ha	1980 All farms average size	1980 Percent distribution Small <6 ha	1980 Medium 6-50 ha	1980 Large >50 ha
Cagayan	4.5	85.0	15.0	0.0	–	–	–	–
Pangasinan	2.9	91.0	9.0	0.0	–	–	–	–
Bulacan	23.7	13.5	73.1	13.4	21.4	15.3	74.8	9.9
Quezon	–	–	–	–	12.5	36.4	61.6	2.0
Mindoro Oriental	–	–	–	–	16.1	47.4	47.4	5.2
Masbate	23.8	6.5	87.1	6.4	–	–	–	–
Iloilo	37.5	13.2	60.4	26.4	–	–	–	–
Capiz	–	–	–	–	12.7	39.1	57.8	3.1
Negros Oriental	–	–	–	–	12.6	45.8	54.2	0.0
Bohol	9.6	52.4	47.6	0.0	7.5	69.1	30.9	0.0
Lanao del Norte	–	–	–	–	5[illegible]	39.1	56.5	4.4
Zamboanga del Sur	14.6	18.0	82.0	0.0	–	–	–	–
Sample average	16.3	43.0	50.0	7.0	15.6	40.6	55.9	3.5

will limit the use of supplementary inputs to lessen their exposure to risks, while large farms may likewise limit supplementary inputs, but because of capital constraints.

Fully 59% of the surveyed milkfish farms are accessible by roads, with the rest accessible by rivers or trails. Almost one-half of producers have their own means of transportation, and only 3% claim to have no access at all to either personal or public transport means (Table 36). The vast majority of fishfarmers have no problem, in their assessment, in obtaining inputs (Table 37). Chicken

Table 36. Means of transportation relied upon by milkfish farmers.

Province	Transportation means Own	Public	Both	None
Bulacan	70	23	5	2
Quezon	47	43	4	6
Mindoro Oriental	47	47	–	6
Capiz	43	53	2	2
Negros Oriental	25	71	4	–
Bohol	28	59	8	5
Lanao del Norte	52	39	9	–
Sample average	47	45	5	3

Table 37. Milkfish farmers' perception on accessibility to inputs.

Province	Difficult (%) Seeds	Difficult (%) Fertilizers	Difficult (%) Pesticides	Not difficult (%) Seeds	Not difficult (%) Fertilizers	Not difficult (%) Pesticides
Bulacan	20	7	2	80	93	98
Quezon	19	8	4	81	92	96
Mindoro Oriental	11	6	0	89	94	100
Capiz	22	8	5	78	92	95
Negros Oriental	43	22	15	57	78	85
Bohol	39	14	12	61	86	88
Lanao del Norte	26	7	6	74	93	94
Sample average	26	10	6	74	90	94

manure suppliers are reported to canvass milkfish farmers for their requirements of chicken manure. They supply and deliver it straight to the farm. Other inputs such as inorganic fertilizers have to be purchased in nearby towns and are not delivered to the farm. There are regional differences, however; access tends to be more of a problem in Negros Oriental, Bohol and Lanao del Norte, and steps therefore could be taken to improve input accessibility in these locations. These problems have not stopped Negros Oriental from attaining one of the highest levels of productivity in the country, however, averaging 1,000 kg/ha/year. Access to inputs or transport difficulties have been frequently cited in the media and public meetings as some of the main problems facing Philippine milkfish farmers. However, the above results do not support the proposition that milkfish farmers face difficulties in getting access to inputs.

Fish brokers were also reportedly going directly to the farm to purchase milkfish in some provinces. Because these fish brokers are better equipped to handle and transport fish and due to economies of scale can do it at lower cost than the milkfish farmers, this recent marketing development will benefit the milkfish farmers in the long run. Milkfish farmers can concentrate on production and not worry about transporting produce to markets. Good roads obviously have a contributory role in this marketing development. Water-borne transportation is another inexpensive means of sending milkfish to the market since some farms are linked to the markets by rivers.

On the other hand, some provincial and municipal officials have expressed the fear of exploitation of small farmers by "middlemen" from outside because of the availability of good farm-to-market roads. In fact, a few cases have been reported in the Visayas. Middlemen from outside, besides competing with local middlemen for milkfish, were also reported by these government officials to be engaged in "bad"marketing practices, such as taking advantage of the small farmers' ignorance of external market conditions. In general, however, marketing problems were not cited by producers as a cause of low yields.

Age of milkfish ponds was incorporated as one of the explanatory variables to explain fertilizer use because it was significant in explaining milkfish output (Chong et al. 1982), and therefore was hypothesized to explain variations in fertilizer expenditure in this study. New ponds are less productive than older ponds; for example, in Indonesia and Taiwan, milkfish ponds require an average of five years to become productive (Chen 1976). The significance of the age of milkfish ponds in milkfish production has to do with the leaching of toxic substances from the pond bottom and also organic matter accumulation. The age composition of milkfish ponds as recorded from the 1979 and 1981 surveys is found in Table 38. In the results of the input use variation model, age of pond was not a significant explanatory variable, possibly implying that farmers are not fully aware of accepted methods of hastening the remedy of the acid sulphate soil problem.

Table 38. Age of Philippine milkfish ponds, 1978 and 1980.

Province	1978 Average age (years)	1980 Average age (years)
Cagayan	5	–
Pangasinan	22	–
Bulacan	44	41
Quezon	–	18
Mindoro Oriental	–	15
Masbate	13	–
Iloilo	30	–
Capiz	–	20
Negros Oriental	–	27
Bohol	10	15
Lanao del Norte	–	15
Zamboanga del Sur	15	–
Sample average	20	23

Knowledge of Philippine milkfish pond soils is sketchy and there is little understanding on the way fertilizers affect productivity in brackishwater ponds. Information on pH of pond soil is not very extensive; most of this information is localized in certain islands, for example, Panay. A decade ago, it was crudely estimated that about 60% of the total hectarage of Philippine milkfish ponds or 117,000 ha suffered from acid sulphate soil problems (Tang 1973, 1979). This problem may have declined somewhat as ponds have aged. In an effort to improve the current knowledge of milkfish pond soils in the Philippines, soil samples were collected during the survey from those 322 milkfish farmers who were willing to cooperate. Samples were brought back to the laboratory to be analyzed for pH, salinity and N-P-K content. According to the results of the analysis for acidity or alkalinity, more than half of the samples had soil pH of less than 6.0. Only two provinces had soil pH of more than 6.0 on average (Table 39). In fact, only 8% of the milkfish farms in Bulacan (the province with the highest per ha yields and among the oldest ponds) had pH of less than 6.0, 72% have pH of 6.0-6.9, and 20% with pH of 7.0-7.4. Note that the highest pH reading from the 322 soil samples was 8.0, which is consistent with the information from the Bureau of Soils which indicates that pH of Philippine soils seldom goes above 8.0.

Table 39. Results of pond soil analysis conducted by the Philippine Bureau of Soils, Ministry of Agriculture, using soil samples submitted from 322 farms by the survey team.

Province	Salinity (μmhos/cm)	pH (soil)	"Nitrogen"[1]	Phosphorous (ppm)	Potassium (ppm)
Bulacan	66.3	6.5	3.8	61.2	1,531.9
Quezon	76.2	5.2	6.3	21.3	1,794.4
Mindoro Oriental	33.1	5.5	5.6	13.8	562.9
Capiz	62.9	5.9	4.9	31.6	2,032.0
Negros Oriental	84.9	6.1	3.9	25.8	1,744.8
Bohol	88.2	5.3	6.1	13.9	1,170.3
Lanao del Norte	82.3	5.5	4.1	20.9	670.9
Sample average	74.6	5.7	5.2	29.7	1,501.4

[1] Nitrogen level is reflected through organic matter content (%) of soil sample.

The inherent fertility of the pond soil has to be considered before making fertilizer recommendations. Yield response to inputs is also known to vary with the type of soil (clay, silty clay, etc.). The organic-matter content of the soils is taken as a measure of the nitrogen level in the soil. The organic-matter content of the pond soils collected from seven provinces showed a wide range (Table 39). Seven percent of the samples had less than 2% organic matter; another 7% had more than 10% organic matter. About 60% of the samples had 2-6% organic matter, 26% with 6.1-10% organic matter.

Among the three elements, nitrogen, phosphorous and potassium, (N-P-K), phosphorous is most often limiting. The analysis of the 322 soil samples shows that the amount of phosphorous available in milkfish pond soils ranged from less than 20 to over 100 ppm, using the Olsen's phosphorous method. Fifty percent of the samples tested contained less than 20 ppm while 2% have more than 100 ppm. The presence of large amounts of phosphorous (over 100 ppm) was again recorded in Bulacan. In the other provinces, the phosphorous content was low (Table 39).

The need for potassium is not as critical as for phosphorous or nitrogen. Potassium fertilizers have not been used in milkfish ponds as potassium levels are normally adequate in brackishwater environments (PCARR 1976). As a result, fertilizers commonly marketed and used for aquaculture are incomplete fertilizers such as 16-20-0 or 18-46-0. The soil samples collected from 322 milkfish farms at random from each pond compartment exhibited wide variation in potassium level, 100 to 4,000 ppm. Of this, 81% of the farms had 200 to 2,000 ppm of potassium in their soils (Table 39).

The fact that none of these soil parameters explained variation in fertilizer expenditure is not really surprising because for the most part, farmers were unaware of the properties of their soil. Farm-by-farm results were sent to all 322 respondents so they would have some feedback from the survey.

Philippine milkfish ponds are generally quite shallow (Table 40). The depth parameter had no explanatory power regarding levels of fertilizer expenditure. However, shallowness of ponds has been suggested by Chong et al. (1982) as a major constraint to increased productivity per ha, and by other knowledgeable observers (e.g., William Chan, South China Sea Programme, pers. comm.). Indeed, as noted earlier, producers in Taiwan, where land is relatively scarce, are finding that the deepwater method is their answer to the need for higher productivity and profits per ha. This method (which requires supplementary feeding), though not comparable in the technical sense to the Philippine system, provides some indication of producer responsiveness to economic conditions as reflected in the relative availability of inputs (land, labor, capital). The economic incentive to build deeper ponds or to shift to more profitable species (e.g., shrimps) can also be expected to come about in the Philippines as land suitable for fishpond development becomes more scarce and hence more expensive to own or rent.

Table 40. Average pond depth of Philippine milkfish farms.

Province	Average depth (meter)	Farms with less than 0.5 meter (%)
Bulacan	0.5	53
Quezon	0.6	38
Mindoro Oriental	0.6	37
Capiz	0.4	63
Negros Oriental	0.6	42
Bohol	0.6	35
Lanao del Norte	0.9	17
Sample average	0.6	44

Finally, the results show no significant relationship between climate types and fertilizer expenditure. Yield differences among climate types are shown in Table 41.

Table 41. Yield differences among climate types.

Climate types	Characteristics	Examples of provinces	1978	1980
I	two pronounced seasons, dry from November to April and wet during the rest of the year	Pangasinan, Bulacan, Iloilo	1,056	1,275
II	no dry season, wet, maximum rain period from November to January (pronounced rainfall)	Quezon	–	468
III	seasons not very pronounced, relatively dry from November to April and wet during the rest of the year	Cagayan, Mindoro Oriental, Masbate, Capiz, Negros Oriental, Zamboanga del Sur	150[1]	873[1]
IV	rainfall evenly distributed throughout the year	Bohol,[2] Lanao del Norte	308	397
Average			761	831

[1]The wide difference in yield between the two surveys is because the surveys cover different provinces although classified under the same climate type. The implication is that the lower yield can be increased through improved management; climate is only partly limiting.

[2]The BADTP classifies the western half of Bohol as Climatic Zone III.

In summary, the major findings regarding physical parameters relate to the relative intensity of fertilizer use on medium-sized farms and the lack of serious problems related to input or market accessibility.

SUMMARY OF FINDINGS

The findings of this study have led to the identification of key constraints to increased yields and to the elimination of other factors often put forward to explain the behavior of milkfish producers. These results have been drawn not only from the significant variables in the fertilizer expenditure model, but also from the nominal levels of insignificant variables (which represent rejected hypotheses) and from a managerial profile of producers. The major findings can be summarized as follows:

(1) Output-input price ratios for both organic and inorganic fertilizers are significant in explaining variation in their use, thus implying that producers do respond to relative prices in their production decisions. This finding dispels the views which hold that Philippine milkfish farmers are poor or irrational decisionmakers. Producers were observed to reduce their supplementary input expenditures as the ratio between output and input prices declined, and to increase expenditures as the ratio increased. Both forms of response are consistent with the behavior of profit maximizing entrepreneurs using a given technology.

(2) Yields per ha were found to be a function of the age and the experience of the producer. Yields were lower for young and old farmers and highest for middle-aged farmers. Yields of experienced farmers were higher than those of inexperienced farmers in all provinces surveyed. No relationship between yields and tenure status or absentee ownership (or part-time involvement) was established.

(3) Medium-sized farms (6-50 ha) used significantly more fertilizers per ha than either small farms (< 6 ha) or large farms (> 50 ha).

(4) A further indication of producers' responsiveness to relative prices was found in a 30% reduction in fingerling stocking rate between 1978 and 1980 in favor of fry as stocking materials. This shift makes economic sense given that the fingerling price is higher than that of fry by an amount that more than offsets any gains to be made from the shorter rearing period required for fingerlings. Rates of application of organic and inorganic fertilizers increased by 5% and 30%, respectively, between 1978 and 1980.

(5) Although no data on land costs were collected during this study, the fact that land, or access to land through government leases, can be obtained relatively cheaply (compared for example to the higher cost of capital) will serve to encourage producers to continue extensive rather than change to intensive methods. In this, they are but responding to the relative prices of land and capital.

(6) Producers complained, however, of deteriorating output-input price ratios, which would explain their reluctance as a group to increase their expenditures on supplementary inputs. Nationwide, the real price of milkfish at the retail level (i.e., adjusted for inflation) has been declining since 1972. High prices of organic fertilizers in several provinces (Lanao del Norte, Bohol and Mindoro Oriental) further discouraged producers from increasing input use. In these provinces the cost of organic fertilizers exceeded their marginal value product (i.e., the added cost exceeded the added benefit).

(7) The deteriorating milkfish price-input cost picture can be partially offset by more efficient use of a given level of supplementary inputs. For example, the platform method of fertilizer application and distribution has been shown to be 20-40% more efficient than the broadcast method; yet most producers still use the latter.

(8) Another indication of the need for education or enlightenment was the belief that fertilizers impart a bad taste to milkfish was found to be significant in explaining variation in fertilizer expenditure. This belief was especially prevalent in Lanao del Norte, Bohol and Negros Oriental.

(9) Two-thirds of all respondents indicated that they did not associate increased supplementary input use with higher risks. Most claimed that their major problem was not perceived risks but lack of capital.

(10) Eighty-one percent of the producers claimed they would be willing to go into debt to secure production credit. However, in 1978 only one of 324 respondents reported using a bank loan for production input purposes. The banks' almost exclusive emphasis has been on loans for pond development or repair. A significant majority of producers were highly critical of the government banking system, and discouraged from seeking loans from formal lending institutions. When expenditures arising from unforeseen additional costs are included in the computation of interest payments, the effective interest rate is higher than the official rate of interest. Those that obtained loans for inputs (primarily stocking materials) did so from input suppliers such as fry dealers or from marketing intermediaries. The real interest rate of these non-formal credit sources was also significantly higher than the official bank lending rate. The high cost of credit was thus found to be a major constraint to the adoption of more intensive methods.

(11) Only 30% of the producers had contact during 1980 with the BFAR extension service. There were significant differences by province, however, ranging from 3% in Bulacan (where average productivity is the highest in the country) to over 60% in Bohol and Lanao del Norte. Most encouragingly, 93% of those who had contact with the extension service thought such contact was useful.

(12) Significant gaps remain in the technical knowledge of the majority of producers. While simple concepts related to input use are generally understood, more sophisticated concepts regarding interactions among inputs (i.e., fertilizers, stocking densities, pond depth and soil conditions) are not widely known. The potential for increasing production and profits from a given pond area through better water control by using pumps was also not widely appreciated. Lack of technical knowledge as to the rationale for intensive production is another major constraint to increased use of supplementary inputs.

(13) Only 25% of the producers belonged to the Philippine Federation of Aquaculturists (PFA). The majority of non-members viewed the PFA as a lobbying organization rather than one to promote technical interchange. Most exchange of technical information takes place informally among producers. Encouragingly, those using the least inputs were the most willing to work on the farms of other producers to learn new techniques of production.

(14) Only 10% of producers had any written technical materials on milkfish farming. None had a copy of the standard publication "Philippines Recommends for Bangus". There is thus a significant gap between the producers' stated willingness to learn more intensive production techniques and the almost complete lack of written technical materials available to producers that might enable them to appreciate the added benefits to be derived from intensification. Two-thirds of the producers have the apparent technical ability and the necessary literacy level to be able to use written technical materials if they were made available. Weak information dissemination is thus a further constraint to increased productivity. Significantly, extension agents have not been provided with extension handouts to be left with their clientele. Without such handouts to be used as references at a later date, extension activities are less effective.

(15) Finally, several hypothesized constraints to increased supplementary input use and productivity can be eliminated from consideration based on the results of this study.

This study found that:

(a) Stocking material shortages were not perceived as a problem by producers;
(b) Accessibility to milkfish markets and marketing outlets is generally high;
(c) Ignorance and sociocultural barriers do not appear to be major problems for the majority of producers;
(d) Tenure status (owners or lessees) had no significant impact on yield levels; and
(e) The extent of owner involvement in actual supervision of the farm management has no significant effect on yields.

Each of the major constraints identified above need to be addressed if a more rapid rate of increase in yields is to be forthcoming from Philippine milkfish farms. The concluding section of this report therefore examines the implication of these constraints for government policy and discusses policy options that might be considered.

Conclusion: Implications for Aquaculture Development Policy

Before embarking on a discussion of the implications of our findings for aquaculture development policy, it is useful to first put these findings in the context of the various theories of agricultural stagnation and transformation that were outlined in the second section of this report.

INDUSTRY STAGNATION OR TRANSFORMATION

Depending upon one's point of view regarding the relative weight of sociocultural or economic explanations of the process of agricultural growth, there are several points at which the Philippine milkfish industry could become stagnant. For example, the sociocuitural view on the one hand, holds that producers' own attitudes regarding change are the limiting factor for transformation of traditional agriculture. One version of the economic viewpoint, on the other hand, is that producers are trapped in a technical and economic equilibrium where they are "poor but efficient"; that is, they efficiently use the resources at their disposal given the prevailing resource prices (especially the high cost of capital). The way out of this trap according to economists (e.g., Mosher 1966; Schultz 1965) is to either change the relative prices farmers face or make available a significantly more efficient technology so as to induce producers to innovate. Technological innovation among producers is thought by some to induce institutional innovation in turn. Ruttan (1977) cites examples where institutions that serve agriculture (e.g., research centers) are also induced to change their focus by changing prices of inputs. Recent examples include research responsiveness to increased energy prices. Of perhaps more concern to this study of aquaculture constraints, however, is the responsiveness of credit, extension and information dissemination institutions. While agreeing that technological and institutional innovation is necessary to transform traditional agriculture, others (e.g., Bromley 1979) argue that institutional rigidities such as patron-client relationships and effective control of institutions by local elites will act as severe constraints to change by the majority of small producers.

Of these various explanations, which, if any, seem most applicable to the Philippine milkfish industry? Based on the findings presented at the end of the previous section, the authors believe that far from stagnating, the industry is undergoing the dynamic process of transformation. Evidence follows.

The production function study of Chong et al. (1982) demonstrated that the "average" milkfish farmer in the Philippines is inefficient in that higher profits could be earned through increased use of supplementary inputs.[3] The sociocultural theory that "small farmers are poor decisionmakers"

[3] We are speaking here in a nationwide sense. As noted earlier there are substantial differences in input supply and prices from province to province.

is consistent with these results in that farmers do not appear to be taking advantage of the availability of the improved technology that could lead to increased yields and profits. However, this study brings into serious question any characterization of milkfish producers as fatalistic, passive members of the "subculture of peasantry". A large majority of milkfish producers were found to be active information seekers, possessing the basic skills necessary for decoding technical information and willing to obtain credit for production purposes. These characteristics are in stark contrast to sociocultural explanations for stagnation. Attitudes of producers do not appear to be a constraint to adoption of more intensive methods.

Nor are fishfarmers caught in a low level technical and economic equilibrium trap. This study clearly shows that producers are responsive to differences in output-input price ratios and Chong's earlier study corroborates that opportunities do exist for increased profits with increased supplementary input use. Experience with supplementary input use was also clearly shown to be a major determinant of yields; increased yields can therefore be expected as farmers gain added experience with more intensive methods.

Neither of the two major alternative explanations of stagnation ("small farmers are poor decisionmakers"; "small farmers are poor but efficient") appear to apply to the majority of Philippine milkfish farmers or the industry as a whole. An explanation must be found for the wide gap between the benchmark yield (2,000 kg/ha/year) obtained by the more progressive farmers and the actual average yields (800 kg/ha/year). Since it is agreed that the high-payoff technology is available and that prevailing input and output prices in most locations provide the inducement for farmers to adopt more intensive methods, it is believed that explanations for the prevailing benchmark–actual yield gap must be found in an examination of the *process* of change and transformation and the institutions which facilitate it.

There appear to be four possible explanations.The first is that the relative prices have been incorrectly interpreted by failing to ascribe a sufficiently high value to the element of risk as perceived by producers. However, in this study less than one-third of the producers associate production intensification with added risk. Still, in selected provinces (Lanao del Norte, Bohol and Mindoro Oriental) where prices of organic fertilizers are higher than their marginal value product, it makes no economic sense for producers to increase their use of this input. The declining real market price of milkfish in many parts of the country is a further constraint to intensification of supplementary input use.

The second possible explanation is that institutional constraints are preventing milkfish producers from taking advantage of the available technological innovations. This study found strong evidence of institutional rigidities and constraints in credit institutions that are supposed to serve the capital requirements of the milkfish producers. The official 14-16% interest rate is actually much higher once "processing" charges have been included; the rate of return on investment in milkfish culture is thus lower than it would be if the official rate were the actual cost of borrowing. Moreover, the credit that is available is generally restricted to pond development costs, not for production. Coupled with the low lease fees for government mangrove land when converted to fishpond use, this credit emphasis encourages extensification instead of intensification.

Third, while producers claim to be interested in more intensive techniques, at the time of this study there was an almost complete lack of written information actually available to them. Though such materials have been published (e.g., PCARR 1976), an organized system for getting them into the hands of producers, especially the small-scale farmers seems to be nonexistent. Nor were the authors aware of any technical publications for farmers translated into local dialects. Contact time for the average farmer with extension workers who might have more ready access to these materials is likewise extremely low. Farmers interested in adopting more intensive methods thus must rely primarily on informal exchange with other fishfarmers if they hope to supplement their existing knowledge.

The fourth possible explanation is that the lag in producer adjustments to technological improvement and changing relative prices is caused by the fact that such adjustments do not take place instantaneously, but rather take time to diffuse. This study certainly found evidence that some producers, especially those 11% still practicing extensive methods, do not keep their farms primarily for economic reasons, but rather for reasons of security in land ownership or because of the status that land ownership implies. However, this group is a distinct minority, and even the most dynamic of industries have such an inefficient (though socially acceptable) component.

This study provides strong evidence in support of all the explanations outlined above. Given the changes that have been occurring in the milkfish industry (e.g., a 34% increase in average yield per ha in the last 10 years; a reduction in fingerling stocking rates between 1978 and 1980 in response to relative fry and fingerling prices; 5% and 30% increases in rates of application of organic and inorganic fertilizers, respectively, between 1978 and 1980, to name a few) and the extreme range in production intensity and yields which characterize the dualistic structure of the industry, the milkfish industry can hardly be characterized as stagnating. Rather the findings of this study point to an industry that is undergoing transformation and benefiting from gradual diffusion of more intensive production technology. Technological innovation has occurred but induced institutional innovation using Ruttan's (1977) terminology, is lagging behind. Furthermore, the institutional constraints are concentrated in the formal government institutions (e.g., credit and information dissemination in particular) rather than in informal rural institutional relationships such as patron-client relationships. The latter certainly exist in the Philippine rural agricultural sector where tenant farming is prevalent, but not apparently to a major extent in the milkfish industry.

The basic question facing Philippine aquaculture planners, therefore, is not how to *transform* a traditional aquaculture sector, but rather how to *accelerate* the ongoing process of transformation. By some standards, a 34% productivity increase in 10 years might be considered acceptable. However, in the Philippines population is growing at that rate and capture fisheries supplies are levelling off. Therefore, this rate of milkfish productivity increase is insufficient to maintain per capita intake of fish protein, and certainly less than the annual 20% increase that has been projected for the aquaculture sector. The results of this study point to several "action steps" that might be considered to accelerate the rate of adoption of more intensive production methods, and hence production of milkfish and indeed other aquaculture commodities.

ACTION STEPS

This study has identified several major constraints to the more rapid diffusion and adoption of intensive milkfish culture techniques. For purposes of discussion, these constraints can be grouped into two general categories:

(1) those related to the relative prices of output and inputs; and
(2) those related to technical knowledge of producers.

Credit programs, supplementary input availability and prices and costs of extensification vs. intensification fall into the first category; extension and information dissemination belong in the second. A focus on the first category by government would create incentives for producers to adopt more intensive methods; a focus on the second would encourage an outward shift in the production frontier with the government's role being primarily that of facilitator. Cutting across both categories is the need for institutional reform and modification. Tacitly assumed in both approaches is that profit-motivated producers will respond to changes in relative prices or to the availability of more efficient production technology. Given our findings, both of these assumptions seem realistic. Action steps to overcome these constraints are summarized in Table 42.

Changing relative prices

Aquaculture planners should especially consider reducing the cost of capital that is made available to milkfish producers. Costs of supplementary inputs in certain provinces need to be

Table 42. Summary of constraints identified and possible 'action steps' to overcome them.

Category	Constraint	Primary action steps
1. Those related to relative prices of output and inputs	High cost of capital	Production credit. Institutional reform to minimize red tape.
	Fertilizer shortage and high prices (selected provinces)	Encourage poultry farming. Input subsidies and dual pricing subsidies.
	Low cost of mangrove land	Strictly enforce the mangrove conversion moratorium.
2. Those related to the technical knowledge of producers	Low contact with extension workers	Increase mobility of extension officers and contact hours with farmers.
	Poor information dissemination	Make available more handouts and improve distribution network for written extension materials. Translate technical materials into local dialects.
	Belief that fertilizers impart bad taste to marketable milkfish	Taste tests in selected provinces end dissemination of results through media outlets.

reduced or subsidized in some way. Finally, a mangrove conversion moratorium needs to be strictly enforced, so that the price of land suitable for milkfish culture increases to reflect its social value to Philippine society rather than its private value to those who are fortunate enough to obtain government fishpond leases to convert public mangrove lands to private use. All three of these action steps would encourage the adoption of more intensive milkfish production techniques. Each "action step" is examined in somewhat more detail below.

The major needs identified by milkfish producers are to reduce the *real* cost of borrowing and to make available *production credit.* The *real* cost of borrowing can only be reduced through banking reform that minimizes incorrect banking practices. Until the banking system is reformed in this manner, the real cost of borrowing will continue to discourage milkfish producers.

The need for production credit is a related, though separate issue. Milkfish producers claimed that the primary constraints to intensification from their perspective are capital shortage, particularly for the purchase of supplementary inputs, and the perceived high collateral requirements of government development banks. Other production credit programs (e.g., *Masagana* 99) that provide operating capital in the Philippine agricultural sector have run into serious difficulties due to low repayment rates. However, there are significant differences between the average 'newly emancipated tenant rice farmer' and the average milkfish producer. The former is likely to have no other source of income besides rice farming and thus have more difficulty surviving the transitional periods between harvests. In contrast, almost one-half of the surveyed milkfish producers have other sources of income. The latter are thus much more likely to use a production credit loan for its intended purpose than to meet immediate consumption needs. Furthermore, the average milkfish producer has a household income almost three times the national average (Table 43), and previous experience with both borrowing and repaying for farm production purposes, albeit from informal institutional sources, both of which put him in the entrepreneurial class, and not the subsistence farmer category. The recent initiatives of the Asian Development Bank and the Fishery Industry Development Council which are seeking to design a production credit scheme for fishfarmers are therefore strongly endorsed.

Table 43. Selected income indicators of the Philippines (1980 pesos).

Income measures (family of six)	Household income	Main activity income	Household expenditures
Poverty threshold (national)	14,600	–	
Rural average income	8,400	–	9,800
Urban average income	14,700	–	15,500
Metro Manila	18,500	–	18,100
Other urban	12,500	–	13,900
National average	10,300	–	11,500
Municipal fisherman	5,900	3,100	–
Rice farmer	4,400	700	4,200
Coconut farmer	7,000	1,100	7,900
Milkfish farmer	30,000	9,700	–

Source: Librero et al. 1982 and NEDA 1982. All figures have been adjusted by 1980 consumer price index.

It is of paramount importance, of course, that the implementation of any production credit scheme by government banks be accompanied by serious attempts at institutional reform to reduce unforeseen credit charges. Also, this proposal for production credit should not be viewed as a recommendation that loans for pond construction or redesign should no longer be made. Pond construction loans are particularly necessary for the deepening of Philippine brackishwater ponds which are too shallow on average to support a highly intensive production technology.

The low supply of organic fertilizers in several provinces, especially Lanao del Norte, Bohol and Mindoro Oriental of the seven surveyed provinces, has led to high prices that have discouraged the intensive use of these supplementary inputs. There are two options to help resolve this constraint. One is to encourage *poultry farming* in the affected provinces, if economic opportunities favor it. The second is to implement a *dual pricing subsidy scheme* for organic and inorganic fertilizers that would effectively subsidize the purchases of these inputs by those farms that are currently applying only low levels, especially small farms.

Dual pricing would subsidize the prices paid by small farms for fertilizers by charging them less than larger farms. Governmental distribution networks should not be necessary, but some cross-checking of amounts purchased and receipts of input suppliers would be. To minimize fraud in such a dual pricing scheme for fertilizers, strict criteria should be developed and adopted such that only bona fide small farmers are benefited. These criteria can be further reinforced to eliminate remaining loopholes in the dual pricing scheme by requiring small milkfish farmers to organize themselves into a group farming unit in order to avail of the subsidy. If small farmers are organized in this fashion they are more likely to benefit from government development programs. The PFA does not unfortunately fill this role at present because few small farmers are members.

If land is cheap relative to other scarce inputs, such as capital, there is no particular economic incentive for fishfarmers to optimize production per unit area; rather they would wish to maximize the return on their capital investment. There are sound ecological reasons for slowing if not halting the conversion of mangrove area to fishponds. Effective enforcement of the *moratorium on mangrove conversion* would also have the long-term effect of encouraging intensification per unit area because the moratorium would increase the cost of land. This change in the price of land relative to the capital and labor inputs would provide incentive to producers to use their land more efficiently.

Improving technical knowledge of producers

Although milkfish farmers generally have a basic knowledge of the techniques of supplementary input use, there are major gaps in their knowledge. This shortcoming is caused in part by a low level of contact with the BFAR extension service and by an extremely weak information dissemination network. Both the farmers and the extension agents cited the lack of extension publications as one of the main weaknesses of the BFAR extension service.

To overcome the first of these problems, the *contact hours of extension officers with producers must be increased.* There are currently approximately 300 extension agents for 10,000 milkfish farmers, or one extension agent for every 30 producers. This ratio is better than that which prevails in agriculture as a whole. Our findings, based on producers' data, show that during 1980 each extension agent on average contacted only 30% or 10 of the producers for which he was responsible. Therefore, the task is primarily one of increasing the mobility of the existing extension service rather than adding additional agents. The government is very much aware of the present shortcomings and indeed the four Brackishwater Aquaculture Development and Training Centers are designed primarily to upgrade the technical skills of extension agents so that they can be more confident and effective in the field. At the same time the problem of inadequate financial compensation and travel allowances for these extension agents must be resolved.

In addition to training, the BFAR should consider hiring extension agents with a rural background who are willing to undertake considerable fieldwork. Adequate funds for local transportation and per diem are prerequisites for increasing the mobility of the extension service. The present per diem and transportation rates are based on rates prevailing in the 1930s. Remembering that what is reported here is based primarily upon perceptions of milkfish farmers, an objective evaluation of the extension service should be carried out, ranging from selection procedures through training to effectiveness in the field.

An equally important indicator that milkfish farmers are generally left to fend for themselves is the fact that only 10% have any written materials that might assist them in their decisionmaking. Since basic technical materials exist[4], the primary need is to *improve the information dissemination system.* Technical materials, preferably translated into major Philippine dialects, must get into the hands of the producers if they are to add to producers' knowledge. Research results are also not prepared in a form suitable for readers from the milkfish sector. A major weakness is the lack of an effective link between the research community (i.e., universities, government, national and regional research centers) and the extension service. There are few if any incentives for researchers to produce their findings in a form that would directly benefit the private sector.

For example, there are known techniques for the partial mitigation of acid sulphate soil conditions, a problem for many brackishwater aquaculturists, especially with new ponds where organic matter has not yet built up on the pond bottom. But the results of this research are not in the hands of farmers. The same situation exists regarding elements of pond design (including depth) and water management techniques. What is needed is a conscious program to publish and disseminate research results in a popularized form, even comic book style.

One of the significant factors constraining use of fertilizers in Lanao del Norte, Bohol and Negros Oriental was the belief that fertilizers impart a 'bad taste' to milkfish. *Taste tests,* using milkfish reared on fertilizers and those which are not, could be conducted, and assuming that the belief is disproven, results could then be disseminated to producers.

It is worth emphasizing that some of the above recommended action steps need to be tailored to the requirements of individual regions or provinces. For example, dual pricing of organic fertilizers makes sense only in those locations where the price is high. As has been shown, there is a wide range in these prices around the country. Production credit, however, appears to be a pressing need in all parts of the country.

While this study has demonstrated that milkfish producers are motivated by economic incentives, there is a clear role for the government to play in accelerating the ongoing transformation of

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[4]The BADTP has produced a model management system and technical materials describing it for the four climate zones to be used as an extension aid.

the sector to a more productive and profitable level by helping to overcome the constraints identified in this study. This can be done by changing the relative prices of output and inputs *and* improving the technical knowledge of producers through extension and information dissemination. It is insufficient to do one or the other; both actions are required. To assist in these tasks it is important that the aquaculture planning process include on a regular basis an evaluation of the costs and benefits of alternative approaches.

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Appendix: Questionnaire Used in this Study

CONFIDENTIAL

Interviewer ______________
Affiliation ______________
Date ______________
Editing (Field/Office) ______________
Call back required ______________

A Survey on Constraints to Higher Yields of Milkfish Farms in Selected Areas of the Philippines*, 1981

(Reference period is 1980 if specific information is needed; otherwise, obtain information on average experience)

A. GENERAL INFORMATION

Name of Respondent: ______________ Job Status: ______________
Address: ______________

____

Site of Farm: ______________
Accessibility of Farm: ______________

Mode of transportation and frequency.
Specify whether farm can be rached by road, boat or trail or a combination of each of the above.

Tenure Status: Privately Owned ________ Gov't Leased ________ Others ________
Age of Pond: ________ years. Year Operation Started: ________
Size of Farm: ________ Ha.

				Depth of Water	
Nursery	Ha. ______	______	No. of compartments	______	cm.
Transition	Ha. ______	______	No. of compartments	______	cm.
Rearing	Ha. ______	______	No. of compartments	______	cm.
Undeveloped	Ha. ______	______	Average depth of all ponds	______	cm.

B. SECTION ON SOCIOECONOMICS

1. How many are you in the family? ________

Household Members	Age	Highest Grade/ Course Attended	Occupation	Percent of Time Work on Farm
Husband	___	______	______	______
Wife	___	______	______	______

*A project of the UNDP/FAO-BFAR Brackishwater Aquaculture Development and Training Center, implemented jointly by International Center for Living Aquatic Resources Management (ICLARM), the Bureau of Fisheries and Aquatic Resources (BFAR), and the Bureau of Agricultural Economics (BAECON).

Children > 10 years old (Helping on farm)

a) _______________ ____ _______________ ____________ ______________
b) _______________ ____ _______________ ____________ ______________
c) _______________ ____ _______________ ____________ ______________

Other relatives

a) _______________ ____ _______________ ____________ ______________
b) _______________ ____ _______________ ____________ ______________

2. How many years of milkfish culture experience do you have?

a) Total: _______ years
b) Use input/fertilizers: _______ years

3. Would you consider yourself: (Check one)

a) Full-time fishpond operator* __________
b) Part-time fishpond operator __________

* A full-time operator is one who spends 40 manhours/week attending to his fishpond operations. Also, if he has no other occupation but spends less than 40 manhours/week, he would be considered full-time.

4. If part-time, what percentage of your time is devoted to milkfish production?

a) ___________ percentage
b) ___________ average number of hours/day
c) ___________ average number of days/month

5. What alternative work would you be doing if you are not producing milkfish, that is, can you find other employment if milkfish production is not available to you? (Check one)

Yes __________ No __________

a) If yes, what? ____
____
b) If no, why not? ____
____
c) Is this alternative work easy to find? ____
____
d) What is your expected income per month from this alternative work?
____
____

6. Over the last 5 years, what have been your milkfish yield/ha/year?

Year	Farm Size	No. Stocked	No. Harvested	Piece/ Kg.	Total Prod.	Kg/ Ha/Yr.	Good/Bad Yr. Reason**
1980							
1979							
1978							
1977							
1976							

**For example—typhoon, no fry or input available, etc.

7. a) What is the range of prices you have received for milkfish in 1980?

   i) average ₱______/kg ii) highest ₱______/kg iii) lowest ₱______/kg
   iv) ₱______/piece

   b) To what factors would you attribute such price variations?

   ____

   ____

8. a) Do you time your harvest to coincide with expected higher prices? (Check one)

   Yes __________ No __________
   If no, why not? ______________________________

9. Do you think other species of fish compete with milkfish in the market? (Capture and culture fisheries)

   Yes / No (Circle one). Remarks: ______________________________

   ____

10. Over the last 5 years, can you say that your per hectare yield from your farm: Check one and explain.
    __________ has increased ______________________________
    __________ has stayed the same ______________________________
    __________ has fluctuated ______________________________
    __________ has decreased each year ______________________________

11. a) Since you started milkfish production, what has been your lowest yield?
    __________ kg/ha/year.
    b) Do you consider this yield to be a bad one? Yes / No. (Circle one).
    c) If no, how low? __________ kg/ha/year.

12. Do you have the necessary technical information and skills to produce higher output?
    Yes / No (Circle one)

    a) If yes, why don't you do it? ______________________________

    ____

    ____

    b) If you cannot produce higher output, why not? ______________________________

    ____

    ____

13. What are the restrictions/constraints you face in increasing your income from milkfish production?

    ____

    ____

14. Do you consider the use of larger quantities of inputs to be more risky than no supplemental inputs or your present level of input use?

    a) if yes, why? ______________________________
    b) if no, why not? ______________________________

    ____

15. Do you try to economize on input application, that is, apply less than what you know should be applied to maximize returns? Yes / No (Circle one).
    Explain. ______________________________

    ____

    ____

16. Does the annual recurrence of typhoon and flood influence your decision to use or not to use input?
Yes / No (Circle one). Explain.

____

____

____

17. How much fertilizers did you use in crop year 1980 (Entire farm)?

i) Organic: (Specify)

______________ _____ kg/ha/year ______________ ₱/kg
______________ _____ kg/ha/year ______________ ₱/kg
______________ _____ kg/ha/year ______________ ₱/kg

ii) Inorganic: (Specify)

______________ _____ kg/ha/year ______________ ₱/kg
______________ _____ kg/ha/year ______________ ₱/kg
______________ _____ kg/ha/year ______________ ₱/kg

18. Do you think you are already applying the maximum quantity of each of the inputs?
Yes / No (Circle one)

i) If yes, do you think you are already optimizing your operations?
Yes / No. (Circle one). Remarks: ______________________________
____

ii) If no, why not? ______________________________
____

19. For the extensively managed farm: Would you consider applying inputs such as fertilizers in your farms?
Yes / No (Circle one)

a) If yes, why? ______________________________
____

b) If no, why not? ______________________________
____
____

20. Would the application of inputs such as chicken manure, 16-20-0, urea, etc. affect the taste of the milkfish?
Yes / No (Circle one)

If yes, why? ______________________________
____
____

21. a) As a milkfish producer, is your aim to earn as much as possible?
Yes / No (Circle one).

b) If no, what is your aim? ______________________________
____

c) If yes, how do you work towards attaining such an aim? ______________
____
____
____

22. In any production activity, there are at least two aspects which require a decision from you, the producer.
These are:

a) Whether to maximize profit which in turn requires the use of input, or
b) Whether sufficient capital is available to buy the necessary inputs to maximize profit.

Which of the above two aspects (a) or (b) have the most immediate consideration in your decision making process?

i) if (a), why? ____________________

ii) if (b), why? ____________________

23. Who makes the major decisions regarding your farm operations? ____________________

24. What do you look out for as "signals" or important factors for your production decision?
   a) Price signals and trends
   b) Government subsidies
   c) Risks
   d) Non-pecuniary factors (recreation)
   e) Weather condition
   f) Other (specify) ____________________

25. a) Do you think you will obtain higher output from your fish farm if you devote more time to it?
   Yes / No (Circle one). Remarks: ____________________

   b) If yes, why don't you devote more time? ____________________

26. What percentage of your income in 1980 is from milkfish production?
   a) Milkfish ________ % b) Non-milkfish ________ % (other than fishpond)

27. How many percent of your net income from milkfish production per year are you able to save or set aside for future use? (Note: if possible, ask how much per year).
   ________ % ₱ ____________

28. If you have some extra money from the sale of milkfish or other sources, would you use it to improve your milkfish production operations or to put the money in a bank to earn interest? Check one.
   a) ____________ improve milkfish production operation?
   b) ____________ put into a bank to earn interest
   c) Others (specify) ____________________

29. Would you use your non-milkfish income to pay your milkfish production expenses?
   Yes / No (Circle one). Explain. ____________________

30. How do you regard people who are budget conscious or thrifty? (Check one)
   a) __________ highly b) __________ lowly

31. How do you regard savings?

a) __________ highly desirable b) __________ desirable
c) __________ indifferent d) __________ undesirable

32. Does it pay for you to save?

a) If yes, why? __________

b) If no, why not? __________

33. What do you think of a person in debt? __________

____

34. What are your attitude/feelings toward credit or being in debt?

____

____

35. Would you be willing to borrow money for:

a) production purposes __________
b) consumption purposes __________
c) children education __________
d) Others (specify) __________

36. a) What do you consider as acceptable risks? For example, a 10 or 20 or 30 or 40 or 50 or 60 or 70 or 80 or 90 or 100% collateral requirements as security for a loan (Check one).
b) What sort of minimum guarantee/assurance* do you look before putting your money into an investment such as milkfish production? __________

____

____

* Idea is to get the respondent to discuss risk considerations. For example, how much does he expect to get back from putting ₱1,000 into a production activity?

37. Have your ponds been idle before? Yes / No (Circle one). If yes, why? __________

____

____

38. Do you know of any yield differences in milkfish output in your locality?

a) Yes __________ range __________ b) No __________
c) To what factors would you attribute such yield differences?

____

39. a) How do you compare your pond productivity with that of other ponds in your province? __________

____

____

b) With those in the other provinces (specify the province) __________

____

____

40. a) Would you sell your farm if a more profitable use of the money from the sale is available?
Yes / No (Circle one)
Explain why or why not? __________

____

b) If you are to sell your entire farm, how much would you ask for?
₱ __________

41. What is your normal mode of transportation? (Check one).
    a) own vehicle
    b) public transportation

C. SECTION ON TECHNICAL PARAMETERS

1. How would you describe yourself? (Check one)
   a) Agricultural farmer turned fish farmer
   b) Been in fishfarming ever since
   c) Professional (e.g., attorney, physician, engineer, etc.) turned fishfarmer
   d) Fisherman turned fish farmer
   e) Others (specify) ____________________

2. Do you have any farming background through:
   a) Formal education
   b) Working on a farm/plantation before
   c) Grow up in an agricultural setting
   d) Learning on the job to fend for oneself
   e) Others (specify) ____________________

3. Have you attended any training/seminar course in milkfish culture in the last 5 years?
   Yes / No (Circle one)
   a) Have you applied what you learned from the seminar?
      Yes / No (Circle one)
   b) Did you find it effective/useful?
      Yes / No (Circle one) Remarks: ____________________

4. How and when did you acquire your knowledge on fertilization and pest control?
   a) Fertilization ____________________
   b) Pest control ____________________

5. Over the years (since you engaged in milkfish farming), have you had any change in your production technique? Yes / No (Circle one)
   a) If yes, when? __________ In what way? ____________________
   b) Did the change prove beneficial? Yes / No (Circle one)
      Remarks: ____________________

6. a) Do you think production techniques which give higher yields are always more risky?
      Yes / No (Circle one). Explain. ____________________
   b) As a milkfish producer, what do you think is your greatest risk?
      ____

c) What do you think can be done to reduce such risk? ________________________________
____
____

7. Do you know that experiments conducted in the Philippines have obtained yields of two tons/ha/year or more? Yes / No (Circle one)

8. Why do you think these experiments have been able to get yields of 2 tons/ha/year or more? ____________
____
____

9. Do you know of any milkfish producers in your province or elsewhere who have been able to get 2 tons/ha/year or more? (mention names).
____
____

10. Would you be interested to find out how to get high yields?
Yes / No (Circle one)

11. Who designed your pond layout? (Give names and background) ____________________
____
____

12. Do you think your pond is well designed for milkfish production?
Yes / No / Don't know (Circle one)

13. Would you consider redesigning or deepening your milkfish pond?
Yes / No (Circle one)

14. Have you ever had your pond soils and water analyzed?
a) Yes / No (Circle one). If yes, what were the results? ____________________
____
b) By whom? ____________________________________
c) How much? ₱ __________________________________

15. How often do you change the water in your pond per year? (During production)
____
____

16. How often do you drain and dry your pond in a year? (After harvest) ________________
____
Number of times ____________ Length of time ____________

17. a) What fishfood do you grow?

	Type	Period
_____	Lumut	____________
_____	Lab-lab	____________
_____	Plankton	____________
_____	Others	____________

b) Are you able to grow enough lumut, lab-lab, or plankton in your pond? (Encircle the appropriate item for positive answer).

c) If no, why not? ______________________________
____

18. Stocking rate in 1980

Fry ________________ pcs/ha/year

Fingerlings ________________ pcs/ha/year

Month of Purchase	Fry pcs.	Fingerling pieces	Price/000 pieces	Source Purchased (Name of Place)
a) ________	________	________	________	________
b) ________	________	________	________	________
c) ________	________	________	________	________
d) ________	________	________	________	________
Total Purchase	________	________	________	________

19. How long is your average crop cycle in 1980?

________________ months (from stocking to harvesting)

20. How many croppings did you have in 1980?

____

21. Would you be interested in working on your neighbor's or friend's fishfarm?

Yes / No (Circle one)

22. a) How many times last year (1980) did you discuss your milkfish production operation with your fellow milkfish farmers?

1) being consulted ________________ in 1980.

2) seeking consultation ________________ in 1980.

b) Do you make observations of how other fishfarmers manage their ponds?

Yes / No (Circle one)

23. In obtaining technical information on milkfish production, how do you classify yourself? (Check one)

a) Active information seeker b) Passive information seeker

24. What costs are involved in gathering this information? Itemize each cost (Search costs)

Item	Cost (₱)
________	________
________	________
________	________
________	________

25. How would you consider the government's effort in disseminating information on milkfish production? Explain.

Strong ________________ Weak ________________

____

____

____

D. SECTION ON INSTITUTIONAL PARAMETERS

1. Are you a member of any organization related to fishery?

a) Yes / No (Circle one) If no, go to item(e).

b) Since when ________________

c) Name of organization ______________________________

____

d) What sort of benefits do you derive from the organization? ______________________________

____

e) If no, why not? ______________________________

____

2. Do you know of any aquaculture/fishery extension agents in your area?
Yes / No (Circle one)

a) If yes, have you had consultations with him? Yes _______ No _______
If no, why not? ______________________________

____

b) Do you find the consultations effective/useful? Yes _______ In what aspects? ______________

____

No ________ In what aspects? ______________________________

c) Do you think the number of extension workers in your locality is enough?
Yes / No (Circle one). Explain ______________________________

____

3. Number of visits by aquaculture/fisheries extension agents:

a) In 1980 __________________ number of visits

b) average per year over the last five years ______________________________

4. Describe your past and present experience in dealing with aquaculture/fisheries extension agents when you go to them for consultation (e.g., advice, assistance).

____

5. In your opinion, do you think these aquaculture/fisheries extension agents have a tendency to be selective in their dealing with different groups of milkfish producers, perhaps favoring one group over another? Explain why do you think so.

____

____

____

6. In constructing/improving your pond system, did you obtain any assistance/advice from any government agencies, private companies or even individuals?

a) If yes, from whom? ______________________________

b) Type of assistance ______________________________

7. Do you know of any other government policies/programs in assisting milkfish farmers and give examples:
Yes / No (Circle one)

____

____

____

____

8. Do you own a copy of "Philippine Recommends for Bangus" or any other aquaculture extension publications? (Check one).

a) Philippine Recommends for Bangus ______________________________

b) Others (Specify) ______________________________

____

____

c) What are your sources? ______________________________

d) How often do you acquire them? ______________________________

e) Do you find them useful? Yes / No (Circle one) Remarks: ______________________________

____

9. Do you obtain information on the market conditions of production inputs?

a) Yes ____________

i) on prices ____________ ii) on location where inputs can be purchased ____________

b) If no, why not? ______________________________

____

10. Do you have difficulty in buying inputs?

a) Seeds (fry and fingerlings) — Yes / No (Circle one)

b) Fertilizers — Yes / No (Circle one)

c) Pesticides — Yes / No (Circle one)

11. Number of loans applied and approved for milkfish production in 1980:

a) Number applied for __________ Number approved ______________________________

b) Value and source of each loan (list if more than 1)

Value	Purpose of Loan	Source	Loan Period	Interest Rate
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______

c) How long did it take for the loan to be released? (months from time of filing)

____

d) What problems did you encounter in obtaining loans? ______________________________

____

____

12. How would you describe your previous experience in loan application? Explain.

Good ______________________________

Bad ______________________________

13. What costs are involved in obtaining a loan from a bank? Itemize each cost.

Item	Costs (₱)
______	______
______	______
______	______
______	______

14. For your future production operations, do you need to borrow?
Yes / No / Not Sure

15. Do you borrow from non-institutional sources (family, input suppliers, milkfish buyers, etc.)

E. SECTION ON PHYSICAL PARAMETERS

1. Costs of round trip and distance of farm to:
   a) Input market

		(Round Trip)	(One Way Distance)	
i) Fry	P	________	________	km.
ii) Fingerlings		________	________	
iii) Organic Fertilizers		________	________	
iv) Inorganic Fertilizers		________	________	
v) Pesticides		________	________	
vi) Others (specify)		________	________	
b) Milkfish market	P	________	________	km.
c) House		________	________	
d) BADTC		________	________	
e) Bank (he deals with)		________	________	
f) BFAR Office		________	________	
g) Fisheries School		________	________	

2. How far is your milkfish farm from the main source of water? ________________ km.

3. a) When do you first use fertilizers/pesticides to produce milkfish? (Specify)
   i) Organic fertilizers ________________
   ii) Inorganic fertilizers ________________
   iii) Pesticides ________________
   b) Do you believe that the use of fertilizers, pesticides and supplemental feeds enhances pond yield?
   Yes / No (Circle one). Remarks:
   ____
   ____
   c) How much did your milkfish output differ from applying inputs and not applying inputs?
   ____________ kg.

4. Are your milkfish ponds used for other purposes such as salt making or lumut cultivation during some period of the year when no milkfish is being produced?
   a) If yes, type of activity: ________________
   ____
   b) Why do you suspend milkfish production? ________________
   ____

5. Have you encountered any losses/damages to the fishpond over the last five years?
   Yes / No (Circle one)

   Specify: Theft ____________
   Typhoon ____________
   Others (specify) ____________
   ____

6. Do you know the following milkfish husbandry concepts/ideas? Are you practising them and since when? (Place check marks and year).

Milkfish Production Concepts	Familiar	Practising	Since When	Rating
i. Acclimatization				
ii. Stock Manipulation				
iii. Draining and refreshening				
iv. Soil Analysis				
v. Pest and predator control				
vi. Fertilization				
vii. Supplemental feeding				
viii. Pond Design				

7. From your point of view, what production practices would you recommend to improve your milkfish yield?

8. Next to brackishwater fish culture, what other uses can these brackishwater land be put to?

9. Fill in the observed values of:

a) Salinity ______________ b) pH ______________

10. Request respondent to sketch in the lay-out of his farm showing water source, canals, main and secondary gates, embankments, nursery, transition and rearing ponds.

Would you be interested in group farming, i.e., where your farm will be combined with other farms to form a much larger farm without changing your present ownership status to grow milkfish?

Yes / No (Circle one).