Socioeconomic Factors that Influence the Adoption of Small-Scale Rural Fish Farming at Household Level in Zimbabwe

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Introduction

Fish farming for the rural sector in Zimbabwe has received increased attention since independence in 1980, as part of ongoing Integrated Rural Development programs. The targeted households are in rural communities that need to enhance their food security. However, to adopt fish farming as a new venture, such households would have to reallocate their time, labor and other resources and to integrate fish farming with their traditional activities (crop farming, market gardening, etc.) without threatening these.

In Zimbabwe, two projects aimed at promoting rural aquaculture development have been going on during the last five years: part of the regional project, "Aquaculture for Local Community Development" (ALCOM) executed by FAO, with funding from Belgium and Sweden, which seeks to develop and to test appropriate methods for integrated rural aquaculture development; and a UNDP/FAO project, "Support for Rural Aquaculture Extension" which seeks to rehabilitate infrastructure for rural aquaculture development. Both projects have investigated the socioeconomic aspects of small-scale rural fish farming.

This complementary study was conducted to investigate the socioeconomics of rural aquaculture development at sites representing different national agroecological regions: Mutasa district in Manicaland province, representing Regions I and II, and Chivhu district in Midlands province representing Region III (Fig. 1). There are six agroecological regions in Zimbabwe based on rainfall and soil parameters (Balarin 1984). These regions range from Natural Agricultural Region I, mainly covering the Eastern Highlands, to Natural Agricultural Region VI in the Zambezi valley. The intensity and type of agricultural activities vary from one region to another, with a distinctive pattern in crops cultivated as one moves from Region I to Region VI. In Regions I and II (Mutasa district) and Region III (Chivhu district) where the fieldwork on which this study was based, agriculture is comprised of tea and coffee cultivation; cotton and cereal crop production; and sunflower, cotton and heat-resistant grain crops like millet and sorghum, respectively (Table 1).

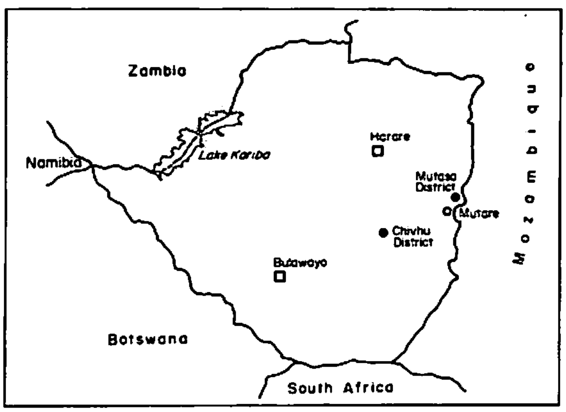

Fig. 1. *Map of Zimbabwe showing the survey regions.*

The objective of this study was to compare the socioeconomic profile of fish and nonfish farming households in three different agroecological regions in Zimbabwe and investigate how these factors might influence the adoption of fish farming.

Methodology

In Mutasa and Chivhu districts, composed of 12 and 7 wards (third level of administrative area after province and district levels, made up of a few villages) respectively, household social units were quasi-randomly selected: based on set criteria followed by random selection. The sample constituted 30-50% of the total ward administrative units in the study area. Within the wards, the number and spatial distribution of villages were considered and an effort was made to get household units consisting of 60% fish farmers and 40% nonfish farmers from a

Table 1. Summary characteristics of agroecological regions in Zimbabwe.

Region	Characteristics
I	>1,000 mm rainfall; high altitude areas prone to erosion hence not extensively cultivated but suited for diverse farming activities (cattle, plantations and orchards). Mainly in the Eastern Highlands with crops including timber, tea, coffee, fruit, vegetables, some dairy and sheep.
II	750-1,000 mm rainfall; mainly along the central plateau with good soils and little drought threat; intensive farming systems concentrating on maize, forming the "maize belt"; also intensive beef, dairy, mutton and piggery; tobacco and cotton important commercial crops.
III	650-800 mm rainfall; mostly to the southeast of the country; marginal for intensive cropping but more suited to semi-intensive livestock ranching. Crops include tobacco, maize, millet, cotton and groundnuts.
IV	450-650 mm rainfall; has natural timber forests; characterized by seasonal droughts, thus, unsuitable for intensive crop production without irrigation. Best suited for extensive beef ranching.
V	<500 mm rainfall; very dry area suited only to extensive cattle ranching.
VI	Extremely lowveld and Zambezi valley areas; has poor soil and steep slopes hence unsuitable for agriculture. Main location for game reserves.

variety of villages in each ward. Where the number of fish farmers exceeded 60%, standard stratification of households for interview was done on the basis of one or a combination of the following criteria: gender of fish farmer, fish farming history, scale of operation in terms of number of ponds and total pond area, and socio-economic background. These characteristics were decided from secondary information on a fish farmer census conducted by the Government Department of Agricultural Technical and Extension Services in Zimbabwe as well as locally based extension worker advice.

Household characteristics investigated included household size and age distribution, primary occupation and sources of income, education and literacy levels, and gender of household heads. Farm size and land use were also included in the analysis. Comparisons were made for each variable between fish and nonfish farm households in each of the natural regions covered under the target survey area.

Once household units were selected, trained enumerators asked household heads or other household members specific questions in a face-to-face situation using a structured verbatim questionnaire (Sen 1990a, 1990b). Coded answers, determined by pretesting the questionnaires, were used for 90% of the questions (Moser and Kalton 1971; Peil et al. 1980; Chambers 1985). After the interviews, completed questionnaires were checked and answer codes were verified or altered for standardization. The Mann-Whitney and Kruskal-Wallis tests for nonparametric methods were used for ANOVA on all the ordinal data using the SPSS/PC+ statistical package. Categorical data were analyzed using cross tabulations to calculate the χ^2 statistic. All statistical analyses were done at significance level $P<0.05$ (Zar 1984; Siegel and Castellan 1988).

Results and Discussion

Household Size

No significant differences were apparent for household size between fish farming households (FFH) and nonfish farming households (NFFH) in Regions I and II (Table 2). This situation contradicts the logic that households with more members would tend to take up fish farming because they would have access to more domestic labor. However, most households in this area learned about fish farming while at work on commercial farms elsewhere. Thus, they acquired basic expertise and understanding, and could easily venture into the activity regardless of domestic labor constraints. Region III, on the other hand, showed significant differences in household size for FFH and NFFH, with the former having more members, hence more labor, and a clear need for self-employment.

Table 2. Size and age distribution of fish farming households (FFH) and nonfish farming households (NFFH) in the survey regions.*

	Average household size	Age category (years)
Region I		≤17[a]
FFH (n=20)	7.9[a]	18-59[a]
NFFH (n=11)	7.6[a]	≥60[a]
Region II		≤17[a]
FFH (n=56)	6.6[a]	18-59[a]
NFFH (n=40)	5.8[a]	≥60[a]
Region III		≤17[a]
FFH (n=44)	7.2[a]	18-59[b]
NFFH (n=38)	5.5[b]	≥60[a]

*Value with the same superscript letters are not statistically significant ($P>0.05$).

Age Distribution

Household age distribution which also has an important influence on labor and dependency status was not significantly different in Regions I and II (Table 2). Region III, however, showed significant differences for the economically active category of 18-59 years, with FFH having more members than NFFH. This could suggest that fish farming was adopted because availability of labor was envisaged. Such labor could either be direct, where the household members take up fish farming as a form of self-employment, or indirect where members are engaged in other remunerative activities that enable them to finance hired labor for fish farming.

Education Levels and Literacy

Contrary to the expectation of having more educated and literate FFH members than NFFH members, no significant differences in most categories of these parameters existed in the regions studied (Table 3). The only exception was the significant difference in Regions II and III for the secondary education level and literacy level of reading and writing Shona and English. Here FFH in each case had more members that their NFFH counterparts. Such a relationship showed that the secondary level of education was the most common among the respondent households, and also the average required to be able to read and write Shona and English. Other categories of education and literacy were not common so no significant differences were apparent among the few respondents studied. It can therefore be suggested that better educated households are less conservative and more tolerant to innovation, and hence tend to adopt fish farming more than less educated and illiterate community members. This is in agreement with Shang's observations (1990) in Southeast Asia that less educated fish farmers were reluctant to adopt new fish culture technology.

Primary Occupation and Sources of Income

Respondent households depended on a variety of economic activities as occupation and sources of income. Since this was mainly dependent on the ecological nature of the region, these parameters were ranked by region. The three important occupations and sources of income were crop farming, horticulture and livestock rearing, respectively (Table 4). Only few respondents had fish farming as a main economic activity which was indicative of the novelty of this activity in rural communities. Horticulture decreased

Table 3. Kruskal-Wallis one-way ANOVA of education and literacy levels for fish farming households and nonfish farming households in the survey regions.

Education level	Region I n=31 Education	Region I n=31 Literacy	Region II n=96 Education	Region II n=96 Literacy	Region III n=82 Education	Region III n=82 Literacy	Literacy category
Primary	*	*	*	**	*	**	read and write Shona and English
Secondary	*	*	**	*	**	*	read and write Shona only
High School	*	*	*	*	*	*	read and write Ndebele only
Tertiary	*	*	*	*	*	*	read and write Shona and Ndebele
Never attended	*	*	**	*	*	*	neither read nor write

* Insignificant at P<0.05; **significant at P<0.05.

in importance as one moved from Regions I to III, a pattern attributable to the decrease in rainfall amount and reliability.

Overall, the activities engaged in by the respondent households can be regarded as compatible with fish farming given its reliance on on-farm crop, vegetable and other residues. Thus, the scope for introducing integrated fish farming is very positive in these regions with crop-fish culture, poultry-fish culture and pig-fish culture being some of the obvious options for integration.

Table 4. Percentage distribution of primary occupation[a] and sources of income of households across regions.

Occupation	Region I n=31	Region II n=96	Region III n=82	% of total n=209
Crop farmer	42	71	80	70.3
Livestock farmer	13	12	4	8.6
Horticulture farmer	13	10	6	9.1
Fish farmer	6	1	1	1.9
Salaried job	10	1	5	3.8
Other activities	16	5	4	6.2

[a]An activity where the household derives >80% of its livelihood.

Land Size and Use

The size of land available per household varied between the different regions, and the allocation of land for different uses was investigated for FFH and NFFH. Land use classification fell under four major categories: crop farming, horticulture, residence and other uses (growing cash crop, fish farming, etc.) (Table 5).

In Region I, land under crop farming generally averaged three acres while that for horticulture, residence and other uses averaged one acre (Table 5). More FFH had land allocated for horticulture, while NFFH had more land for cash crop farming (coffee and tea cultivation). Region II had a similar trend, with crop farming with the largest share of total household land (1-6 acres) while horticulture and other uses with very small plots (<1 acre), and no differences existed according to fish farming status. Region III had more land devoted to crop farming, but with more FFH (37%) having plots >6 acres as compared to only 10% of the NFFH with similar-sized plots. Moreover, land devoted for other uses was greater for FFH than NFFH (25% and 5%, respectively), a situation attributable to the larger number of fish farmers with civic status which made it easy for them to acquire land use rights.

Land is of paramount importance in rural communities. Observed variations of land allocation to different uses by each household mean that interests and investments differ between and within households as productive and consumption units. Horticulture and other uses were allocated the smallest plots of land, mainly because these activities need location close to rivers or wetland areas (*dambos*, etc.) which were limited in the regions studied.

Balarin (1984) observed that only 25% of the total land area in Zimbabwe is suited for fish culture, 20% of which suits the culture of tilapias. This reflects a fairly restricted area for fish farming, but these *vlei* (marsh), *dambos* (wetlands) and streambank sites have low or virtually zero opportunity costs since they cannot be used for conventional farming (Shepherd 1974; Grover et al. 1981).

Gender of Household Head

The gender of the household head has important implications for access to land and water resources. Inheritance patterns followed in the three survey regions were patrilineal, meaning that females could not claim inheritance to land when their spouses passed away. This gave only limited access to land and other productive resources to women (Woodford-Berger 1987). This social constraint may explain why there is only a small number of female-headed households farming fish.

Regions I and III had more male-headed households than female-headed households, with Region III having proportionately more *de facto* heads than *de jure* ones. Out of the 57% of the household survey sample consisting of female household heads in Region II, 41% were *de facto*. However, the general trend in all regions showed the typical traditional dominance of male household heads (Table 6).

Other Factors

Apart from the socioeconomic factors investigated by this study, several others are important determinants of the adoption of aquaculture in rural areas in Zimbabwe.

Availability of credit for start up capital is essential in rural communities where

Table 5. Land use for different economic activities of fish farming (FFH) and nonfish farming households (NFFH) in the survey regions.

Different uses	Region I FFH	Region I NFFH	Region I % of total	Region II FFH	Region II NFFH	Region II % of total	Region III FFH	Region III NFFH	Region III % of total
Crop Area									
<1 acre	1	0	3	0	0	-	0	4	5
1-3 acres	9	4	42	24	18	44	12	19	38
4-6 acres	5	3	26	24	18	44	14	13	33
≥6 acres	5	4	29	8	4	12	16	4	24
Gardening									
<1 acre	16	8	77	32	32	67	29	33	76
1-3 acres	4	2	19	21	8	30	11	5	20
4-6 acres	0	0	-	1	0	1	2	0	2
>6 acres	0	0	-	1	0	1	0	0	-
No land	0	1	3	1	0	1	0	2	2
Residence									
<1 acre	14	8	71	46	38	88	12	19	38
1-3 acres	6	3	29	10	2	12	27	21	58
4-6 acres	0	0	-	0	0	-	2	0	2
>6 acres	0	0	-	0	0	-	1	0	1
Other uses									
<1 acre	9	0	29	12	5	18	8	2	12
1-3 acres	4	2	19	12	7	20	3	0	4
4-6 acres	0	1	3	4	0	4	0	0	-
>6 acres	0	1	3	0	0	-	0	0	-
No land	7	7	45	28	28	58	31	38	84

Table 6. Gender of household heads in the survey areas as percentages.

Region	Male-headed households	*De jure*[a] female-headed households	*De facto*[b] female-headed households
I (n=31)	87	0	13
II (n=96)	43	16	41
III (n=82)	66	12	22
Total (n=209)	58	12	30

[a] Households where the head is either not married, divorced or widowed, or some case of polygamously married wives (Woodford-Berger 1987).
[b] Households resulting from male migration and desertion (Sen et al. 1991).

economies are small and in most cases of limited capacity to finance additional economic activities. Existing financial institutions do not consider aquaculture as an important sector, and also as a result of its novelty, they do not know the risks associated with such enterprises. Linked to this factor is the issue of marketing. Most rural farmers are already producing surplus crop products for sale, and it is only logical for them to expect to be able to do the same with fish products. The existence of a ready prime market is therefore an important incentive for fish farming.

Additional factors that influence adoption of fish farming in rural communities include the availability of aquaculture extension services, sources of fish fingerlings, broodstock and affordable fish feed.

Conclusion

The household socioeconomic conditions and the extent to which they influence the adoption of fish farming are varied in the three agroecological zones studied. It therefore emphasizes the need to investigate these aspects as part of baseline studies whenever a fish farming development project is planned. While not many significant differences were noted among FFH and NFFH for the factors studied, the study certainly confirm the need for education and literacy in order for fish farming to be accepted. Information on household size, age distribution, education and literacy levels, gender of household head, primary occupations and sources of income, furnished by this study give an insight on what may be the important factors to be considered whenever fish farming projects in rural areas are proposed.

While this study identifies some of the direct socioeconomic factors that should be considered when developing aquaculture in rural areas, the interactions among these factors and agroecological regions need further investigation. It may be worthwhile finding out how the individual factors interact in influencing the adoption of fish farming, and to also rank the factors in order of importance. The latter may vary from one region to the other.

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References

Balarin, J.D. 1984. National reviews for aquaculture development in Africa. 1. Zimbabwe. FAO Fish. Circ. 770.1, 69 p.

Chambers, R. 1985. Shortcut methods of gathering social information for rural development projects, p. 397-415. *In* M.M. Cernea (ed.) Putting people first: sociological variables in rural development. World Bank Publication, Oxford.

Grover, J.H., D.R. Street and P.D. Starr. 1981. Review of aquaculture development activities in Central and West Africa. Research and Development Series No. 28, Auburn University, Alabama.

Moser, C.A. and G. Kalton. 1971. Survey methods in social investigations. 2nd edition. Heinemann Educational Books Ltd., London.

Peil, M., P.K. Mitchell and D. Rimmer. 1980. Social

science research methods: an African handbook.
Sen, S. 1990a. Fishing activities and fish consumption around small reservoirs in Lesotho and Botswana. ALCOM Series, GCP/INT/436/ SWE 12, FAO.
Sen, S. 1990b. Utilization of small water bodies, Lesotho: socioeconomic survey on demand for fresh fish in communities around small waterbodies. ALCOM Series, GCP/INT/436/SWE 11, FAO.
Sen, S., E. Seki and J. van der Mheen-Sluijer. 1991. Gender issues in fisheries and aquaculture: including proceedings of the workshop on enhanced women's participation in fisheries development. ALCOM Report. Harare, Zimbabwe.
Shang, Y.C. 1990. Socioeconomic constraints of aquaculture in Asia. World Aquaculture 21(1). 4 p.
Shepherd, C.J. 1974. The economics of aquaculture - a review. Oceanogr. Mar. Biol. Ann. Rev. 13:413-420.
Siegel, S. and N.J. Castellan, Jr. 1988. Non-parametric statistics for the behavioural sciences, 2nd Edition. McGraw-Hill Statistic Series, New York.
Woodford-Berger, P. 1987. Gender, rural development, and aquaculture in Southern Africa: factors influencing the representational involvement of women. University of Stockholm, Sweden.
Zar, J.H. 1984. Biostatistical analysis. 2nd edition. Prentice Hall, New York. 718 p.

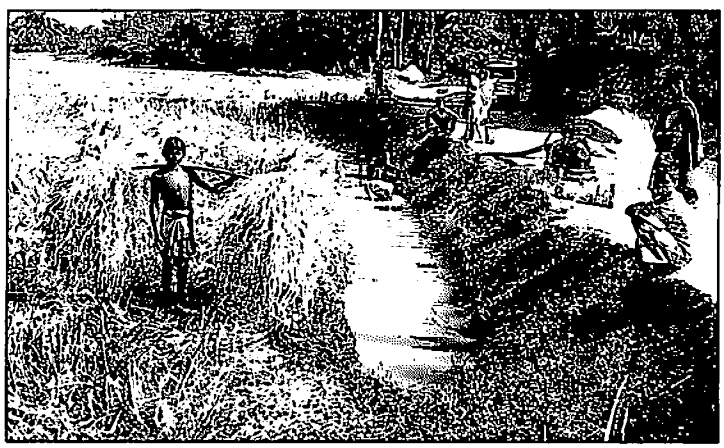
NEWS ITEMS

Harvesting Operations: Deepwater Rice-Fish Culture Experiment

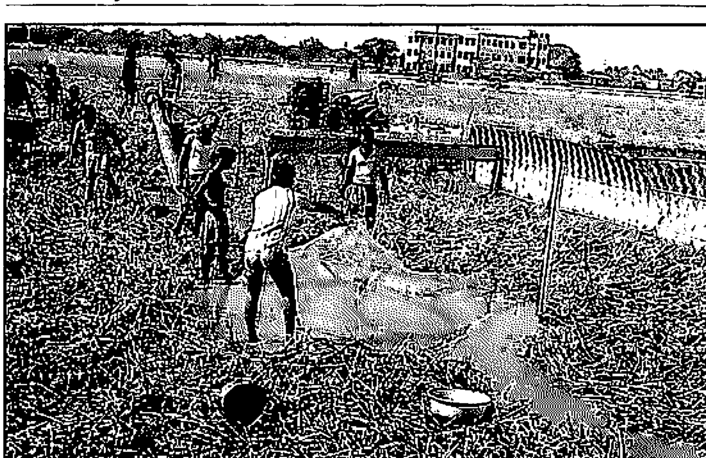
THE ACCOMPANYING PHOTOS (by D.N. Das and B. Roy) depict different experimental plots in an International Rice Research Institute-Indian Council of Agricultural Research collaborative deepwater rice project, funded by the Asian Development Bank in West Bengal (India) during early December, 1989. On-farm experiments comprised control plots (deepwater rice only), treatment I (deepwater rice + fish, without supplementary feed) and treatment II (deepwater rice + fish, with supplementary feed). The supplementary feed was rice bran and mustard oil cake (1:1), given at 5% of the body weight of the fish biomass, periodically adjusted. Each plot had the area of 1,333 m^2 and was provided (1-m deep x 1-m wide) on two sides with lateral trenches as fish refuges.

The species combination used was designed to comprise 15% surface feeders, 35% column feeders and 50% bottom feeders. This was achieved by using eight species. Fingerlings (10-12 cm) were stocked at a total of 10,000/ha: The actual numbers of fish stocked are given in Table 1. The rice variety used was an improved cultivar 'sabita' (NC492) developed at the Rice Research Station, Chinsurah, West Bengal for a lowland/deepwater ecosystem.

The first photo shows the harvesting of rice from an on-farm deepwater rice-fish plot, to which no supplementary fish feed has been added at the village of Buniadpur, West Dinajpur, West Bengal. The field was dewatered so that the fish became concentrated in the trenches, while the farmer harvested rice for further processing. The harvest from treatment I (rice + fish, no feed) comprised 3.1 t/ha of rice and 730 kg/ha fish after 180 days.



Harvesting rice from a farmer-cooperator's field at Buniadpur, West Dinajpur, West Bengal, India. Note the trench in this deepwater rice-fish system.



Harvesting fish from an experimental deepwater rice-fish plot at the Rice Research Station, Chinsurah, West Bengal, India. The harvesting is done by cast net from the central catch basin after harvesting the rice and draining the plot.

The second photo shows the harvesting of fish by cast net after harvesting rice and dewatering, from an experimental plot (250 m^2) with a 3 x 3 x 1 m central sump as a fish refuge at the Rice Research Station, Chinsurah, West Bengal, again rice + fish feed, without supplementary feed. The experimental treatments (rice variety and fish species, stocking density, % composition, etc.) were the same as for on-farm plots. On-station replicates were made by partitioning a large diked field into three, with tight and compactly woven bamboo mat barriers between neighboring plots, instead of earthen dikes. This treatment I plot on-station yielded 3.4 t/ha of rice and 780 kg/ha of fish after 180 days. All the summary production data for controls and all treatments (I and II) at both sites are given in Table 1.

Deepwater ricelands are defined as those areas where the rice ecosystem is usually flooded to a depth that exceeds 50 cm for one month or longer