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**AQUACULTURE SYSTEMS
RESEARCH IN AFRICA**

PROCEEDINGS OF A WORKSHOP HELD IN
BOUAKE, CÔTE D'IVOIRE,
14-17 NOVEMBER 1988

**RECHERCHES SUR LES
SYSTÈMES AQUACOLES
EN AFRIQUE**

COMPTE RENDU D'UN ATELIER TENU À
BOUAKÉ, CÔTE D'IVOIRE,
DU 14 AU 17 NOVEMBRE 1988

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Aquaculture systems research in Africa

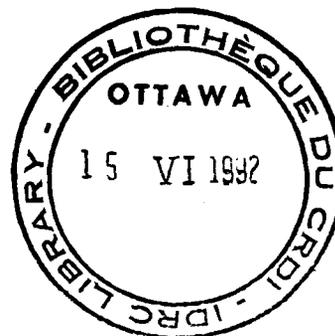
Proceedings of a workshop
held in Bouake, Côte d'Ivoire,
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Recherches sur les systèmes aquacoles en Afrique

Compte rendu d'un atelier tenu à
Bouaké, Côte d'Ivoire, du
14 au 17 novembre 1988

Editors/Rédacteurs

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**LARGE-SCALE RECONNAISSANCE SURVEY OF SOCIOECONOMIC CONDITIONS
OF FISH FARMERS AND AQUACULTURE PRACTICES IN THE WEST
AND NORTH WEST PROVINCES OF CAMEROON**

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Abstract A total of 959 farmers - 903 males and 56 females - were identified in the West and North West provinces of Cameroon through a large-scale reconnaissance survey undertaken in the area in 1987. The average age of the farmers was 48 years, with a large concentration between the ages of 36 and 55 years. The population had an average of 15 years experience in aquaculture. All of the female farmers and 96% of the male farmers were married; 48% of the marriages were monogamous. The average number of children per farmer was six and the average household size was 12. Of the farmers surveyed, 70% were Christians, 20% were Moslems, and the rest practiced traditional religions or no identifiable religion. The social life-style of the farmers indicated a strong attachment to the extended family and a high affinity to fish farmers' associations.

About 70% of the farmers had no formal education or training in trades. The lack of such training limited the farmers' occupational mobility, imposing on them predominantly traditional agro-pastoral activities of which fish culture - an introduced activity - was a small component.

The farmers owned 1269 ponds, or 1.3 ponds per farmer. The majority (75%) were diversion ponds and the average pond size was 307 m². About 95% of the producers were owners/operators. The main species cultured were *Tilapia* spp., *Cyprinus carpio*, and *Clarias gariepinus* in monocultures or polycultures. Eight farmers practiced integrated livestock-fish culture. Aquaculture stations were the main sources of fingerlings.

The existing pond technology indicated, among other things, that present production methods underutilize existing ponds - there

is an apparent apathy on the part of a sizeable segment of the population toward aquaculture - and that farmers' access to technical knowledge and management skills is not very satisfactory and farmers are facing problems regarding the availability of credit and seeds, as well as land and water rights.

The average gross annual income of the farmers was 490 000 FCFA, derived from crop production (280 000 FCFA), animal production (180 000 FCFA), and fish farming (30 000 FCFA). The low contribution of aquaculture to the gross annual income was attributed to the small size of the ponds, low average yields of 1138 kg/ha per year, and family consumption of 48% of production.

Policy implications are noted, and suggestions to increase and improve aquaculture production are provided.

Résumé Nous avons recensé 959 agriculteurs, 903 hommes et 56 femmes, dans les provinces de l'Ouest et du Nord-Ouest du Cameroun au cours d'une vaste enquête réalisée dans ces régions en 1987. Ces agriculteurs, âgés en moyenne de 48 ans, sont surtout concentrés dans le groupe d'âge des 36 à 55 ans. Ils justifient d'une expérience de 15 ans en aquaculture. Toutes les femmes et 96 % des hommes sont mariés et 48 % des mariages sont monogames. Le nombre moyen d'enfants par agriculteur est de six, et la taille moyenne des familles est de 12 personnes. La proportion des chrétiens atteint 70 %, celle des musulmans est de 20 %, les autres pratiquant des religions traditionnelles ou ne pratiquant aucune religion identifiée. Le style de vie des agriculteurs laisse deviner leur grand attachement à la famille étendue et aux associations de pisciculteurs.

Environ 70 % des agriculteurs recensés n'ont reçu aucun enseignement ni aucune formation professionnelle. Ce manque de formation limite leur mobilité professionnelle et leurs coûts de renonciation, les astreignant à des activités agro-pastorales traditionnelles parmi lesquelles la pisciculture, une activité introduite, n'occupe pas une grande place.

Les agriculteurs possèdent 1 269 étangs, soit 1,3 étang par personne. La majorité de ces étangs (75 %) sont des étangs de dérivation et leur superficie moyenne est de 307 m². Quatre-vingt-quinze pour cent des producteurs sont propriétaires des étangs qu'ils exploitent. Les principales espèces produites sont des tilapias, Cyprinus carpio et Clarias gariepinus, produits en mono ou en polyculture. Huit des agriculteurs ont intégré l'élevage du bétail et la pisciculture. Les stations d'aquaculture sont la principale source d'alevins.

La technologie actuelle de l'élevage en étang porte notamment à conclure ce qui suit : les méthodes actuelles de production n'utilisent pas les étangs existants à leur plein potentiel; on observe une certaine apathie de la part d'une importante portion de

la population à l'égard de l'aquaculture; les agriculteurs manquent de connaissances techniques et de méthodes de gestion et ils éprouvent par ailleurs des difficultés à obtenir les crédits et les produits d'ensemencement nécessaires ainsi que les droits d'utilisation des terres et de l'eau.

Le revenu brut annuel moyen des agriculteurs s'établit à 490 000 F CFA, et provient de la production végétale (280 000 F CFA), de l'élevage (180 000 F CFA) et de la pisciculture (30 000 F CFA). Le rôle mineur joué par l'aquaculture est attribuable à la petite superficie des étangs, aux faibles rendements moyens (1 138 kg/ha par année) et à la consommation par les membres de la famille qui atteint 48 % de la production totale.

Nous examinons la signification des résultats obtenus sur le plan politique et nous formulons des suggestions visant à accroître et à améliorer la production en aquaculture.

Introduction and purpose of the study

The aquaculture industry in Cameroon is essentially rural and its objectives are to increase fish supplies and provide supplementary and/or alternative employment, income, and nutrition to subsistence farmers. The Cameroonian government and international agencies have designed and implemented assistance programs to accelerate aquaculture development. However, many of the programs have shown a limited ability to reach the small-scale farmer and the potential of aquaculture to improve rural nutritional and income standards has only been slightly realized. This assertion is evidenced by the slow growth of aquaculture in the country, some 40 years after it was introduced, and by the fact that the sector's contribution to national fishery production is insignificant - about 300 t out of about 100 000 t (Mezainis and Satia 1975; SOGREAH 1982; Anonymous 1987a; FAO 1988).

The prevailing situation is unfortunate for the following reasons in particular:

- ° the country has considerable potential for aquaculture development (Satia 1980; SOGREAH 1982; Balarin 1985)
- ° fish supplies from natural sources, particularly the marine sector, are leveling off or even declining as limits to stock exploitation are reached, whereas the demand for fish continues to rise under the pressure of increasing population, urbanization, and income growth (MINEP/SEDA 1981; SATEC 1982; Anonymous 1987a; MINPAT 1987)

It is hypothesized that inadequate information/knowledge regarding the sociodemographic and socioeconomic conditions of the small-scale farmer - the target group for past assistance programs - is one of the reasons for the low adoption and utilization of

aquaculture technologies (Anonymous 1987b; Nash et al. 1987). The present study was undertaken to provide such information in the hope that it would be useful for planning and formulating future programs. Furthermore, the study was undertaken on the premise that an analysis of existing aquaculture systems and practices might facilitate understanding the technical and socioeconomic environments under which producers operate and into which improved technologies could be introduced. In particular, the study was undertaken to provide baseline information for an on-station and on-farm integrated aquaculture research and extension project, financed by the International Development Research Centre (IDRC) of Canada, in two provinces of Cameroon.

Study area

This study was limited to two of the 10 provinces of the country, namely the West and North West provinces, a densely populated and very important agricultural region (MINPAT 1987) (Fig. 1). Twenty-four percent of Cameroon's population - approximately 10 million - live in these two provinces, the surface area of which makes up only 18% of the total land area - approximately 475 000 km². Administratively, the West province has six divisions, namely Nde (72 644 inhabitants), Haut Nkam (111 719), Menoua (215 218), Bamboutos (165 825), Mifi (259 049), and Noun (211 142). The provincial capital, Bafoussam, is in the Mifi division. Although English and French are the country's official languages, the province is essentially Francophone. The North West province, which is basically Anglophone, has five divisions, namely Mezam (319 504 inhabitants), Momo (126 315), Mentchum (198 452), Donga-Mantung (184 516), and Bui (151 744). The provincial capital, Bamenda, is in the Mezam division (MINEP 1976).

On the basis of temperature, the West, North West, and Adamaoua provinces constitute the "temperate aquaculture zone" of Cameroon. The water temperature is about 18°C, as opposed to 20-25°C in the "mild aquaculture zone" of the Centre, East, South, and parts of the Littoral and South West provinces, or the greater than 25°C temperatures found in the "hot aquaculture zone" of the North and parts of the Littoral and South West provinces. Five aquaculture stations, five breeding centres, an aquaculture research station, and the only fisheries school in the country are located within the study area.

Agricultural production is centred on hand cultivation of a variety of food crops (corn, rice, cocoyams, potatoes, soybeans, vegetables, etc.) and on cash crops (mainly coffee and tobacco). Primary agricultural by-products are available and justify the presence of two functional animal feed mills in the region. In addition to two rural development specialization schools for cooperative and community development training, the region is endowed with a university centre at Dschang, which is responsible for training senior staff in plant and animal production. The region also has three agricultural schools (Bambui, Bafang, and

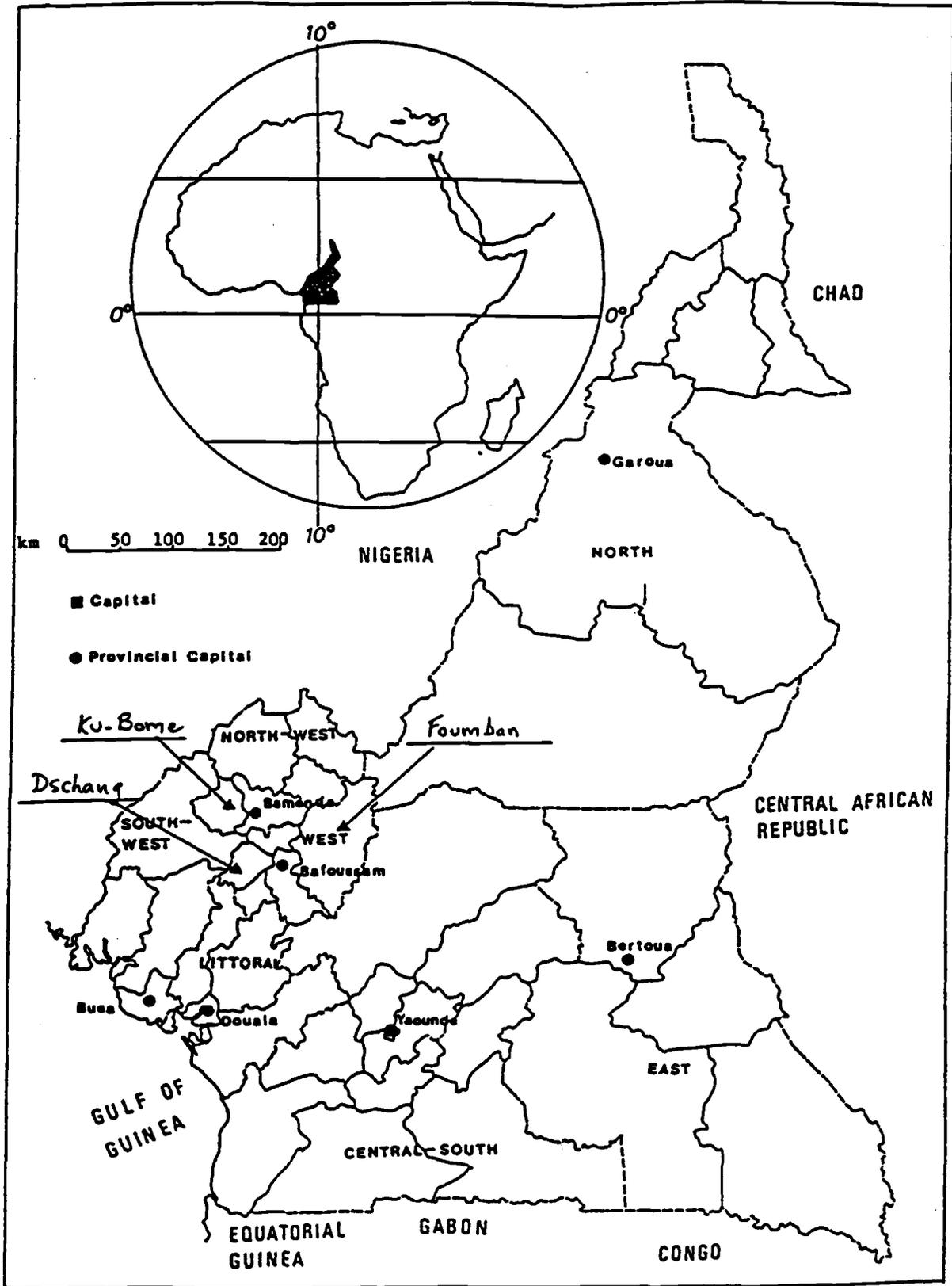


Fig. 1. Location and administrative map.

Nkambe) for training mid-level and low-level staff, and a network of agricultural research centres and stations located in the area. In addition, there are at least four parastatals, North West Development Authority (MIDENO), Wum Area Development Authority (WADA), Upper Noun Valley Development Authority (UNVDA), and the Rice Development Project of the Mbo Plains in Santchou (SODERIM), involved in agricultural development and extension in the region.

Animal production in the region is based on cattle and small livestock, including pigs, poultry, rabbits, sheep, and goats, which benefit from the presence of animal research centres and stations at Mankon, Bambui, and Bangangte; veterinary pharmacies at Bafoussam and Bamenda; and two livestock stations at Kounden and Bali, as well as several veterinary clinics and zootechnical centres. Furthermore, one of the two veterinary and zootechnical schools for training mid-level personnel in these disciplines is located in the study area at Jakiri, in the North West province.

Methodology

In this study, a fish farmer is defined as "one who owns one or more facilities for cultivating fish for human consumption." Data for the study were obtained through recall questionnaires, personal interviews, and record-keeping forms (Satia 1987) for all identified fish farmers in the study area. The questionnaire, with identical French and English versions, was designed so that

- ° information could be gathered on one or a series of production facilities (all of which are earth ponds) owned by a single farmer or a group of farmers
- ° information gathered could be analyzed using the micro version of the SPSS statistical package

The questionnaire contained 82 items made up of Likert-type items, open-form and closed-form questions, and classification-type questions, as well as space for additional comments by respondents and enumerators for purposes of catharsis. The questionnaire was field tested through a pilot study involving six aquaculture extension agents (enumerators) and six farmers in the study area - three farmers and three enumerators per province.

To ensure adequate coverage of the study area, farmers and administrative, political, and traditional authorities were sensitized through meetings, posters, radio, and individual contacts. This sensitization period lasted 6 months - 3 months before the field operation and throughout the data collection period. Furthermore, two separate 2-day workshops were held at the provincial headquarters - Bafoussam, for Francophones, and Bamenda, for Anglophones, at which 44 enumerators (aquaculture extension agents) and nine supervisors participated. During the workshops, the purpose of the survey was explained and techniques for

interviewing and data collection were discussed. The questionnaire was also studied in detail and possible ambiguities were explained. Each enumerator and supervisor was given a set of questionnaires, fuel, and writing materials.

The field operation (data collection) was conducted between July and September 1987, mostly through a single interview between an enumerator and a farmer at a time convenient for the farmer. There was no time limit set for the interview. In some cases, however, the interview was conducted over two visits. The supervisors and the authors oversaw the work of the enumerators, providing guidance where necessary.

In total, 959 questionnaires were returned, which were processed by a group of 24 third year social science undergraduates at the University of Yaounde who analyzed the information using the micro version of the SPSS statistical package.

Limitations of the study

This study was an extensive and total survey in which recall questionnaires, interviews, and record-keeping forms were the sources of information. Recall questionnaires and interviews are particularly susceptible to errors in quantifying farm inputs used and outputs attained. Other measurement errors can also occur if the interviewer or farmer fails to correctly delineate one input from another. Record-keeping forms were introduced as an extension tool in 1983 in an attempt to track pond inputs and outputs. However, owing to the high rate of illiteracy among farmers and to neglect by extension agents, some of the records were not properly kept. Furthermore, the basic unit of analysis was the fish farming household limited to the fish farmer alone.

In spite of these shortcomings, the care taken in developing the questionnaire, the workshops organized for enumerators and supervisors before field operations began, and the close supervision of enumerators, coders, and other workers involved in data analysis all probably helped to maintain a low margin of error. Interpretation of the results should be limited to the study area in question.

Results

Sociodemographic information

The survey identified 959 fish farmers in the study area: 512 in the West province and 447 in the North West province. There were 903 male (94.2%) and 56 female (5.8%) farmers. The average age of the population was 48 years, but individual ages ranged between 20 and 74 years. The percentage distribution of farmers by age group was as follows: 20-25 years, 6.5%; 26-35 years, 26%; 36-45 years, 29.2%; 46-55 years, 26.1%; and 56-74 years, 12.1% (Table 1).

Table 1. Number, age, and years of aquaculture experience of fish farmers in the West and North West provinces.

| Division | Number of farmers | | Age of farmers (years) | | | | | | | | | | Experience in fish culture (years) | | | | | |
|---------------|-------------------|--------|------------------------|------|------|-------|-------|-------|------|-------|---------------|------|------------------------------------|-------|-------|------|-------|---------------|
| | Male | Female | In FFA* | | <25 | 26-35 | 36-45 | 46-55 | >55 | Total | Missing cases | <5 | 6-10 | 11-15 | 16-20 | >20 | Total | Missing cases |
| | | | Total | FFA* | | | | | | | | | | | | | | |
| Bamboutos | 51 | - | - | - | 13 | 22 | 14 | 2 | 51 | - | 10 | 19 | 13 | 3 | 4 | 49 | 2 | |
| Haut Nkam | 93 | 15 | 3(1) | 3 | 31 | 24 | 28 | 8 | 94 | 14 | 21 | 54 | 14 | 4 | 1 | 94 | 14 | |
| Menoua | 95 | 3 | 33(2) | 8 | 25 | 30 | 25 | 8 | 96 | 2 | 35 | 45 | 6 | 1 | 5 | 92 | 6 | |
| Mifi | 54 | 1 | - | 2 | 10 | 20 | 21 | 2 | 55 | - | 14 | 28 | 7 | 1 | - | 50 | 5 | |
| Nde | 21 | - | - | - | 5 | 8 | 5 | 3 | 21 | - | 2 | 10 | 3 | 1 | 2 | 18 | 3 | |
| Noun | 178 | 1 | 26(1) | 9 | 36 | 55 | 47 | 31 | 178 | 1 | 81 | 44 | 17 | 14 | 12 | 168 | 11 | |
| Bui | 122 | 8 | 104(4) | 6 | 49 | 16 | 32 | 24 | 127 | 3 | 34 | 43 | 35 | 7 | 7 | 126 | 4 | |
| Donga-Mantung | 51 | 5 | 50(1) | 2 | 23 | 13 | 12 | 3 | 53 | 3 | 5 | 19 | 18 | 9 | 4 | 55 | 1 | |
| Mentchum | 64 | 4 | 32(1) | 21 | 7 | 14 | 13 | 9 | 64 | 4 | 25 | 33 | 4 | 1 | 5 | 68 | - | |
| Mezam | 102 | 11 | 36(1) | 5 | 24 | 38 | 29 | 11 | 107 | 6 | 38 | 18 | 27 | 11 | 13 | 107 | 6 | |
| Momo | 72 | 8 | 22(1) | 4 | 16 | 28 | 14 | 10 | 72 | 8 | 23 | 19 | 25 | 5 | 3 | 75 | 5 | |
| Total | 903 | 56 | 306(12) | 60 | 239 | 268 | 240 | 111 | 918 | 41 | 288 | 332 | 169 | 57 | 56 | 902 | 57 | |
| % | 94.2 | 5.8 | 31.9 | 6.5 | 26.0 | 29.2 | 26.1 | 12.1 | 95.7 | 4.3 | 31.9 | 36.8 | 18.7 | 6.3 | 6.2 | 94.1 | 5.9 | |

*Number of FFAs in parentheses.

All of the female farmers and 96% of the male farmers were married. Of the married male farmers, 48% were monogamous, 23% had two wives, 11% had three wives, and the rest had four wives. Five farmers, all traditional rulers, had between 20 and 60 wives. The average number of children per farmer was six, ranging from no children (2.8%) to well over 100 children (0.01%). However, the majority of the farmers (63.5%) had 3-9 children.

The proportion of the farmers who lived with only their nuclear family was 16.6%, whereas 83.4% had other persons (relatives or hired hands) in their homes. The average number of other persons in a household was four. In a monogamous home, the average household size was 12. Some 306 farmers (32%) belonged to one of the 12 fish farmers' associations (FFAs) in the area. The tendency to belong to a FFA was greater in the North West province, where 224 farmers (54.6%) in that province were members of eight FFAs, compared with 62 farmers (12.1%) being members of four FFAs in the West province. Furthermore, the affinity to the FFA was more pronounced in the Bui division, North West province, than in any other division, with 85% of the farmers in the Bui division being members of four FFAs. There were no FFAs in three divisions: Bamboutos, Mifi, and Nde (Table 1). With respect to religion, 70% of the farmers surveyed were Christians, 20% were Moslems, and the rest practiced traditional religions or no identifiable religion. The bulk of the Moslem population lived in the Noun and Mezam divisions.

Socioeconomic information

About 70% of the farmers had no formal education, and very few farmers had training in such trades as building or carpentry, although many of their houses were self-constructed. There were no full-time fish farmers, and aquaculture was not the main occupation of the fish farmers. Of the farmers surveyed, 31.9% had less than 5 years experience in fish culture, 55.5% had 6-15 years of experience, 8.5% had been involved in fish culture for 16-25 years, and 3.9% had practiced fish farming for more than 25 years.

In addition to growing fish, 41.6% of the farmers surveyed were involved in crop and animal production, 10.4% were government employees or parliamentarians, 4.1% were businessmen or traders, and 6.7% were carpenters, builders, tailors, etc. (Table 2). Only eight farmers combined animal (poultry, pigs, or rabbits) and fish culture.

In terms of crop production, coffee was a universal export crop grown by about 63.9% of the farmers, whereas 10.6% grew oil palm, 4% grew cacao, and 2% grew tobacco. A variety of food crops was grown in all of the divisions, whereas rice growing was widespread throughout the study area except in Haut Nkam, Mifi, and Donga-Mantung. The average area devoted to these crops was as follows: coffee, 3.3 ha; cacao, 3.0 ha; tobacco, 1.7 ha; palm oil, 2.3 ha; rice, 1.6 ha; and other food crops, 1.5 ha.

With regard to animal production, poultry, sheep, and goats were raised in all of the divisions; rabbits were raised in all of the divisions except Nde; and Noun was the only division in which none of the farmers raised pigs. Furthermore, whereas an average of 10 farmers per division in the North West province reported owning cattle, only seven farmers in the entire West province owned cattle. The animal herd per farmer was generally small: 11 pigs, 16.7 sheep/goats, 20.9 rabbits, 87.3 cattle, and 138 for poultry.

The average annual income for the agro-pastoral farmers was about 490 000 FCFA, derived from crop production (280 000 FCFA), animal production (180 000 FCFA) and fish farming (30 000 FCFA) (Table 2). (Note: At the time of the survey, 350 FCFA = 1 USD.)

All of the farmers surveyed owned at least one house and some furniture. The majority of the houses were mud-plastered buildings with corrugated zinc sheets. Some farmers also owned such durables as vehicles (10 farmers), motorcycles (22 farmers), bicycles (35 farmers), radio sets (567 farmers), and push-push farm carts (462 farmers). Portable water supply equipment was available in about 50% of the villages in the West province, and about 20% of the villages in the North West province were served with electricity. Primary schools were located in almost all of the villages in the area. There were also 104 secondary schools, 46 secondary technical schools, 18 hospitals, 32 health centres, 15 pharmacies, and 28 pro-pharmacies in the two provinces.

Groundnuts, beans, wild game, poultry meat, beef, small ruminants (sheep, goats, and rabbits), and fish were ranked by the farmers as the dominant protein foods in their diet. About 48% of the fish produced in ponds was consumed by farmers, their households, and relatives. The rest was readily sold at the pond site or at village markets. Although 94% of the farmers stated that they regarded fish as a fairly or very important source of protein, they added that it was in short supply. The survey did not generate enough data to permit delineating the standard of living of the farmers.

Distribution and ownership of ponds

The number of ponds identified in the study area totaled 1269 - 697 in the West province and 572 in the North West province. Of the 959 farmers surveyed, 735 owned one pond each, 151 owned two ponds each, 50 farmers owned three ponds each, and 23 farmers owned four ponds each. The average number of ponds per farmer was 1.3 (Table 3). Farmers owning two or more ponds generally used non-household labour or loans to build the second or subsequent ponds. About 95% of the producers were owners/operators.

Three types of ponds were identified in the area, namely diversion ponds (1009 or 75% of the total number of ponds), underground water ponds (211 or 16.6%), and barrage ponds (49 or 3.9%). The average pond size was 307 m², but ponds in the North West province were larger (400 m²) than those in the West province

Table 2. Occupations: income source and its distribution among fish farmers in the West and North West provinces.

| Location | Agriculture and livestock | | | | | | | Mean annual income (FCFA)* | | | Total | |
|---------------------|---------------------------|-----------|------------|----------|--------|-------|--------|----------------------------|--------------|--------|-------|--|
| | Agriculture | Livestock | Government | Business | Others | Total | Crops | Livestock | Fish farming | | | |
| West province | | | | | | | | | | | | |
| Bamboutos | 26 | - | 10 | 3 | 5 | 51 | 332000 | 169000 | 16600 | 517600 | | |
| Haut Nkam | 52 | 5 | 6 | 5 | 15 | 93 | 329000 | 198000 | 33500 | 560500 | | |
| Menoua | 48 | 1 | 39 | - | 5 | 95 | 289000 | 190000 | 18000 | 497000 | | |
| Mifi | 9 | 2 | 31 | 3 | 5 | 55 | 271000 | 200000 | 14500 | 485500 | | |
| Nde | 11 | 1 | 5 | - | 1 | 21 | 326000 | 161000 | 35800 | 522800 | | |
| Noun | 98 | 1 | 41 | 6 | 7 | 175 | 256000 | 124000 | 11000 | 391000 | | |
| Subtotal | 244 | 10 | 132 | 17 | 38 | 490 | - | - | - | - | | |
| North West province | | | | | | | | | | | | |
| Bui | 61 | 1 | 40 | 5 | 8 | 124 | 262000 | 159000 | 50700 | 471700 | | |
| Donga-Mantung | 34 | - | 6 | 3 | 4 | 52 | 303000 | 216000 | 18000 | 537000 | | |
| Mentchum | 1 | 10 | 44 | - | 1 | 64 | 246000 | 137000 | 21000 | 404000 | | |
| Mezam | 27 | 2 | 46 | 8 | 10 | 107 | 324000 | 246000 | 49500 | 619500 | | |
| Momo | 12 | 1 | 48 | 4 | - | 75 | 225000 | 209000 | 15000 | 449000 | | |
| Subtotal | 135 | 14 | 184 | 20 | 23 | 422 | - | - | - | - | | |
| Total | 379 | 24 | 316 | 37 | 61 | 912 | - | - | - | - | | |
| % of population | 41.6 | 2.6 | 34.6 | 4.1 | 6.7 | 100 | - | - | - | - | | |

* At the time of the survey, 350 FCFA = 1 USD.

Note: There were 47 missing cases.

Table 3. Distribution of ponds by type and area (m²) in the 11 divisions.

| Location/ division | Number of farmers | Type of pond | | | Total number of ponds | Average area (m ²) | Number of ponds per farmer |
|-----------------------|----------------------|--------------|---------|-------------|-----------------------------|-----------------------------------|----------------------------------|
| | | Diversion | Barrage | Underground | | | |
| West province | | | | | | | |
| Bamboutos | 51 | 54 | 3 | 10 | 67 | 153 | 1.31 |
| Haut Nkam | 108 | 138 | 6 | 8 | 152 | 449 | 1.41 |
| Menoua | 98 | 97 | 3 | 21 | 121 | 169 | 1.23 |
| Mifi | 55 | 48 | - | 33 | 81 | 160 | 1.47 |
| Nde | 21 | 30 | 3 | - | 33 | 123 | 1.57 |
| Noun | 179 | 195 | 6 | 42 | 243 | 200 | 1.36 |
| Provincial | 512 | 562 | 21 | 114 | 697 | 236 | 1.36 |
| North West province | | | | | | | |
| Bui | 130 | 166 | 7 | 6 | 179 | 326 | 1.38 |
| Donga-Mantung | 56 | 30 | 8 | 32 | 70 | 643 | 1.25 |
| Mentchum | 68 | 75 | 2 | 9 | 86 | 279 | 1.26 |
| Mezam | 113 | 100 | 8 | 40 | 148 | 464 | 1.31 |
| Momo | 80 | 76 | 3 | 10 | 89 | 282 | 1.11 |
| Provincial | 447 | 447 | 28 | 97 | 572 | 400 | 1.28 |
| Study area | 959 | 1009 | 49 | 211 | 1269 | 307 | 1.32 |

(236 m²) (Table 3). Pond area was also a function of pond type and the average areas were as follows: barrage ponds, 1130 m²; diversion ponds, 300 m²; and underground water ponds, 150 m².

Pond engineering

Culturing of fish starts with the construction and preparation of the ponds, which were dug by hand (97% of the ponds) or using a bulldozer (3%), to a depth of 1-2 m. For hand-dug ponds, the principal sources of labour were family and household dependents (46.3% of the ponds), hired hands (35%), and meeting groups, friends, and FFAs (18.7%). The majority (62.4%) of the ponds were built on clay soils, 28% on sandy-clay soils, 5.2% on gravel soils, and 4.4% on sandy soils. About 25% of the ponds experienced seepage problems. Many ponds were located near the homes of the operators, with 52.2% within 1 km, 17% between 1 and 2 km, 3.5% between 2 and 3 km, and 1.7% at distances greater than 3 km from the home. The main reasons given for the location of ponds were the availability of suitable sites and a desire to avoid or reduce losses through theft. Although 79% of the ponds were completely drainable, only 28% of the ponds had draining devices; 22% were fitted with galvanized or plastic pipes or with bambous, whereas 5.3% had monks. Consequently, breaking the main dike was the principal method used to empty ponds for harvests.

About 36.5% of the identified ponds were constructed before 1975, whereas 27.7% were built between 1976 and 1980 and 35.8% were built between 1981 and 1987. Most ponds (90%) were dug within 6 months, either at the end of a wet season and stretching into the dry season or during the dry season and stretching into the early rains. Construction of 7% of the ponds, however, lasted about 1 year, with construction on 3% of the ponds lasting 30 months. Extension agents were the principal source of technical assistance, as 75% of the ponds were constructed under their guidance. Another 10% of the ponds were constructed by the prospective farmers on the advice of other farmers, whereas 14% were built without "expert" advice. Nevertheless, more than 80% of all ponds seem to have been well constructed.

The majority (87%) of the farmers used their personal resources to build their ponds; only 13% of the farmers indicated that they had obtained loans/credit to build their ponds. Meeting groups, commonly known as "Mjangai" in the North West province, or "Tontine" in the West province, were the main sources of credit, accounting for 78.5%. This was followed by friends and relatives (16.1%), commercial banks (3.4%), and the Rural Development Fund (FONADER) (2%). Of the farmers who obtained loans, 6% said the amounts were adequate and 80% of the beneficiaries reported that repayments were made regularly. However, 50 farmers stated that they had been unable to receive credit from formal sources (i.e., commercial banks and FONADER).

Procurement subsystem

The main species cultured were *Tilapia* spp. (68.5%), *Cyprinus carpio* (18%), and *Clarias gariepinus* (13.5%). Aquaculture stations were the source of about 60% of the fingerlings; the remainder, particularly *Tilapia* spp., was produced by the farmers. About 18% of the farmers were self-sufficient with respect to fingerlings and sold their excess crop to about 25% of their colleagues. Carp and *Clarias* fingerlings were produced only at aquaculture stations in the North West province; however, three farmers in that province also produced carp fingerlings through natural spawning in their ponds. Approximately 74% of the fingerlings obtained from aquaculture stations were transported in plastic bags by extension agents via their motorcycles. Farmers transported about 20% of the supplies, whereas station vehicles transported 6%. The mortality rate due to transportation was about 10%.

Only 10 of the farmers surveyed had nursery or holding ponds; therefore, fingerlings were placed directly into rearing ponds. Stocking rates varied from 1 fish/m² (48.4%) to 4 fish/m² (16.1%), with intermediate rates of 2 fish/m² (22.6%) and 3 fish/m² (12.6%). Fewer than 10% of the farmers prepared their ponds before stocking; this preparation was limited to drying the ponds after draining. In some cases, however, farmers also applied some undetermined quantities of lime to eliminate predators and other undesirable fauna. At the time the survey was undertaken, only 74% of the ponds were stocked.

Transformation subsystem

About 60% of the farmers surveyed practiced monoculture: *Tilapia* spp. (50%), carp (5%), and *Clarias* (3.4%). The rest practiced polyculture involving two or all three species. Ponds were managed primarily by the farmers and their families as follows: farmers, 87%; wife or wives, 5%; and children, 4.5%. Hired labour involvement was 3.5% for farmers with one or two ponds, but increased to 8.6% for those owning three or more ponds.

Management involved clearing the pond banks; composting (57% of the farmers) and feeding (70% of the farmers), using kitchen wastes, maize hullings, rice bran, and leafy vegetables; and the soaking of cassava tubers in ponds. Most farmers fed their fish only two or three times a week and the quantities of feed were very small. Similarly, composting was irregular and inadequate as only 40% of the ponds had any blooms. However, more than 90% of the farmers reported that they visited their ponds at least once a week. In this regard, 12.1% of the farmers reportedly visited their ponds once a week; 24.7% twice a week; 25.4% three or four times a week; and 32.5% five or six times a week. The other 5.3% did not visit their ponds at all. The time spent per visit ranged from 30 min (33.9% of the farmers) to 2 h (5.4%), with intermediate times of 30-60 min (47.5%) and 1-2 h (13.2%).

Delivery system

For the majority of the farmers (77.7%), the growing/culture period for fish was 5-12 months, but 14.5% of the farmers grew their fish for 12-24 months, and the culture period was more than 24 months for 7.8% of the farmers. Single/complete harvesting was adopted by 71% of the farmers; the rest adopted partial harvesting. Breaking of the principal dike was the most common technique used to drain ponds, followed by the removal of fish using either baskets or nets.

The average fish production was 1138 kg/ha per year. On average, farmers consumed 48% of fish production; the rest was sold at pond sites or at village markets at average gate prices of 425 FCFA/kg for Tilapia, 565 FCFA/kg for carp, and 575 FCFA/kg for Clarias. However, there were marked variations between the divisions for all three parameters: production, self-consumption, and prices (Table 4).

Farmers' opinion on aquaculture

For about 50% of the producers, fish farming is a difficult activity. Furthermore, a significant proportion (74%) of the producers stated that aquaculture is a lucrative activity, but less so than crop or animal production. Only 11% of the producers, including the eight farmers who practiced integrated livestock-fish culture, stated that fish farming was more lucrative than either crop or animal production. More than 80% of the farmers were satisfied with their aquaculture activities, a view that is confirmed by the large percentage of producers (88%) who indicated that they would like to build more ponds if land were available compared with the 12% who stated that they would abandon their ponds.

The producers identified nine main constraints to their activities (Table 5). These constraints are not universal, but are site specific. They fall into three categories:

- ° Man-made constraints, such as the lack of land and/or water, as well as theft - constraints that are imposed by the producers' peers.
- ° Biological constraints, e.g., the presence of predators and the shortage of fingerlings - constraints due, in part, to the fact that carp and Clarias in captivity do not reproduce easily in ponds or, if they do, not in a manner that is satisfactory to the aquaculturists.
- ° Constraints that have vestiges of man-made, social, and biological characters, such as the lack of feed and capital, insufficient technical assistance, and the high cost of fingerlings. No environmental constraints were identified by the farmers.

Table 4. Average production, self-consumption, and farm gate prices of aquaculture products in the West and North West provinces.

| Division | Production (kg/ha per year) | Production consumed (%) | Average farm gate prices (FCFA/kg) ^a | |
|---------------|--------------------------------|----------------------------|---|----------------|
| | | | Tilapia spp. | Carp |
| Bamboutos | 1744 | 80.2 | 450 | 600 |
| Haut Nkam | 520 | 61.3 | 390 | 565 |
| Menoua | 1102 | 70.3 | 415 | 520 |
| Mifi | 1908 | 66.3 | 540 | 740 |
| Nde | 2915 | 44.1 | 500 | - ^b |
| Noun | 1085 | 60.3 | 415 | 320 |
| Bui | 2263 | 31.1 | 380 | 565 |
| Donga-Mantung | 160 | 51.4 | 415 | 440 |
| Mentchum | 848 | 9.2 | 540 | 650 |
| Mezam | 555 | 63.7 | 395 | 580 |
| Momo | 2338 | 33.7 | 420 | 590 |
| Survey area | 1138 | 48.5 | 425 | 565 |

^a At the time of the survey, 350 FCFA = 1 USD.

^b Species not cultured.

Note: Missing cases, 310 or 32.3%.

Table 5. Checklist of constraints to aquaculture development in the West and North West provinces.

| Constraint | West province | | North West province | |
|-----------------------------------|---------------|------|---------------------|------|
| | Farmers (%) | Rank | Farmers (%) | Rank |
| Lack of fingerlings | 6.1 | 7 | 13.7 | 3 |
| Lack of/insufficient land | 8.8 | 6 | 48.3 | 1 |
| Inadequate water supply | 10.9 | 4 | 8.9 | 4 |
| Lack of/inadequate feed | 3.9 | 8 | 5.3 | 5 |
| Lack of capital | 29.9 | 1 | 18.0 | 2 |
| Insufficient technical assistance | 0.5 | 9 | 1.9 | 6 |
| High cost of fingerlings | 17.2 | 2 | 0.5 | 8 |
| Stealing of fish | 12.5 | 3 | 1.7 | 7 |
| Presence of predators | 10.2 | 5 | 1.7 | 7 |

Self-evaluation of extension agents

More than 80 and 62% of the extension agents in the West and North West provinces, respectively, evaluated their work as extensionists to be either good or very good compared with the 16.6% (West province) and 31.9% (North West province) who felt it was fair. In addition, 3.4 and 6.1% of the extension agents in the West and North West provinces, respectively, evaluated their output to be weak or bad.

Discussion

Sociodemographic and socioeconomic conditions

The findings confirm reports that aquaculture is not "a male only activity" (Trottier 1987). Women who do not own ponds also participate in pond construction and pond management, indicating a complementarity of the division of labour in the village. Furthermore, women's involvement in aquaculture may also contribute to effective utilization of the production for family nutrition. This study revealed that about 48% of the production was consumed by the farmers, their households, and relatives.

The average age of the population approximates the national average for farmers, i.e., 47 years (MINPAT 1987). However, because a substantial proportion of the farmers were more than 36 years old and a small fraction were less than 25 years old, one could infer that

- ° Fish farming is becoming an activity for the older segment of the population.

- ° Possession of a fish pond is a status symbol (Nji 1986) and, in a traditionally stratified society, it is not unusual that status symbols are more attractive to the elderly, irrespective of the economic viability of the activities associated with the symbol.
- ° Youths are not attracted to aquaculture, a phenomenon that applies to other rural development activities, resulting in the urban population being younger, whereas villages are dominated by the old (MINPAT 1987). This phenomenon has often been attributed to the absence of social amenities and employment in rural areas.

In the present study, there were other possible contributing factors, namely the absence of land and water rights, as well as the absence of land, particularly in the West province where the population density is reducing available agricultural land and creating an increasing number of landless labourers. The government has long recognized that a healthy nation depends on a healthy and productive rural life, and it has made efforts to improve social amenities in villages, has set up a number of agricultural parastatals in the area, and has also initiated youth programs, such as the "Civic Centre for Participation in Development," which provides, among other things, training in crop and animal production, but not in fisheries and aquaculture. Furthermore, aquaculture is not part of the curriculum in schools.

This study revealed that the attachment to the extended family is strong as households typically contained relatives and hired hands (which, in the long run, are considered to be and are treated as part of the family) in addition to the nuclear pair and their children. This strong attachment is understandable in view of the low educational attainment of the farmers and the low proportion of the population with formal technical training, factors that are likely to hamper their occupational mobility, imposing upon them traditional agro-pastoral activities with an adherent high demand for labour. The varied agro-pastoral activities of the population are probably necessary as they provide employment to family labour and diversify family food supplies and incomes. Although many of the farmers had no formal education, it was estimated that more than 75% of their children were going to school or had completed at least primary school.

The findings showed a real affinity of the farmers for the FFA. This suggests that the state of social and even economic solidarity is strong and people tend to feel a sense of common interest and responsibility. The attachment to the FFA is justified by the roles of these associations in the lives of their members. This role includes

- ° tool loan schemes for members

- assisting members with the construction of ponds and other labour-intensive chores
- grouping orders for fingerlings and their transportation, which was identified as a constraint by farmers
- programming fish harvests to regulate supplies with a view toward maintaining high prices for fish

It is interesting to note that the FFAs could be assimilated to pre-cooperatives, but that, unlike most cooperatives in the country that have an up-down structure with an evident presence of government officials, the FFAs were organized and run by the farmers, with very little input from government officials.

Considering the low educational attainment of the farmers and the predominant agricultural milieu of the population, it is hypothesized that their involvement in crop and livestock production approximates their age. By contrast, fish farming is an introduced activity with peculiarities, which places it somewhere between traditional capture fisheries and agriculture. Hence, a producer's involvement in aquaculture can be situated within a specific time frame. The proportionately high number of farmers with less than 15 years experience in this activity seems to tailor with the history of fish farming in Cameroon (Mezainis and Satia 1975; Satia 1980; SOGREA 1982; Balarin 1985) for only over the past 18 years, starting with a short-lived United Nations Development Programme (UNDP)/Food and Agriculture Organization of the United Nations (FAO) project from 1972 to 1975, has government involvement in fish culture been maintained. The input by government has, nonetheless, been very small.

The gross annual income of the farmers may have been over- or underestimated. On the one hand, farmers might have underestimated incomes for fear of taxation; on the other hand, farmers are known to receive cash gifts from children, relatives, or friends, which were not included in these assessments. Although the contribution of aquaculture to the farmers' gross annual income was very small due to the small size of the ponds (averaging 307 m²) and low production (1138 kg/ha per year), an interesting revelation of this study is that no matter how small the scale, the farmer is not likely to aim at only subsistence production, but also at production for a market. However, increased incomes do not necessarily lead to better nutrition if the accrued income is not used to purchase foodstuffs. In the Philippines, where aquaculture is more developed, fish farmers' household income is said to be seven times that of the rice-farming household and about four times that of the average coconut-farming household (Liberio et al. 1985).

Fish was rated low as a source of protein in the farmers' diet. This was due more to unavailability than either high prices or a dislike for fish. The unavailability of fish is due to the absence of large rivers or resource-rich lakes, the small size of

the ponds, and low production. About 50% of the farmers stated that frozen fish was not even available in their area. The absence of frozen fish can be attributed to the high cost of installing cold storage facilities and the absence of electricity in some of the villages, particularly in the North West province. With regard to price, groundnuts and beans are produced by the farmers or could be bought at relatively low prices (400 FCFA/kg). However, fish is much cheaper (650 FCFA/kg) than meat products (1100-1200 FCFA/kg); hence, under conditions of equal availability, farmers would be tempted to buy fish and not meat products. The preference for fish is evident from the fact that farmers consume about 48% of their production, and the relatively high proportion of farmers who stated that fish was a fairly or very important source of protein, but that it was in short supply.

The standard of living of a household depends largely on its disposable income relative to its size, as well as on the availability of public services and amenities. Disposable cash income in the context of this study would have been the sum of fish farming and nonfish farming income earned by the household (3200 FCFA/person per year). Because the study did not consider the entire household income, however, it is not possible to use this indicator. Similarly, the study did not generate enough data on ownership of consumer durables and private consumption expenditures to determine Engle's coefficient for the population, neither did the study obtain detailed information on the rate of savings nor on the availability of public and social amenities, all of which are common indicators of the standard of living (Panayotou 1985).

Fish pond technology

The majority of the ponds were properly sited and well constructed, but ponds were small and the number per farmer was low. Pond size and the number owned by a farmer are influenced by many factors, including the cost and type of labour (hand/machine) used in construction. Aquaculture requires intensive capital investment for the construction of ponds. When construction is done by hand, as was the case for about 97% of the ponds in this survey, not only is the work tedious, but compacting of the soil may be inadequate, as reflected in the high percentage of ponds with seepage problems. Furthermore, although labour was theoretically available (large household size), household, meeting group, or FFA labour has, nonetheless, opportunity costs, including the provision of food and drink, which some farmers cannot afford. Evidently, farmers who had personal resources or who obtained credit built more than one pond.

Very few farmers - even if they wanted to - obtained loans from formal institutional sources, thereby indicating that small-scale farmers are not in a position to raise capital through borrowing from such sources, as credit is usually available only against collateral, which farmers may not have. The situation was accentuated by the economies of scale of their aquaculture activity

and the fact that the profitability of aquaculture has not been proven. The high rate of repayments on loans was due to the principal sources of credit (Njangais and Tontines). Members of these associations are bound by codes of ethics and conduct, as well as a sense of solidarity and equality of members with regard to rights and obligations, such that noncollaborative members are usually frowned upon and regarded as outcasts, which limits even further their chances of obtaining credit as avenues for credit from formal sources are limited.

The survey revealed that the majority of ponds had been constructed between 1976 and 1987. However, other reports (Lemasson and Bard 1964; Meschkat 1967; SOGREAH 1982) alluded to the presence of thousands of ponds in the West province prior to 1970. One would infer that most of these ponds have become filled or abandoned over the years. A sizeable proportion (12%) of the farmers in this survey indicated that they might discontinue aquaculture, whereas, at the time of the survey, about 26% of the ponds were not stocked or were not being used. The factors causing farmers to abandon fish farming are insufficiently known as little importance has been placed on monitoring fish farming operations and the socioeconomic and cultural backgrounds of the people who have taken up this activity.

The investigations of this study revealed the following characteristics with regard to the unused ponds and their owners, as well as farmers who might discontinue aquaculture:

- The ponds were small and old, usually more than 10 years old. Production from unmaintained ponds, which are silted and, like small ponds, are unsuitable due to reduced depth, is low and, hence, not very interesting.
- The farmers involved were usually over 50 years of age and, although ownership of a pond might confer upon them a status symbol, such farmers do not have the required initiative, imagination, and motivation to maintain their ponds, especially when returns in the past have not been good.
- The paternalistic approach adopted in introducing aquaculture in the early 1950s, which was characterized by, among other things, heavy subsidization in pond engineering and in procurement and transformation subsystems has left some farmers, particularly the elderly, disillusioned about aquaculture as these subsidies have gradually been curtailed.
- In the Menoua division, cultural belief, which asserts that the appearance of the rainbow indicates that owners have transformed into pythons and have taken refuge in their ponds from where they attack children, has a tendency to dissuade some producers from using their ponds. As older people are more sensitive to accusations related to witchcraft, they are usually the greatest culprits.

The provision of inputs, particularly feeds, may be regarded as an indicator of the producers' attachment to aquaculture, the availability of financial resources, and the producers' ability to make the Boserup shift - changing from extensive to semi-intensive or intensive production (Boserup 1965). In the present survey, very little of this was apparent. Despite several years of association with aquaculture, the close proximity of ponds to producers' homes, and the assertion that farmers "visited" their ponds regularly, the aquaculture system was basically extensive, characterized by small and irregular inputs (even composting), low yields, and low financial returns. Furthermore, existing ponds do not appear to be operating at full capacity in terms of either area or productivity and their production is inadequate to meet the protein requirements of the average household. Visiting a pond is not synonymous with actually working a pond. Because most ponds are backyard ponds or are located on farms, it is likely that each time a farmer passes his or her pond, it might be considered to be a visit.

The reluctance of the producers to use more inputs and also to pay more attention to the management of their ponds can be attributed to, among other things, the absence of packaged technology; the price of inputs; the lack of some of the inputs, particularly good quality seeds; inadequate extension services; and the lack of adequate support facilities.

In view of the need to meet the increasing protein requirement of its growing population, the country cannot afford low production from its fish ponds. However, given the country's and the farmers' factor endowment, it is reasonable to suggest that the average farmer should choose extensive culture accompanied by optimal composting, as this requires low capital investment and less risk, on the condition that producers have stable and secure land and water rights.

In the farmers' opinion, there are many constraints to aquaculture development; however, ranking these constraints indicated that the majority of them are location specific. Knowledge of such specificities could be useful in formulating assistance programs.

Generally, credit was the most limiting factor: where cash is not available, farmers cannot build large or several ponds even in areas where ecological factors are not limiting. Furthermore, a lack of credit limits the farmers' accessibility to factors of production. The inadequacy of financing is not limited to private ponds. It accounts, in part, for the shortage and high cost of fish seeds, particularly carp and *Clarias* spp., produced at fish stations. The high cost of seeds is compounded by the fact that producers bear the cost of transporting seeds from aquaculture stations to their production units. This constraint - lack of capital/credit - is likely to persist as long as aquaculture is regarded as a social, rather than an economic, enterprise.

The lack of feed was stated by farmers as a constraint. However, Ndam (1987) has shown that, at prevailing prices, it is uneconomical to use supplementary feeds or compounded diets in aquaculture and that, on the contrary, composting should be preferred. This survey confirmed Ndam's revelation for farmers who practiced integrated livestock-fish culture were among the 11% of the surveyed population who stated that aquaculture is more lucrative than either crop or animal production.

Access to land and water is of fundamental importance to aquaculture. Access to land does not seem to be a major constraint because, theoretically, all of the land belongs to the state, except in cases where people have obtained legal rights or title. In practice, however, proof of ancestral use of a piece of land precludes other users, whereas allocation of new land is usually based upon the approval of local leaders - administrative, political, and traditional - but rapid increases in population and the poor performance record of aquaculture do not favour the aquaculture aspirant. In addition, the techno-biological factors of available sites may not be suitable for fish farming.

Poaching has forced farmers in Zaire to give up Tilapia farming (Low 1985) and was identified as a constraint in this survey. However, the high rating given to this factor by producers in the West province is somewhat surprising because the strong socioeconomic and cultural conditions, as well as the functioning leadership structure of village communities in the survey area, would imply that poaching should be of minor importance. Because the scale of aquaculture operations does not justify the financial inputs required for safeguarding, the only possible remedy would be for producers to locate their production units close to their houses.

Finally, although extension agents rated their work performance as being high, there is every reason to suggest that farmers' access to technical knowledge and management skills was very small.

Summary and policy implications

The sociodemographic and socioeconomic profile of the population reflects several characteristics that are roughly comparable to those of the national agro-pastoral population of which they are a part. These include the average age of fish farmers (48 years) and their concentration in the 36-55 years of age group, implying a low entry rate of rural youths into aquaculture; the high household size, indicating a high dependency ratio; the diversification of the farmers' activities, implying a complementarity between aquaculture and other activities in the milieu; and the participation of women, reemphasizing women's role in rural development.

Existing pond technology indicates, among other things, that present production methods underutilize existing ponds; there is an apparent apathy on the part of a sizeable segment of the population toward aquaculture; farmers' access to technical knowledge and management skills is not very satisfactory; and farmers are faced with problems regarding the availability of credit and seeds, as well as land and water rights.

From the foregoing, the following policy options are indicated:

- ° A step-by-step, multidisciplinary approach to the development of aquaculture should be adopted. In this regard, farmers should be encouraged to maintain their extensive practices while appropriate technology packages emphasizing low-cost production systems are developed through on-station and on-farm trials. This would permit acceptance of proposed techniques and provide extension agents with something to sell to the producers.
- ° It would be rational at this stage, and in view of the difficulties associated with producing carp and *Clarias* spp., to place emphasis on *Tilapia* culture and encourage farmers to be self-sufficient in the production of *Tilapia* seeds and to be less dependent on public sector support.
- ° Farmers should be encouraged to deepen their old ponds, which have become shallow through silting, making use of household labour, especially during slack periods of agricultural activity. However, to ensure that the supply of fingerlings, particularly carp and *Clarias*, which are preferred by some farmers, is adequate, aquaculture stations should be equipped to meet the demand for such species as pond utilization gathers momentum.
- ° Most lands used for aquaculture are, theoretically, public property; hence, appropriate institutional arrangements would be necessary to establish the security of land tenure required for long-term investments in aquaculture.
- ° In view of the fact that even the most extensive farming system requires a minimum of technical knowledge and management skills, support through training and communication skills for extension workers should be provided and contracts between extension agents and producers should be maintained on a sustained basis to ensure the acceptance and use of technology.
- ° With a view toward attracting youths into aquaculture and reducing their dependence on their parents, training in aquaculture at the village level and the introduction of aquaculture into the school curriculum through "School Ponds Programs" should be considered.

- ° Rural development parastatals in the region should view aquaculture as part of the larger rural economy and include the subsector in their development programs.

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