EVALUATION OF IMPACT OF NAMIBIAN RURAL AQUACULTURE DEVELOPMENT
APRIL- MAY, 2009

CONDUCTED BY

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August to September, 2009

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REPORT OF THE EVALUATION OF IMPACT OF NAMIBIAN RURAL AQUACULTURE DEVELOPMENT

EXECUTIVE SUMMARY

The Government of the Republic of Namibia (GRN) has solicited the assistance of the Spanish government and the Xunta Galicia to promote continental aquaculture through two complementary lines of action. The first phase included the consolidation of the Inland Aquaculture Centre (IAC) as the centre responsible for driving and promoting aquaculture in the area, increasing its technological development capacities (production of improved fingerlings and development of suitable feed at affordable prices). The second phase added training and practical education of staff and technical employees, improvement of extension and increased production of fish. The first phase, which began in 2003/2004 and was funded at a level of 569,372.64 Euros, was mainly to develop the physical structure for brood stock selection and the production of fingerlings. The second phase, which began in 2007, was designed to improve extension and training of staff. The total cost of the second phase was 750,440 Euros. Feed production was also to be initiated during the second phase, which ended in 2009.

The project addresses an important need: improving food security, nutrition and well being of Namibian citizens through the utilization of unused resources for the production of value-added high-quality fish product.

Dr. Jolly, Professor of Agricultural Economics at Auburn University, was requested to conduct an evaluation of the project during his visit to Namibia from the 15th of April to the 26th of April 2009 (Resume seen in Appendix 1). He reviewed literature and project documents and interviewed project participants, farmers and officers from the Ministry of Fisheries and Marine Resources (MFMR). The terms of reference for the evaluation are seen in Appendix 2. He also visited the various sub-stations and facilities developed through the project.

The project fits the agricultural development strategy of Namibia, which has a major thrust of food security, especially among HIV victims. The project description and outputs are clear. The cost effectiveness of the project is undermined by the less than adequate human capital allocated to the project. Fish production was not, on average, a major contributor to the basic diet of Namibian consumers, but with the increase in the price of meat, many rural people found that fish can be a good substitute for meat. Currently fish products are from wild caught and are seasonal. Many consumers revealed purchasing dried fish, which are sourced from produced caught from the wild after the rainy season and are brought down from flood waters originating in Angola. Sometimes project area residents do not have sufficient funds to purchase the fish, but if they are able to grow their own fish on their farms they can supplement their diets and income. Hence, the GRN decided to embark on a strategy to increase small-scale farm fish production and to stock inland bodies with fish to supplement the protein diets of rural residents.

The first phase of the project, which included the installation of facilities, the selection of brood stock and the production of fingerlings, was completed with a few deficiencies. The number of catfish fingerlings is still inadequate to meet the growing demand and this is due to large numbers of deaths during the larval and post-larval stages. However, there was an abundance of tilapia fingerlings produced because the tilapia spawned after two to three months.

The feed mill has been installed, and trial-runs of feed production from locally sourced material are being executed. The feed mill has a capacity to produce a ton of feed per hour but currently production is held up because the specialist wants to use up previous batches of feed purchased from South Africa.

The ingredients for feed come from fish mill, millet and broken maize, plus imported minerals. Fish meal is abundant in Namibia and can be obtained at reasonable costs. At present, millet and broken maize can be obtained with ease because the mill has not been working at full capacity and fish production is in its embryonic stages. The question should be raised "Will there be an adequate supply of millet and broken maize available if the mill is operating at full

capacity?" We are still far away from this point, but it is not too early to raise this issue since the farmed fish will be competing with humans for the same food source.

Fish production is ongoing. Tilapia production dominates fish production. However, there is no way of controlling spawning in the tanks. Though production is great, it is impossible to obtain indicators of efficiency such as feed conversion ratio and growth rates during a given period since there is pond spawning due to invasive species entering the ponds with flood waters during the rainy season. Catfish production is playing a minor role since there are only two ponds stocked with catfish.

Fish production at the Omahenene Station is ongoing in a number of ponds stocked with tilapia. Fish sales are up and the station can sell all the fish produced. Whenever fish are harvested, sales are completed in less than two hours. Of the six ponds stocked with food fish, only two had catfish at the time of the site visit.

The centre is used for training of technicians and farmers. A number of technicians have received on-the-job training. The number individuals trained has not been enumerated. Extension training is taking place and there are plans for extending the training program.

The extension office has been lodged in Oshakati. The physical environment is good as a central point to travel to service the fish farmers. It is also great to communicate with leaders, but there is no room to stock fish or to create an environment related to fish production. However, in a month the extension staff will be moving to their new location, which is equipped with holding tanks for fingerlings, laboratories and land for the placement of new ponds. This will provide the type of environment to encourage the extension specialist to concentrate on the diffusion of aquaculture technology.

Staffing is inadequate. There is only one trained fish biologist technician, one technician and one secretary. Given the distribution of fish farmers over a large area, it is almost impossible for the extension specialist to serve all the farmers' needs and to monitor them. Many farmers have to wait until the extension specialist is available to assist them with stocking or harvesting.

The extension service effort is dispersed thinly and lacks direction and organization. The extension effort must be re-directed and an attempt should be made to relate fish production to the physical environment of Namibia. The extension officers must be equipped with a technological package based on local applied research appropriate for diffusion under Namibia's conditions.

Farmers declared that they are willing to allocate resources for the production of fish if they are able to derive food and income from fish. Many farmers interviewed were excited about the prospects of fish production but so far they have not experienced consistent net benefits derived from fish production. Farmers interviewed wanted to grow fish but they would show more interest if the benefits from production outweighed the costs.

The implementation of a project can take place within the planned period if Namibians are motivated. The placement of the facilities for fish production was launched during the required time but the initiation, execution and operation of the extension system required more time. Hence, future development of programs requires a longer planning horizon.

The development of a program in which human beings are involved requires the selection of the best individuals who are willing to take on new initiatives. It also involves human capital development, which is costly and time consuming.

The data base is only as good as the information entered. The intended use of the data should dictate the quality and quantity of data to be collected. At present fish farming data are collected on forms that are not standardized and are not updated. The use of the data for improving the functioning of the extension system is questionable.

The physical environment and climate influence the selection and development of fish brood stock, which are locally adapted. Since floods may introduce new genetic material that may not be desirable, the selection of such brood stock may be compromised by the constant entry of invasive species into the breeding program. However, farmers are likely to stock species washed downstream from floods that may increase their total production.

The management of the project has been deemed satisfactory by an audit performed in 2007 to 2008. There were over-expenditures for certain line items thatwere compensated by under-expenditure for other line items.

INTRODUCTION

Continental aquaculture in Namibia has been ongoing at various scales for a long time. It began with the introduction of carp in the 1880s, but not much was done for its development since its introduction. In1980 a number of exotic species were introduced and stocked in cattle watering holes, reservoirs and other fresh water bodies (Iitembu 2005). Freshwater aquaculture in Namibia has been dominated by the catfish (*Clarias gariepinus*) and tilapia species (*Oreochromis niluticus* and *O. Mossambicus*). The level of aquaculture production in Namibia is not known, but there is great potential for aquaculture development in the Okavango, Kunene, Orange and Zambezi, as well as in dams and reservoirs (Fishery and Aquaculture Country Profile 2009). The demand for fish as a substitute for high priced meat has encouraged the Government of Namibia (GRN) to include the promotion of continental aquaculture as a strategic sector.

The GRN has, therefore, solicited the assistance of the Spanish government and the Xunta Galicia to promote continental aquaculture through two complementary lines of action. The first phase included the consolidation of the Inland Aquaculture Centre (IAC) as the centre responsible for driving and promoting aquaculture in the area, increasing its technological development capacities (production of improved fingerlings and development of suitable feed at affordable prices). The second phase added training and practical education of staff and technical employees, improvement of extension and increased production of fish. The first phase, which began in 2003/2004 and was funded at a level of 569,372.64 Euros, was mainly to develop the physical structure and for brood stock selection and the production of fingerlings. The second phase, which began in 2007 and was funded at 750,440 Euros, was designed to improve extension and training of staff. Feed production was also to be initiated during the second phase, which ended in 2009.

Hence, it is necessary to evaluate the project at this time to determine its progress and to suggest new directions for the future. This is why Curtis M. Jolly, a Professor in Agricultural Economics and Rural Sociology from Auburn University (Alabama), was requested to conduct the evaluation. The terms of reference is seen in Appendix 1.

During his visit from the 15th of April to the 26th of April 2009, he reviewed literature and project documents and interviewed project participants, farmers and officers from the Ministry of Fisheries and Marine Resources (MFMR). The terms of reference for the evaluation are seen in Appendix 2. He also visited the various sub-stations and facilities developed through the project. He paid special attention to activities around Oshakati, seen in Figure 1.

Figure 1: Map of Namibia showing location extension office in Oshakati.

MAJOR FINDINGS AND RECOMMENDATIONS

Findings

The project addresses an important need: improving food security, nutrition and well being of Namibian citizens through the utilization of unused resources for the production of value-added high-quality fish products.

Fish products are not, on average, major contributors to the basic diet of Namibian consumers, but with the increase in the price of meat many rural people find that fish can be a good substitute for meat. Currently fish products found in the project area are wild-caught and are seasonal. Many consumers revealed purchasing dried fish, which are sourced from wild-caught fish after the rainy season. Sometimes they do not have sufficient funds to purchase the fish, but if they are able to grow their own fish they can supplement their diets and income through the consumption and sale of fish products. Local consumers revealed a preference for fresh fish and stated that they are willing to pay a higher price for fresh fish.

Breeding and Selection

The first phase of the project, which included the installation of facilities, the selection of brood stock and the production of fingerlings, was completed with a few deficiencies. The number of catfish fingerlings is still inadequate to meet the growing demand and this is due to large numbers of deaths during the larvae and post-larvae stages. The problem seems to be one of management and can be resolved through the improvement of sanitation through sterilization of hatching equipment. However, an abundance of tilapia fingerlings were produced because the tilapia spawned after two to three months.

Feed Production

The feed mill has been installed and trial-runs of feed production from locally sourced material are being executed. The machine has a capacity to produce a ton of feed per hour but currently production is held up because the specialist wants to use up batches of feed previously purchased from South Africa.

The ingredients for feed comes from fish mill, millet and broken maize, plus imported minerals. Fish meal abundant in Namibia and can be obtained at reasonable costs. At present millet and broken maize can be obtained easily because the mill has not been working in near capacity and fish production is in its embryonic stages. The question should be raised 'Will there be an adequate supply of millet and broken maize available if the mill is operating at full capacity?' We are still far away from this point, but it is not too early to raise this issue since fish will be competing with humans for the same food source.

Fish Production at Epalela

Fish production is an ongoing farm activity. Tilapia culture dominates fish production. However, it is impossible to control spawning in the elevated tanks. Though production is great, there is no way to obtain indicators of efficiency such as feed conversion ratio and growth rates during a given period since there is early spawning and entry of invasive species in the ponds. Catfish production is playing a minor role since there are only two ponds stocked with catfish. Fish sales are up and the station can sell all the fish produced. When fish are harvested, sales are completed in less than two hours.

Training

The center is used for training technicians and farmers. The facilities in place are appropriate to provide the desired training. A number of technicians have received on-the-job training. The number of individuals trained has not been enumerated. Extension training is taking place and there are plans for extending the training program.

Extension

The extension office has been lodged in Oshakati. The physical environment is good as a central point to travel to service the fish farmers. It is also great to communicate and network with leaders and stakeholders, but there is no room to stock fish or to create an environment related to fish production. However, in the near future the extension staff will be completely moved to their new location, which is equipped with holding tanks for fingerlings, laboratories

and land for the placement of new ponds. This will provide an environment to encourage the extension specialist to concentrate on the diffusion of aquaculture technology.

Staffing is inadequate. There is only one trained fish biologist technician, one technician and one secretary. Given the distribution of fish farmers over a large area, it is almost impossible for the extension specialist to serve all the farmers' needs and to monitor them. Many farmers have to wait until the extension specialist is available to assist them with stocking or harvesting.

The extension service effort is dispersed thinly and lacks vision and organization. The extension effort must be directed and relate fish production to the physical environment of Namibia.

Farmers declared that they are willing to allocate resources for the production of fish if they are able to derive food and income from fish at a reasonable cost. Many farmers interviewed were excited about the production prospect of fish, but so far they have not seen the net benefits from fish. Farmers interviewed wanted to grow fish but they would show more interest if the benefits outweighed the costs of production.

One group of women who produced fish through a support group indicated that, after they had spent money buying the fingerlings at 30 cents Namibian a piece, they had no more money for the purchase of fuel to operate a pump to replenish the pond with water.
The Namibian administration is dedicated to increasing fish production from aquaculture, but must examine the scope and scale of aquaculture production in Namibia and must be ready to devote the necessary resources to enhance production growth of aquaculture.

Comment

The goal of the project is ambitious, given the planning horizon in which to implement the project. There is potential in the development of small-scale aquaculture, but the project requires more time and injection of human and physical capital resources to achieve its goal of improving food security and human welfare.

RECOMMENDATIONS

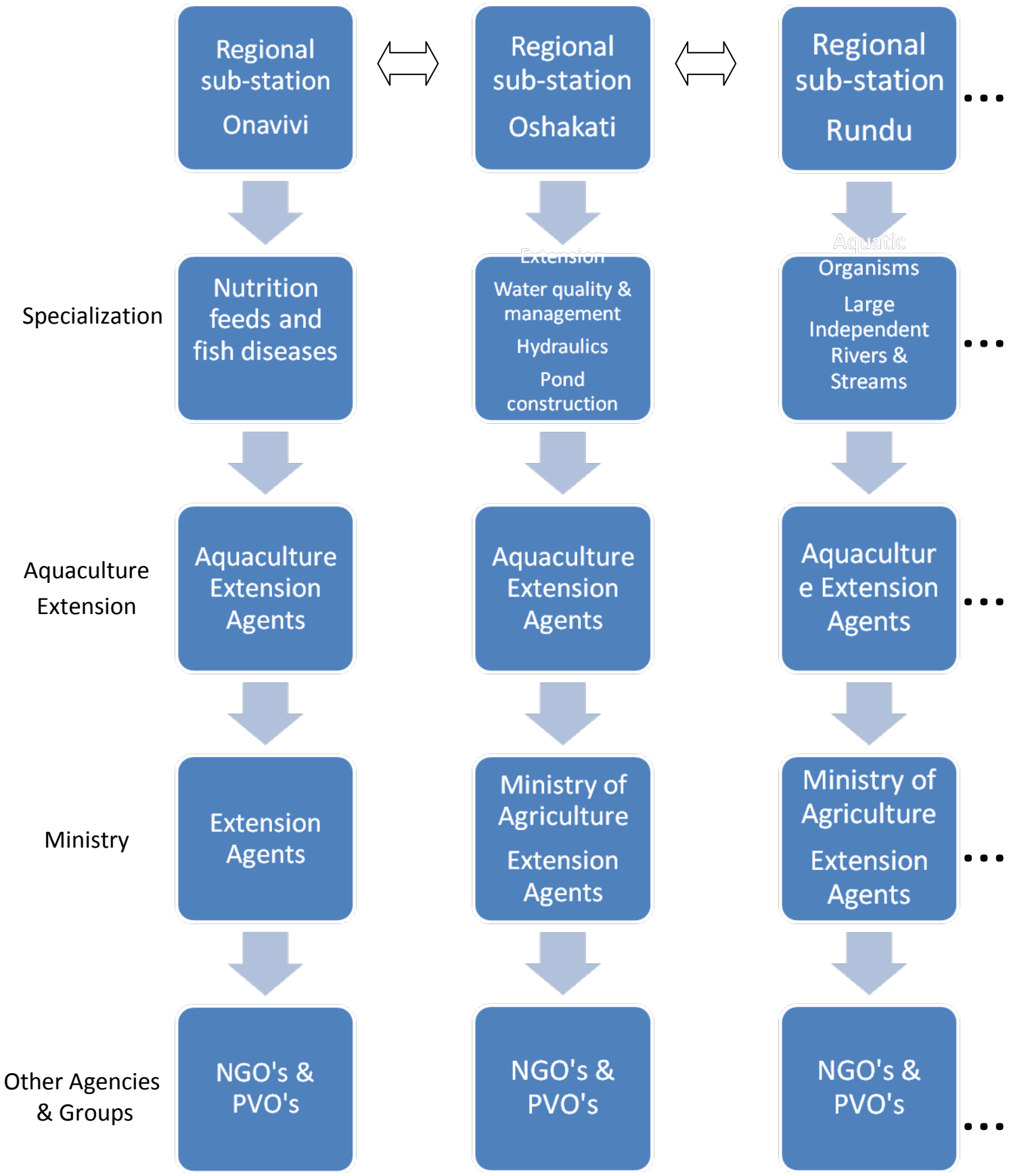
1. Increase the number of extension specialists to include individuals trained at least with Masters' degrees in :
   a. Aquaculture Extension and Management,
   b. Economics of Aquaculture,
   c. Pond Construction, Water Quality and Hydraulics,
   d. Hatchery and Nursery Management,
   e. Fish Nutrition, or
   f. Fish Diseases and Epidemiology.
2. Increase the number of extension agents to one per region.
3. Collaborate with the Ministry of Agriculture extension service to train individuals in aquaculture during a three-month period and encourage these individuals to include aquaculture in their program.
4. Examine the construction of ponds to allow the holding of fish for a longer period of time and to prevent flooding and loss of fish. Increase the slope gradient to minimize erosion and to reduce pond maintenance costs.
5. Stocking fish earlier in the season, maybe in November and December, and follow a distribution pattern based on physical risks and farmers' production cycles.
6. Increase production levels by stocking male-only tilapia. Also, try to reduce the mortality of fingerlings and larvae of catfish. A study on sex reversal of tilapia should be given priority.
7. Extension should organize their efforts and focus on making fish production relevant to the needs and environment of Namibia.
8. Given the current economic situation and the level of human capital, the system should be reorganized so that each sub-station becomes autonomous but specializes in one major activity. For instance, the Onavivi/Omahenene sub-station should concentrate on selection and breeding of fish and feed production. However, fish production and all the other functions should continue. At the Oshakati sub-station, they should concentrate on extension, emphasizing technology diffusion, economics and management. At

Rundu, efforts should continue on the ecological evaluation and identification of local species for various uses, while all the other functions continue. At HARDAP, research on nursery and hatchery management should be the main thrust and efforts should be made to continue the other functions. The other region should concentrate on hydraulics, water quality and pond construction (see Figure 2).

9. Examine the quantity and quality of data collected on fish production and fish farming activities. At present there is no way of obtaining information on the number of farmers engaged in fish farming.

10. A mix of small-scale and large- to medium-scale aquaculture may be more appropriate for advancing aquaculture development in Namibia. There are possibilities for exploring water harvesting and use on a much larger scale in the project area. The regulations governing ground water exploitation should be given immediate consideration.

Figure 2: Proposed organization of aquaculture field operations.



BACKGROUND:

Based on the strategy of improving rural livelihoods in Namibia, GRN, with assistance from the Spanish government and the Xunta de Galicia, initiated a project to improve food security and alleviate poverty through the development of various components of rural sectors, including fisheries and aquaculture in 2003/2004. The potential for aquaculture production in Namibia has been recognized. It was estimated that only about one-third of the available water area is currently used for aquaculture purposes. In order to support freshwater fish culture development in the northwestern part of the country, the government established the Inland Aquaculture Centre (IAC) in 2004 under the MFMR with the major responsibility of developing suitable freshwater aquaculture technologies including fish breeding, seed production, training and research to meet domestic requirements. At that stage, support was extended by the Spanish Agency for International Cooperation (AECI) and MFMR to this sub-sector through a technical assistance project "Aquaculture in Northern Namibia (ANN)" since April 2007 and continued until February 2009.

The project is included within the cooperation framework established between MFMR of Namibia, the AECI and the Xunta de Galicia (CETMAR), in accordance with the commitment undertaken at the Fourth Hispano-Namibian Bilateral Commission to provide technical and financial support for feed production for the development of continental aquaculture. As a result of the commitments adopted at the *Third* Hispano-Namibian Bilateral Commission signed on 21 June 2002, the project entitled "Centre for Continental Aquaculture Reproduction and Production in the Pilot Phase and Training in Northern Namibia," was officially successfully implemented in March 2006 and transferred to the MFMR.

This project consisted basically in the construction and start-up of a Continental Aquaculture Centre - the Inland Aquaculture Centre (IAC) - in Omahenene, in the Omusati region. The centre has several functions. The project aimed to support the development of the continental aquaculture of native tilapia and catfish species through small-scale rural aquaculture. The project enhanced the capacity of IAC and the Oshakati Extension Office in the field of applied research and organized training for technical staff at the centre and fish

farmers. As a result, several freshwater aquaculture technology packages were modified and adopted by the project and made available for its transfer to the end users.

PROJECT OBJECTIVES AND THEIR RELEVANCE

The project goal remained the same throughout the five years of project activity even though the life was divided in two parts, 2003/2004 to 2007 and from 2007 to 2008. The goal of the first phase was:

To guarantee food security for the target population through the sustainable development of extensive inland aquaculture systems and the provision of the equipment, know-how and training needed to ensure the sustainability of the project.

Therefore, four specific objectives were established:

- Rearing fingerlings to supply fish farmers' ponds,
- Restocking of lakes and other freshwater reserves,
- Development of a semi-intensive pilot section for fish production, and
- Training of fish farmers and technical staff at the centre.

The goal changed slightly during the second phase to include the contribution to sustainable development of rural aquaculture in Namibia.

The objective for the second phase is the development of small-scale rural aquaculture in the northern Namibia based on the principles of productivity, efficiency and sustainability.

The specific project objective was to develop small-scale rural aquaculture in the Owambo region (Omusati, Oshikoto, Ohangwena and Oshana) based on the principles of profitability, efficiency and sustainability. This included the strengthening of the extension system and technical services; guaranteed the production of fingerlings in sufficient quantity and quality to satisfy the demand of small-scale rural aquaculture farmers; guaranteed supply of suitable feed at a price that is affordable and profitable for small-scale aquaculture farmers;

and improved the capacity and technical training of technical civil servants and aquaculture farmers involved in the development of aquaculture in the area.

Comment

The project goals were relevant but ambitious. The planning horizon for fish to assist Namibian to attain food self-sufficiency was too short. Small-scale aquaculture production requires more time and technology diffusion to make any significant contribution to Namibian farmers' welfare.

PROJECT DESIGN

The first phase was based on the development of a desirable stock for the long-term production of fingerlings to satisfy farmers' needs to restock lakes, reservoirs and water bodies. To produce a breeding stock of catfish and tilapia, which would be used for fingerling and food fish production, ponds had to be built for rearing brood stock and for the growing of fingerlings. Buildings were built and equipment was acquired. A semi-intensive production unit was put in place and fish production started. Selection of a fish appropriate for the program began by collecting wild stock for inclusion into a breeding program.

Staff and security were brought in and houses were built to accommodate staff. The staff had to secure brood stock from the wild. The selected brood stock was used to produce fingerlings to distribute to farmers, to stock in water bodies and reservoirs, to set up a semi-intensive pilot farm. The farmers who received the fingerlings were to be monitored. The stocking of water bodies was put on hold and the pilot farms were developed.

The second phase was a continuation of the first phase, but the design varied and included the wide distribution of fingerlings and the growing of fish. This involved the development of an extension system, the improvement of fingerlings, the putting into place of a feed mill to produce feeds from local raw materials and the enhancement of the IAC professionals.

The two phases seemed well designed given the time frame for planning and execution of the project. The planning phase was rather short and required the initiation and implementation of a number of activities to ensure the success of the various stages. The placement of structures was well executed but the establishment and functioning of the extension system and the various activities took longer than anticipated. The training of farmers also required a considerable amount of time. The time allocated for fingerling improvement was limited. The training of the staff and technicians extended over the planning period.

Comment

The plan for the development of the two phases was prepared in detail and the execution was initiated in a relatively short time. However, there was no appropriate technology package for extension. At present, extension agents are supplied with a modified extension package and has yet to be rigorously tested under Namibian conditions. The training of extension personnel was rather inadequate and the number of extension agents to cover all the regions was grossly insufficient.

PROJECT IMPLEMENTATION

The second phase of the project hinged on the support and participation of the existing institutions and the Oshakati Extension Office to improve the quantity and quality of technical support provided to farmers; the IAC for strengthening the production system and improving the quality of seedlings and start the feed production using local material; and increasing the training capacity of the IAC to improve the technical capability of the service personnel and technical staff at the facilities. The project included technical assistance that was solicited from the Spanish cooperation. The Spanish technical assistant was required to work with a local counterpart to improve the performance of their activities and to enhance the sustainability of the project. The local counterpart was supposed to be furnished by the MFMR as the institution responsible for the Oshakati Extension Office and for the Epalela aquaculture facility. A project

management and monitoring committee was supposed to be set up with representatives from the IAC management, one from the MFMR, the Spanish coordinator of the project, one CETMAR representative, one AECI representative and one representative of the Xunta de Galicia. The GRN was supposed to appoint an intermediary in the Omusati region responsible for the technical management of the project.

The design of the project included a technical director who was an aquaculture expert and who was to coordinate and execute project activities. The CETMAR was to provide support to the PTD.

The viability of the project was dependent on low-cost techniques, equipment and machinery. Genetic improvement of local stock and feed production from local material were to contribute significantly to project success. The technological packages to be disseminated had to be appropriate to local conditions.

The implementation of this new project phase was based on the application of low-cost aquaculture technology, and the use of rudimentary techniques adaptable to small-scale aquaculture while increasing the productive capacity of limited-resource farmers. The project was designed to demonstrate equitable distribution of resources across gender lines and to include significant numbers of women. Measures were to be put in place to ensure an absence of discrimination against women. The extension agents were to ensure that women's participation was encouraged through training and methodology adaptation. Women were to be included among extension agents.

Practices selected to improve aquaculture production were to be ecologically friendly. All practices adopted in this phase had to be environmentally sustainable. The size of farms and the species used had to be in accordance with project design.

The project design included institutions, previous aspects of the first project phase, farmers and other relevant organizations. The project included various issues such as cultural patterns in the area, gender and environmental issues.

In spite of the clever design of the project, there were some organizational and management set-backs. The local counterpart was not available at the initiation of the project.

It is unclear whether the technical advisor and the local counterpart worked in harmony to ensure that project activities were implemented in a timely manner. The extension office in Oshakati never became fully operational and staffed as anticipated. The project implementers experienced a number of technical constraints.

The main technical constraints seemed to be water availability year-round to produce fish. Farmers claimed to be having water for a period of three to seven months after stocking their fish. The length of the season seems adequate to grow a crop of tilapia to a decent size if the quality of fingerlings and quantity and quality of feed are appropriate. However, there are a number of factors that may affect the growth of fish during the period. The fish are stocked in March but the temperature begins to drop in June. Such low temperatures increase the amount of feed required for body, maintenance and growth. Hence, growth rate is reduced during these months. The temperature begins to rise but by that time the water level begins to drop; thus affecting the farmers' decisions to harvest before the fish attain a weight of 200 g.

Catfish production suffers because of a lack of water. Catfish require an extended growing season to attain a harvestable size of 1.0 kg . At present the lack of water reduces the number of farmers who grow catfish even though producers indicated that the African catfish is a highly desirable fish.

Most of the ponds used for fish production are merely some dugout holes that are not designed to capture or deflect surface water flow. There is an absence of banks or drainage system for water diversion. The farmers interviewed indicated that their ponds are flooded every other year and there is considerable fish loss from overflowing from the pond banks. Also, a number of other invasive species enter the ponds and add to the biomass, which some farmers think is good but constrains operational efficiency.

The breeding of tilapia in ponds is not controlled. After three months of stocking the tilapia multiply and the number of fish in the ponds increase but the growth of the fish is retarded. This poses a number of technical problems. One is that farmers are unable to know

the number of fish in a pond at a given time. Hence, they are unable to determine the amount of feed to place in the pond or to calculate the feed efficiency ratio. This also poses other problems related to water quality and the risks associated with present stocking density. At harvest the size of fish vary from a few marketable sizes to a large number of small fish.

Financial Access

Financial access for expansion seemed to be a major constraint. Funds are needed for pond and enterprise expansion. Farmers revealed that would like to have access to capital for the construction of ponds, the purchase of pumps for obtaining water and the acquisition of working capital. The rural financial institutions are not yet fully geared to finance aquaculture enterprises. A fisheries officer indicated that they have been working with the credit banks to prepare them to service aquaculture enterprises, but currently no one knows of the number of farmers serviced by these rural banks.

PROJECT OUTPUTS

The outputs included a selected brood stock, improvement of fingerlings, trained technicians, an operating extension system, trained farmers producing large quantities of fish and a data base generating information on farmers engaged in the production of fish. The selection of brood stocks is an ongoing activity. The improvement of fingerlings depends on the quality of brood stock developed.

The improvement of the extension system requires an action plan to execute the program. The action plan includes supplying a trained technician and a list of practical and theoretical courses, ad-hoc training courses for extension and seminars and workshops. The project also included the provision of a data base. The data base was required to monitor farmers and their fish ponds and to enable extension to monitor farmers and their practices. This involves the distribution of quantity, size and stocking rate, and the follow-up with farmers to provide assistance at a given time.

The MFMR project goals had an expectation of reaching 500 fish farmers by 2010. So far the project has listed 700 farmers and can be said to be overachieving its target. According to the data base information there are about 800 farmers listed. However, the list of farmers is cumulative and includes all those who received fingerlings from the extension service once. There is no information on famers who survived the first season and continued to produce fish over a sustained period. There have been no follow-up surveys on adoption and management of the fish farms stocked during the first year of stocking.

One major problem is the presence of large numbers of seasonal farmers. Farmers stock tilapia and harvest during a single season. In some countries, farmers produce up to 2.5 crops during a single year. This means that farmers can lower per-unit fixed and total costs of production since they are producing more fish per total investment. Added to this is that the number of ponds is relatively small and the average sizes are less than 200 square meters. The number of tilapia stocked per area is about 1000. If we estimate the size of fish to be 0.4 kg and assume that only 300 farmers are actively engaged in production using recommended practices, then the quantity of fish produced per season approaches 120000 kg. Even if we assume that twice the number of farmers was practicing fish culture we would be far from goal attainment. This quantity of fish is too lowto assist the project in meeting its goal of food self sufficiency in the near future.

The project was expected to produce a quality feed based on the use of available raw materials. This activity involved the formulation and manufacturing of different types of feed to meet the nutritional requirements of the various fish species. So far feed production has only been done on a trial bases.

Comment

It is hoped that once previous purchased stocks of feed from South Africa are utilized the mill will begin operating at full capacity. It is hoped that once fish business is on the rise, private venture will replace state-owned fish mills.

FINANCIAL MANAGEMENT

Funds given to the project were well managed. The budgetary matters were executed with transparency and timeliness. A number of students and supervisors received training under this project. Anaudit carried out at the end of the project's second phase stated that "the affairs of the project were carried out with transparency and near accuracy." Most of the funds were spent in Namibia other than funds for equipment and machinery not available in Namibia, and feeds purchased from South Africa. Hence, there was not much drain on foreign reserves and the project implementation added to the local economy. There was over-spending on some line items, but under-spending of other items. The differences were made up with value added tax (VAT) funds. There were some difficulties in money transfers and making adjustments for exchange rate changes, but the problems were manageable. In terms of cost effectiveness, the budgets were executed in detail. The development of infrastructure in stage one was great but the extension effort still is in its embryonic stages and cannot be effectively justified based on funds utilized and fish farmers' levels of production.

Comment

Efforts should be made to increase fish production at the farm level rather than simply registering large numbers of fish farmers. A few farmers efficiently engaged in the production of fish from which they receive considerable financial and nutritional benefits may serve as leaders for other innovators and lagers.

PROJECT EFFECTS AND SUSTAINABILITY

Most of the farmers indicated that they sold part of the fish harvested, consumed some and gave neighbors some as gifts. Few farmers revealed that they sold limited quantities of fish to their neighbors but indicated that, if production increased, they would be willing to sell more. The production of fish from aquaculture is a new alternative for farmers in the area but the quantity produced is too small to have a measurable impact on nutrition in the project area.

Fish production in a given area may result in the development of backward and forward linkages. The development of fish production in the local area has had little effect on other businesses in the project area since only a small amount of fish being produced.

There is great possibility of integrating fish culture into the farming system. The use of farm product waste for feeding the fish may help improve sustainability and reduce production and financial risks. Fish-cum-animal and cereal production seems possible. Fish-cum-vegetable and fruit production may also help improve sustainability. As most farmers indicated, all is dependent on water use and availability.

Fish production seems to be a good enterprise for group participation and can be used to bring vulnerable and under-represented societal groups to participate in main stream activities. The production of fish has extended to groups such as those suffering with HIV/AIDS and orphanages. It provides a support for those in need.

Fish production in the project area may have a positive effect on other enterprises in the area. At present production is too small to notice any measurable effects on communities or the households.

The production of fish in the production area will be sustainable since local stock is used for breeding, but the production of improved fingerlings is done at a cost and, unless subsidized by government, will not continue in the future. Hence, the sustainability of the project is vulnerable because, unless there is institutional support, aquaculture will again disappear. Environmentally the project is sustainable since the production of fish in its present form is based on rudimentary practices that are environmentally friendly. The small ponds do not require much disturbance of the environment. Since most of the water dries out before the end of production cycle there may be little problem of pond bottom residues being drained or released in streams or on fields.

Comment

The production of fish seems sustainable if the water and fingerling problems are resolved.

LESSONS LEARNED AND FUTURE OPPORTUNITIES

The implementation of a project can take place in a given time if Namibians are motivated. The placement of the facilities for fish production has been done during the required time but the initiation, execution and operation of the extension system requires more time. Hence, future development of programs requires a longer planning horizon.

The development of a program in which human beings are involved requires the selection of the best individuals who are willing to take on new initiatives. It also involves human capital development, which is pretty costly.

The physical environment and climate influence the selection and development of fish brood stock that are locally adapted since floods may introduce new genetic material which may not be desirable. The selection of such brood stock may be compromised by the lack of control of invasive species. However, farmers are likely to stock species washed downstream from floods, which may increase their total production, but not necessarily their production efficiency.

The data base is only as good as the information entered. The use of the data should dictate the quality and quantity of data collected. Unless the data forms are designed to capture the essentials of fish culture and care is not taken to consistently monitor the collection and entry of data, the collected data may become a costly and useless exercise.

The diffusion of aquaculture technology in Namibia can be enhanced by using a few demonstration farmers who are able to earn their livelihood from aquaculture as a single enterprise or integrated into the farming system. There is potential for the expansion of aquaculture in Namibia but the progress hinges on the diffusion of appropriate technology, the production of uniform seed and the harvesting and use of water resources.

FUTURE PLANS

Future plans should be engaged in activities with the highest pay-off. This would involve searching for the type of aquaculture that would allow a sustainable livelihood to household members. That is, aquaculture production should provide household family members the highest and best living standards possible. It is also important to examine the future direction of commercial aquaculture. The levels of activity in the end of project status (Table 1) should approach 100 percent to determine project success.

Table 1: END OF PROJECT STATUS

End of Project Status				
Activity	Goals Set	Indicator	Level of Achievement	Comment
1. Improve the contribution of aquaculture to food security.	1. Number of rural households benefiting from Aquaculture. 2. Minimize poverty levels of targeted households.	500 household 1 %	40 % Achieved	The number of households is large but the level of production still low.
Promote aquaculture development.	fish farms operating % Contribution to GDP	75 1%	20 % Achieved	There are more than 75 households practicing fish farming, but individual production is low.
Contribute to the sustainable development of rural aquaculture in northern regions in	Increase in the number of rural households that engage in aquaculture as part	Increase in average productivity of households by 30%	30 % Achieved	Households are practicing aquaculture but their productivity

Namibia.	of their rural productivity			has not increased by 30% in two years.
Improve the productive capacity of small rural aquaculture farmers based on the principles of productivity, efficiency and sustainability in northern regions in Namibia (Omusati, Oshikoto, Ohangwena and Oshana).	Production per pond in the large regions is increased; technical capacity of rural aquaculture farmers is increased	Kg of fish is increased by more than 50% The technical capacity of farmers is increased by 70% because of extension	60% Achieved	Productivity has increased slightly. Farmers' knowledge of fish farming has increased. Farmers have a basic booklet but the farmers are still dependent on extension for making minor decisions.
Strengthened and improved the extension and technical assistance services for rural aquaculture farmers.	Farmers receive technical assistance A data base of all farmers exists	30% of farmers receive technical assistance during the first year The existence of a data base	60% Achieved	Farmers receive technical assistance, but the level and frequency of assistance is unknown. A data base is developed. The quality of the data set is questionable.
Guaranteed the production of fingerlings in sufficient quantity and quality to satisfy the demand of rural fish farmers.	The IAC produces 700,000 fingerlings in year-two of the project and 1,000,000 in year-three	The tilapia fingerlings are produced, but the number of catfish fingerlings is still inadequate	70% Achieved	There are problems with catfish fry survival. This can be reduced by improving handling at the egg and fry stages. Improvement of sanitary

				conditions has been recommended.
Guaranteed supply of efficient feed of affordable prices and portable for small aquaculture farmers.	Farmers who purchase fish from the IAC will be able to purchase feed at affordable prices	About 50% of farmers will be able to obtain feed	80 % Achieved	Feed has been available from imports. The capacity is present for producing sufficient feed for local needs.
Improved preparation and technical training of technical civil servants and aquaculture farmers Involved in the development of aquaculture in the area.	The officers have received training courses to qualify them for performing their functions	Staff, extension agents and farmers received technical training	80% Achieved	Training has been conducted but the number of individuals trained is unknown.

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Centre Inland Aquaculture (IAC) IAC Project Technical Report. 2006.

Appendix Table 1.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.

NAME	POSITION TITLE
Curtis Jolly	Alumni Professor
eRA COMMONS USER NAME (credential, e.g., agency login)	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Jamaica School of Agriculture, Jamaica	ASc	1973	Agriculture (Hons)
Tuskegee University, Alabama	BS	1976	Animal Science
Auburn University, Aubum, Alabama	MS	1977	Agricultural Economics
Louisiana State University, Baton Rouge, LA	PhD	1980	Agricultural Economics
George Washing Univ., Washington, DC	Univ. Fellow	1989-90	Applied Statistics

A. Positions and Honors. List in chronological order previous positions, concluding with your present position. List any honors. Include present membership on any Federal Government public advisory committee.

Positions and Employment

1976-77	Research Assistant, Auburn University, Auburn, Alabama
1982-85	Research Assistant, Louisiana State University, Baton Rouge, Louisiana
1986-87	Advisor, Institute Senegalais de Rescherche Agricole, Senegal
1986-87	Farming Systems Economist, Institut de l'Economie Rurale, Bamako, Mall
1980-87	Assistant Professor, Auburn University, Auburn, Alabama
1988-98	Associate Professor, Auburn University, Auburn, Alabama
1998-Present	Professor, Auburn University, Auburn, Alabama
2004-2006	Professor/Interim Chair, Department of Agricultural Economics and Rural Sociology
2006- present	Alumni Professor/Chair

Other Experience and Professional Memberships

Member, Educational Committee, Auburn University Credit Union, 2000

Promotion and Tenure Committee, Auburn University, 1999-2001

Chair and Member, Committee for Persons with Disabilities, 1995 to present

President, Auburn University Black Caucus, 1994-1995

Member, Cultural Diversity Committee, 1994 to present

Member, President's Minority Affairs ad hoc Committee, 1994-present

Member, President's Minority Education ad hoc Committee, 1994-present

Honors

- **Expert Consultant** on the Assessment of Socio-economic Impacts of Small-scale Aquaculture, FAO, Vietnam, November 2009

- **Expert Consultant** on the Assessment of Socio-economic Impacts of Small-scale Aquaculture, Ankara, FAO, Turkey, 4-8 February 2008

- **Outstanding Leadership Award, for contribution to West Africa Bio-safety Workshop, Tuskegee University, 2007**
- **Recognition for Contribution to Economics of Peanut Production in Bulgaria**, by the National Centre of Agricultural Sciences Institute of Plant Genetic Resources, Sadovo, Bulgaria, June 2007
- **International Educator Award**, Greater Birmingham Chapter, UNA/USA, 2007
- **Outstanding Minority Achievement Award**, Auburn Alumni Association, 2006
- Gama Sigma Award-Tuskegee University, 2005
- Member of the Board of Directors Auburn University Credit Union-2OOl-present

B. Selected peer-reviewed publications (in chronological order).

Jolly, C. M., and T. Kusumastanto. Socio-economic and Environmental Consequences of Public and Private Investment in Shrimp Aquaculture: The Case of Indonesia, *International Journal of Ecological Economics and Statistics (IJEES)* (Vol. 14.):47-66.

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Keefe, A.M., and **C. M. Jolly**. "Price Flexibility and International Shrimp Supply." *Aquaculture Economics and Management*, Vol. 5, No. 1&2, (2001):37-48.

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Appendix Table 2.

Terms of Reference (TOR)

For

Impact Evaluation of ANN Project

Post Title: **Rural Aquaculture Development (Impact Evaluation) Expert (International)**

Location: **Oshakati Extension Office and Omahenene Inland Aquaculture Centre (IAC)**

Duration: **Two weeks (March 2009)**

BACKGROUND:

The Government of Namibia gives priority on food security and poverty alleviation through developing various components of rural sectors including fisheries and aquaculture. The country has magnificent potential for the development of aquaculture. It was estimated that only about one third of the available water area are currently in use for aquaculture purposes. In order to support the freshwater fish culture development in the North Western part of the country, the government established the Inland Aquaculture Centre (IAC) on 2004 under the Ministry of Fisheries and Marine Resources (MFMR) with the major responsibility of developing suitable freshwater aquaculture technologies including fish breeding, seed production, training and research to meet the domestic requirements. At that stage support was extended by Spanish Agency for International Cooperation (AECI) and MFMR to this sub-sector through a technical assistance project "Aquaculture in Northern Namibia (ANN)" since April 2007 and will be continued until February 2009.

The project is included within the cooperation framework established between the Ministry of Fisheries and Marine Resources (MFMR) of Namibia, the Spanish Agency for International Cooperation (AECI) and the Xunta de Galicia (CETMAR), in accordance with the commitment undertaken at the Fourth Hispano-Namibian Bilateral Commission to provide technical and financial support for the construction of a fish feed production centre for continental aquaculture. As a result of the commitments adopted at the *Third* Hispano-Namibian Bilateral Commission signed on 21 June 2002, the project entitled "Centre for Continental Aquaculture

Reproduction and Production in the Pilot Phase and Training in northern Namibia", was officially successfully implemented in March 2006 and transferred to the MFMR.

This project consisted basically in the construction and start-up of a Continental Aquaculture Centre - the Inland Aquaculture Centre (IAC) - in Omahenene, in the Omusati region. The centre has the following functions:

- Produce tilapia and catfish fingerlings to supply small fish farmers in the area.
- Rearing of both species in a semi-intensive system in the pilot phase
- Training technical staff at the centre and fish farmers.

The project aimed to support the development of the continental aquaculture of native *tilapia* and catfish species through small-scale rural aquaculture. The project enhanced the capacity of IAC and Oshakati Extension Office in the field of applied research and organized training for technical staff at the centre and fish farmers. As a result several freshwater aquaculture technology packages were developed by the project and made available for its transfer to the end users.

PURPOSE:

- Analyzing the intervention of the Spanish Cooperation in the aquiculture sector in Namibia since 2003 till 2009.

- This evaluation should allow the relevant actors to know whether the actions and objectives planned in the implementation documents have been achieved and the reasons of differences if existence.

- This report should accomplish information regarding design, coverage, and impact of the project on the region. It should also address issues concerning participation of counterparts, implementers and any other relevant actors involved. An analysis of the management and administration of funds, human resources and equipment as well as staff capacity and participation will be needed.

The Consultant will:

1. Draw lessons from the project's experience for possible application in other regions. This should include both development/extension aspects and project implementation under the Spanish Cooperation programme.
2. Provide comments and recommendations regarding:
   - The direction of future interventions similar to this project.
   - Means to enhance the sustainability of project interventions/activities.
   - The government's capacity to implement an aquaculture development strategy that is self-sustaining and that can be replicated in other parts of the country.

SCOPE OF THE EVALUATION:

Appropriateness and coherence: Adequacy of objectives, strategies and results in the contexts of the interventions and priorities of the Government of Namibia.

Impact: Analysis of positive and negative intervention effects on the areas of influence, at local and regional level. Establishing the reasons of to those effects to provide lessons to be learned. Real Improvement of live conditions, coverage of the intervention, institutional development, capacity built among the staff, and visibility of the Spanish cooperation.

Feasibility: Analysis of the probability of counterpart maintaining the plant and production centre in good conditions and profitably after Spanish Cooperation intervention is finished.

Analysis of participation and coordination of institutions and centers involved. Analysis of capacity needs for workers and local counterparts. Analysis of responsibilities, budget and actions to be taken to ensure the sustainability of the project.

The Consultant will assess the:

1. Relevance of the project to development priorities and needs taking account of:
   - The "capacity" of the government staff within MFMR and the regional fisheries services,
   - The appropriateness of the project, with respect to the resource base and socio-economics of North-West Regions rural livelihoods.
2. Clarity, and reality of the project's development and immediate objectives, including specification of:
   - Targets and identification of beneficiaries and prospects for sustainability.
3. Quality, clarity and adequacy of project design including:
   - Clarity and logical consistency between, inputs, activities, outputs and progress towards achievement of objectives (quality, quantity and time-frame);
   - Reality and clarity in the specification of prior obligations and prerequisites (assumptions and risks);

- Reality and clarity of external institutional relationships, and in the managerial and institutional
- Framework for implementation and the work plan;
- Cost-effectiveness of the project design.

4. Efficiency and adequacy of project implementation including: availability of funds as compared with:
   - Budget for both the donor and national component; the quality and timeliness of input delivery by both AECI, CETMAR and the Government; managerial and work efficiency; implementation difficulties; adequacy of monitoring and reporting; the effectiveness of the co-ordination mechanism between CDC (Constituency Development Council) and RDCC (Regional Development Constituency Committee) levels related to project implementation; the extent of national support and commitment and the quality and quantity of administrative and technical support by AECI.
5. Project results, including a full and systematic assessment of outputs produced to date (quantity and
   - Quality as compared with work plan and progress towards achieving the immediate objectives with reference to the indicators and success criteria listed in the project document), including:
   - Development of Government and local staff (MFMR) capacity to identify, plan, implement and monitor small-scale rural aquaculture projects,
   - Extent to which project outputs have been or will be utilized by other rural development projects and the Government
   - Extent to which gender aspects and equity issues have been adequately addressed.
6. The prospects for sustaining the project's results by the beneficiaries and the host institutions after the termination of the project, including :
   - To what extent are the capacities of the human resources developed within the project being used effectively, (including the fish farmer groups trained under the project)?
   - Will the Government be willing and/or able to operate and maintain the facilities renovated/installed by the project (e.g. Government's commitment in terms of management and staff resources, physical facilities and equipments)?
   - To what extent are the techniques and methods used by the project, appropriate and transferable within rural communities of Namibia
   - What, if any, are the potential environmental impacts of the project?
7. The cost-effectiveness of the project in comparison with alternative approaches.

The Consultant will also:

8. Undertake a series of evaluations with deployed project office staff members at all time, using a range of participatory, visualization and evaluation techniques. This will include project stakeholders such as farmers, school teachers, local community people, district extension units, project implementation units and mass organisations.

9. Evaluate separately the farmers who were not impacted by the project (both those with aquaculture systems and those without).

Based on the above analysis the consultant will draw specific conclusions and make proposals for any necessary further action by MFMR and/or AECI, CETMAR and other donors to ensure sustainable development, including any need for additional assistance and activities of the project prior to its completion. The consultant will draw attention to any lessons of general interest". *Any proposal for further assistance should include precise specification of objectives and the major suggested outputs and inputs.*

Recommendations will in particular address the following:

a. If project objectives have not being satisfactorily attained, should further initiatives be pursued to attain the objectives? If so, what form of intervention should be pursued (including follow-up technical assistance) and would be recommended? Identify appropriate parties for implementation.
b. If the analysis of project sustainability reveals problems, what are the perceived constraints, and what further actions (including follow-up technical assistance) are recommended? Identify appropriate parties for implementation.
c. If the project activities were to be extended or expanded, what should be the pace for such expansion and whether additional technical assistance (over extent at present) would be required? How could the additional technical assistance be delivered, if so recommended?
d. To what extent do the Executing Agency (MFMR) and co-operating parties (RDCC or CDC, Regional institutions, Constituency and Village farmers) “own” the project? Is the MFMR taking a “leadership” role? If not, what are the factors hindering this and what would be the recommendations to ensure the various stakeholders’ “Ownership” and “Leadership” in project execution?
e. Issues pertaining to AECI’s role in supporting the project and the National Execution process.

OUTPUTS:

The Consultant is fully responsible for its independent report, which may not necessarily reflect the views of the MFMR, AECI or CETMAR. The report will be prepared according to the following outline

a) Executive summary (maximum 2 pages)
b) Introduction

c) Major Findings and Recommendations
d) Background to the Project
e) Project Objectives and Their Relevance
f) Project Design
g) Project Implementation (including Budget and Expenditure)
h) Project Outputs according to the Logical Framework
i) Project Effects and their Sustainability and Impact (including cost effectiveness)
j) Lessons Learned and future opportunities

- The report will be prepared by the Consultant in-country and the findings and recommendations will be fully discussed with all concerned parties and wherever possible consensus achieved.
- The final report will be submitted by the Consultant to AECI/MFMR/CETMAR prior to mission departure from Namibia.
- At the end of the mission, the Consultant will hold a meeting with representatives from MFMR, AECI and CETMAR, to present the findings of his/her report.

Qualifications and experience:

- Post-graduate in aquaculture/fisheries/agriculture or related discipline.
- Proven experience in aquaculture development with emphasis on rural subsistence farming systems.
- Experience of development project evaluation including the use of participatory evaluation techniques.
- Familiarity with logical framework or goal-oriented planning methods
- A minimum of ten years relevant work experience.
- Experience in the African region.
- Fluent in English.

METHODOLOGY:

The evaluation should be done in three phases:

First approach: *The available documentation regarding the project design, implementation, intermediate and final reports will be available for the consultant to get familiarize with the project and its objectives and framework.*

Field work: *Meetings and other exchanges with relevant actors counterparts, beneficiaries, public and private institutions involved in the project.*

***Final Report**: Information to be presented to the Ministry of Fisheries and Marine Resources of Namibia for further discussion.*

The report needs to be submitted in English or Spanish to the Ministry of fisheries and Marine Resources (MFMR) of Namibia.

The maximum budget for the realization of this evaluation will be 6.000 Euros.

The payment will be done after approval of the report and presentation of the invoice.

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