

Potential For Inland Aquaculture Development Along The Kuiseb

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1. INTRODUCTION

The main aim of this project was to investigate the potential of inland aquaculture as a possible land use development for the Topnaar community.

Aquaculture is defined in Namibia's aquaculture act (no.18 of 2002) as the farming and ranching of aquatic organisms. On the popular level, aquaculture is referred to as fish farming. Inland aquaculture utilizes the land, ponds, tanks, and enclosures that depend upon the culturist for maintenance of water quality, food supply and waste removal.

The fish *Oreochromis mossambicus*, commonly known as tilapia, are washed down past Gobabeb when the Kuiseb river floods, but no viable population can survive as far downriver as Gobabeb. The fish survive through the Namib's dry season in small pools protected from the sun by cliffs, far upriver of Gobabeb.

In this report results about the current status of inland aquaculture in the Kuiseb area and other limiting factors like water, technical feasibility of aquaculture, legal issues, and the level of awareness with reference to inland aquaculture in the Kuiseb area will be presented.

Currently Gobabeb is negotiating with other stakeholders and the Ministry of Environment and Tourism to get a concession to build a lodge in the area. This could be a viable market for the community to sell locally-raised tilapia.

The study investigated other limiting factors of aquaculture like legal issues, water-related issues in the area, the community's level of awareness and the current status of aquaculture in the area.

1.1 Study Area

The riverine habitat provides daily needs to the Topnaar community, a Nama tribe who inhabited the banks of the lower Kuiseb river since at least 300 years ago (Budack, 1977). The Topnaar community used to be mainly pastoralists and hunter-gatherers, although today many live and work in Walvis Bay. Their villages are scattered along the Kuiseb on the northern riverbank (Werner 2003).

In former times the Topnaar community used #hamti, fishing baskets or anchored nets (or weirs) made of rushes to catch fish in the Kuiseb river. (Solomon 1855:22; Engelbrecht 1936:12).

2. PROJECT OBJECTIVES

1. To determine what factors are limiting Topnaar adoption of aquaculture: specifically
 - a) Level of awareness,
 - b) Legal issues
 - c) Economic viability (lack of resources or markets)
 - d) Technical feasibility
2. To assess current status of aquaculture in this area.
3. To assess the environmental sustainability of aquaculture.
4. To assess the use of recycled water for fish production.

3. METHODS

These are the methods undertaken during the in-service in order to achieve the necessary information needed for the project. Observations of community aquaculture practice, interviews, and questions in the household surveys and detailed interviews were used to gather information on the viability of aquaculture for the community. A trial pond was constructed to gain insight into the technical feasibility of aquaculture in the Kuiseb.

3.1. To determine what factors are limiting Topnaar adoption of inland aquaculture

3.1.1 Level of awareness

Two questionnaires were used during the interviews. A scheduled interview was conducted with two residents and three labourers at Gobabeb (see Appendix 1). Two key informants interviewed: Chief Seth Kooitjie, the Topnaar traditional leader, and Joel Kooitjie, the area's agricultural extension officer.

The main purpose was to find out more about community awareness of aquaculture in the Kuiseb area and to find out what they are promoting for development. (Refer to Appendices 2 and 3).

In addition, questions (refer to Appendix 4) were asked of a sample of 30 people chosen at random from all 16 settlements. This study was conducted with other GIST students (see Munsu, this volume). The point of this study was to find out in more detail how much the community knows about inland aquaculture, whether they will consider raising fish in the Kuiseb, and also other development issues.

3.1.2 To determine the legal issues that might be limiting inland aquaculture

The department of aquaculture in the Ministry of Fisheries and Marine Resources at Swakopmund was visited and different manuals stipulating inland aquaculture policy and act were reviewed.

The Ministry of Environment and Tourism was also visited since they are responsible for the management of the Namib Naukluft Park.

3.1.3 Market research on viability of inland aquaculture

In late March 2006 a structured interview (average time: 15 – 25 minutes) was conducted with 4 lodge owners in Walvis Bay. A questionnaire was combined by one agriculture student and myself (see Appendix 5). The purpose of the study was to identify potential market for freshwater fish and vegetables raised in the Kuiseb area.

3.1.4 Technical feasibility

The small trial pond, 3m x 2m x 0.5m deep, was constructed in March this year to assess the technical feasibility of aquaculture in the Kuiseb.

The pond was divided in three layers. One pond was filled with freshwater from the Gobabeb borehole and two ponds were filled with the recycled water from the trickle filter.

Two feeding methods were used during the study: goat manure (suggested by an aquaculture expert elsewhere in Namibia) and artificial feedstuff. This was in part a measure of economic viability.

Table 1: Layout of the experiment

Pond 1	Pond 2	Pond 3
Artificial feedstuff (pellets)	Artificial feedstuff (pellets)	Goat manure
Recycled water	Freshwater (borehole)	Recycled water

Tilapia (*O. mossambicus*) from the river was used and 10 fingerlings were raised in each pond during the study.

The following instruments were used during the trial: Hand held thermometer, a conductivity meter to measure the salt content in the water, Universal indicator paper, Ruler and balance.

3.2 To assess current status of aquaculture in the Kuiseb area

Interviews were carried out with two pond owners at Gobabeb and also with Chief Seth Kooitjie at Walvis Bay.

The purpose was to find if they know about inland aquaculture, their reasons for undertaking aquaculture, reasons for raising fish, and ask if they have problems with their aquaculture scheme (Refer to the questionnaire used in Appendix 2).

3.3 To assess the environmental sustainability of aquaculture

Interviews were conducted at Gobabeb with two residents to find about their aquaculture system, when the ponds were constructed, maintenance, feeding method used, and pollution problems. (Refer to Appendix 6).

3.4. To assess the use of recycled water

Recycled water was used in pond 1 and pond 3, while pond 2 was filled with the freshwater from the borehole. The main aim was to investigate how well do Tilapia grow and survive in recycled water. Refer to section 3.1.4 for more details on the fish pond.

4. RESULTS

In this study it has been found that awareness of freshwater fish species is not widely developed in the Kuiseb area, when compared to other regions in Namibia like Oshana, Kavango, Caprivi, and Otjozondjupa.

4.1. To determine what factors are limiting Topnaar adoption of inland aquaculture

4.1.1 Level of awareness

During the interviews conducted the key informants mentioned that:

"Young people from the Topnaar community were trained at Gobabeb in agriculture and tourism and they were given certificates for the past 3 years but currently most young people who were trained are not identifying projects in the area. We also have other representatives in the Kuiseb: Nara! Committee, agriculture committee, and use of environment resources committee.

Legal barriers on aquaculture in the area, only from the Ministry of Environment and Tourism, but no other legal rights and for aquaculture development you do not need a lot of land especially here in the park, the traditional leader has the responsibility in its jurisdiction, and when it comes to any development one have to apply to the traditional leader to be given the rights". (*Chief Kooitjie pers.com*) **(Refer to appendix 2)**

"The Topnaar community lack the knowledge about inland aquaculture and there is a lack of information sharing, the community is too reluctant because they can not even maintain small gardens, as an extension officer I am involved in the capacity building, provide training and information especially about livestock production and we have the water point organisation in the Kuiseb area. The community can perform different land use activities like farming, gardening, mining at small-scale, and hunting is also allowed if the community apply to the MET. And I think fishing also, if it's a community based organization—but one have to apply to the MET". (*Joel Kooijie pers.com*) (Refer to Appendix 3).

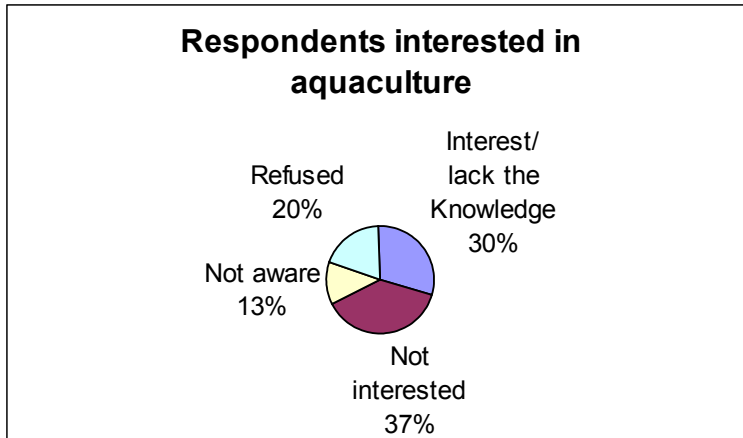


Figure 3. Topnaar interest in aquaculture (n = 30)

Nine respondents mentioned that they are interested. They lack knowledge to start fish farming but they would do it if they get proper training.

Eleven respondents mentioned that they were not interested because of the time and maintenance involved. 6 respondents refused to give comments especially in settlements like Gautanab, Uriras, !Ubas. 4 respondents reported that they do not know anything about inland aquaculture.

All 30 respondents interviewed mentioned that water is the main problem in settlements like Uriras, !Ubas, /Gautanab, and Utuseb, Armstraat where the water was closed off by Namwater due to payment. In settlements upstream like Soutrivier, Homeb, Natab1, 2, Klepnus, Swartbank, the communities only pay for borehole maintenance, and water is not such a problem.

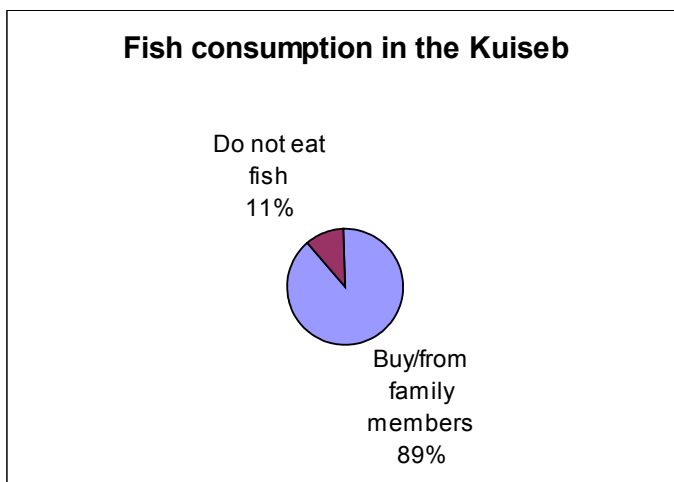


Figure 4. Topnaar fish consumption (n = 55)

49 respondents indicated that they only eat marine fish, which they usually buy or get from family members from Walvis Bay, and not always since there are no shops in the Kuiseb area. 6 respondents do not eat fish because of personal reasons.

One tuck shop which sell groceries was identified at Rooibank but they do not sell fish products, only meat and other foodstuff.

55 respondents said they did not eat the freshwater tilapia found in the Kuiseb because of a lack of knowledge, and because the fish are too small eat. One respondent mentioned that freshwater fish smell worse than marine fish, so he prefers marine fish

4.1.2 To determine the legal issues that might be limiting inland aquaculture.

The Aquaculture Act (no.18 of 2002) states that it is illegal to be involved in aquaculture activities like selling live fish from aquaculture facilities without permission from the Ministry of Fisheries and Marine Resources., Anyone found guilty will be charged a penalty not less than N\$10 000 in addition to any other penalty which may be imposed in respect of that offence.

According to the Aquaculture Act (no.18 of 2002), aquaculture in protected areas is a subject to the specific law governing such proclaimed conservation or protected area.

The Ministry of Fisheries and Marine Resources has set up guidelines considered during the feasibility study for aquaculture venture [can we cite this properly?]. The Ministry of Environment and Tourism in Swakopmund mentioned that the community can apply to the MET if they want to start aquaculture activities in the settlements.

4.1.3 Market research on viability of inland aquaculture

The results are not intended as a quantitative assessment and cannot be statistically projected into the industry at large. The study established that there is lack of awareness when it comes to freshwater fish. 4 lodge owners who were interviewed indicated that they only buy and catch marine fish such as: Hake, Snuck, Kabeljou, Monkfish, King clip, and Eagle fish. 2 lodge owners mentioned that the price for marine fish was expensive—Hake -N\$ 30/kg, and monkfish N\$50/kg—but that sometimes the price fluctuates depending on demand.

The owner of one lodge had this to say: "It's very important to promote inland aquaculture to reduce the pressure on marine resources because they will be finished up one day".

Due to time constraint the following were not carried out: Price survey of fish at small and large retail, and interviews with a sample of commercial fish stores in Walvis Bay was not conducted.

4.1.4 Technical feasibility

30 fingerlings were caught in the Kuiseb river after the February flood. 22 of 30 fingerlings that were stocked in the three layers of the pond survived in the recycled water and freshwater from the borehole.

Algae formation was observed in pond 1 and a high evaporation rate was also observed during the study because no shade netting was used.

The use of goat manure seems to have been poisonous to the fish. It produced green algae in pond 3 and a mortality rate of 80% was recorded in the pond after only two days. The manure was filtered and poured directly on top of the water. This may have depleted the oxygen level in the water.

The fingerlings were fed twice a week Monday and Friday, but it was discovered later that the fingerlings in pond 1 and 2 were not picking up the artificial feedstuff (pellets). The pellets dissolved producing algae on the bottom of the pond.

Table 2 Parameters that have been recorded in the trial fish ponds.

<i>Parameters</i>	Pond 1 recycled water	<i>Pond 2 freshwater</i>	<i>Pond 3 recycled water</i>
PH	9	7-8	11
Temp/°C	18	15	11
Dissolved solids (measure of salinity mg/l)	576	740	770

These conditions play an important role when raising fish and help aquaculturalists to understand the safety of the species cultured.

The readings were captured during the summer period from April-June, I observe that the temperature was almost the same in the morning, midday and evening, but 11°C was recorded when 8 fingerlings died in pond 3 and it was foggy that day. In my opinion the foggy condition affected the fingerlings because they were small.

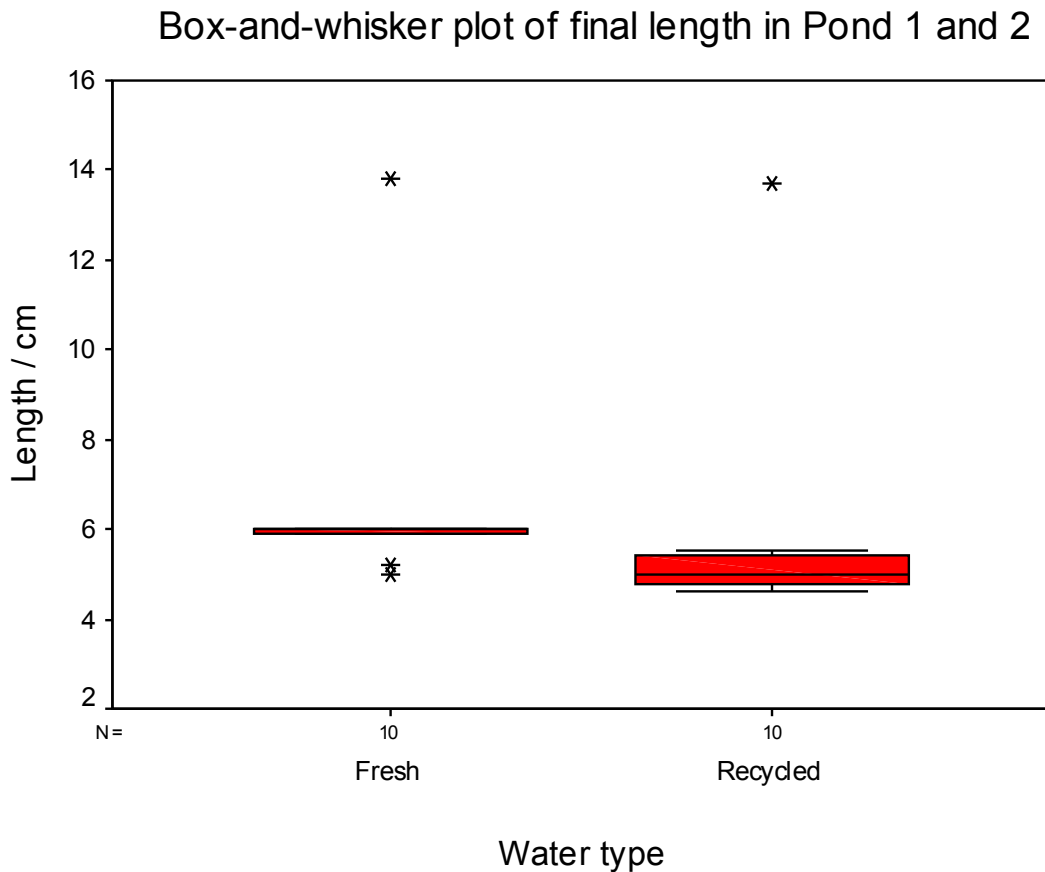


Figure 5. Box-and-whisker plot of final length in artificial feed ponds

The data from the aquaculture trial was analyzed using an independent samples t-test. It clearly shows that there was no significant difference when comparing the

length or weight of fish in pond 1 and 2 ($P = 0.548$ and 0.836 , respectively). Pond 3 was not included in comparisons because most fish did not survive.

4.2 To assess current status of aquaculture in the Kuiseb area

Observations were carried out in all 16 settlements. 1 small pond and 2 reservoirs stocked with tilapia from the Kuiseb were found at Homeb, and 2 bird ponds stocked with tilapia at Gobabeb. (Refer to appendices 1 and 2)

2 residents were interviewed at Gobabeb, the respondents mentioned that the existing ponds in the area was constructed some years ago but they never experienced problems so far and they believe that the mosquito larvae is being reduced, because the tilapia species are feeding on mosquito larvae, but they mentioned that the evaporation rate was very high in the pond (**Refer to appendix.1 & 2**).

4.3 To assess the environmental sustainability of aquaculture

No chemicals were used during the study conducted at Gobabeb, just artificial feedstuff pellets. Some problems were identified in the existing bird pond during the study, poor site selection, fish overcrowding in the bird pond, air pollution and poor drainage causing soil erosion when cleaning the pond.

In general inland aquaculture may only be possible in settlements upstream because in the downstream area there are many competing users and these could also affect the Kuiseb aquifer in the downstream.

4.4. To assess the use of recycled water

20 fingerlings that were raised in the recycled water survived, however 8 fingerlings died in pond 3 when the goat manure was used, and the recycled water did not seem to have an adverse effect in pond 1.

5. DISCUSSION OF RESULTS

During the interviews conducted in all the 15 settlements it was observed that the community lacks knowledge about inland aquaculture: the study established that the Topnaar community are not yet ready for inland aquaculture, because they lack the knowledge for freshwater fish species. In my opinion a better level of awareness is

needed in order to promote natural resources available in the area through training of qualified staff members

The absence of an extension office in the Kuiseb area will affect the development of aquaculture to the Topnaar community: during the detailed interview conducted in different settlements like Amstraat, Klepneus, and Utuseb, respondents mentioned that the extension office is only accessible in Walvis Bay. In other regions in Namibia the extension officers are very close to the community but in the Kuiseb area it is very difficult for the community to get information, since transport is a problem.

Although one needs to have a license to operate aquaculture activities it is not very difficult for the community: they only need to apply to the Ministry of Environment and Tourism to get permission, and the traditional leader will also advise the community about the proposed development, in accordance with law and regulations governing such proclaimed conservation or protected area.

The Department of Aquaculture is responsible for training with other line Ministries involved.

The market study that was conducted in Walvis Bay established that there is a lack of awareness when it comes to freshwater fish and in my own opinion most Shops like Sea pride in Walvis Bay do not sell freshwater fish and that could also be a negative factor for commercial aquaculture in the Kuiseb.

The feasibility study that was conducted at Gobabeb was a bit difficult because of some factors like the changes in the weather condition during the summer period which could also affect inland aquaculture development in the area, and the artificial feedstuff pellets that was purchased in Mariental was expensive. Low temperatures from April to June could also be a factor.

In brief, the current status of aquaculture in the Kuiseb is not promising because the community lacks the knowledge and the skills to practice inland aquaculture. The possibility of integrating aquaculture into irrigation systems should, however, be considered as an option for improved efficiency of water use especially in settlements upstream where agriculture activities are taking place and there are facilities like reservoirs.

During the interview conducted at the station it seem that the residents who interviewed are satisfied with their aquaculture system although they do not benefit

from the pond it shows that water is not a problem at the station and in future they can also use the recycled water. The recycled water that was used during the trial proved to be a good option during the study because the fingerlings that were raised in the recycled water treated with the artificial feedstuff survived just the same as those in freshwater.

6. CONCLUSION

Inland aquaculture is not an easy development especially to the Topnaar community because they do not know much about aquaculture and it will be very difficult to market the product because they lack knowledge about aquaculture development. Water could also be a limiting factor because all settlements along the Kuiseb depend on the underground water from the Kuiseb aquifers.

It is very important to choose aquaculture methods and sites for development in such a way that negative environmental effects are minimized, but through integration with agricultural practices, the existing resources can be used in an efficient way.

7. RECOMMENDATION

The Agricultural Extension services must be closer to the community especially at Utuseb where there are facilities such as Telecommunication, Electricity in order to carry out more research in order to promote natural resources available in the area.

The Ministry of Fisheries and Marine Resources should provide training and educate the local community, especially farmers who are already involved in agriculture in the area to integrate with aquaculture so that they can conserve water.

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