

Clarias (male)—60 cts. per lb. (c.f. Lwampaga 33 cts. per lb.)

Protopterus (mamba)—33-60 cts. per lb., depending on season and distance from main markets.

Tilapia (nandere or ngege)—33-50 cts. per lb.

Barbus (kisinja)—25-50 cts. per lb.

Mormyrus (kasulubana)—30 cts. per lb.

Smoked Fish—

Protopterus (mamba)—Shs. 1/50-Shs. 2 per lb.

SECTION IV.—FISH FARMING

Report by Fisheries Officer

Staff

334. The establishment of the Kajansi Fish Farm was strengthened by the promotion of the Engineering Assistant to the post of Fisheries Development Officer. By the end of the year it had not been possible to fill the post vacated by the Engineering Assistant. It was possible to maintain a Fisheries Development Officer in Kigezi throughout the whole year. The Kajansi staff remained at one Fisheries Assistant and eight Fish Guards, one of whom has been posted permanently to Bukedi and Bugisu Districts in the Eastern Province.

General

335. The year has again been a good one from the point of view of fish farming extension work. Many more ponds have been built and a great many of the builders have been stimulated to do so by the example of their neighbours and friends, by visits to Kajansi, and demonstrations by the Department staff. The demand for assistance has again been considerable, and the small section devoted to fish farming has not been able to visit and advise everyone who has asked. A large number of demonstrations have however been given at Kajansi, and in March, 1957, the first full-scale course was organised which was attended by Community Development Assistants, Local Government and departmental nominees from several districts in Uganda. Greater facilities have been made at Kajansi for fry production and fry resources were well up to demand throughout the year. Many people visited the Fish Farm to collect fry, some of whom came long distances, spending considerable sums of money on hiring taxis and other transport. Work at the Kajansi Fish Farm has been mainly concerned with extending and improving the ponds, replacing buildings of a temporary nature and starting the first full-scale series of experiments.

Kajansi Fish Farm

336. The main constructional work completed during the year has been the modification of the six $\frac{1}{2}$ -acre ponds and the installation of furrows and sluices to the two 2-acre and the one 4-acre ponds constructed during the previous year. All ponds at Kajansi are finished to a very high standard.

Each one has an individual inlet and outlet sluice allowing for complete control of the water levels at all times. Some modifications in the design of the sluices were made in the period. All ponds are now in use for experimental work. A start has also been made in increasing the number of ponds by building one $\frac{1}{4}$ -acre pond and two $\frac{1}{8}$ -acre ponds. It was found that these sizes of pond were required as the experience gained on the extension work had shown that these are the sizes most favoured by African farmers. Due to the extremely heavy rains experienced in the early part of 1957 it was not possible to complete these three extra ponds.

337. The access road begun at the end of the last year has now been completed and joined to the main Entebbe/Kampala road. The work carried out on the drainage scheme for Kajansi during the last period has proved extremely successful and heavy rain caused only slight flooding. No extra staff housing was undertaken but houses for both the Engineering and Fisheries Assistants and permanent quarters for three Fish Guards which were started in the previous year have been finished. A lecture room has been constructed and this has been in use throughout the year and has made teaching much easier. The Fish Farm has again undertaken various minor miscellaneous works for the rest of the Department during the year.

Fish Stocks

338. The fry shortage which took place at the end of last year has now been brought under control and some 50,000 fry have been distributed from Kajansi. This is considerably less than last year and is due to the public becoming aware that it is not always necessary to stock ponds with vast numbers of *Tilapia* for them to be successful. It is now understood amongst fish farmers that a small initial stocking of some 30 fry is ample to ensure production in their ponds. The greatly reduced number of fry given away from the Fish Farm has allowed a start to be made on the experimental programme and some 15,000 fry have so far been used for this purpose. In addition to the supply of fry issued free at Kajansi, several fish farmers who stocked their ponds earlier have entered the fry market and fry are now available for sale in many parts of Mengo at a price of Shs. 1 to Shs. 1/50 each. At a conservative estimate this allows a fish farmer to obtain an income of some hundreds of shillings from his pond often within four months of stocking the original fish. It should be mentioned however that not all pond owners sell fry; there are many progressive fish farmers who give away fry to all comers.

339. Investigation made into fry production at Kajansi during the year showed that one reason for the poor returns of young fish from fry ponds was due to sexual imbalance. It had been assumed, when stocking fish in fry ponds, that the sexes would, by chance, be equally represented. This, however, was found to be not necessarily true. One pond contained 95% males and another pond consisted of 80% females. From the date of

this observation all fish placed in fry ponds for spawning have been sexed before the culture has been set up. This has resulted in a much higher yield of fry. At the same time a trial has been started to investigate whether there is an optimum population density of adults for the production of fry. There was some doubt whether or not *Tilapia zillii* which is primarily a herbivore, was in the habit of eating its own fry when they were present in the ponds in any density. To this end cultures have been maintained containing various numbers of parent fish. These ponds are regularly fished and the number of fry produced counted. So far it is too early to reach more than a tentative conclusion but the results to date have indicated that there does not appear to be an optimum density below and above which the yield of fry is depressed. These observations are being continued.

340. A start was made in the latter part of the year on feeding trials at Kajansi and six $\frac{1}{2}$ -acre ponds are being fed varying amounts of food to determine what feeding rate gives the best possible yield. It is obvious that the law of diminishing returns will eventually work on the amount of food added to a fish pond and it is necessary to find the upper limit of feeding so that individual fish farmers may be advised how much of their effort to put into fish feeding. A series of observations has also been started to determine whether or not fish populations can be kept in balance by heavy fishing, and prevented from running. A heavily fished pond at Kajansi is being compared with African owned fish ponds and the pond is being sampled regularly to note any deterioration in the size of the fish and any marked increase in the total numbers.

341. Attempts were again made to discover the role of predatory fish in fish pond population dynamics. As in 1955 the fish chosen was the Nile perch, but, once again, we were most unfortunate. On two occasions the lorry carrying the fish from Butiaba to Kajansi broke down and all the fish died whilst standing overnight. The Nile perch needs extremely well oxygenated water for its well-being. This part of the experimental programme is continuing and a third, and it is hoped lucky, attempt will shortly be made to introduce the Nile perch to Kajansi.

342. Temperature records have been maintained throughout the year at Kajansi by a continuous water recording thermometer and other types of thermometers. It is desired to build up a picture of the water temperatures found in fish ponds throughout the year in a hot area so that they can be compared with average temperatures in the colder areas such as Kigezi. There is an indication that in certain types of fish pond sites in Kigezi (specifically, steep heavily shaded valleys where both sun and wind is largely excluded) the temperature and light intensity are so low that they interfere with the breeding of *Tilapia zillii* which is the principal fish used.

343. To investigate this problem more fully a set of fish ponds at the Kasizi flax factory has been prepared by the Fisheries Development Officer, Kigezi. An observer has been posted from Kajansi who is collecting data on the growths and temperatures of the ponds so that a formula can be

deduced to govern the siting of fish ponds in the district. It should be mentioned however that the problem of breeding in Kigezi ponds does not seem to affect the growth of the fish which are able, at the low temperatures, to make steady growth of between one and half and two centimetres per month. This means that in twelve months a fish has grown to just under a pound and is, at that size, a welcome addition to a family's diet. Some ponds which have already been built in these places where breeding is depressed could easily be restocked every year, in the same way that seeds of normal food crops are planted. A crop is then taken in the same way that food crops are reaped. We have shown that it is possible to breed *Tilapia* in large numbers in very many places in Kigezi.

344. Observations on edible canna and the Russian comfrey have been continued at Kajansi and the yields have once again been over 70 tons of canna per acre and some 50 tons of comfrey per acre. Many fish farmers are now planting these two crops close to their fish ponds. Chemical analyses on both these plants have been carried out for us by the nutritional chemist of the Veterinary Department and have shown that they are an adequate protein source and, as such, are valuable plants for feeding fish ponds.

345. A small flock of poultry and two small flocks of muscovy ducks and domestic geese have been maintained at Kajansi during the year. A great deal of interest has been expressed in the poultry by visitors and it is proposed that greater attention be paid to their management in future. In this connection new housing and paddocking has been provided.

346. An attempt has also been made to establish the European Mallard at Kajansi. Eggs of this species were flown out from England in May, 1956. Some 50% of these were hatched in an ordinary incubator and were reared with no further loss. The flock very rapidly acclimatized itself to local conditions and within two months was in breeding plumage and had started to pair and mate. At this point a great deal of difficulty was encountered due to the ducks resting in the more inaccessible parts of the forest, and they had to be penned. However, one setting of eggs was lost through snakes and one through the eggs having been abandoned, but a third setting was successful and ten eggs were hatched. Of these six died within a few days. The reason is obscure but it would appear that the young ducklings are very sensitive to damp and cold and that the mother was unable to brood them properly. The other four were reared successfully to adulthood and are still in good health. These and four adults remaining from the original hatch now constitute the Kajansi flock. They have all been pinioned and it is hoped that by penning them when they come into breeding condition next year we shall be able to build up a flock. The remaining loss of the adults was due to the fact that once they went into moult they deserted the site by flying away; the remainder which had been pinioned left on foot and have not been seen since.

347. The Mallard ducks have shown themselves to be voracious snail hunters and eaters. If it is possible to build up a stock at Kajansi it is

hoped that we may be able to release them on some of the heavily infested dams in Ankole, where, if they manage to establish themselves, they might be able to effect some reduction in the snail population and consequently go some way to reducing the very high incidence of liver fluke in stock in that area.

348. In conjunction with the Pollution Control Officer of the Labour Department an extensive series of tests has been carried out to determine the factors which lead to mortality when transporting fry. These tests have on the whole supported the previous criteria considered to control mortality, but have shown that some of the criteria laid down previously are in some cases erroneous or misleading. Important factors in transport have been shown to be the purity of the water, and the size of the fish. The presence of a mixture of large and small fish leads to heavy mortality, and it has been shown that there is an optimum length for safe transport. One point which has emerged most clearly, and rather unexpectedly, from these experiments is that *Tilapias* are able to remain alive for a long period after all the oxygen has been used up in the water in which they are being carried, as long as there is an adequate air space above them from which they can gulp and absorb atmospheric oxygen. It has been shown that the violent shaking of the water which takes place in transporting fish in cans is of great value to the fish as the amount of oxygen in the top layer of the water is increased. A special machine has been designed which is capable of shaking the fish cans to reproduce as far as possible, the actual conditions of transport in a lorry. The machine was built so that the fish received 24 shocks per minute. It has been found, by previous tests, that this is the average frequency of shock when travelling in a lorry over a rough road. Further series of trials were carried out to test the effect of various anaesthetics on fish. Preliminary results of these indicate that fish which are mildly anaesthetised are capable of being transported over much greater distances than are more livelier fish. These trials are being continued.

Instruction

349. The Kajansi staff spent a great deal of their time instructing and demonstrating to visitors the various techniques involved in pond building and in pond management. Some 200 people per month have visited the fish farm throughout the period under review. Some of these just came to look, some came for fry and some came to ask specific questions. All these people went away with a good idea of how to build a fish pond and how to handle and feed the fish and how, when the fish are ready, to catch the crop. In addition throughout several months of the year Fish Guards were posted to various sazans in Mengo to carry out extension work; this proved extremely valuable as direct contact was made with the people who wished to build ponds on their own land. A great many ponds were marked out in sites selected by teams of this sort. The limiting factor in this type of extension work is transport, particularly as the Department has

not sufficient transport to fulfil all its requirements and bus services in most areas are but poorly developed. The bicycles of our demonstration teams were motorized and the Fish Guards have found them a great help in getting around the districts they are visiting. The machines have proved themselves to be a cheap and practical method of increasing the range of field instructors.

350. In March, 1957, a course lasting one month was conducted at Kajansi on all aspects of fish farming. This was attended by some twenty people who came from all over Uganda and proved most successful. It is hoped that we will be able to increase eventually the number of these courses. Several courses on net making were run at Kajansi. The people were either privately sent or were nominated by gombolola councils. They were shown how to make cast nets, which seem to have gained a great deal of popularity as a method of cropping fish ponds since they were introduced by this Department some two years ago.

351. A great many of the ponds that have been built, particularly in Mengo, are now yielding their first crop of fish and the Department has had a host of enquiries about fishing methods. Many fish farmers, having gone to the trouble of building and stocking a pond, expect the Department to produce a fishing method whereby the fish leave the ponds and arrive in the frying pans without human aid. Regretfully they have had to be dispossessed of these ideas, and greater efforts are now being made to demonstrate various fishing techniques to fish farmers. This programme has been limited by the fact that the type of fishing gear normally imported into Uganda is unsuitable to the small scale operations of fishing a pond. To overcome this the Fisheries Officer has designed several types of gear and the importers are now obtaining prototypes so that they can be fully tested and then be made available to fish pond owners. The difficulty here has been that these prototype nets having been specially made in small quantities tend to be rather expensive. It is to be hoped that as fish farmers show their readiness to buy this gear, longer production runs can be achieved by the manufacturers and the price will consequently drop. The use of cast nets and home-made basket traps in particular is being encouraged.

Extension Work

352. Once again the year has been notable for the very rapid increase in the numbers of ponds built. This applies particularly to Kigezi and Mengo Districts where the bulk of the propaganda and demonstration has been concentrated. The rate of increase has been quite spectacular. It was reported last year that there were some 425 ponds in the Protectorate; it can now be reported that there are some 1,500. This is more than a threefold increase. The table below shows the numerical distribution of fish ponds in the Protectorate by districts:—

Number of fish ponds

District	1955/1956	1956/1957
Kigezi	170	310
Mengo	114	741
Masaka	8	29
Mubende	80	400
Bugisu	10	29
Bukedi	4	39
Ankole	2	2
Toro	6	6
Bunyoro	20	20
Acholi	5	9
West Nile	3	3
Busoga	0	2
Teso	0	1
Karamoja	1	1
Lango	2	2
TOTAL ..	425	1,594

Rural Water Supplies

353. Great attention has been paid recently to the improvement of rural water supplies by several departments, and this is particularly so as schemes for farm planning gather momentum. It is an integral part of any farm plan that each unit has its own water supply. Fish ponds have shown themselves to be a very adaptable type of water storage and the Department, during the years that it has been advising on the making of ponds, has gathered a large amount of experience on this type of water storage and the cost of construction. Thought is now being given to methods of take-off, and we hope that we can incorporate a cheap and fool-proof method with the normal sluices used in fish pond work. To date, few pond owners have constructed sluices of the type which we use at Kajansi, but with the great interest being shown in methods of cropping ponds many fish farmers will shortly require our advice on the construction and the costing of various types of sluices. This would be a good opportunity of incorporating a method of take-off of water into feeding troughs or wells. The construction of fish ponds in many valley bottoms in Mengo District is now on such a scale that previously unutilized marginal land can be drained, cultivated and irrigated with the help of the fish ponds. For instance a pond built in the top of a valley which is partly waterlogged by a seepage or spring will normally have a channel dug along the side of the pond wall to remove the excess water. This can be extended to form a contour channel. The removal of water along a contour channel on the slope allows the previously wet bottom to be drained, cultivated and in turn, if required, irrigated from the channel.

FISH FARMING EXTENSION SCHEME, KIGEZI

Report by the Fisheries Development Officer

354. Fisheries work in Kigezi has been carried out by the Fisheries Development Officer and one permanent Fish Guard. The great interest of

the Kigezi African Local Government in fish farming was shown by the fact that during the year they recruited two trainee Fisheries Assistants to help with the work. Good co-operation has also been provided by the District Administration and the Agricultural Department.

355. Up to 26th April, 1957, 310 ponds had been completed, of which 270 have been stocked with fish. The exact acreage under water is difficult to assess, but it is thought to be approximately 50 acres; one pond near the Kisoro Road is $2\frac{1}{2}$ acres and is the largest so far constructed. Ndorwa Saza has the largest number of ponds. In October, 1956, prizes were presented to the owners of the best individually-made ponds, the first prize of Shs. 100 going to a farmer of Kyanamire Gombolola and the second prize to a man of Bubale Gombolola. In Ankole, for which district the Fisheries Officer became responsible in February, 1957, six ponds have been completed. Interest is not so keen here as many people still do not eat fish.

356. Much advice has been given with regard to the construction of fish ponds which it is recommended should be kept as simple as possible. People have been advised to avoid such items as sluice gates, etc., initially as construction in brick or concrete is difficult in the "peaty" sites of Kigezi, besides which most ponds can be filled by natural seepage. No definite size or shape is insisted upon, though 60' x 60' has been regarded as the minimum desirable dimension. Water tests have been carried out regularly in all areas, as no ponds have been recommended if the water has been lower than pH6.

357. It has been shown that a pond can be built by an average family in approximately two months, but it is also common for a number of families to join together and build a communal pond, when building times are reduced considerably.

358. The following short notes give the construction methods recommended by the Field Officer and will probably be of interest to the public:—

"After the water has been tested, the owner prepares to build his pond by first cutting down the grass and reeds on the site required. If in a swampy section, the man starts off by digging down with a shovel or hoe, and the pieces which are cut out are placed on the side to form a wall. This is the easiest way to get rid of excavated earth or peat, and at the same time make a firm wall around the pond on which the owner can walk without sinking into the swamp. Generally, after a few feet have been dug, the owner finds himself up to his knees in water. If he is working in peat, he can cut out large pieces and float these to the side for stacking on the wall, but if he is working on a solid substance such as clay, he generally uses a small sledge for this purpose or an old canoe-shaped beer vat.

If the pond is being built in a gradually-sloping valley with a small stream running down the centre, a furrow is first dug to by-pass the selected site, so that other people further down the valley will not be deprived of their water supply. A site for a wall across the valley is

then cleared of all roots, grass and stones and excavated for a core. A borrow pit is afterwards dug in the impoundment area, the material from which is used to fill the core of the dam. A spillway is built at one end of the wall, big enough to take any excess flow of water. A small channel is then cut, tapping the by-pass furrow, the pond is filled, and the channel is closed again near the top. Some pond-owners have used the spillway as the water outlet, instead of building a by-pass water furrow, and have fixed wire netting across the opening to prevent fish from escaping, but this method is not recommended. Still water is better for *Tilapia* culture than running water."

359. During the year 4,500 fish were distributed to ponds, lakes and dams in the area. Stocking was held up during July and August, 1956, owing to a shortage of fry, both in Kigezi and at the Kajansi Fish Farm. This difficulty should shortly be resolved as a small set of breeding ponds have now been established at the old flax factory at Kisizi where the retting tanks were converted for this purpose. The total cost of the work excluding travelling expenses was £200, funds being made available from this Department and that of Community Development. Five months after stocking with mixed *Tilapia* species it was found that *Tilapia zillii* and *Tilapia leucosticta* had bred, whilst *Tilapia nilotica* showed no signs of doing so. The Kisizi ponds are also being used for experimental purposes to study the causes of delayed breeding in *Tilapia* in conditions of heavy shade and low temperatures, and growth rates. These experiments have been mentioned elsewhere in this report under the main section concerning fish farming.

360. The rate at which fry could be stocked has been largely limited by a shortage of funds for mileage and suitable transport. These difficulties have been recognized and approval has been given for the purchase of a Land Rover, trailer and fry tank when the financial situation permits. In the meantime the difficulties continue.

ENTEBBE,
FEBRUARY, 1958.

B. G. KINLOCH,
Game Warden.