付　属　資　料

① 合同調査報告書（JOINT SURVEY REPORT）
② 灌漑開発公社組織図
③ 灌漑開発センター組織図
④ 要請書
⑤ 事前調査ミニッツ
⑥ 分野別報告関連資料
　(1) 稲作栽培状況調査結果
　(2) 農家経営関連資料

JOINT SURVEY REPORT ON THE IRRIGATED AGRICULTURE PROMOTION PROJECT IN THE REPUBLIC OF GHANA
(Tentative Title)

29 MAY 1996

GHANA IRRIGATION DEVELOPMENT AUTHORITY
JICA LONG-TERM SURVEY TEAM

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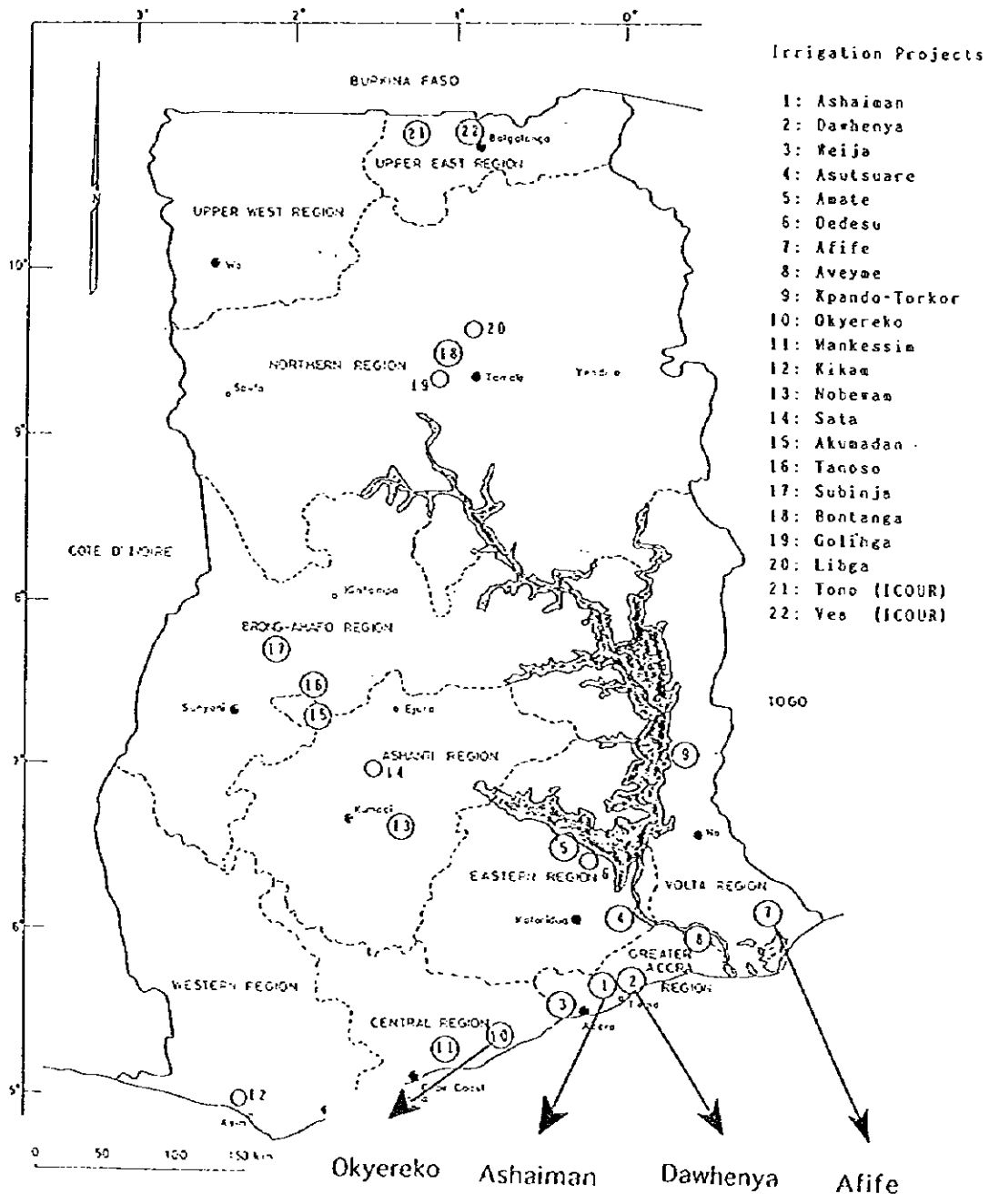
LOCATION OF IRRIGATION PROJECTS



1. THE FRAME WORK OF THE PROJECT-TYPE TECHNICAL COOPERATION PROJECT

1) Project Site:

The Irrigation Development Centre (IDC) was selected as project site for the Project-Type Techical Cooperation Project. Although other potential sites were surveyed and found promising, IDC was chosen due to the following:

a. Some facilities (eg. laboratories, equipment) already exist at IDC.
b. IDC is already known countrywide and internationally as doing some adaptive work in irrigated agriculture.
c. IDC has just completed a Japanese Grant Aid 'Mini-Project' type technical cooperation. Thus the Project-Type Technical Cooperation Project will serve well the purpose of continuity.

As IDC is about 30km from Accra (GIDA headquarters) it is agreed upon that one(1) Project room in GIDA (Accra) be procured for use by JICA experts and their counterparts on the Project.

2) Name of the Project:

It was agreed upon that the Project be referred to as the Irrigated Agriculture Promotion Project (IAPP) in Ghana. 'IAPP' is to be considered as an activity being performed at IDC (and the name IDC as pertains to the present Ashaiman site is maintained).

3) Objective of the Project

The main effect of the Project (IAPP) is to establish a model system to promote an economically sustainable agriculture at the existing irrigation sites. This has been clearly spelt out in the 'Minutes of Understanding' on 21st Dec. 1995.

4) Project Activities

The main project activities among others are the following:

a. Identification of farmers' needs at the Project Model Sites and other GIDA irrigation sites.

b. Conduction of Applied (adaptive) Research and Technology generation: There will be collaboration with the Ghana Universities and institutes and other related institutions overseas (WARDA, IRRI).

c. Training and Extension: Each section will take care of and integrate the activities of Research, Extension and Training as one unit. That is each section performs all 3 activities on its own. This allows for easy co-ordination and quick solution to problems in the face of lack of qualified personnel. However there will be collaboration with other sections and related institutions.

Extension workers will be trained at IDC. Farmers on irrigation sites will be trained at their field sites through the Farmer Field School (FFS) programme.

5) Model Sites

Three model sites have been selected to reflect the 3 levels of activities/production existing on the GIDA project sites (low, medium and low activity/productivity levels).

The model sites and level of activities/productivity are as follows:

1. Dawhenya Irrigation Site - higher activity/productivity level (35km from Accra)
2. Afife Irrigation Site - medium activity/productivity level (160km from Accra)
3. Okyereko Irrigation Site - low activity/productivity level (60km from Accra)

6) Project Organization and Counterparts: See Appendix 1.

'Crops Department' includes Rice, Horticulture and Agro-Environment Sections and the activities.

Each section will have 2 university graduates and 2 technicians/assistants. It might be efficient to assign two (2) counterparts to the Japanese Team Leader. The Chief Executive will be an administration counterpart while the IDC Director will be the Officer-in-charge.

7) Necessity Facilities in IDC

1. One(1) main building including Director's room, team leader room, meeting room, one big room for all staff in.
2. Three(3) labs for crop, water management, soil with store room each.
3. One(1) workshop
4. One(1) machine hanger
5. One(1) dry yard
6. One(1) garage
7. One (1) car washer site
8. One(1) experimental field (about 2ha)
9. One(1) training building include one classroom, one AV room and one store room
10. One(1) dormitory for 30 persons (kitchen, dining room, small library, shower room and toilets).
11. One(1) overhead water tank
12. Stand-by generator
13. Fence

8) Agreed Priority

1. Constructing a main building
2. Experimental field rehabilitation
3. Laboratories

9) Equipment (At 1st year)

1. Vehicles
2. Mobile wireless
3. Powertillers
4. Computers and copy machines
5. Air conditions

10) Joint Committee List (to meet at least once a year)

1. Chief Executive
2. Deputy Chief Executive (Agronomy)
3. Deputy Chief Executive (Engineering)
4. Director in IDC
5. Ministry of Finance
6. Department of Crops Services in Ministry Food and Agriculture
7. Department of Extension in Ministry of Food and Agriculture
8. Department of Manpower and Training in Ministry of Food and Agriculture
9. Farmer Representative
10. JICA Team Leader
11. JICA Office Co-ordinator
12. JICA Office Representatives - Japanese Embassy Representative

11) Slogan

- "Farmers First"

2. MEMBER LIST

Mr. Tatsushi Tsuboi/Leader, Rice Cultivation and Extension
JICA Expert (Rice Cultivation) in Agricultural Machinery Training Project for Irrigated Rice Cultivation in Ivory Coast.

Mr. Masayuki Senda/Farm Economics
Senior Researcher
Laboratory of Farm Management, Chugoku National Agricultural Experiment Station, Ministry of Agriculture, Forestry and Fisheries

Mr. Hiroshi Ono/Vegetable Cultivation
Special Advisor
Agricultural Technical Cooperation Division, Agricultural Development Cooperation Department, Japan International Cooperation Agency

Mr. Katsumasa Sato/Irrigation and Water Management
Instructor
Irrigation Section, Tsukuba International Centre
Japan International Cooperation Agency

Mr. Hiroyuki Sato/Training and Technical Cooperation
Associate Specialist
Agricultural Technical Cooperation Division
Agricultural Development Cooperation Department
Japan International Cooperation Agency

Mr. O.K. Gyarteng
Chief Executive
Ghana Irrigation Development Authority

Mr. M.A.K. Afram
Deputy Chief Executive (Agronomy)
Ghana Irrigation Development Authority

Mr. D.N. Ohemeng/Director, Operations(GIDA)
Director
Irrigation Development Centre, Ghana

Mr. James Akatse/Principal Agronomist
Research Co-ordinator
Irrigation Development Centre, Ghana

Mr. Damien A. Amoatin
Agric. Economist
Ghana Irrigation Development Centre, Ghana

Mr. Felix Fynn/Agronomist
Head of Section, Horticulture
Irrigation Development Centre, Ghana

Mr. Peter M. Abugah/Agronomist
Head of Section, Agro-Environment
Irrigation Development Centre, Ghana

Mr. George Osei/Agric. Engineer
Head of Section, Water Management
Irrigation Development Centre, Ghana

Mr. Simon Apio/Snr Agric. Engineer
Head of Section, Agric. Machinery
Irrigation Development Centre, Ghana

Ms. Joyce Gyamera Ampofo/Senior Agronomist
Head of Section, Soils
Irrigation Development Centre, Ghana

3. PURPOSE OF SURVEY

Following activities were to be achieved:

- To analyse problems in the field of farm economy, farm management in rice cultivation and vegetable production, irrigation facility and water management, training and extension.
- To formulate the most feasible frame work of the Project-Type Technical Cooperation Project.
- To identify Model Sites where the Project impact would be most effective.
- To establish a mutual understanding between JICA experts and Ghanaian personnel working on the Project.

4. SCHEDULE OF SURVEY

Date		Contents of Work
April	29(Mon)	Courtesy call to JICA Ghana Office, GIDA, Embassy of Japan
	30(Tues)	Joint meeting with GIDA Visiting IDC
May	1(Wed)	Visiting Asutsuare Irrigation Site
	2(Thur)	Visiting Afife Irrigation Site and Aveyime Irrigation Site
	3(Fri)	Visiting Mankessim Irrigation Site, Okyereko Irrigation Site and Weija Irrigation site
	4(Sat)	Day Off
	5(Sun)	Day Off
	6(Mon)	Farmers Interview in Ashaiman Irrigation Site
	7(Tue)	Farmers Interview in Ashaiman Irrigation Site
	8(Wed)	Farmers Interview in Dawhenya Irrigation Site
	9(Thur)	Farmers Interview in Dawhenya Irrigation Site
	10(Fri)	Discussion with IDC director in Ashaiman
	11(Sat)	Day Off
	12(Sun)	Day Off
	13(Mon)	Farmers Interview in Okyereko Irrigation Site
	14(Tue)	Farmers Interview in Okyereko Irrigation Site
	15(Wed)	Discussion with IDC director in Ashaiman
	16(Thur)	Ashaiman Market Survey
	17(Fri)	Tema Market Survey
	18(Sat)	Day Off
	19(Sun)	Day Off

Date	Contents of Work
20(Mon)	Preparation of Joint Survey Report
21(Tue)	Preparation of Joint Survey Report
22(Wed)	Preparation of Joint Study Report, Discussion with GIDA
23(Thur)	Preparation of Joint Study Report
24(Fri)	Reporting to Ministry of Finance, Ministry of Food and Agriculture and Embassy of Japan
25(Sat)	Day Off
26(Sun)	Day Off
27(Mon)	Preparation of Joint Survey Report
28(Tue)	Preparation of Joint Survey Report
29(Wed)	Submission of the Report to GIDA and JICA Ghana Office

5. CRITERIA FOR SELECTION OF MODEL SITES

The following conditions must be satisfied for Model Site selection:

a. Easy access to IDC
b. The effect of the Project must be seen within 5 years
c. Reasonable working condition for Japanese experts as follows:

- Safety
- Accommodation
- Communication facilities(telephone or radio equipment) and
- Commutable distance from IDC

d. Availability of project management conditions as follows:

- Availability of trial plot
- Adequate irrigation water
- Active farmers' association
  - Water management activity is practised.
  - Positive attitude of the Farmers' Association (leader) toward the Project.

6. METHOD OF SURVEY

Seven sites were surveyed, all of them located in the coastal savannah belt namely Afife, Ashaiman, Aveyime, Dawhenya, Mankessim, Okyereko and Weija. Farmer interviews were however, conducted on three of the sites - Ashaiman, Dawhenya and Okyereko. Six farmers were interviewed on each of the sites on their production activities.

7. FINDING OF THE SURVEY

7.1 Farm Economy Survey

7.1.1 Present Condition of Farm Management

a. Farm Size/Land Holding

Farm land holding ranges from 0.4 ha to 2.5 ha. (5 farmers with 0.4 ha, 5 farmers with 0.7 ha, 5 farmers with 1.1 ha, one farmer with 2.5 ha in the Ashaiman, Dawhenya and Okyereko Irrigation Sites).

b. Distance to the field

Average distance to their field from farmer's house is 1-2 km in Ashaiman Irrigation Site, 2-4 Dawhenya Irrigation Site, about 300 m in Okyereko Irrigation Site.

c. Labour Force

The farmer takes care of his field alone. His family help during harvesting time.

Land preparation is done by a hired tractor. Hired labour is common for harvesting and processing as well.

d. Production Cost

i. Tilling and Crossing Charges range from ¢87,500.00 to ¢90,000.00. (¢87,500.00/ha/season in Ashaiman Irrigation Site, ¢90,000.00/ha/season in Dawhenya Irrigation Site and ¢60,000.00/ha/season in Okyereko Irrigation Site).

ii. Levelling Charge: This is ¢40,000.00. Farmers normally do levelling by themselves.

iii. Transplanting charge: This is ¢170,000.00/ha/season. (¢12,000.00 to ¢210,000.00 at Dawhenya Irrigation Site)

iv. Weeding Charge: This is ¢60,000.00/ha/season.

v. Harvesting and Processing: This ranges from ¢100,000.00 to ¢180,000.00/ha/season. (¢100,000.00/ha/season for 5 farmers, ¢130,000.00/ha/season for 2 farmers, ¢180,000.00/ha/season for 8 farmers in 3 irrigation sites).

e. Cost of Fertilizer Used

This ranges from ¢175,000.00 to ¢370,500.00/ha/season. (¢175,000.00/ha/season for 2 farmers, ¢225,000.00/ha/season for 3 farmers, ¢275,000.00/ha/season for 2 farmers, ¢375,000.00/ha/season for 2 farmers in Ashaiman and Dawhenya Irrigation sites).

f. Cost of Chemical

This ranges from ¢4,000.00 to ¢115,000.00/ha/season. (¢4,000.00/ha/season for 3 farmers, ¢60,000.00/ha/season for 2 farmers and ¢115,000.00/ha/season for 4 farmers in Ashaiman and Dawhenya Irrigation Sites).

g. Irrigation Charge

It is ¢50,000.00/ha/season at the Ashaiman and Okyereko Irrigation sites and ¢160,000.00/ha/season in Dawhenya.

h. Total Cost of Production

This ranges from ¢525,000.00 to ¢925,000.00/ha/season for the 3 project sites. (¢525,000.00 for 3 farmers, ¢575,000.00 for 2 farmers, ¢625,000.00 for 1 farmer, ¢675,000.00 for 2 farmers, ¢775,000.00 for 1 farmer, ¢825,000.00 for 1 farmer, ¢875,000.00 for 3 farmers and more than ¢925,000.00 for 2 farmers in 3 irrigation sites.

i. Average Yield

The average yield is 5.3 t/ha in Ashaiman and Dawhenya Irrigation Sites. In Okyereko it is 4 t/ha. The yield of the second crop decreases by 30 - 50% in comparison with that of the first crop at Dawhenya Irrigation Site. The highest yield among the 3 irrigation sites is 7.1 t/ha recorded for a first crop at the Dawhenya Irrigation Site.

j. Sales of Products, Income and Net Income

The volume of rice sale increases in proportion to size of the farm. The amount sold is ¢150,000.00 to ¢600,000.00 for 5 farmers, ¢1,950,000.00 for 1 farmer, ¢2,600,000.00 to ¢2,900,000.00 for 4 farmers, ¢3,500,000.00 to ¢4,000,000.00 for 4 farmers, ¢5,750,000.00 for 1 farmer and ¢8,850,000.00 for 1 farmer.

The income from rice ranges from ¢400,000.00 to ¢2,000,000.00 (¢400,000.00 for 5 farmers, ¢1,000,000.00 to ¢1,300,000.00 for 2 farmers, ¢1,600,000.00 to ¢2,000,000.00 for 6 farmers and over ¢2,000,000.00 for 3 farmers).

It is very difficult to make a living by only cultivation rice of 0.4 ha once a year but generally speaking income from irrigated agriculture is not too bad to sustain his family in comparison with other profession (eg. industrial labour).

Rice price/bag paddy increase as follows: ¢15,000.00 in 1994, ¢29,000.00 to ¢35,000.00 in 1995 and ¢37,000.00 to ¢40,000.00 in 1996.

k. Net Income

The net income ranges from under ¢500,000.00 to ¢1,340,000.00/ha/crop. (below ¢500,000.00 for 3 farmers, ¢900,000.00 for 5 farmers, ¢1,000,000.00 for 3 farmers, ¢1,150,000.00 for 2 farmers, ¢1,250,000.00 for 1 farmer, ¢1,340,000.00 for 1 farmer).

l. Annual Expenditure

This ranges from ¢1,100,000.00 to ¢2,000,000.00 (¢1,100,000.00 to ¢1,300,000.00 for 3 farmers, ¢1,500,000.00 to ¢1,800,000.00 for 5 farmers, ¢2,000,000.00 for 1 farmer) out of 9 farmers interviewed in Ashaiman and Dawhenya Irrigation Sites. 5 farmers managed some savings whilst 4 farmers got into debts.

m. Preference of Crop

This depended on ease of cultivation and labour availability. 2 farmers out of 3 preferred okra cultivation because it is easy to cultivate with family labour and it guarantees constant sales. On the other hand, one farmer preferred rice because he can rely on hired labour even if he lacks family labour.

7.1.2 Problems in Cultivation

The farmers pointed out the following problems during the interview:

i. Lack of finance for land preparation
ii. Lack of machinery for land preparation
iii. Technical problems in farm management
iv. Shortage of water
v. Diseases of okra

7.2. Rice Production in Ghana - An Overview

Rice is one of the major food crops ranking next to wheat in imported food (MOA, 1990). It is becoming very popular with rural and urban dwellers due mainly to its ease of preparation.

The average annual rice production (1991-1994) is 150,000 MT paddy. With a per capita consumption of 8.2 kg/year in 1994, the total annual rice demand (milled rice) is 130,000 MT/year, which will be derived from 208,000 MT of paddy (rough rice) at a milling recovery of 60% (FAO, 1990; PPMED Projections, 2000, 2020).

Both the expansion of rice growing areas (especially valley bottoms) and increased output per unit area (by intensification packages) are being encouraged by policy makers in order to meet local rice demand.

The MTADP on rice, for example, focuses on increased small-holder production, efficient utilization of agro-inputs and strengthened technology transfer to achieve high production levels.

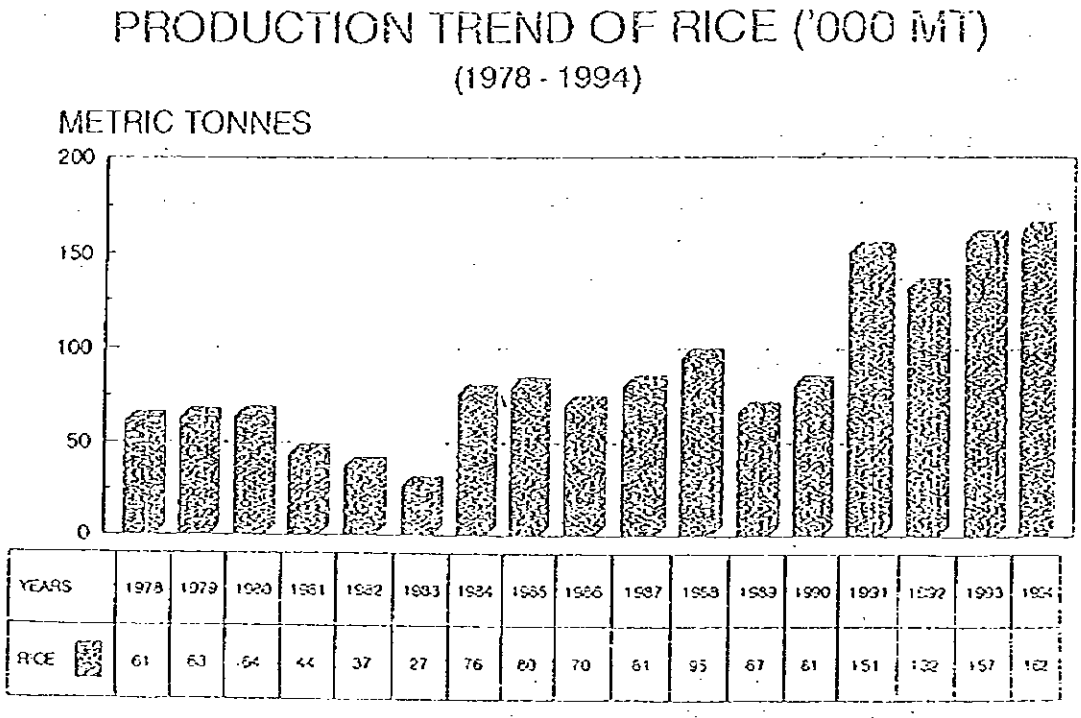


Figure 1 Production trend of rice in Ghana (1978-1994) (MOFA, 1994)

Recently, certain government policy issues and their effects have greatly enhanced rice production. They are as follows:

1. Rice is highly placed on the priority list of commodities by NARP.
2. IPM on rice was declared a national policy for protecting the crop.
3. Tariff imposition leading to reduction in the volume of rice imports since 1994. Local production thus, became stimulated.
4. Continuous annual increase in consumer demand for rice.
5. Sharp increase in rice consumer price levels (Table 1).

Table 1 Farm Gate Price Trend for GIDA Rice

Year/Month		*Price of Rice (¢ per 83 kg bag)
1994	June	12,000.00
	Dec.	20,000.00
1995	June	29,000.00
	Dec.	35,000.00
1996	(May-June)	40,000.00

* Ashaiman-Dawhenya Farm Gate Price Records

7.2.1. **Rice Cultivation : The Present Situation**

a. Rice Variety and Seed Treatment

Varieties commonly grown by farmers are the IITA Releases (eg. ITA-222, ITA-304). These have been continuously grown by farmers with seeds from the previous crop. Use of a common drying floor for seeds and virtually no field rouging activities results in poor quality seeds. The rice seed is kept in the house or project storage with minimal or no pesticide storage.

Before seeding the rice seeds are either pre-germinated for wet seeding/broadcasting or broadcast dry (dry-seeding).

The pre-germination involves soaking overnight (24 hrs) and a further 48 hr incubation in jute bags or fertilizer sacks.

b. Land Preparation

Paddy fields are either prepared dry or wet. With dry land preparation, 4-wheel tractors are used to plough and harrow. A second harrowing is usually done which is essentially seed covering. The field is then irrigated or rainfed for germination to take place.

With wetland preparation, powertillers are used to till bunded and flooded fields. A first tilling is usually followed 1-2 weeks later by a second tilling/crossing. Labour is then employed to handpick weeds, level the plots and get it to a puddled state after which much water has been drained off. In most cases, the final phase of poor levelling and good handpicking is not achieved. This causes weed problems especially for broadcast systems.

c. Planting Method

Two main methods are employed (1) Direct Seeding and (2) Transplanting.

With direct seeding, pre-germinated seeds are broadcast onto levelled and puddled fields. Seed rates in use range from 70-200 kg/ha. An average of 126 kg/ha is common.

With transplanting 14-28 day old seedlings from wet bed nurseries are transplanted onto levelled and puddled fields. Nursery seed rates range from 84 kg -103 kg/ha. The following spacing are common for line/row planting (15x20cm and 20 x 20cm). However random/irregular planting is the most popular with farmers. Currently, the choice of planting method is strongly tied to farmers' financial capability especially at planting time. Most farmers on the irrigation projects are now turning to direct seeding due to lack of labour and funds to pay for expensive transplanting labour costs albeit the numerous benefits to be derived from transplanting rice on farmers' fields.

d. Principal Breeds for Cultivation

With the current trend of rice imports (presently low though, due to tariff imposition) and the low patronage of locally produced rice, a much greater attention is been given to rice quality works (variety selection, post-harvest and milling technology). Varieties which when milled have the lustre, grain length, low breakage and a general appeal to compete with imported types (American long grain) are being searched for (IDC-FRI Trials). Currently, TOX-3108, IR-64, GK-88 and ITA-222 have almost met these qualities. There is the need for more work in this area.

e. Fertilizer Application and Management

Three main forms of fertilizer (Urea, Sulphate of Ammonia, Compound NPK) are used to supply the basic rice plant nutrients as N, P_2O_5 and S. Use of poultry manure is on a minor scale due to bulkiness in transportation.

Fertilizer use is more extensive on the irrigation projects where water is better controlled.

These nutrient ranges are quite common

N: 88-200 kg/ha (Average 104 kg/ha)
P_2O_5/K_2O: 19-75 kg/ha (Average 45 kg/ha)

The N-fertilizer is mostly split applied while the P_2O_5 and K_2O are usually all supplied at first application. In areas where S and P deficiency have been detected, provisions have been made for adequate levels of these nutrients to be supplied (Asutsaure and Kikam).

f. Weed Management

Weed have been and is still one of the major constraints to rice production. Problem weeds usually encountered are the grasses (Echinochloea spp and Ischaenum rugosum), the sedges (Cyperus spp) and broad leave (Euphorbia spp and Marselia crenata). The effective control of these weeds, especially the grasses, is more of a problem in rice broadcast systems than in transplanting.

Weed management methods in use comprise (a) Herbicides (2) Handweeding and (3) Water.

Herbicides: The post-emergence selective herbicides like Saturnil (ai: 20% propanil + 40% thiobencarb) and Basagram (ai: 34% propanil + 16% Bentazone) are very common with the

irrigate rice farmer.

The lack of timely herbicide application and handweeding coupled with improper herbicide dosage are the major causes of the poor results of weed control.

g. Pest Management

The dominant pest groups affecting rice cultivation are insect pests, diseases, birds, rodents and weeds. While birds can be controlled through vigilant scaring and rodents through baiting and good phyto-sanitary practices, the apparent problems (minimal, though) fall on insects and diseases.

The common insect pests are the defoliators and stemborers while diseases are mainly blast, brown spot, sheath rot, blight and RYMV.

With the insect pests and diseases, control is by continuous and indiscriminate or 'blanket' spraying of toxic insecticides. Some pesticides used are inappropriate.

Presently, the IPM-Farmer Field Schools being run countrywide will equip farmers with pest monitoring techniques to manage pest safely and at a reduced cost.

h. Harvesting

The general practice on small holdings (eg. 0.5 - 2 ha of GIDA projects) is the intensive use of man labour where sickles and cutlasses are used for harvesting. Threshing is with (against) concrete blocks or big wooden boxes (Bambam).

After threshing the rice paddy is sent to the platform (drying floor) for open air/sun drying. With regular sweeping and stirring through the spread rice drying is hastened to a moisture content of 15-14% within 2-3 days. When properly dried, the paddy is winnowed by the 'pan-air-blow' method and then bagged at 82-84 kg/bag paddy units.

Yields recorded range from 3.6 - 7.1 t/ha. The average is 5.4 t/ha.

i. Post Harvest and Marketing

The bags of paddy are then sold mainly to middlemen (mostly women very powerful in determining market price levels of the paddy. These middlemen also serve as financiers for most of the farmers on the irrigation projects.

Milling is done at privately owned mills sited on the projects or in towns. These mills are generally of 'Satake' make and the 'One-Pass' type.

A rice quality survey conducted (May 1996) in the Ashaiman/Dawhenya area (project site and market) on various kinds of rice showed the following.

Table 2 Rice Quality Test

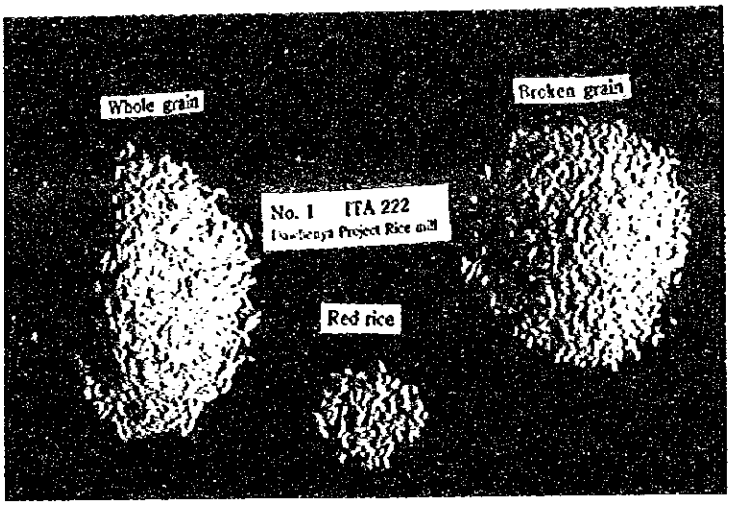
No	Variety, brand	Place	Price	Whole grain	Broken grain	Red or yellow rice
1	ITA-222	Dawhenya rice mill	700¢/kg (Farm gate)	53.0%	44.7%	Red rice - 2.3% (118 grains/100g)
2	CIAT-19970	Dawhenya rice mill	700¢/kg (Farm gate)	50.5%	47.9%	Red rice - 1.6% (70 grains/100g)
3	"FINEST" 2000 Ltd(Ghana)	Accra Supermarket	¢1500/kg (1 kg pack)	76.3%	18.3%	Yellow rice - 5.3% (R.R - 40grains/100g
4	? (Ghana rice)	Ashaiman market	¢400/260g(1can) (¢2045/kg)	76.8%	23.2%	Red rice - 127 grains/100g
5	"Golden rice" Thai rice(Import)	Ashaiman market	¢450/220g(1can) (¢2045/kg	94.1%	5.9%	Non
6	"US Long grain" US rice(Import)	Ashaiman market	¢325/225g(1can) "¢1444/kg"	75.4%	24.6%	Non

Price: 13 - 16, May 1996

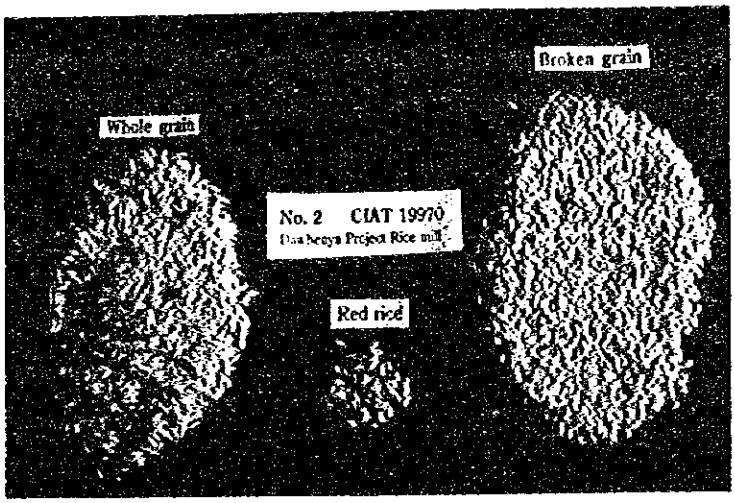
The survey indicates a good market price for more percentage whole grain (Head Rice) recovery and low percentage broken. Colouring (red or white) is an indication of impure grains.(Fig. 2)

The pointer is that there is more work to be done on the quality of our locally produced rice to bring it to competitive level.

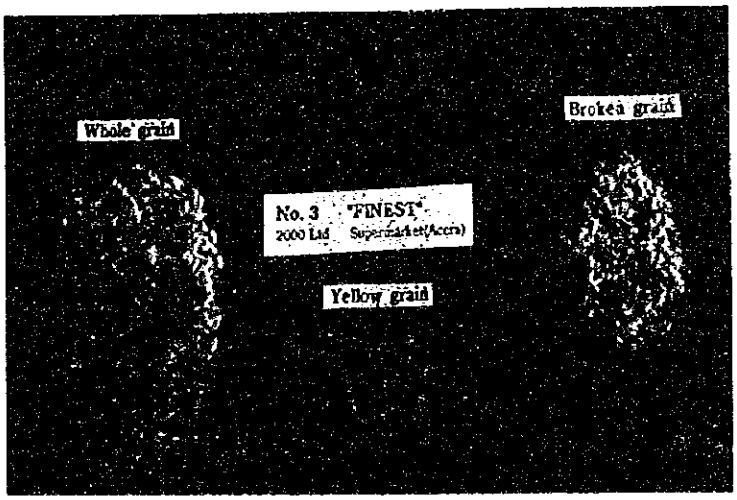
FIGURE 2 Rice Quality Test



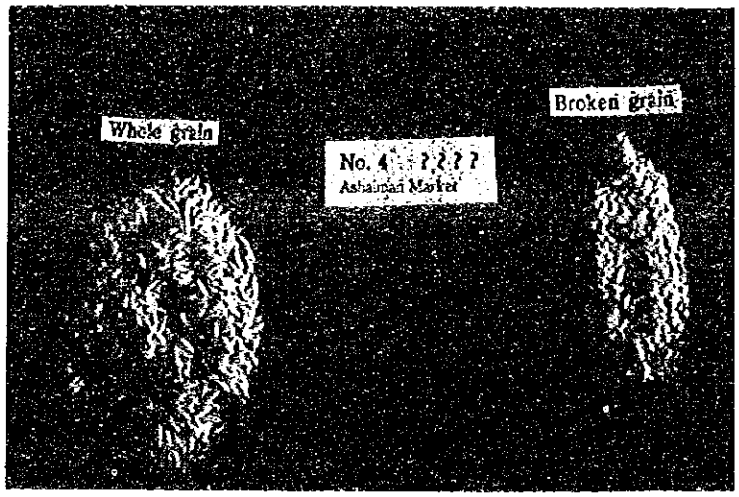
700 Cedis/kg
(Farm gate price)
Whole grain : 53.0%
Broken grain : 44.7%
Red rice : 2.3%



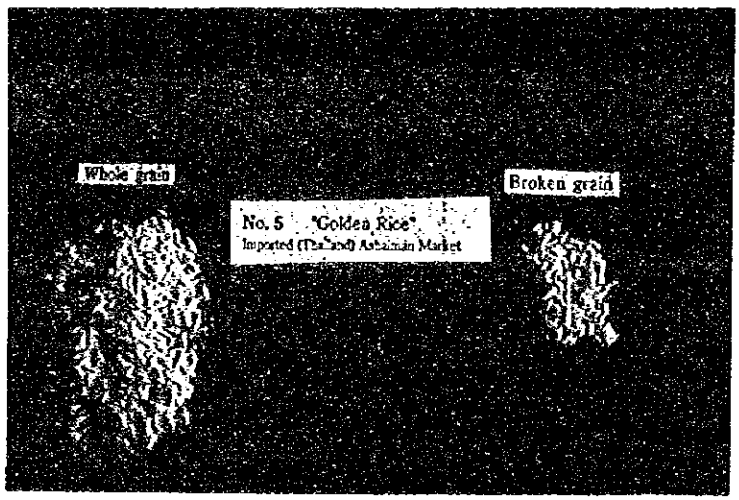
700 Cedis/kg
(Farm gate price)
Whole grain : 50.5%
Broken grain : 47.9%
Red rice : 1.6%



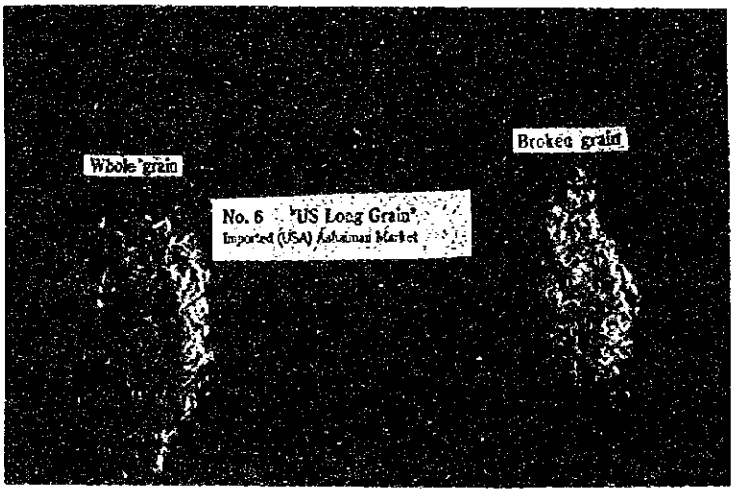
1,500 Cedis/kg
Whole grain : 76.3%
Broken grain : 18.3%
Yellow grain : 5.3%



1,538 Cedis/kg
Whole grain : 76.8%
Broken grain : 23.2%
Red rice : 127 grains/100g



2,045 Cedis/kg
Whole grain : 94.1%
Broken grain : 5.9%



1,444 Cedis/kg
Whole grain : 75.4%
Broken grain : 24.6%

j. Rice Production Constraints

- Lack of credit facilities
- Lack of machinery for land preparation
- Water shortage or some projects
- High cost of agro-inputs

7.2.2. Identification of Problems

A review of the current situation of rice cultivation on the irrigation projects identified the following problems:-

a. Fertilizer Application

- Very high quantities of fertilizer esp. N are being used. Increases production cost.

- Farmers have little knowledge of fertilizer quality (N-levels in various types are different).

- Timing of fertilizer application is generally not appropriate to derive economic benefits.

The import is that with good fertilizer management, the same or even higher yield levels could be obtained when fertilizer quantities are reduced by 50%.

b. Rice Variety

- Current varieties cropped though better yielding than the original DS-3 (1970 - 1980) are still far below the expected high yields of 6-7 t/ha.

- Varieties are not selected to suit the planting method. Typical varieties for either direct seeding or transplanting are available and must be cultivated.

- Most of the varieties lack good milling quality.

c. Weed Management

- Lack of effective herbicides especially for rice broadcast systems
- Herbicide application rates are woefully inadequate
- Time of herbicide application and handweeding are invariably very late
- Earliness in application must be greatly emphasized to control problem weeds (eg. Echinocloea spp).
- Overdependence on broadcasting increases the weed problem. A shift to transplanting can help reduce the weed menace.
- Improper land levelling and water management results in more weed problems.

d. Harvesting

- High labour costs for harvesting. Payments in kind may be encouraged.
- Labour shortage during peak harvesting time. Use of family labour and exchange labour must be encouraged.

e. Pest and Diseases Management

With the exception of birds and rodents,

- Pest and disease problems are very small compared to what pertains in Asian countries.

Consequently, farmers can pursue the IPM package to reduce production cost. Expenditure on agro-chemicals can be saved.

- Chemical control can be expensive and must not be encouraged.

7.2.3. Research Activities

Approach

They must be adaptive and farmer oriented. The Farmer Field School (FFS) concept for training farmers will be adopted on all project sites.

Trials and demonstrations will be conducted on farmers' fields. Farmers will be taught to be doing most of the trial activities and the school will be a forum for sharing experiences.

However, preliminary trials or investigations will be conducted first at IDC (Trial plots) before being sent to the farmers' field schools.

Topics

a. *Varietal Trials:*

To select high yielding varieties with good cooking and milling qualities. Farmers to play active roles in FFS varietal trials and demonstrations.

b. *Fertilizer Trials and Demonstrations:*

- To determine economic fertilizer application technology for each project.
- Fertilizer management will be cultivation based rather than by soil analysis.
- Rates and timing trials will be conducted
- Farmers to play active roles in FFS fertilizer trials and demonstrations.

c. *Cropping System Trials*

- To determine appropriate crops for incorporation into the rice cropping system. Selected crops - rice rotation.

d. *Seed Production (at IDC)*

Seed policy is to provide farmers with high quality seeds.

Methodology

i. Obtain promising varieties from WARDA or IRRI
ii. Conduct varietal trial
iii. Perform adaptability test
iv. Multiply seeds for selected farmers
v. Selected farmers become seed growers for other farmers
vi. Farmers use the same seed for only three seasons

Finally the seed production technology will be imparted to farmers.

7.2.4. TRAINING

Training will be conducted for two categories of people (1) Extension Officers and (2) Farmers.

a. Extension Officers (from GIDA and MOFA)

The courses will be at two levels.

Level 1: Basic Rice Cultivation. Emphasis will be on field practice or learning by 'do-it-yourself' method. Final examination will be conducted to select best performers for the advanced course.

Level 2: Advanced course in rice cultivation. Extension Officers will be trained to conduct trials, analyse data and write reports.

b. Farmers' Training (on Project Sites)

The Farmer Field School (FFS) approach will be followed with a Curriculum/Time Table.

i. Three (3) attendances per month for 5 months (ie 15 attendances to cover topics on Rice (11), Farm Machinery (2) and Water Management (2).
ii. 25 farmers per FFS. Farmers to be in smaller groups of 5 to facilitate teaching and interaction. Snack will be provided to farmers.
iii. Trials and demonstrations will be conducted at each FFS.
iv. Collaboration with WARDA, CRI, ARS and other related institutions.

7.3 Vegetable Production

7.3.1. Present Conditions on the Field and Markets

a. Field Condition

Of the seven Irrigation Sites surveyed, three Irrigation Sites (Ashaiman, Weija and Mankessim) cultivated vegetables in the irrigated area.

Because of machine acquisition problems Mankessim Irrigation Site was ploughing their field at the time of visit when they should have been harvesting. The Irrigation Site practices mixed cropping using water melon and egg plant or water melon and okra.

Ashaiman Irrigation Site has both rice and vegetables (okra) grown in the irrigated area. Some farmers grow only rice or vegetable (okra). Some of the rice farmers combine the two, rice in the rainy season (April to August) and vegetable (okra) in the dry season (Nov to March) when reservoir level is low and harmattan reduces yields of rice.

Weija Irrigation Site has been taken over mainly by commercial farmers, however it has good proximity for vegetable experiments for the benefit of the small scale farmers there.

b. Market Conditions

Observational visits were also made to the Ashaiman and Tema markets and a seed shop also in Tema to check on the availability and prices of vegetable fruits and seeds at this time of the year.

Market survey showed that vegetables like tomato, garden eggs, pepper, okra and onion are available in the Ghanaian market throughout the year. These vegetables are used everyday in the various Ghanaian dishes.

Rice has more stable price in a season than vegetables. From interviews with market women during the market visit there was the indication that vegetable prices reach a peak in the period between January and February when production levels are low and decreases to bottom low between June and July when production levels are rather high. Find prices of vegetables in Table 1.

Table 1 Prices of Vegetables in Tema in the Month of May 1996

Vegetable	Price/kg (¢)[z]
Cowpea	1,321.00
Onion	854.00
Red pepper	400.00
Ginger	1,886.00
Garden egg	684.00
Okra	1,176.00
Tomato	833.00
Rice	1,080.00

[z] Calculated on retail price per pile

c. Seed Condition

Farmers depend on three sources of seeds during production period. They are

i. Seeds extracted by the farmers themselves from previous crop.
ii. Seeds bought from the open market extracted by the market women from unmarketable fruits.
iii. Seed shops which sell seeds either imported or from local seed growers.

Seeds bought from the market women are cheap (¢1,050/100g for tomato and ¢1,500/100g for okra) but are of poor quality (lots of foreign bodies, poor seed colour and smaller seed sizes) with low germination percentage (Table 2).

Some of the locally produced seeds bought from the seed shop were not as cheap as those from the open market (Table 3) and also germinated poorly (Table 2).

Table 2 Germination percentage of Locally produced Seeds of Tomato and Okra

Vegetable	Germination(%)
Local tomato seed from Ashaiman market	47.3
Local okra seed from seed shop(Tema)	11.5

The seeds were set at 30°C (Room condition) for 6 days. 100 seeds in 4 replications were used. The seeds were sown in petri dishes with 2 wet saturated filter papers.

However, seeds from seed shops are expensive (Table 3) but are of good quality and they are expected to germinate well though germination test could be completed on them.

Table 3 Prices of Vegetable Seeds from Seed Shop in Tema

Vegetable	Price(¢/100g)
Cowpea	100.00 [z] [y]
Onion	8,500.00 [y]
Lettuce	14,000.00
Cabbage	40,000.00
Cucumber	8,500.00
Carrot	12,000.00
Egg plant	12,000.00 [z]
French Bean	8,500.00
Sweet pepper	14,000.00 [z]
Tomato	12,000.00
Chinese cabbage	40,000.00
Hot pepper	8,400.00 [z] [y]
Garden egg	8,400.00 [z] [y]
Okra	3,400.00 [z] [y]
Cauliflower	50,000.00
Radish (white)	2,500.00
Radish (red)	40,000.00
Water melon	6,500.00 [z]
Parsley	12,000.00

[z] Available seeds at time of survey
[y] Locally produced seeds available

7.3.2. What Needs to be Done

i. Research

- The cowpea varietal trials started by the horticulture section should continue but the number of varieties should be increased. Other crops should also be included in the varietal trial eg. okra, tomato etc.

- Trials should also cover a look at the cultural practices of traditional crops like tomato, okra, egg plant etc. in line with the production guideline policy of the centre to increase farmers yield and income per unit area. This should also cover exportable crops recommended by the Export Promotion Council like aubergines(egg plant), tinda, squash, melons, ginger etc.

- Trials should also be conducted to investigate the traditional cropping systems of the farmers to improve on them to increase productivity.

ii. Training (Extension)

Demonstration plots should be established closer to the farmers to encourage them to adopt the recommended crops. Farmers should participate in all activities in the plot establishment.

iii. Seed Production

Good quality seeds of selected crops from varietal trials and traditional crops should be produced and sold to farmers at reasonable prices.

Breeder and foundation seeds can be ordered from research stations both at home and abroad and multiplied to be sold to the farmers as guaranteed seeds. Selected farmers can be used as seed growers with price incentives and supervision from horticulture staff.

7.4 Water Management

7.4.1. Present Conditions

The survey and reference materials among others showed the following on the Irrigation Sites:

- No irrigation scheduling based on any cropping pattern exists on the Irrigation Sites. Dawhenya used to be an exception. Because of the European Union's assistance and the availability of technical staff during the rehabilitation period, some formatted irrigation scheduling was done.

- No data has been assembled on the Irrigation Sites

- The Irrigation Sites do not have operation and maintenance manuals and/or water management guidelines. However, because of the presence of a water management expert and a Ghanaian counterpart in IDC from 1994, some technical manual has been produced. The manual is yet to be simplified to reach the level of the extension staff or farmers.

Generally water seems to be available on all Irrigation Sites visited. Water level of the reservoir at Okyereko is very low. As at writing the report (May 1996) no cropping has been done. The survey showed that farmers cultivate rice on paddy fields during the rainy season.

Each staff at the Irrigation Site lacks training on the effective water utilization.

7.4.2. Problems

The following are among others the problems encountered:

- No programme for water distribution
- No formatted data (water requirement, cropping pattern, etc) for effective water management

- No support in the form of measuring devices and equipment.
- Canals and bunds are broken down, drains have become weedy and farm roads and bunds have not been maintained.
- Organizing farmers to rotate water distribution has been difficult

7.4.3. Proposed Solution

- Drawings of the layout of the four(4) Irrigation Sites to be obtained or made.
- Farmers to be advised and helped if possible to begin their activities at the same time.

- Facilities must be repaired:

    - Drains must be cleaned
    - Canals must be repaired
    - Farm roads and bunds must be repaired

- Research

    - Data should be collected
    - Processing and analysis of collected data to establish a base for technology information

- Establishment of water management guidelines for Ashaiman and the three Model Sites.
- Training for farmers and extension staff.

7.4.4 Proposed Activities

The goal is to establish water management guidelines for Ashaiman and the three (3) Model Sites. The purpose of the activities is to do efficient water management at Ashaiman, Afife, Dawhenya and Okyereko Irrigation Sites.

The main activities include the following:

- Meteo and hydrologic data collection
- Setting up water flow measuring devices and other equipments
- Analysis of data
- Cooperate with crops section to establish water requirements for the various stages of plant growth
- Conduct training
- Monitor site facilities
- Develop guidelines

Output Results

- Reduced water wastage on sites
- Improved general farm drainage situation

- Increased life storage of reservoir
- Weed control
- Cropping pattern programme implemented
- Guidelines for water management developed
- Farmers to adopt water management practices
- Obtain optimum yield

7.4.5. Proposed Improvement of the Infrastructure on the Ashaiman Project Site

The following facilities connected with the experimental field has been earmarked for minor repairs:

- Lateral L4 and structures
- Development of the two (2) hectare experimental field
- Farm roads and bunds
- Subdrains on the experimental field
- The main drain
- Provision of subsurface drains

The improvement of the above facilities and the provision of a weir on the main canal upstream of L4 and the provision of a sluice gate on the lateral will enhance research activities.

7.4.6 Proposed Needed Equipments

Item	Description	Quantity	Purpose
1.	Infitrometer /any other	4	Water req on paddy field
2.	Parshall flume	4	Discharge measurement
3.	Current Meter	1	Discharge measurement
4.	Equipment for sand pillar method	1	Water req. for upland field
5.	Pressure plate method	1	- do-
6.	Centrifugal method	1	- do-
7.	Tensiometers(various lengths)	20	- do-

7.5 Farm Machinery

7.5.1 Status

There are insufficient numbers or no agricultural machinery (especially for land preparation) on the irrigation projects. The table below shows.

Project Name	Area (ha)	No. of powertillers/tractors
Ashaiman	150	4 powertillers IDC 3 private powertillers breakdown
Dawhenya	185	4 powertillers
Afife	880	10 powertillers, 1 tractor
Okyereko	40	1 Swaraj tractor

This situation has arisen because machinery management has been poor as operators and owners of machinery have not had the requisite training to ensure sustainability of the machinery. Currently, there is no training centre for operators.

Spare parts supply for the machinery has also been erratic and unreliable resulting in long delays before repair, or people having to make do with spare parts which are not genuine.

Cultivation fees have also been pegged very low, probably because farmers are reluctant to pay higher fees in view of the general low production yields and poor selling price. The end result is that hire service owners are unable to buy spare parts for maintenance or replace overaged broken down equipment when necessary. This situation has led to the introduction of all sorts of machinery to the projects based upon whatever land preparation machinery is obtainable irrespective of suitability or appropriateness.

The absence of adequate agricultural machinery especially for land preparation results in delays in land preparation, wastage of water, the inability to follow a cropping calendar, and low or no production at all.

This area therefore requires special attention if any meaningful production is to take place.

7.5.2 Envisaged Activities of Farm Machinery Section during the Project

a. Establishment of Appropriate Mechanization Guidelines

This section shall make recommendations on appropriate machinery for the various Model Sites based on their sizes, plot sizes, soil types and cultivation methods. Powertillers or 4 wheel tractors may be recommended as the situation may demand.

b. Provision of Agricultural Machinery for Purchase on Loan

The section will assist entrepreneurs by buying agricultural machinery for them on loan through farmer associations to provide hire services to farmers.

c. Advise on Sustainable Machinery Management and Cultivation Fees

The section will work out appropriate cultivation fees which will ensure sustainability of machinery on the Project. Machinery owners will also be taught management of their machinery.

d. Training of Operators and Mechanics

Training programs will be organized for the operation and maintenance of the agricultural machinery. This shall have as its target technical officers, operators and mechanics on the various projects.

e. Stocking up of Spare Parts for Agricultural Machinery

The section shall endeavour to ensure the availability of spare parts at all times for the agricultural machinery. This shall be done by stocking up adequate quantities of spares on the projects, or by arranging with spare parts dealers to stock up.

f. Repair Works

Repairs and maintenance works on agricultural machinery shall be carried out for IDC and other owners. Transport vehicles will however be maintained in well established workshop in town. Only minor repairs on transport vehicles may be done.

g. Post-harvest Technology

The section shall explore and establish appropriate guidelines on post-harvest technology (threshing, drying, milling, destoning, sorting and grading) to improve the quality of rice.

h. Development of Simple Machinery

The development of simple machinery such as threshers, winnowers, rotary weeders etc. to help reduce the drudgery of farmers shall be undertaken.

i. Modification of Machinery to Match Local Conditions

All machinery received under Mini-Project shall be installed, tested and if need be modified to suit prevailing conditions.

j. Workshop Equipment

The section will upgrade the existing workshop equipment to meet the requirement of repair works and simple machinery development and testing by acquiring jigs for bending, folding and some specialist tools.

k. Training Facilities

Equipment and facilities such as audio-visual aids, machinery and land for training in operation and maintenance shall be provided.

7.6 Agro-environment

7.6.1. Monitoring and Compilation of Agro-meteorological Data

Installation of equipment and monitoring started in 1991. The list of equipment are as following:

- Min And Max Six's thermometers
- Wet and Dry thermometer *
- Soil thermometer (5cm, 10cm, 30cm)*
- Earth thermometers (50cm, 100cm, 200cm)
- Evaporation pan (diameter 20cm)
- Rain gauge (manual recording)
- Rain gauge (tipping bucket type)*
- Solarimeter
- Anemometer*
- Anemoscope

Most of these are automatic recorders and they operate on dry battery. Those equipment marked with * need replacement. There is also the need for sun Shine recorder.

The section should be responsible for compiling Agro-meteorological data for all the irrigation site.

7.6.2. Development of Appropriate Technology for the Use of Agro-Pesticides.

The 1995 IDC survey showed that use of Agro-pesticides in the Irrigation Sites are very minimal at the moment. The farmers have the belief that pesticide application can help improve the quantity and the quality of their food products. It is therefore assumed that there is the possibility of increase in the use of pesticides in future. The current problem is the misuse of pesticide by farmers in and around the Irrigation Sites that could be harmful to the farmer and the environment.

The Agro-environment section will collaborate with other sections to train extension officers and farmers on the following:

- Choice of Pesticides
- Methods, Dosage, Time and Frequency of application
- Storage and Safety measures on human health and the environment.

7.6.3. Soil and Water Conservation by Agro-forestry Practices

Vegetation survey of the past showed that many trees are fell for lumber, fuelwood, agricultural and construction purposes. The land is left bare that constitute a source of runoff, soil erosion and its sequential effects.

Efforts have being made during the Mini-Project to establish

- Alley cropping and woodlot for fuelwood
- Trees for electricity poles
- Trees for Avenue, shelterbelt, windbreak and boundary line
- Variety of tropical fruit trees

which will help in water and soil conservation, minimize soil erosion, improve soil fertility and eventually improve the livelihood of the farmer and his environment.

Focus will be on:

- Extension work on seedling production techniques (cutting, budding and grafting).
- Catchment area protection with fruit trees
- Erosion control at the slopes and marginal lands on the Irrigatrion Sites with trees.

7.6.4. Water-borne Diseases, Prevalent and Control Measures

Water borne disease such as Schistosomiasis are associated with stagnant water bodies for irrigation. This affect a number of people both at the lake front and at the irrigated plots.

Past work on the survey (1993 IDC Annual Report) of Bilharziasis was found to be affecting people at the lake front of the Ashaiman Irrigation Site. Similar problems are found in Weija, Okyereko and other Irrigation Sites.

Survey of the Irrigation Sites will be necessary to identify Bilharziasis problems.

- Identification of the snails and their habitat and creating the awareness of the source of contracting the disease.
- Seminars on the courses of Bilharziasis to the farmers and extension officers.
- Create the awareness of preventive measures of Bilharziasis to Extension Officers and the farmers.
- Chemotherapy to the affected persons.

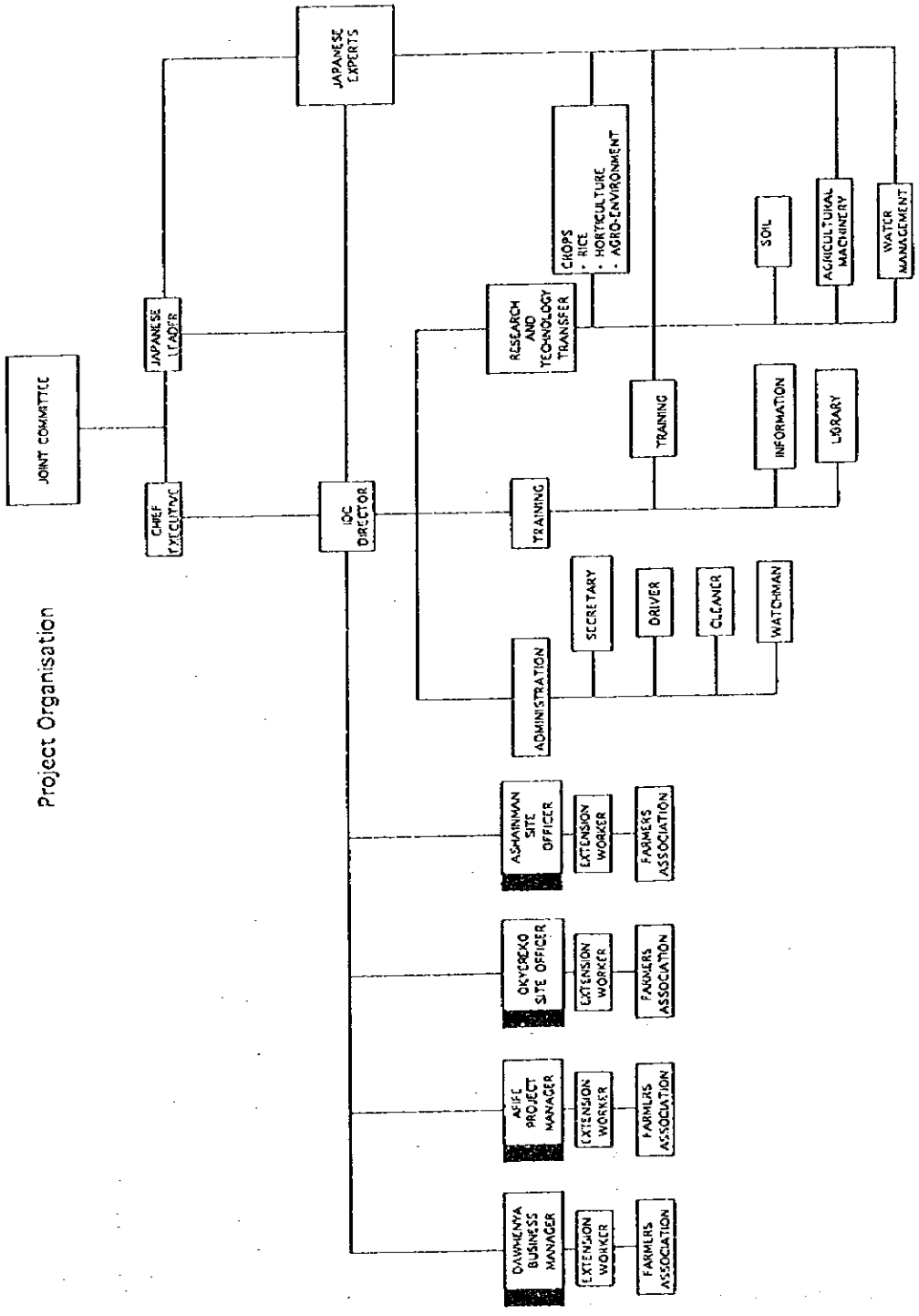
8. REFERENCES

MOA, 1990: Ministry of Agriculture, Ghana Medium Term Agricultural Development Program (MTADP). An Agenda for Sustained Agricultural Growth and Development (1991-2000) 93 pp.

MOFA, (1994): Ministry of Food and Agriculture, 1994 End of Year Report.

FAO, (1990). FAO Computer printouts for projected levels for rice demand and PPMED projections for 2000-2020.

Appendix 1.



Project Organisation

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Appendix 2.

Dahwenya-1 Summary Sheets for Rice Cultivation Survey (1/5)

No.	1	2	3
Name	Felix Koh Sosw	Richard M. Darpot	Eruestina Doku
Area	0.9ha	0.9ha	1.0ha
Variety	CIAT 19970	ITA 304	ITA 222
Reason	High Yield	H.Y. ,Good quari	H.Y. ,Good quari
Source of seeds	IDA	IDA	IDA
Renewal of seeds	Yes	Yes	Yes
Sterilization	Yes Fungurn	Yes Fungurn	Yes Fungurn
Transplanting?	Yes	Yes	Yes
Straight/Random	R	S (15 x 20cm)	R
Seedling age	14days	14days	14days
Cost of TP	78000/ha	61000/ha	50000/ha
Direct seeding	No	No	No
Seeding rate	91kg/ha	91kg/ha	96kg/ha
Land preparation	Powertiller	Powertiller	Powertiller
Cost	135000/ha	90000/ha	75000/ha
Harrowing	↑	↑	↑
Leveling	↑	28000/ha	25000/ha
Fertilizer Amount	88-42-42 NPK/ha	88-42-42 NPK/ha	119-45-45 NPK/ha
NPK(15%)	278kg/ha	278kg/ha	300kg/ha
Urea(46%)			
A.S.(21%)	222kg/ha	222kg/ha	350kg/ha
application time(a)			
NPK	TP, 14DAT	TP, 14DAT	TP, 14DAT, 32DAT
Urea/A.S.	28DAT, 42DAT	28DAT, 74DAT	32DAT, 46DAT, 60DAT
Weeding			
Hand weeding	Once	No	Once
Cost of H.W.	6000x8=48000/ha		25000/ha
Herbicide	Gramaxon? 5.6L/ha	Basagram 5.6L/ha	Basagram 5.6L/ha
Insecticide	Furadan 10kg/ha	No	No
Fungicide	Dursbag 1L/ha	No	No
Water supply	OK	OK	No, seepage
Irrigation Cost	52200/ha	82200/ha	82200/ha
Harvesting	Hired labor	Hired labor	Hired labor
Cost	40000/ha	61000/ha	56000/ha
Threshing	40000/ha	61000/ha	50000/ha
Packing	↑	39000/ha	35000/ha
Drying	2bag/ha	Family labor	35000/ha
Winnowing	↑	39000/ha	↑
Store place		Project	
Yield WS	5.7t/ha	7.1t/ha	5.5t/ha
Yield DS	3.9t/ha	3.6t/ha	4.0t/ha
Selling WS	4735kg	5986kg	ND
Selling DS	3116kg	2870kg	2378kg
Home consumption	410kg/crop	410kg/crop	410kg/crop
Sold Paddy or milled	Paddy	Paddy	Paddy
Sell to ?	Market woman	GNPA	Market woman
selling price	96-DS:35500/82kg	96-DS:35500/82kg	96-DS:35500/82kg
	95-WS:30000/82kg	95-WS:29000/82kg	95-WS:29000/82kg
Problem of rice cultivation	Insect damage	Lack of P-Tiller Water	Lack of P-Tiller Financial Leakage of field

(a)TP:at Transplanting DAT:Days after transplanting DAS:Days after sowing

Summary Sheets for Rice Cultivation Survey (2/5)

Dahwenya-2

No.	4	5	6
Name	Victor Kwame Atatsi	Theophilus Charway	P. L. Adiku
Area	1.0ha	1.0ha	0.65ha
Variety	ITA 304	ITA 222	ITA 222
Reason	Many grains	High Yield	Milling good
Source of seeds	IDA	Cooperative	IDA
Renewal of seeds	No	Yes	No
Sterilization	No	Y Furadan	No
Transplanting?	Yes	Yes	Yes
Straight/Random	R	R	R
Seedling age	14days	14days	21days
Cost of TP	65000/ha	70000/ha	86000/ha
Direct seeding	No	No	No
Seeding rate	103kg/ha	84kg/ha	150kg/ha
Land preparation	Powertiller	Powertiller	Powertiller
Cost	65000/ha	130000/ha	74000/ha
Harrowing	65000/ha	↑	↑
Leveling	40000/ha	↑	Family labor
Fertilizer Amount	115-23-23 NPK/ha	91-45-45 NPK/ha	188-46-46 NPK/ha
NPK(15%)	150kg/ha	300kg	308kg/ha
Urea(46%)	200kg	100kg	309kg/ha
A.S. (21%)			
application time			
NPK	14DAT	14DAT, 28DAT	14DAT, 28DAT
Urea/A.S.	28DAT, 42DAT	56DAT	42DAT, 56DAT
Weeding			3 times
Hand weeding	Once	Once	Family labor
Cost of H.W.	70000/ha	60000/ha	no
Herbicide	Furadan 10kg/ha	Rilof 5L/ha	Dursban 5L/ha
Insecticide	Dursban 5L	Furadan 10kg/ha	No
Fungicide		No	
Water supply	OK	OK	OK
Irrigation Cost	82200/ha	82200/ha	82200/ha
Harvesting	Hired labor	Hired labor	Hired labor
Cost	65000/ha	90000/ha	60000/ha
Threshing	65000/ha	↑	60000/ha
Packing	↑	↑	↑
Drying	Family labor	70000/ha(2bag)	Family labor
Winnowing	35500/ha	↑	Family labor
Store place			
Yield WS			
Yield DS	5.7t/ha	4.4t/ha	5.7t/ha
Selling WS			
Selling DS	5395kg	1764kg	3569kg
Home consumption	82kg	84kg	166kg
Sold Paddy or milled	Paddy	Paddy	Paddy
Sell to ?	Market woman	GNPA	Market woman
selling price	45000/82kg	35500/83kg	33000/83kg
Problem of rice cultivation	Financial	Financial Lack of Labor Home→field far	Acidic soil Financial

Okyerekc

Summary Sheets for Rice Cultivation Survey (3/5)

No.	1	2	3
Name	Comfort Sarfo	R.R. Aggrey	Charles Adjei
Area	0.4ha	0.4ha	0.4ha
Variety	ITA 304	ITA 304	GK 88
Reason	H.Y., Resist. Pest	High Yield	H.Y., Good tast
Source of seeds	Dawhenya	IDA	IDC
Renewal of seeds	No	Yes	Yes
Sterilization	No	No	No
Transplanting?	No	No	No
Straight/Random			
Seedling age			
Cost of TP			
Direct seeding	Yes	Yes	Yes
Seeding rate	87.5kg/ha	105kg/ha	70kg/ha
Land preparation	Tractor	Tractor	Tractor
Cost	50000/ha	37500/ha	45000/ha
Harrowing	25000/ha	37500/ha	22500/ha
Leveling			
Fertilizer Amount	95-38-38 NPK/ha	90-38-38 NPK/ha	90-38-38 NPK/ha
NPK(15%)	250kg/ha	250kg/ha	250kg/ha
Urea(46%)	125kg/ha		
A.S.(21%)		250kg/ha	250kg/ha
application time			
NPK	21DAS, 56DAS	21DAS, 63DAS	35DAS, 56DAS
Urea/A.S.	56DAS	63DAS, 77DAS	77DAS, 84DAS
Weeding			
Hand weeding	twice	twice	twice
Cost of H.W.	60000/ha	30000/ha	110000/ha
Herbicide	No	Stam 34 5L/ha	No
Insecticide	No	No	Yes?-1kg 4000
Fungicide	No	No	No
Water supply	Not enough	Not enough	Not enough
Irrigation Cost	50000/ha	50000/ha	50000/ha
Harvesting	Family labor	Hired labor	Hired labor
Cost	Family labor	60000/ha	45000/ha
Threshing	Family labor	〃	22500/ha
Packing	Family labor	Family labor	Family labor
Drying	Family labor	Family labor	Family labor
Winnowing	Family labor	Family labor	12500/ha
Store place	House	House	House
Yield WS	5.2t/ha	4.6t/ha	4.3t/ha
Yield DS			
Selling WS	1764kg	1650kg	1517kg
Selling DS			
Home consumption	84kg, 252kg→Labor	165kg	205kg(41kg→seed)
Sold Paddy or milled	Milled rice	M.R. 2200/bag	M.R. 2100/bag
Sell to ?	Market woman	Market woman	Market woman
selling price	40000/bag	30000/bag	27000/47kg
Problem of rice cultivation	Water shortage Lack of tractor Financial	Water shortage Financial Store house	Lack of tractor Water shortage Financial

Okyereko-2 Summary Sheets for Rice Cultivation Survey (4/5)

No.	4	5	6
Name	Kofi Acquah	Aba Yaa Nowa	Esther Eyah
Area	0.4ha	0.4ha	0.4ha
Variety	ITA 304	not know(ITA 304?)	not know(ITA 304?)
Reason	High Yield	High Yield	High Yield
Source of seeds	Dawhenya	IDC	IDA
Renewal of seeds	Yes	No	Yes
Sterilization	No	No	No
Transplanting?			
Straight/Random			
Seedling age			
Cost of TP			
Direct seeding	Yes	Yes	Yes
Seeding rate	103kg/ha	103kg/ha	200kg/ha
Land preparation	Tractor	Tractor	Tractor
Cost	40000/ha	62500/ha	45000/ha
Harrowing	20000/ha		
Leveling			
Fertilizer Amount	64-38-38 NPK/ha	103-19-19 NPK/ha	103-19-19 NPK/ha
NPK(15%)	250kg/ha	125kg/ha	125kg/ha
Urea(46%)		125kg/ha	125kg/ha
A.S. (21%)	125kg	125kg/ha	125kg/ha
application time			
NPK	28DAS, 56DAS	28DAS	28DAS
Urea/A.S.	77DAS	56DAS~70DAS	56DAS~70DAS
Weeding			
Hand weeding	Twice	Twice	Twice
Cost of H.W.	62500/ha	50000/ha	100000/ha
Herbicide	No	No	No
Insecticide	No	No hand picking	No
Fungicide	No	No	No
Water supply	Not enough	Not enough	Not enough
Irrigation Cost	50000/ha	50000/ha	50000/ha
Harvesting	Hired labor	Hired labor	Hired labor
Cost	37500/ha	62500/ha	105000/ha
Threshing	37500/ha	↑	↑
Packing	15000/ha	↑	↑
Drying	Family labor	Family labor	50000/ha
Winnowing	25000/ha	Family labor	↑
Store place	House	House	House
Yield WS		4.6t/ha	6.9t/ha
Yield DS	2t/ha(No water)	0.82t/ha(No water)	2.1t/ha
Selling WS	656kg	1555kg	5330kg
Selling DS			
Home consumption	164kg(41kg~Seed)	164kg	164kg
Sold Paddy or milled	M.R. 1600/bag	M.R. 2200/bag	Paddy
Sell to ?	Market woman	Market woman	Market woman
selling price	30000/47kg	40000/bag	30000/bag
Problem of rice cultivation	Water shortage Financial Lack of tractor	Water shortage Financial Soil Problem	Lack of field Field leveling Soil Problem

Ashaiman Summary Sheets for Rice Cultivation Survey (5/5)

No.	1	2
Name	Attah Kamassa	Maxwell Owusu
Area	0.6ha	0.6ha
Variety	GK 88	GK 88
Reason	H.Y. Good taste	H.Y. Good taste
Source of seeds	Market woman	Market woman
Renewal of seeds	No	Yes
Sterilization	No	No
Transplanting?	No	No
Straight/Random		
Seedling age		
Cost of TP		
Direct seeding	Yes	Yes
Seeding rate	187kg/ha	93kg/ha
Land preparation	Powertiller	Powertiller
Cost	87500/ha	87500/ha
Harrowing		
Leveling	17000/ha	
Fertilizer Amount	228-75-75 NPK/ha	85-50-50 NPK/ha
NPK(15%)	500kg/ha	333kg/ha
Urea(46%)	333kg/ha	
A.S. (21%)		167kg/ha
application time		
NPK	14DAS, 30DAS	14DAS, 42DAS
Urea/A.S.	49DAS, 71DAS	74DAS
Weeding		
Hand weeding	Once	Once
Cost of H.W.	Family labor	Family labor
Herbicide	Basgran 5L/ha	Basgran 5L/ha
Insecticide	No	Yes Karate 0.83L/ha
Fungicide	No	No
Water supply	OK	OK
Irrigation Cost	58000/ha	50000/ha
Harvesting	Hired labor	Hired labor
Cost	40000/ha	45000/ha
Threshing	40000/ha	37500/ha
Packing	Family labor	〃
Drying	Family labor	40000/ha
Winnowing	Family labor	〃
Store place	IDA store house	IDA store house
Yield WS	5.6t/ha	5.3t/ha
Yield DS		
Selling WS	3192kg	2520kg
Selling DS		
Home consumption	168kg(84→seed)	420kg(210kg→seed)
Sold Paddy or milled	Paddy	Paddy
Sell to ?	Market woman	Market woman
selling price	35000/bag	35000/bag
Problem of rice cultivation	High input cost Financial Lack of P-tiller	Financial Lack of P-tiller High input cost

Appendix 3. (1/6)

RICE SECTION
EQUIPMENT AND FACILITY LIST

NO.	ITEM	SPECIFICATION	QTY
1.	FRIDGE FREEZER	SANYO(SR-56XS(H)	1
2.	OVEN (ISUZU CONSTANT TEMP)	MODEL 2-2137	2
3.	DESSICATOR	CHAMBER TYPE(80cmx50cm)	3
4.	MOISTURE METER	COMET CD-2 or PROBE TYPE	5
5.	WEIGHING SCALE	YAMATO 30KG	4
6.	WEIGHING SCALE	YAMATO 10-100KG (200g, D701)	2
7.	LEAF AREA METER		1
8.	PERSONAL COMPUTER IBM-COMPATIBLE + ACCESSORIES	OPTIPLEX 466LE	1
9.	CAMERA WITH ACCESSORIES	PENTAX P30N(35-105mm)	2
10.	RUBBER BOOTS (FROG-TOE TYPE)	ROCKETS MAKE SIZE 26-28	1000
11.	SATAKE RICE MACHINE (DEHUSKER)	TYPE : THU CLASS : 35A KW : 0.2-0.4 VOLTAGE: 240V	1
12.	SATAKE RICE WHITENING MACHINE (NEW ONE PASS)	BS-084 240V	1
13.	SATAKE TEST RICE GRADER	TYPE : TRC CLASS:05A 240V	1

Appendix 3. (2/6)

NO.	ITEM	SPECIFICATION	QTY
14.	SATAKE TESTING THICKNESS MACHINE		1
15.	RICE WINNOWER (SASAGAWA)	SUPER 'TOUMI' BM-2 (MOTOR TYPE)	5
16.	ELECTRONIC BALANCE (DIGITAL)	LIBROR EB-3200D	5
	FACILITY		
17.	COLD ROOM (FOR SEED STORAGE)	FULLY AIR-CONDITIONED	1
18.	DRYING FLOOR	IDC & OKYEREKO SITES	2

Appendix 3. (3/6)

EQUIPMENTS LIST - HORTICULTURE

NO.	EQUIPMENT	QTY	MODEL	REMARKS
1	SEED STORAGE CABINET	1	SL-60K	NEW
2.	CAMERA	1	Pentax P30 & Accessories	NEW
3.	CHLOROPHYLL METER	1	Spad 501	NEW
4.	GERMINATOR	1	CAT 111-E (Robertshaw)	NEW
5.	HORTICULTURE LUX METER	1	DM-28	NEW
6.	HAND GRIP SPRAYER	2	Automatic type	NEW
7.	AUTO PRESSURE STERILIZER	1	Model KT	NEW
8.	E.C. METER	1	CM 50D	NEW
9.	ELECTRICAL ANALYTICAL BALANCE	2	Model ER	NEW
10.	INCUBATOR WITH FREEZER	1	Model CR	NEW
11.	RESEARCH MICROSCOPE WITH CAMERA	1	ZLB-T3M1	NEW
12.	THERMO-METER	2	SCTH-350	NEW
13.	OVEN	1	PO 450	NEW
14.	BLENDER	2	Waring commercial	NEW
15.	SCALE (100kg)	2	Avery	NEW
16.	SCALE (30kg)	5	Avery	Old one
17.	SCALE (10kg)	5	Avery	Old one
18.	pH METER	1	Horiba Model F13	Old one
19.	MAGNIFYING GLASS	2	Model C 10X	Old one
20.	MAGNIFYING GLASS	2	Model C20X	Old one
21.	CALCULATOR	2	Casio F2 911N	Old one
22.	KNAPSACK SPRAYER	1	15L	Old one

Appendix 3. (4/6)

SOIL EQUIPMENT LIST

ITEM DESCRIPTION	QTY	NO.
Digital pH/mV meter, Model 6091	1	7053-045
Digital conductivity meter, SC-17A	1	7045-01
Water distilling apparatus, DN-55	1	5313-55
Water storage tank	4	5316-2
*Atomic Absorption Spectrophotometer(VARIAN) with sample changer, glass tubes and printer	1	N/A
Sample changer, Model E674/2	1	7750-674322
Control unit for sample changer, E664	1	7750-664
Auto burette, E665/8	2	7735-80
Drying shelf for laboratory glassware	2	4781-1
Magnetic stirrer, Model MGH-310	1	5066-310
Hot Plate, Model 2	1	5085-02
Shaker, RMS 250	1	5065-73
Ultrasonic pipet cleaner, Model PU-100	1	5082-100
Nitrogen Determination (1)		
Disgester, Model B-430	1	
Distillation Unit, Model B-322	1	
Titrating Aparatus, Model E665	1	
Microprocessor B-343	1	
Printer, Epson FX-800	1	
Boiling Tube		
Boiling tube	20	5404-811A
Rack	2	5404-1248
Condenser	2	5404-2014
Digester, Model B-430	1	5404-300
Nitrogen Determination (2)		
Micro kjeldahl distillation apparatus (Parnas-Wagner type)	1	5412-01
Heating mantle	2	4663-10001
Titrating set	1	5415-01
Micro kjeldahl distillation apparatus 6-unit, electric heating	4	5421-05
Particle Size Analysis		
Motor mixer	1	
Timer	2	

Appendix 3. (5/6)

GLASSWARE

Beakers:(borosilicate)	QTY
5 litres	12
2 litres	12
1 litre	12
500ml	12
250ml	24
200ml	24
100ml	32
50ml	32
Volumetric flask(borosilicate)	
2 litres	12
1 litre	12
500ml	12
200ml	12
100ml	50
50ml	50
Reagents bottles(plastic, graduated	
100ml	100
1 litre	20
50ml	50
Wash bottles	
1 litre	20
Pipets, bulb	
50ml	4
25ml	8
20ml	8
10ml	10
5ml	10
2ml	10
1ml	10
0.5ml	10
0.2ml	5

Measuring Cylinders, (borosilicate), spout

2 litres	10
1 litre	10
500ml	10
250ml	10
100ml	10
50ml	10

Pipets, graduated

1ml	10
2ml	10
5ml	10
10ml	10
25ml	10

** Items from SIGATA except item marked **

JOINT

SURVEY

PHOTOGRAPH

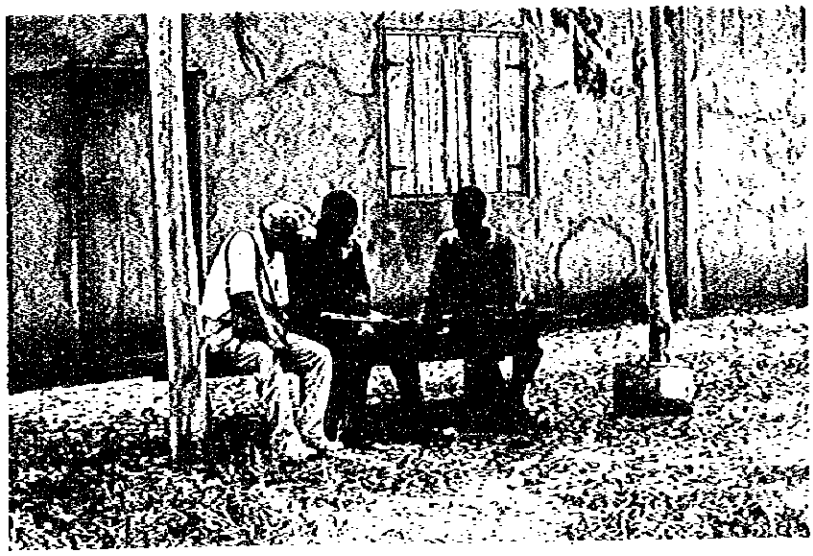
29 MAY 1996

GHANA IRRIGATION DEVELOPMENT
AUTHORITY
JICA LONG-TERM SURVEY TEAM

Joint Survey

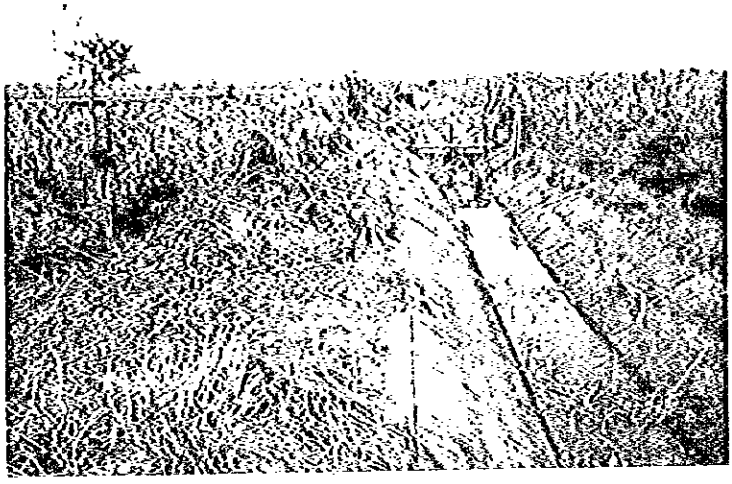
Assistant Project Manager explains the area with model.

Mr. Senda interviewed a staff in Mankessim Site.

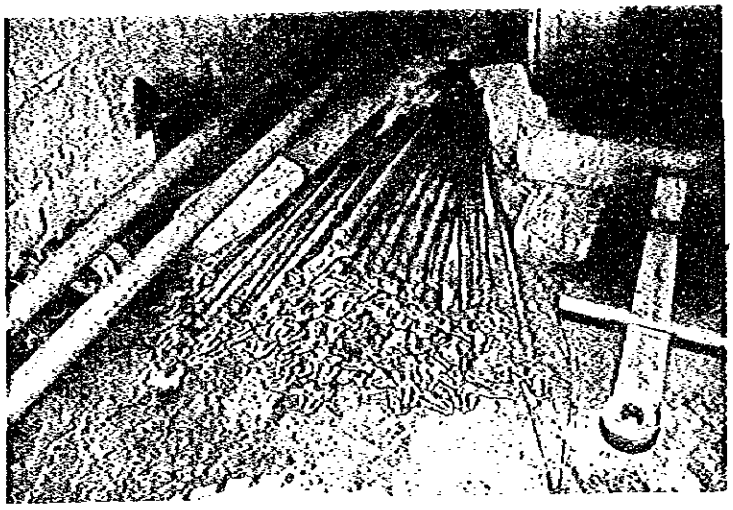


Mr. Tsuboi and Mr. Asatse are interviewing a farmer.

Water Management



Well maintained Canal in Afife Irrigation Site.



Sprinklers in Mankessim Irrigation Site.

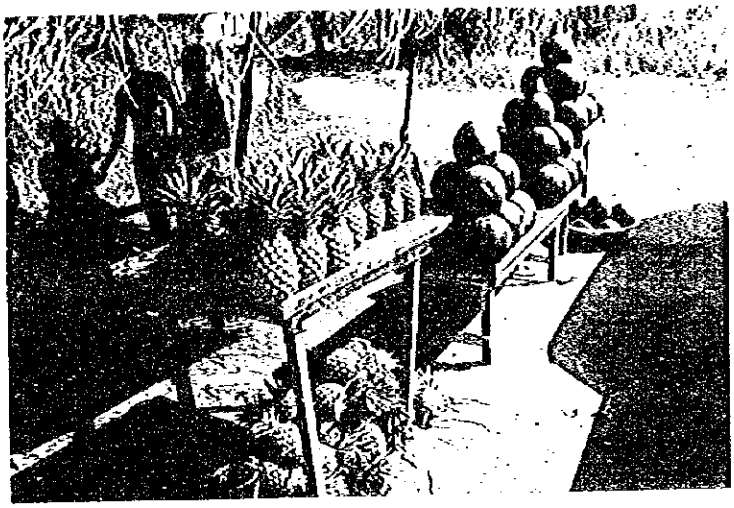
Well maintained Canal in Ashiaman Irrigation Site.

Problems in Rice Cultivation

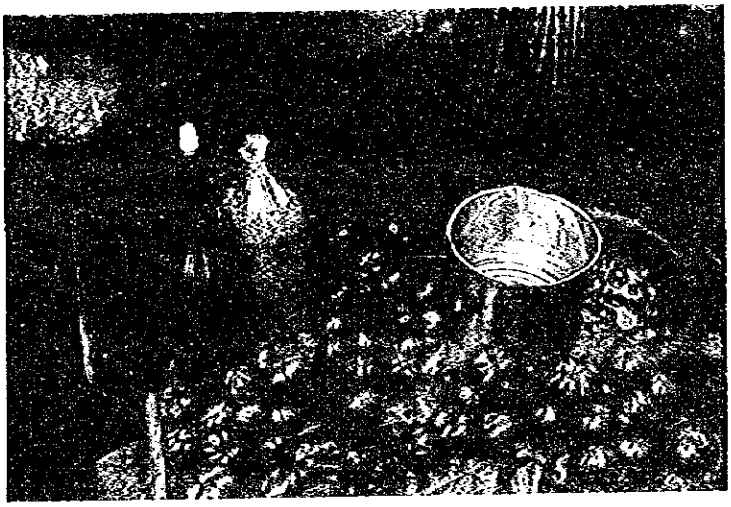
Cultivation by Power Tiller.
Power Tiller will be broken down easily when weed is still in the field.

Transplanting is necessary because the germination is not uniformed in order to direct seeding method.

Winnowing by hand and a winnower developed in IDC.



Water Melon and Pineapple on the route.



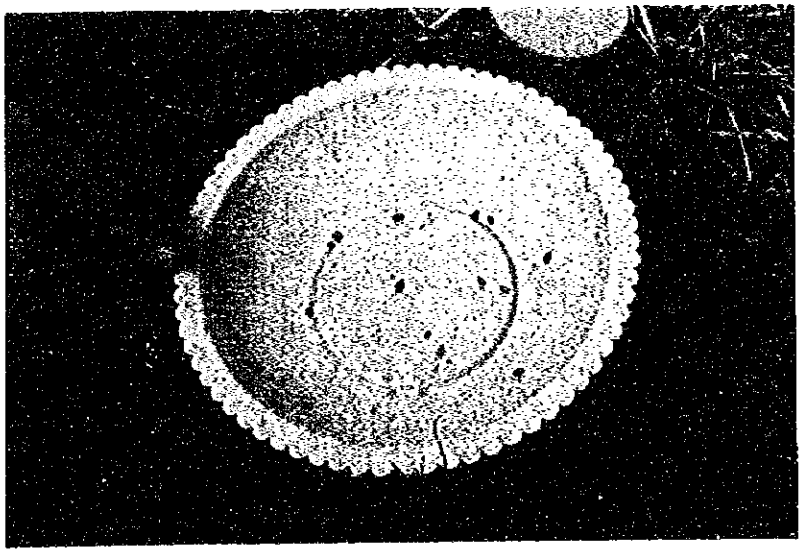
Tomato and Tomato seed which unmarketable extracted fruits in Ashiaman Market.

Seed Shop in Teme Town.

Schistosomes Survey

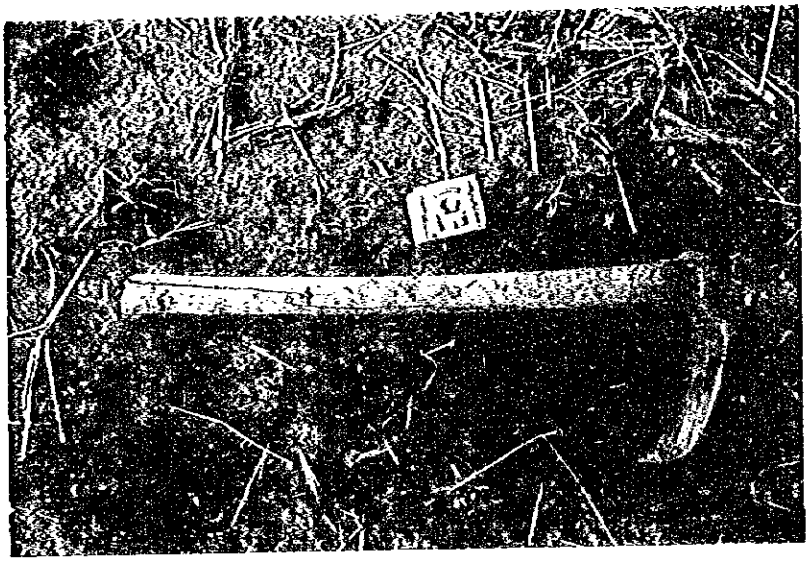
Attention!!!
Children are in danger.
Shistosomes is around them.

Collection of the intermediate hosts in the canal.

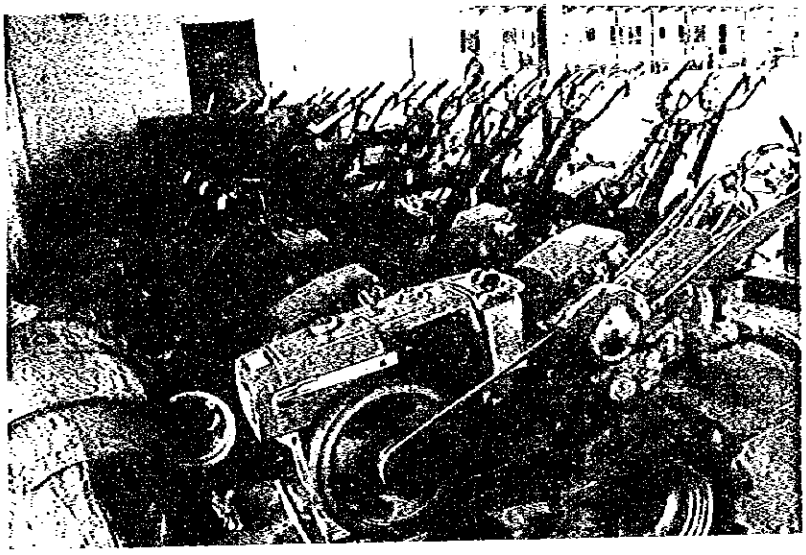


Intermediate host of
S. haematobium
B. (B.) Truncatus.

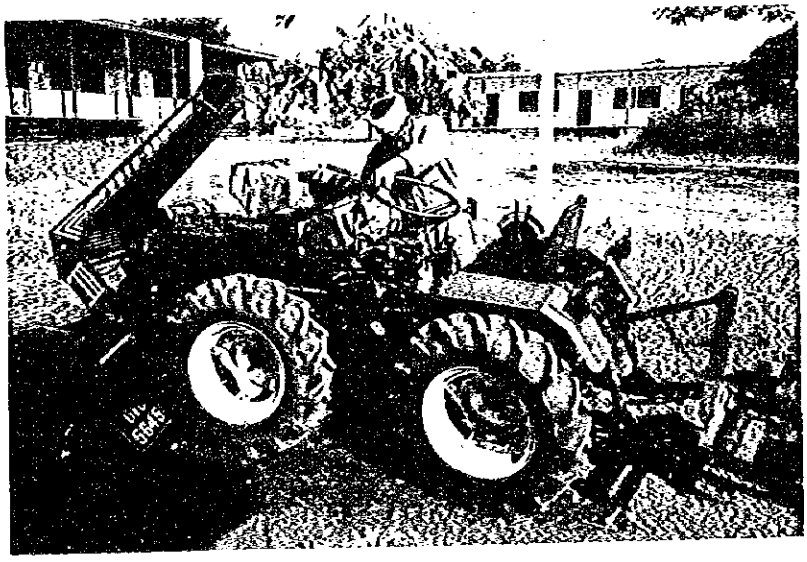
Agricultural Equipment



A Hoe

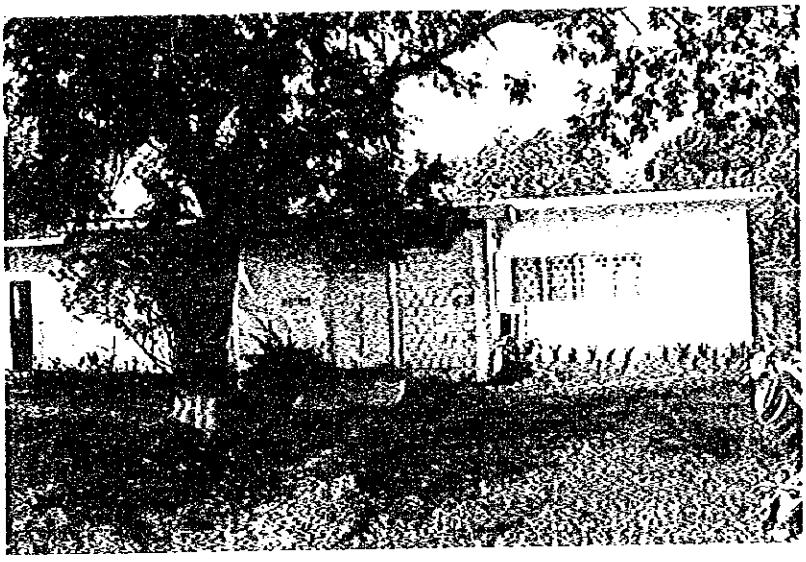


Italian Power Tiller can only use for upland
(Behind the front power tiller) .

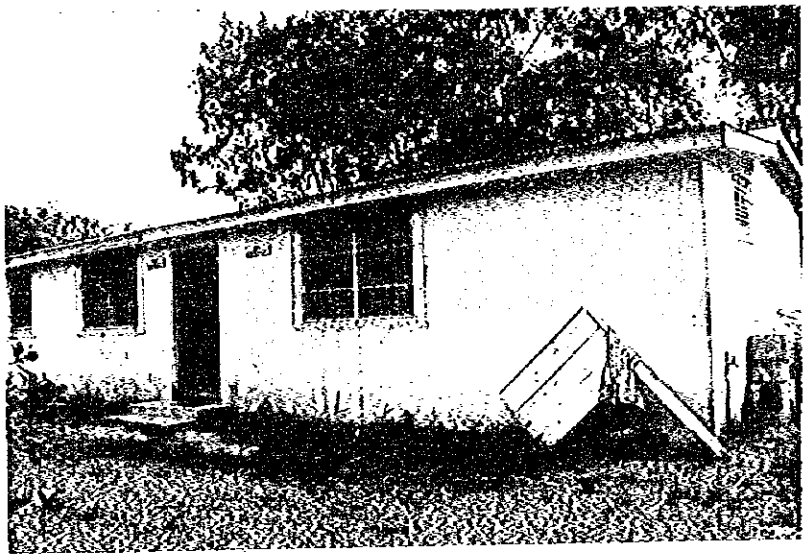


Tractor

IDC Buildings



Main Building
(Soel Section, Reception, Director room)



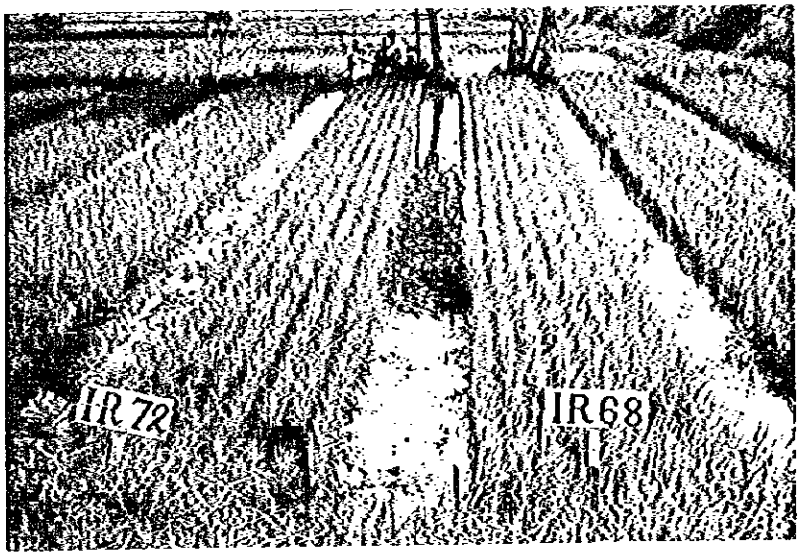
Water Management and Agro-Environment Building.

Meeting Room under the tree.

Ashiaman Irrigation Site

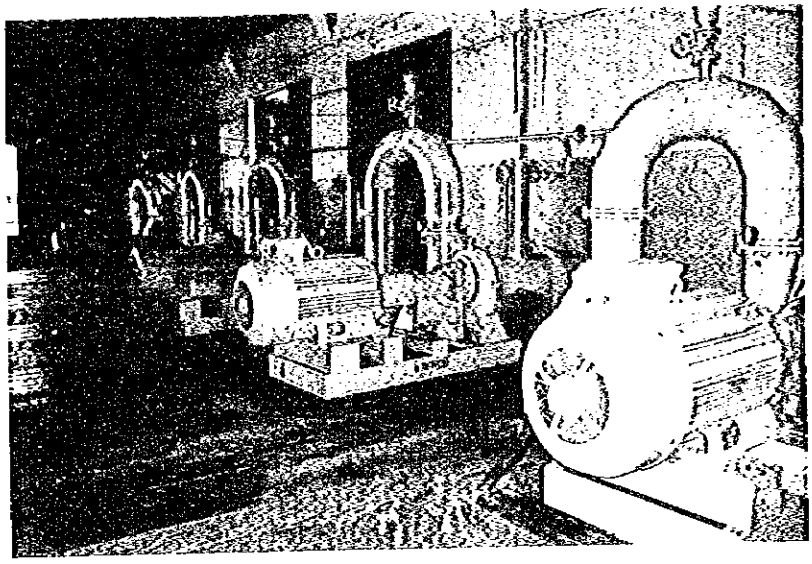
Monitoring insect in Farmers Field School.

Okra in Paddy Field.

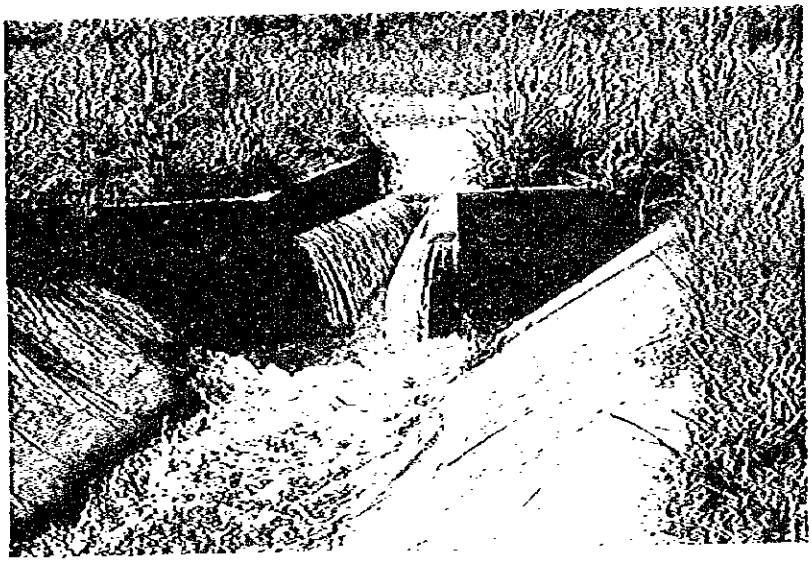


Rice Varietal Trail.
The field is well managed.

Dawhenya Irrigation Site



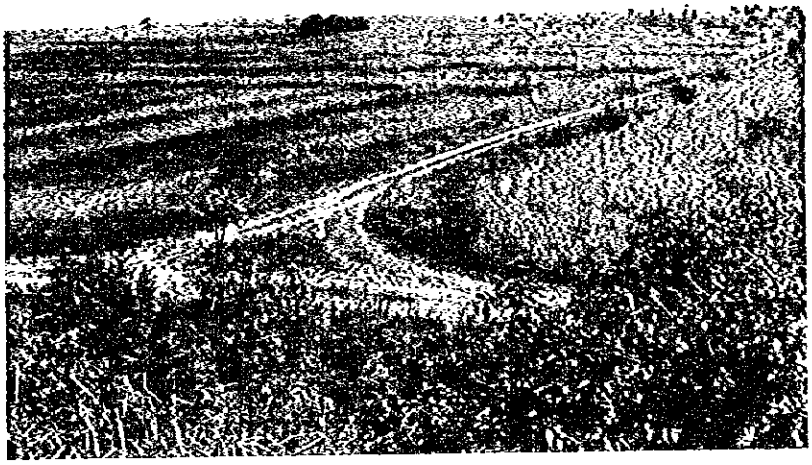
Well maintained irrigation pomps.



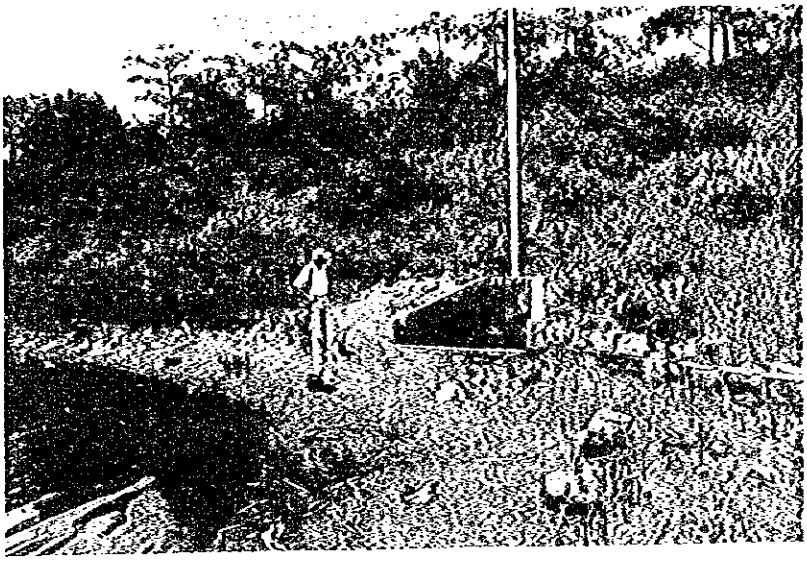
Check Structure

Seed production
(BOUAKE189 from Ivory Coast).

Okyereko Irrigation Site



Rice field and farm road.
The cannel is along to the farm road but weed covers it.
The village locates next to their field.



Water level of the Dam is low seriously.
You can see the intake.

The leader interviewed NANA (Village Chief).

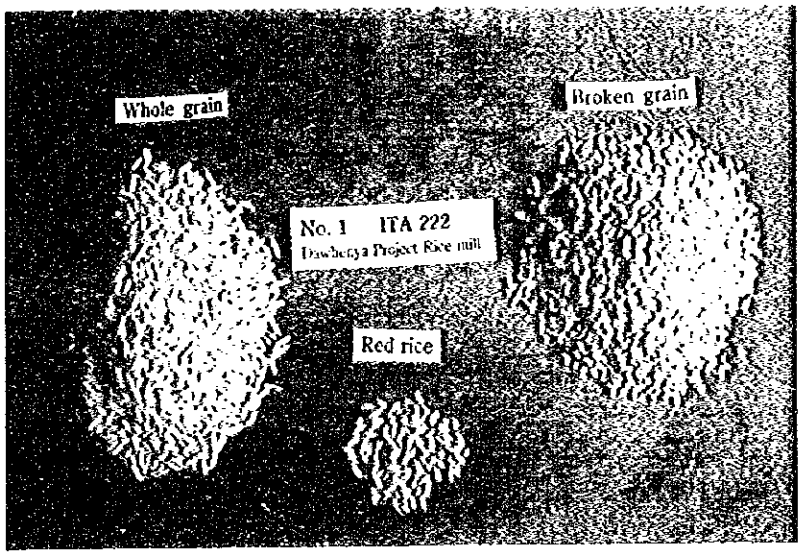
Afife Irrigation Site

Irrigation facilities are still good condition.

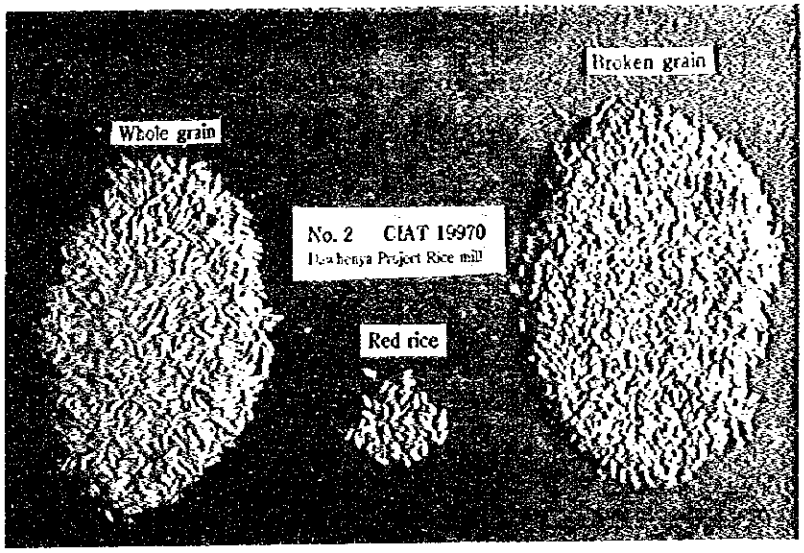
The Project manager explains field condition.

Farmers attend IPM programme, they are interested in participatory learning process (Farmers Field School).

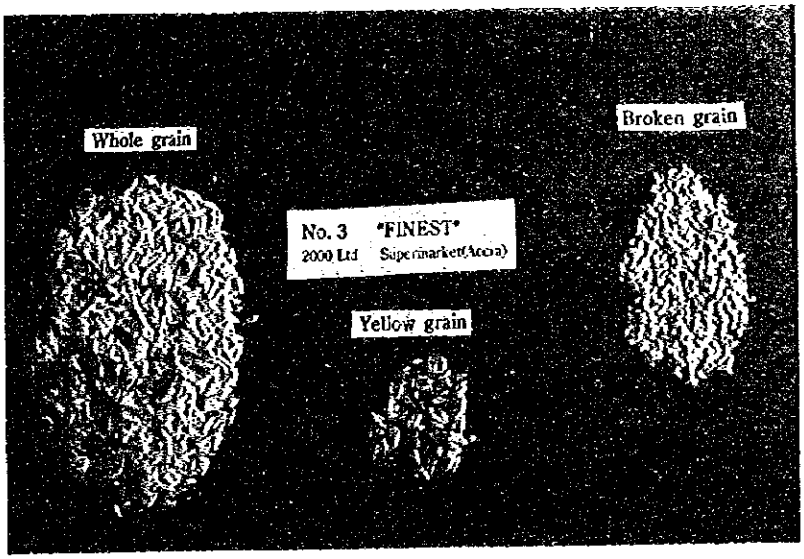
Rice Quality Test



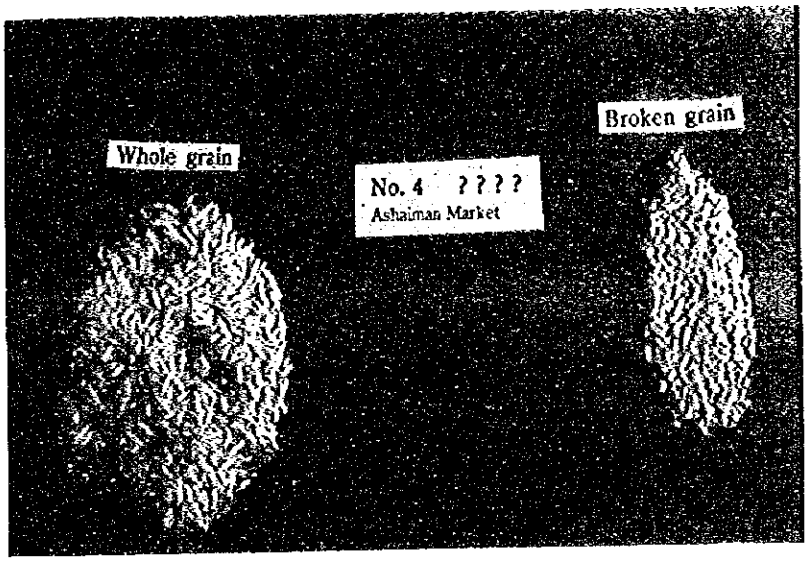
700 Cedis/kg
(Farm gate price)
Whole grain : 53.0%
Broken grain : 44.7%
Red rice : 2.3%



700 Cedis/kg
(Farm gate price)
Whole grain : 50.5%
Broken grain : 47.9%
Red rice : 1.6%



1,500 Cedis/kg
Whole grain : 76.3%
Broken grain : 18.3%
Yellow grain : 5.3%

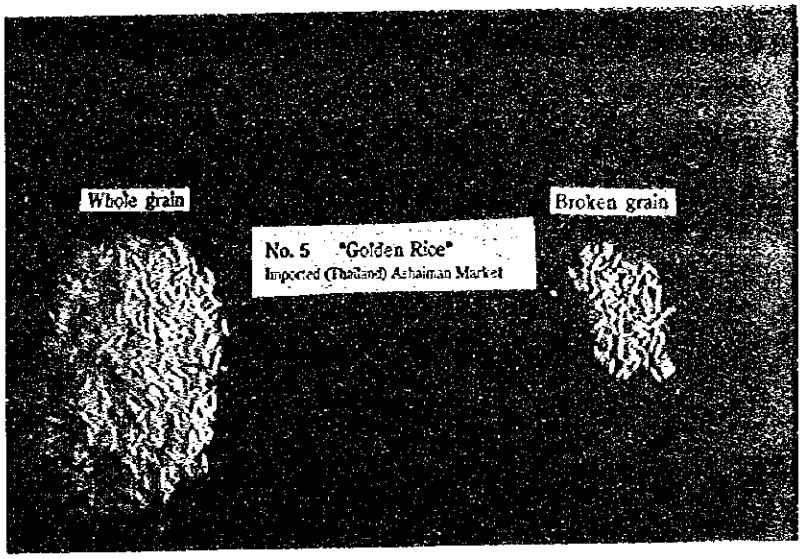


1,538 Cedis/kg

Whole grain : 76.8%

Broken grain : 23.2%

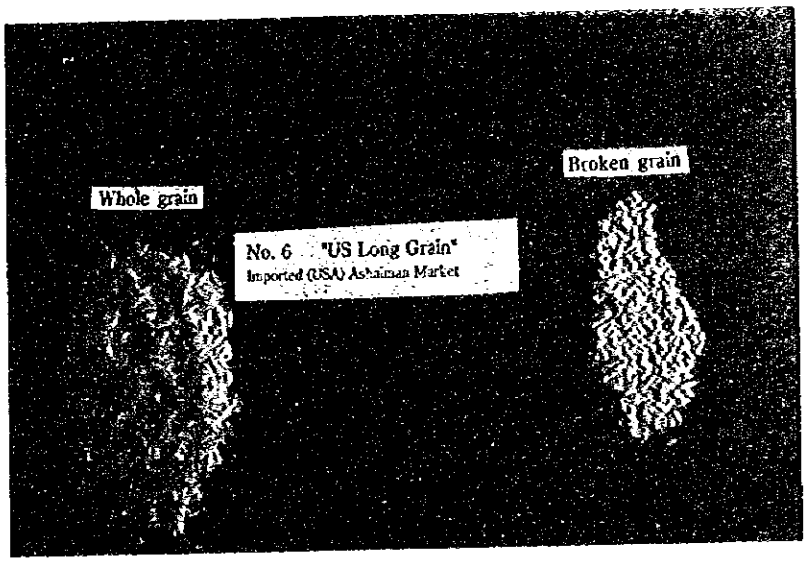
Red rice : 127 grains/100g



2,045 Cedis/kg

Whole grain : 94.1%

Broken grain : 5.9%



1,444 Cedis/kg

Whole grain : 75.4%

Broken grain : 24.6%