

ICAR AD-HOC SCHEME

ON

" MECHANICAL CONTROL AND UTILIZATION OF
FLOATING TYPE AQUATIC WEEDS "

ANNUAL REPORT- 1985

Presented at the Annual Workshop
held at

ANDRAPRADESH AGRICULTURAL UNIVERSITY, HYDERABAD
JANUARY 21-24, 1986.

DEPARTMENT OF AGRICULTURAL ENGINEERING
COLLEGE OF HORTICULTURE
KERALA AGRICULTURAL UNIVERSITY
VELLANIKKARA-680 654
TRICHUR.

I. GENERAL INFORMATION

- 1.1. Title of the Ad-hoc Scheme : Mechanical control and utilization of floating type aquatic weeds.
- 1.2. ICAR Sanction number and date : No.: -2/80... Dt. 4-10-1983
- 1.3. Date of start : 7-3-1984
- 1.4. Date of completion : Continuing
- 1.5. Duration of the scheme : 3 years from the date of start
- 1.6. Sanction granted for the complete duration of the project : Rs. 2,56,920/- (Fully Financed by the KAR).
- 1.7. Name and address of the Principal Investigator : K. John Thomas,
Professor,
Dept. of Agrl. Engg.,
College of Horticulture,
Vellanikkara,
Trichur-686 54.

2. STRENGTH POSITION OF THE SCHEME

| Sl. No. | Name of the Post and scale of pay | No. of posts sanctioned | No. of posts filled up | No. of posts vacant | Name of the incumbent | Date of appointment | Date of leaving |
|---------|--|-------------------------|------------------------|---------------------|-----------------------|---------------------|-----------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. | Asst. Professor (Rs. 800-1600) | 1 | 1 | Nil | M.R. Sankaranarayanan | 7-3-1954 | Continuing |
| 2. | Research Associate (Rs. 400/-P.M. consolidated) | 2 | 1 | 1 | M.S. Hajilal | 1-10-1984 | Continuing |
| 3. | Technician Grade-II (Rs. 420-720) | 2 | Nil | 2 | -- | -- | (x) -- |
| 4. | Technician Grade-III (Rs. 330-515) | 1 | 1 | Nil | B.S. Suresh | 17-11-1984 | Continuing |
| 5. | Workshop Assistant (Rs. 330-515) | 1 | Nil | 1 | -- | -- | (x) -- |

(X) Action is being taken to post Technicians & workshop Assistant immediately.

3. FINANCIAL INFORMATION

3.1. Expenditure Statement for the year 1985-1986 (upto 31st December, 1985)

| Sl. No. | Budget Head | Sanctioned grant Rs. | Expenditure Rs. | Actuals as % of sanctioned grant |
|---------|-----------------------------|-------------------------|--------------------|-------------------------------------|
| 1. | Pay and Allowances | 64,000 | 30801.00 | 48.13 |
| 2. | T.A. | 3,000 | 620.90 | 20.70 |
| 3. | Recurring contingencies | 8,000 | 3625.00 | 45.31 |
| 4. | Non-recurring contingencies | 7,000 | -- | Nil |
| | Total | 82,000 | 5046.90 | 42.74 |

3.2. Expenditure Statement for the year 1984-1985.

| Sl. No. | Subject head | Sanctioned amount | Expenditure Rs. | Expenditure as a percentage of sanctioned grant |
|---------|-----------------------------|-------------------|--------------------|---|
| 1. | Pay and Allowances | 30,200 | 25356.29 | 23.68 |
| 2. | T.A. | 1,500 | 2986.56 | 199.10 |
| 3. | Recurring | 8,000 | 7955.67 | 99.45 |
| 4. | Non-recurring contingencies | 35,000 | 20939.08 | 59.97 |
| | Total | 74,800 | 57287.60 | 76.59 |

4. OBJECTIVES OF THE SCHEME

The ultimate objective of the scheme is to provide an integrated method of control and utilization of the two main floating type aquatic weeds namely Salvinia molesta and Eichhornia Crassipes the large scale infestation of which has been plaguing the State for nearly two decades, through the design and development of appropriate mechanical control measures and utilization techniques.

The specific objectives of the scheme are as follows:-

- i) To study the biological and mechanical properties of the more prominent aquatic weeds of the state namely Salvinia molesta (locally known as African Payal) and Eichhornia crassipes (water hyacinth). So as to evolve design parameters necessary for the development of suitable mechanical control measures and utilization techniques.
- ii) To develop prototype harvesting equipment suitable for different habitats and growth stages of the weeds by evolving original design concepts and development of local innovations which may utilize manual or mechanical power.
- iii) To survey and select aquatic weed harvesting and processing machines from other countries and adapt them for use in the state.
- iv) To carryout specific studies on disposal and or utilization of harvested material through approaches such as drying and burning, bio-gas production etc. and develop pilot plants for the same.

v) TECHNICAL PROGRAMME

1. Technical Programme of the scheme:

- a) Main items of investigation.

The research programme will be organized in five areas of activity in accordance with the stated objectives.

1. Study of mechanical properties and processing characteristics:

Under this section information will be collected on the extent of infestation of the weeds in various parts of the state and stages of growth as a prelude to the study of physical properties and processing characteristics. Information will be collected specifically on spread density, regeneration and rate of growth, compressibility, shear strength, density

pressure relations, plant tool forms, moisture extraction and drying characteristics, etc. The data thus generated will help to evolve suitable design parameters in regard to type and size of equipment to be used for various situations.

2. Design and development of mechanical equipment:

Under this section activities will be concentrated to assemble and analyse various design concepts for harvesting, for disposal as well as for utilisation of weeds. This will involve various stages of laboratory investigations, fabrication of working models, detailed design and fabrication of prototypes, laboratory and field testing, and redesign. Since the weeds occur at various stages of growth in widely differing habitats ranging from shallow ponds and navigation canals to the vast expanses of low lying paddy fields and lake waters, equipments to suit different situations, will have to be conceived, designed, tested and finally popularised. Preference will be given to concepts which utilise locally available prime movers such as pumpsets, power tillers and tractors, in developing such equipment.

3. Adaptive design and testing:

A simultaneous and equally important activity will be to select and import promising mechanical equipment commercially available in other countries on which adaptive trials will be conducted. These machines will then undergo modifications to suit conditions existing in Kerala. Collaborative assistance will also be sought from world bodies in the selection, importation, testing and modification of each equipment.

4. Disposal/utilization studies:

Mechanical harvesting of aquatic weeds assumes greater relevance when economic utilisation of the harvested material is developed. Two approaches will be utilised initially; one dealing with disposal by mechanical pressing and burning and the other by utilising the material for biomass production through small scale units similar to the gobar gas plants. Equipment for moisture extraction, bailing and shredding will be either located or developed along with suitable combustion chambers for the proposed disposal system. Similarly in regard to utilisation, existing gobar gas plant designs will be modified to accommodate aquatic weeds and obtain maximum biomass conversion.

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5. Popularisation:

Equipment found suitable in the course of the project will be field tested for farmer acceptance and popularised through the extension media of publications and demonstrations, including subsidised sales. Arrangements will be worked out with organisations such as the Agro-industries corporation to manufacture prototypes and distribute such equipment to interested private and public agencies.

b. Arrangement for analysis of data:

The bulk of the analysis relates to engineering properties of the material, biological and functional performance of structural and mechanical equipments, which will be carried out by the project staff themselves. Statistician associated with the project will be Head of Department of Agricultural Statistics, College of Horticulture, Vellanikkara.

c. Items of investigation and collaborators :

It is proposed to have consultations on the following items with various organisations at various stages of the study as detailed below:-

1. Survey and extent of infestation University of Calicut, Tenhipalam, Kerala.
2. Local innovations-High Power Committee on salvinia eradication, Government of Kerala, Trivandrum.
3. Physical properties and processing characteristics- Dr.H.D.Bruhn, University of Wisconsin, Madison.U.S.A.
4. Weed control equipment-Weed research organisation, U.K. and International Plant Protection Centre,U.S.A.
5. Bio-gas technology-Science and Technology Department, Government of India.

2. Technical programme (approved for the year 1985-1986 in the last year annual work shop, held at CIAE, BHOPAL) : Procurement of 15/20 HP high head prime mover pumpset. Modification of the existing platform, if needed. Design, fabrication and testing of suitable floating fence to collect the Salvinia weeds. Checking the suitability of this equipment to collect Aichrobia crassipes.

- : Collection of information regarding the utilization aspects of the two floating type aquatic weeds. Seeking of collaborative assistance from other world bodies in the selection, testing and modification of equipment.

6. PROGRESS REPORT OF THE RESEARCH

6.1. Summary of work done:

6.1. During the first year (1984-85) (In brief)

Information regarding the extent of infestation of Salvinia molesta and the regeneration and rate of growth were collected. The spread density values (ie weight of the immediately harvested salvinia per unit area) were found as 16 Kg/m² for this population and 60 Kg/m² for that of a thick population. The wet bulk density of the Salvinia was found to be varied from 370 to 400 Kg/m³. The Collection capacity of the Salvinia Harvesting Machine (SHM) with the newly fabricated 20° deflected secondary slow nozzle assembly and a 30 cmx7.5 cm rectangular Feeding month was 11.3 T/hr at a Static lift of 1m.

6.2 During the reporting period

a) Procurement of a 8/10 HP high pressure pumpset and its laboratory testing:

In this period, a 8/10 HP high pressure pumpset was procured and it's specifications are given below.

Greaves Lambardini Model LDA 510, Single Cylinder, Vertical, air cooled, rope starting, four stroke, 9 HP diesel engine conforming to ISI 1601-1960, coupled with centrifugal pump 1½"x2" by mean of coupling and complete with base plate and lifting handle, total head 40 m and discharge 7.3 lps. A 12 v dyanamo starter with pully was also procured for the easy starting of the engine. The discharge performance of the above pumpset was tested in the laboratory and the test results are given in annexure.I.

b) Modification of the ejector system:

In order to avoid the direction change of solid material in the secondary flow; it was made straight and a 30° direction change was given to the primary flow as shown in Figure (i).

c) Modification of feeding mouth:

Previous test results revealed that for a rectangular mouth the optimum dimensions are 30 cm (length) and 7.5 cm (width). Accordingly it was proposed to fabricate an elliptical mouth with major axis 30 cm and minor axis 7.5 cm. The figure (2) shows the details of rectangular mouth, the length of which could be adjusted by two metal flaps and an elliptical mouth used for the SHM.

d) Fabrication of floating Fence:

The SHM was operated as a stationary equipment in the previous field testing. It was proposed to operate the equipment as a self propelled unit. During the propulsion the weed has to be collected in a floating fence. Hence a floating fence of size 150 cm x 150 cm x 120 cm was fabricated and its floatation was given by 6 polyethylene drums of 50 lts capacity. Weld mesh was used to cover the sides and provision was also made to open one side for the removal of harvested Salvinia from the Fence. The drums are arranged in two rows on either side of the floating Fence. The total weight of the floating fence is approximately 80 Kg.

e) Field testing of Salvinia Harvesting Machine:

Field testing of the newly fabricated ejector system, elliptical mouth and the floating fence was carried out in the third week of September at Nanthikkara, 35 KM from headquarter. With the introduction of the elliptical mouth the possibility of the weeds to be choked in the mouth portion was totally eliminated. Field testing revealed that the collection capacity of the newly fabricated ejector system was 10.15 T/hr at a static lift of 40 cm (Details in Annexure-2)

This test result shows a reduction in collection Capacity of Salvinia as against the earlier test result of 11.28 T/Hr at a static, lift of 1m. This may be due to the difference in submerged leaves (roots) habitat of Salvinia in different growth phases.

The earlier Field testing was conducted in a location where the Salvinia was in the beginning of the second growth phase, and it's maximum submerged leaf (root) length was only 20 cm. The reported field testing was conducted in an isolated pond where the weed density is too high and the length of the submerged leaves of the weed at this location was found to be varied from 10 to 50 cm according to different growth stages. At some places the root may even go upto 75 cm depth. The experiments conducted showed that root length also affects the collection capacity of the Harvester. So it was proposed to conduct studies toward the weight ratios of submerged leaves (roots) to the total weight and it's effect on harvesting capacity.

During the field testing it was found that the size of the floating Fence (150cmx150cmx120 cm) is too high compared to the six numbers of polyethylene drums used for floatation. When the floating fence is half filled with Salvinia it was about to topple and hence decided to reduce the height to 60 cm and to increase the number of drums by fitting two additional drums at the backside of the fence. Where the Salvinia is collected in heap from the secondary flow pipe and according by the modified floating fence was fabricated.

The capacity of the modified floating fence was tested during the second field testing at Fudukkad. When the floating fence is fully packed with Salvinia it was about to sink and the capacity was found to be approximately 450 Kg. (Test results in Annexure 3).

F. Bulk density of Salvinia:

Earlier field testing shown that the wet bulk density of Salvinia (immediately harvested material per unit volume) was about 400 Kg/m³. The drip dry bulk density was also determined during this period and it's value is about 300 Kg/m³. It is the weight of harvested Salvinia per unit volume after complete dripping was over. This value will be very important for transportation and utilization aspects.

6.2 Proposed works to complete within three months (upto March 1986)

In the existing 5 HP, preliminary testings were carried out with 2 nos. of 5 HP, 20 m, 500 lpm pumpsets, connected in series, later they were replaced by one 8/10 HP pumpset having the capacity of 410 lpm at 40 m head. It is proposed to connect the 8/10 HP pumpset with one 5 HP pumpset in series. So as to achieve a total head of about 60 m and a discharge of 450 lpm. It's efficiency shall be tested.

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2. Fabrication of a high capacity ejector system to fit the above arrangement as shown in Figure(3).
3. Fabrication of an elliphical feeding mouth for the above ejector system.
4. Testing of the 13/15 HP pumpset (8/10 HP + 5 HP) to find the ratio of primary flow to secondary flow.
5. Field testing to find out the overall weed harvesting capacity of the machine. Field testing will be conducted in the Trichur Kole lands as well as in the Kuttanadu region.
6. Conducting studies to find the weight ratio's of submerged leaves (roots) to the total weight of Salvinia and its effect on collection capacity of weeds.
7. Modification of the existing floating platform for getting more bouyancy to accomodate high head pumpsets and high capacity ejector system.

6.3 Proposed future line of work during 1986-1987.

1. Procurement of another set of 10 HP high pressure pumpset and it's testing.
2. Fabrication of a high capacity ejector system to sutti the 15/20 HP, 30 m pumpset (2 nos.of 10 HP, 40 m pumpsets).
3. Arrangements to make the whole unit as a self propelled one
4. Field testing of the different units on the Kuttanadu region in different habitats.
5. Checking the suitability of the machine to harvest Eichhormia crassipes also.
6. Studies on the aspects of utilization of these floating type aquatic weeds.
7. Popularisation of 5 HP and utilization equipments through extension media. Making arrangements with organisations like Agro-industries to manufacture prottypes.



ANNEXURE-1

Discharge of 10 HP High Pressure pumpset, RPM. 3000

| Sl No. | Suction Head (cm of Hg) | Delivery Head (Kg/cm ²) | Time to fill 200 l drum, (average) sec. | Discharge lps | Discharge l/m |
|--------|-------------------------|-------------------------------------|---|---------------|---------------|
| 1. | 4.0 | 1.0 | 25.3 | 7.9 | 71 |
| 2. | 4.0 | 2.0 | 25.63 | 7.8 | 73 |
| 3. | 3.0 | 3.0 | 26.9 | 7.4 | 146 |
| 4. | 2.0 | 4.0 | 29.0 | 6.9 | 114 |
| 5. | 5.0 | 5.0 | 11.5 | 17.3 | 267 |

ANNEXURE-2

Collection of Salvinia with 30° deflected primary flow at a static lift of 40 cm.

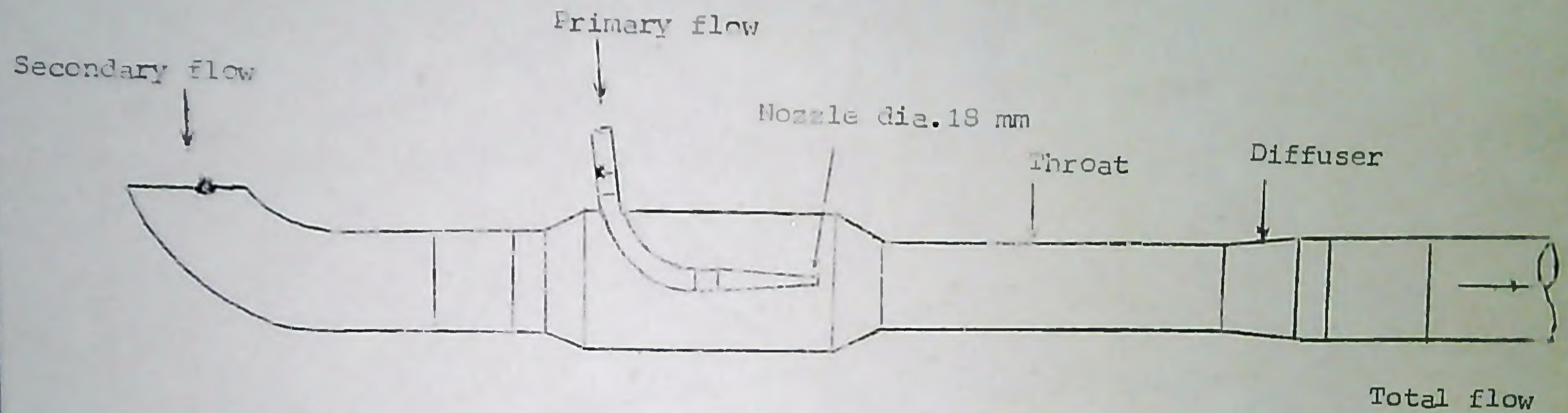
| Sl.No. | Time taken | Weed collected (Kg) | Rate of collection (T/hr) |
|--------|------------|---------------------|---------------------------|
| 1. | 10 Sec | 28.5 | 10.20 |
| 2. | | 27.5 | 9.90 |
| 3. | | 29.0 | 10.44 |
| 4. | | 26.5 | 9.54 |
| 5. | | 29.5 | 10.62 |

ANNEXURE-3.

Capacity of floating fence (150cmx150cmx60 cm)

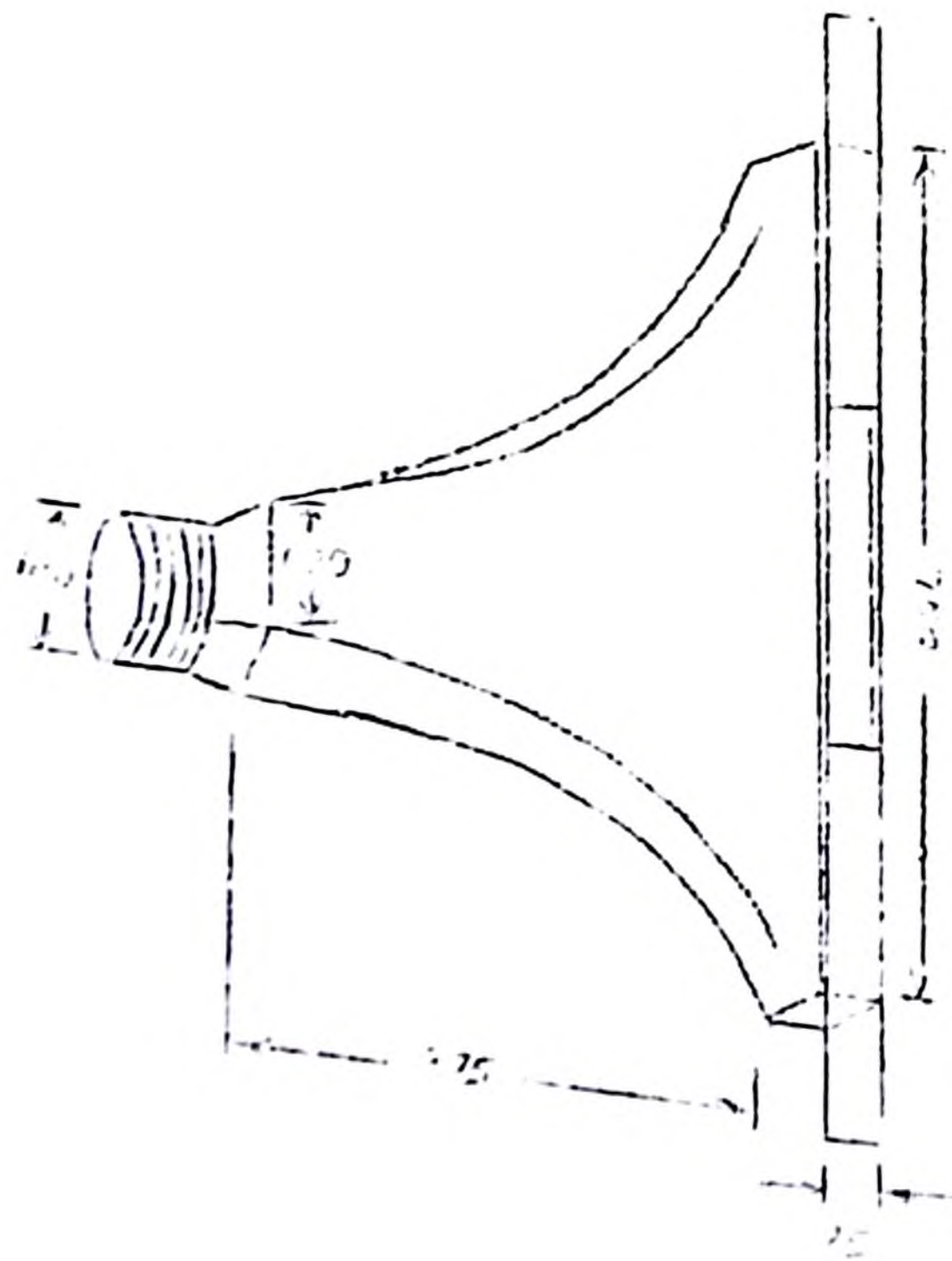
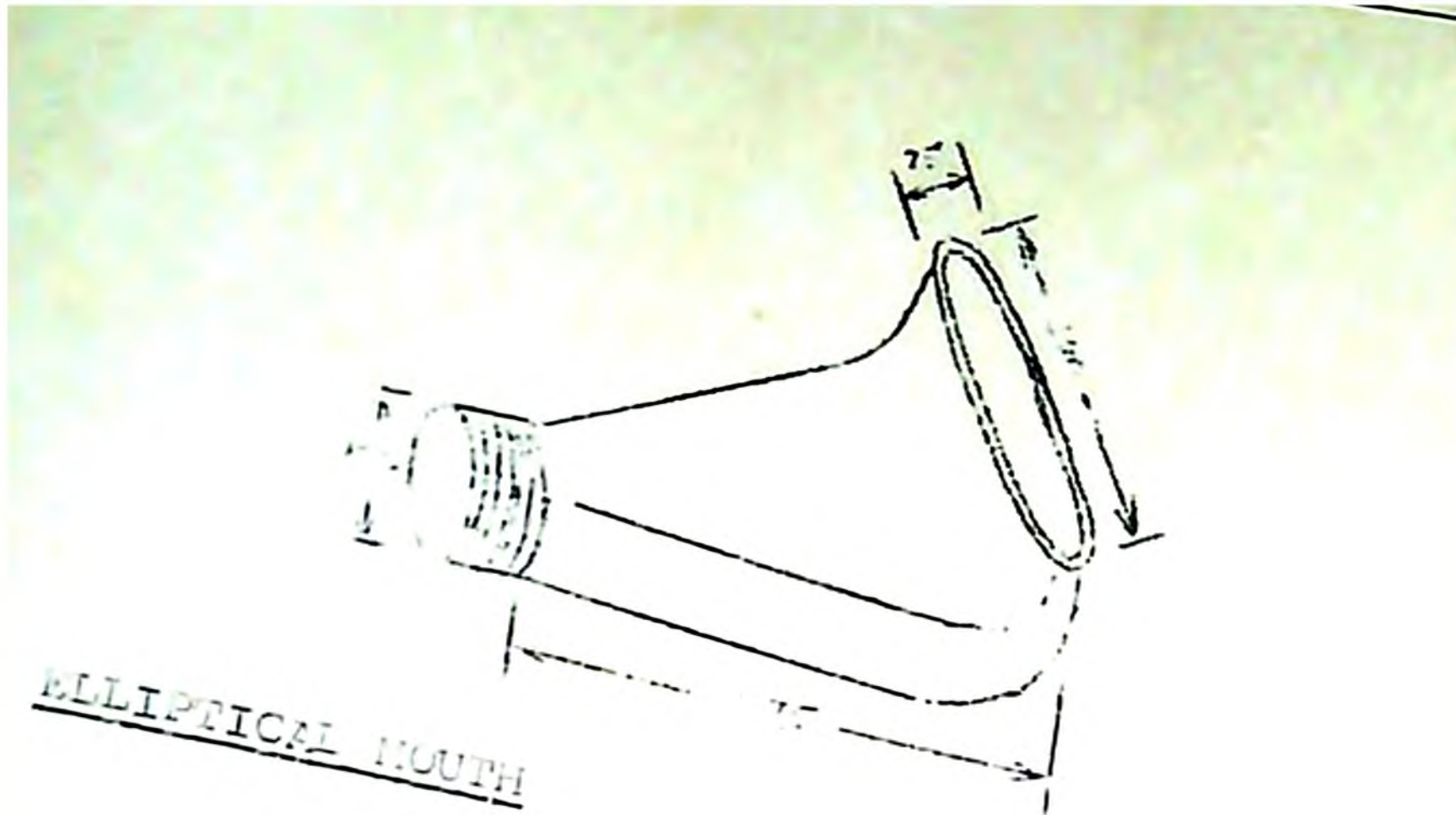
| Sl.No. | Weight of weeds when the floating Fence was about to sink(Kg) | Average Capacity (Kg) |
|--------|--|--------------------------|
| 1 | 456 | 444 |
| 2 | 428 | |
| 3 | 447 | |

Approx.capacity of floating fence-450 Kg
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Scale 1:10

All dimensions in cm



RECTANGULAR MOUTH

Fig. 2

All dimensions in mm
Scale 1:10

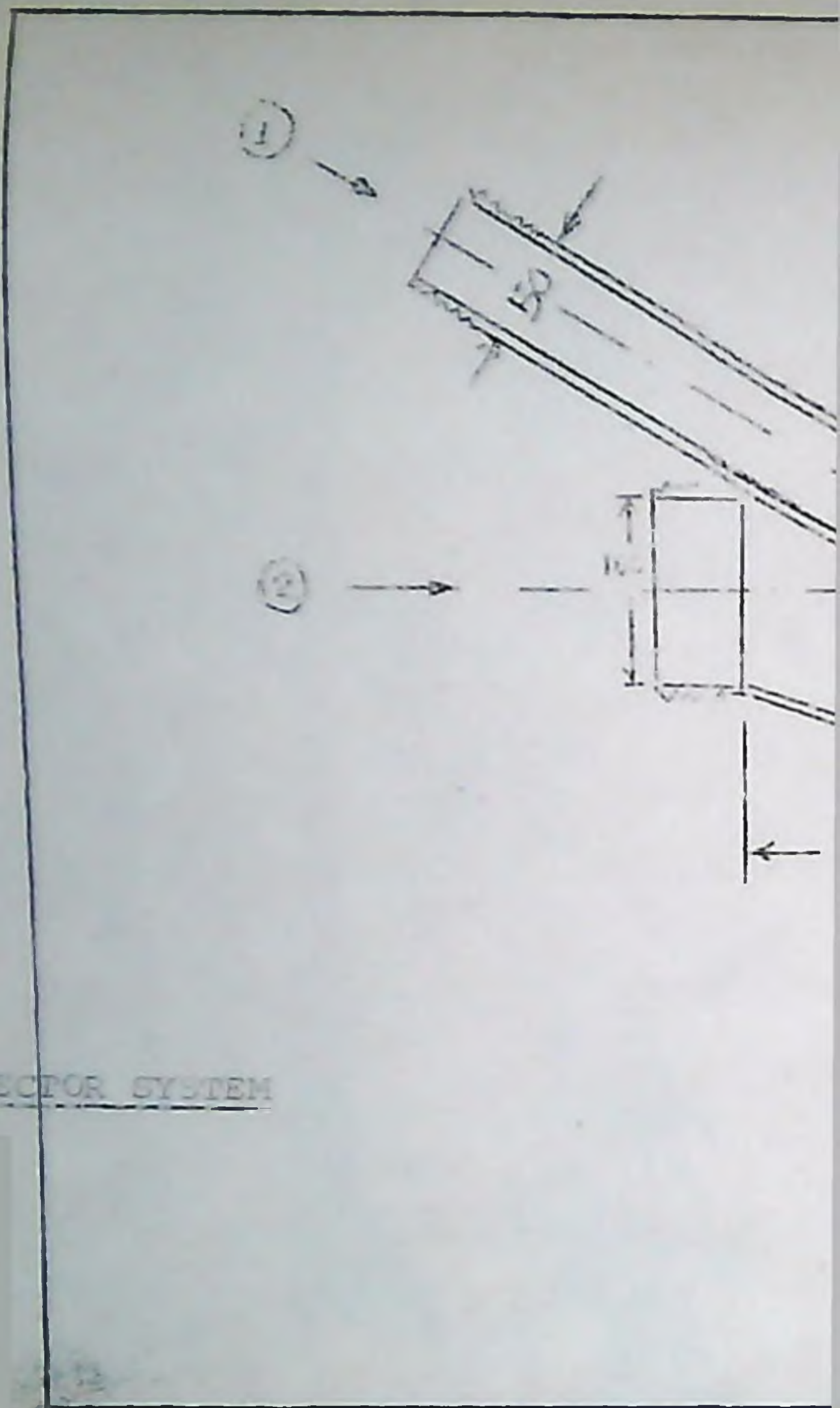
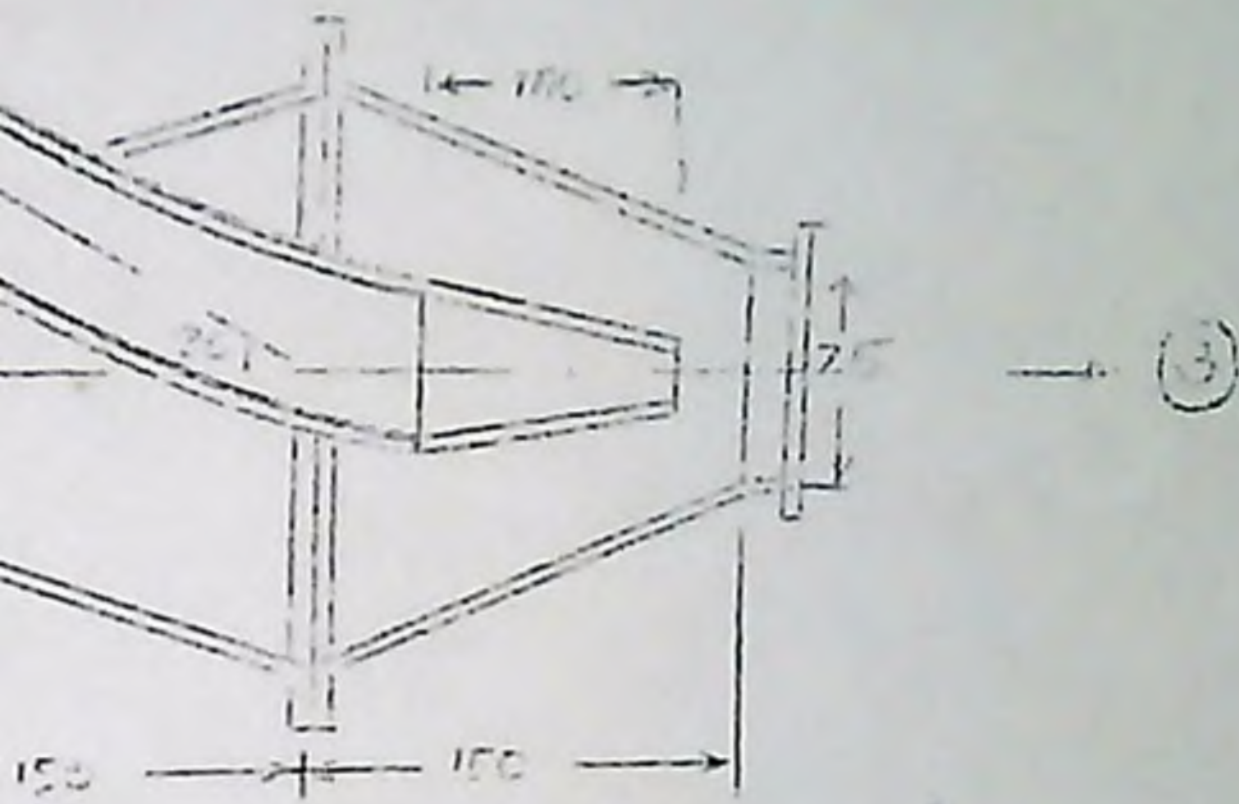
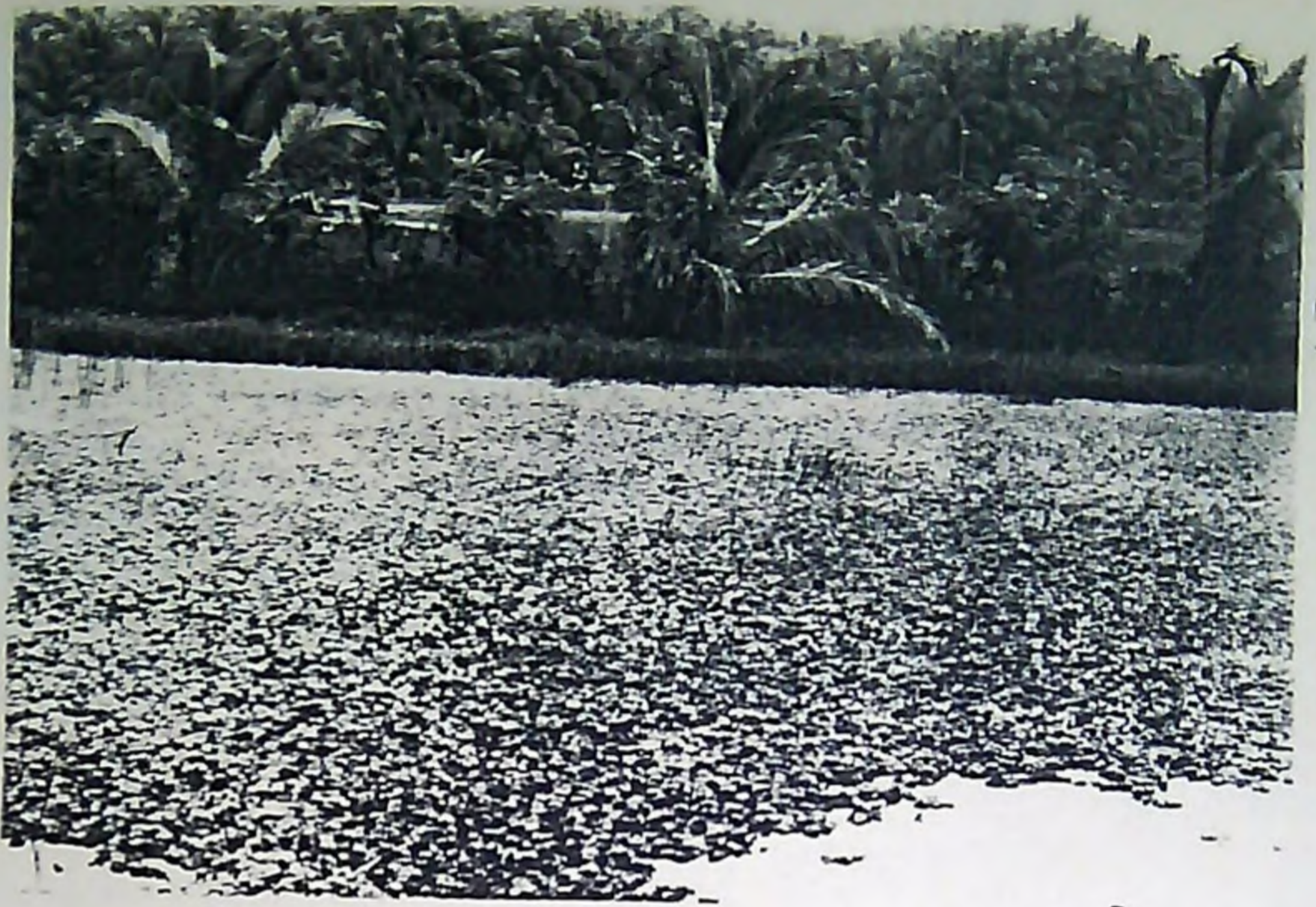


Fig. 1.30^a EJECTOR SYSTEM



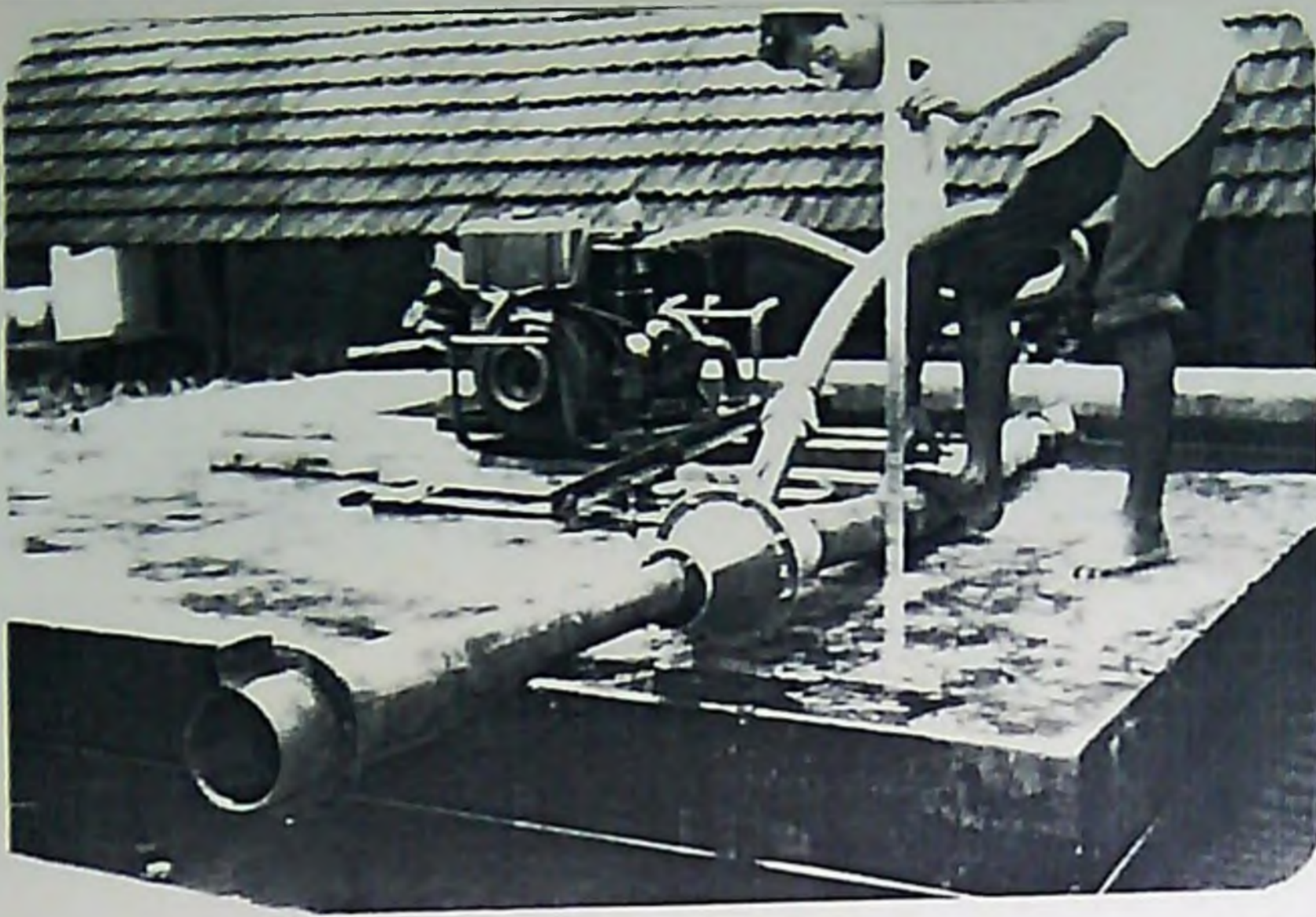
1. Primary flow
2. Secondary flow
3. Total flow

All dimensions in mm
 Scale 1:5

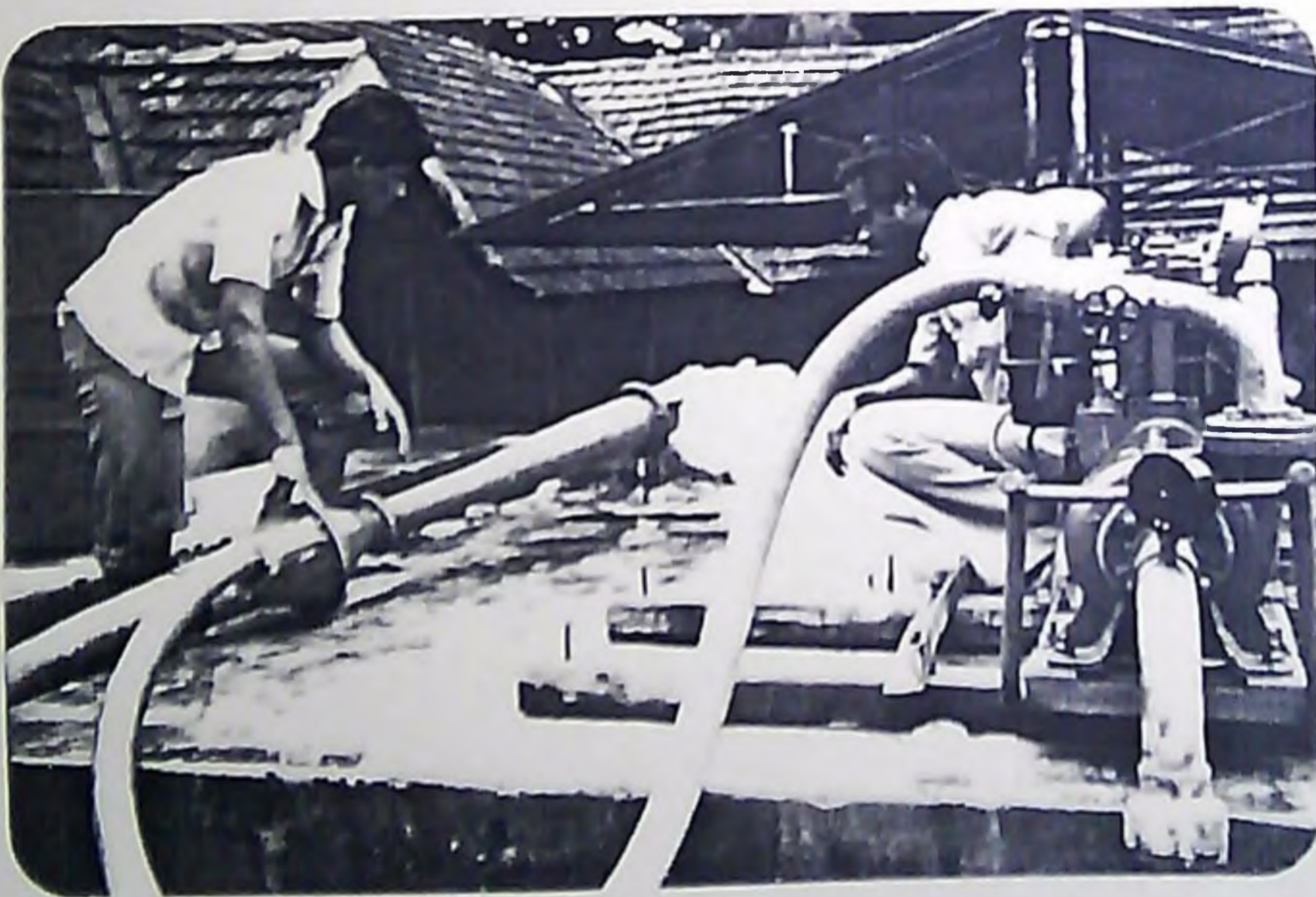


SALVINIA INFESTED FIELDS





PUMPSET & EJECTOR SYSTEM



LABORATORY TESTING

