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**DESIGN AND DEVELOPMENT OF A
MOBILE SEED DRESSING APPLICATOR
PROTOTYPE
SUITABLE FOR AFRICAN COUNTRIES**

UNIDO PROJECT :US/RAF/88/273

FINAL REPORT

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December 14, 1994

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1.0 BACKGROUND

This final report is the third of a set of reports which have to be submitted by TEMDO in fulfilment of the subcontract by UNIDO for this project. It covers in totality the summary of the work done by TEMDO for the whole period of the subcontract ie. from 15-1-1993 to 15-12-94. It also deals specifically with work done in the period July 1994 to December, 1994. Under the same project other institutions were given similar sub-contracts: TDAU of Zambia and Chitedze of Malawi and Silsoe Research Institute of England. While TEMDO was specifically assigned to develop a tractor operated machine, our Zambian, Malawian and British counterparts were to develop pedal operated machines.

The project schedule was closely adhered to in TEMDO's case (Ref. Appendix 5), except that item No. 7 (Batch level manufacture) did not take off as early as indicated much as it was desirable.

2.0 SUMMARY

- . A tractor driven mobile seed treater was successfully designed, developed and tested by TEMDO within the agreed schedule.
- . The testing both at TEMDO and in the field revealed the need to make several design improvements aimed at making the machine cheaper, easier and safer to use.
- . Some of the design improvements were effected in the course of testing ie. provision of ribs and spoilers both on the rotor and stator. The rest of the design improvements will be incorporated during pilot manufacture.
- . Field demonstrations were carried out in nearby villages to popularise the machine. A commercial element was gradually and carefully introduced alongside these demonstrations.
- . Both TEMDO tractor machine and SRI pedal machine were demonstrated in the field.

- . The pilot field demonstrations confirmed that the farmers wanted the services of the machines, but they were less enthusiastic when they were asked to pay for the services.
- . Calculations were made to determine the price of the TEMDO tractor machine and the Silsoe pedal machine ie. US\$ 1,700:- and 900:- respectively.
- . Preliminary calculations were also made to determine the commercial treatment rate if the machines were to be taken by an entrepreneur. A rate of Tshs. 50 /kg. of the farmers seeds was initially set.
- . Efforts to make further village demonstrations were made for the harvesting period of July, August & September with encouraging results. The commercial message was indicated.
- . It has now been realised that the most difficult part of the project is to have the technology reach the targetted end-users, ie. to disseminate it.
- . Fortunately, the parties concerned in the project are not only aware but fully support the actions of immediately going into dissemination efforts. This was so demonstrated at the tripartite meeting held in Lusaka in June, 1994.
- . Consequently, TEMDO has been selected to undertake the dissemination of the technology and a project extension based on the proposal submitted at the Lusaka meeting has been approved.
- . Drawings of the SRI pedal machine were received by TEMDO and they have been studied and adapted for our manufacturing practices.
- . Acquisition of imported standard parts required to make 3pcs. tractor machines and 5pcs. SRI machines has been done.
- . A TEMDO engineer together with an engineer from Zambia were trained in UK in seed treatment machine designs for two months.
- . A study tour organised for heads of participating institutions was attended by the Director General of TEMDO who is also the country co-ordinator for the project.

3.0 SCOPE

In this report a review of progress reports I & II will be made. Then some coverage of the tripartite meeting in Lusaka will be made. Work done on the project for the period July 1994 - December, 1994 will then be presented to highlight demonstration efforts made, machine price and commercial rate calculations, work on design modifications, improvements and future plans for the project, which will mainly be centred on dissemination and perfection of the machines to suite the final end users requirements.

4.0 REVIEW OF PROGRESS REPORTS I & II

The two reports covered work done on the project by TEMDO for the periods January - June, 1993 and July 1993 to June 1994 respectively.

In the first progress report, the project background is given, ie. since the economies of the PTA and indeed most African countries are agro-based and manned by small farmers who are also the majority of the population (80 - 90%), then accessibility of treated seeds aimed at improving their farm yields reducing post emergence crop losses (estimated at 40%) is of vital importance. That is the primary reason why UNIDO decided to promote the development of mobile seed dressing applicators suitable for African countries. TEMDO was one of the institutions sub-contracted to develop a tractor driven seed treaters. The secondary aim of UNIDO was to develop indigenous expertise in the design, development and dissemination of the technology to ensure sustainability of project objective.

While trying to follow the agreed schedules, progress report No. I covered the initial stages of design, ie. identification of the machine design requirements, literature review and visits to existing seed treaters, ie. the HEGE machine and three different types of Rotostat machines. Design specifications were then evolved starting with the choice of the Rotostat principle for adaptation due to the inherent advantages of variable treatable batch size and efficient even distribution of liquid/slurry formulations.

Other specifications were initially set as follows:-

Batch capacity	: 25 kg.
Prime mover	: Tractor PTO
Rotor Diameter	: 625 mm
Rotor type	: Std. plough disc \emptyset 695 Concavity 90 mm
Seed charging	: Through top hinged lid.
Dosage Application	: Through opening in lid.
Rotor Speed	: 540 rpm
Seed discharge	: Hinged opening, centrifugal discharge.

The principle of operation has remained the same as initially conceptualised.

A weighed batch of seeds is put into a rotating disc. After a few seconds a metered chemical liquid or slurry is gradually introduced on the spinning disc which rotates at the same speed. The thorough mixing is effected after a few seconds and then a hinged door is opened to discharge the mixed seed in container by centrifugal action.

According to the first report, preparation of preliminary design layout was completed and some details drawings had started. In the second report the finalisation of layout design was done after the Project Design Engineer had returned from training in UK. As a result of the training, the bare bevel gear set to turn direction of power rotation through 90° was replaced by a standard gearbox, and design of discharge door was finalised.

Thus in the second progress report, the layout designs were completed, details drawings completed and manufacturing of the first prototype embarked upon and completed. Testing was done at TEMDO workshop and on two other sites. This enabled various changes to be made in order to improve the mixing, the most outstanding being incorporation of two big spoilers on the stator.

Further tests ascertained the following machine operation characteristics:-

Capacity : 25kg/batch (continuous)
30kg/batch (max)
Rotor Speed : 220 rpm.
Mixing time : 8 - 30 sec.
Discharge time : 30 sec.
Dosage application time : 8 sec.

Review of design considerations was done and it was found that they were judiciously met by the latest design. The comparison between the initial design and the latest design then were:-

Rotation speed - now 220, then 540 rpm.
Gearbox - reduction 2:1, then 1:1
Rotor/housing clearance - now 0.5 - 0.75; then unspecified.
Material of rotor housing - now cast iron; then same.
Frame - now heavy hollow section 50x50; then same.
No. of legs - now 3, then 4.
Seed charging - now through hinged portion of top lid; then side-hinged at one extremity.
Dosage application - same.
Seed discharge - now spring loaded hinged gate centrifugal action; then same.
Operation principle - same.
Ease of manufacture - now easy; then not so easy.

Progress Report II also covers village tests which were conducted with the help of District Agricultural Extension Officers, and records that the performance of the machine was satisfactory. Overall response on the machine and demonstrations was good. As a result of the tests and demonstrations, a few design improvements were identified and earmarked for the next machine and for pilot manufacture. These include:-

- . Drive arrangement - to be made simpler and cheaper by eliminating two plummer blocks, two couplings and to mount the rotor directly on the output shaft of the gearbox.
- . To modify the discharge hood in order to reduce discharge time.
- . To locate the tractor mounting positions such that various sizes of tractors will be able to couple and hitch the machine without further modifications.

The second report concludes that the tractor mounted machine developed by TEMDO has worked well as can be confirmed by visual and laboratory tests by TPRI. Biological field trial tests were still going on.

It was recommended, in the second report, that commercialisation (dissemination) of the technology is the next and most crucial stage of the project, to be deliberated on in the Lusaka tripartite meeting of 6 - 8 June, 1994. TEMDO would perform further R & D work hand in hand with pilot manufacture and commercialisation, in response to field feedback. TEMDO also plans to address itself with the development of equipment for safer, easier and faster chemical handling.

5.0 THE TRIPARTITE MEETING

A tripartite meeting was held as scheduled between 6 - 8 June, 1994 in Lusaka, to review the development of seed dressing applicators.

The meeting commended the progress made so far in the project, and it was unanimously in agreement on the need to ensure that the project does not end on the prototypes successfully developed and tested. Dissemination of the technology was accorded proper priority. Consequently work programmes for various participating institutions were reviewed to target at the above objective. TEMDO submitted at a meeting a proposal for extension of sub-contract for twelve months whose purpose is to address to issues of optimization the prototype, pilot manufacture and commercialization of the seed treating technology. Project extension has been approved by UNIDO.

The provisional work plan as presented at Lusaka did not take off immediately due to funding constraint. With the project extension, the schedules will be revised accordingly to start January 1, 1995. (See Appendix 1).

6.0 DEMONSTRATION & COMMERCIALIZATION EFFORTS

During the initial machine tests/demonstrations in nearby villages in March 1994, some villagers advised that perhaps the best time to send machines for further demonstrations and commercial trials were during the vesting season spanning from July to September.

Liason with district agricultural extension officers was made and early visits were made to earmarked villages. Two such visits were made to Mareu village in King'ori ward, Imbaseni village, and to villages around Merelani (Mbuguni). During the visits discussions were made with villagers/village leaders on the best way and time to demonstrate the technology.

Working with District Agricultural Extension Officers for Arumeru District in Arusha region visits were made to various villages to determine the best time of sending the two rototype seed treaters and the best sites for demonstration. Missionary Centres were also visited as potential users of the machines and dissemination agents.

Demonstrations were made on market days and prior to demonstrations some lectures were given to explanation to the villagers on the importance of seed treatment and how simple mobile seed treaters would assist peasants and farmers in having easier access to treated seeds. The villagers were also informed of the costs involved in seed treating.

Interested entrepreneurs were given further information on the cost of the two seed treaters and an analysis of commercial chargeable rate of treating one kilogramme of seeds per machine. The payback period was also projected in these calculations.

Appendices 2, 3, 4 give information of projected selling prices of the two types of seed treaters and commercial treatment rates.

7.0 INCORPORATION OF DESIGN RECOMMENDATIONS & FUTURE PLANS

7.1 DESIGN IMPROVEMENT RECOMMENDATIONS

The design improvements recommended in the second interim report have been incorporated successfully in the revised design which will be completed before January, 1995 in readiness for pilot manufacture of prototypes to be demonstrated in the planting season.

(See Appendices 6, 7, 8)

7.2 PILOT MANUFACTURE PREPARATIONS

Preparations for pilot manufacture were started well in advance by ordering from UK three gearboxes for the tractor machine and five pieces bearing clutch units for the Silsoe machine. These components have already been received.

Drawings for the pedal driven seed treater received from SRI have been adapted to TEMDO drawing standards for ease of manufacture.

7.3 FURTHER R & D OPTIMISATION

Already under this topic need to accurately, clearly and swiftly meter and inject the required dosage during application has been established. An order for the peristaltic pump from UK to be used with the machine has been made through the CTA and as soon as it is received the design for its attachment to the seed treater will be finalised.

8.0 CONCLUSIONS

The initial phase of development of the seed treater prototypes suitable for African countries has been satisfactory.

Due to the unflinching commitment and support of the parties involved as demonstrated at the Lusaka tripartite meeting, the project now has to enter inevitably into the most crucial stage - the dissemination of the technology, in order to ensure that the targeted beneficiaries are catered for.

Efforts to commercialise the technology which need to be supported initially will involve incorporation of recommended design improvements in the pilot machines which will be made for demonstrations, performing further R & D work as a result of demonstration of pilot machines to various groups in various areas to cater for specialised requirements, and provision of safer, faster and cleaner chemical handling attachment to the machines.

TEMDO feels greatly privileged to have been selected to participate in this collaborative R & D project. In addition to being involved in adapting a technology which is very useful for the growth of the sub-regional economies, the project has given TEMDO a rare opportunity for the enhancement of its engineering capability. TEMDO will also benefit on the advantages of resource sharing through collaborative R & D arrangements.

The Board of Directors of TEMDO and its Management are grateful to UNIDO for involving TEMDO in this endeavour. It is TEMDO's hope and expectation that the next crucial stage of commercializing the developed technologies will be successful.

9.0 REFERENCES

1. Design & Development of a Mobile seed dressing applicator Prototype suitable for African countries - Progress Reports I & II, by TEMDO for project US/RAF/88/273.
2. Minutes of Tripartite Review Meeting in Lusaka: 7th - 8th June, 1994 for project US/RAF/88/273.
3. Progress Report & Recommendations for future action, by J E Elsworth, project CTA, presented at the tripartite review meeting in Lusaka: 7th - 8th June, 1994.

10.0

LIST OF APPENDICES

- APPENDIX 1 : Future Plans.
- APPENDIX 2 : Cost of Manufacturing Prototypes of seed dressing applicators.
- APPENDIX 3 : Economic analysis of Operation of Seed Treaters.
- APPENDIX 4 : Economic Analysis of Operation of Grain Treatment.
- APPENDIX 5 : Work Schedule for the initial sub-contract.
- APPENDIX 6 : First design draft of tractor mounted seed treater.
- APPENDIX 7 : Design for the 1st Prototype Tractor mounted seed treater.
- APPENDIX 8 : 1st Revised Design of tractor mounted seed treater.

APPENDIX 1
FUTURE PLANS

◀ 1994 | 1995 →

S/N	ACTIVITY	RECOMMENDED SCHEDULE		REVISED SCHEDULE												
		DURATION	RESPONSIBILITY	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
1.	Manufacture of 2 more tractor machines and 2 pedal driven machines (SRI design).	June - Sept. 1994.	TEMDO													
2.	Display machines at Dar es Salaam show and Arusha show.	July, 1994 Aug. 1994	TEMDO TEMDO													
3.	Training of Operatives (Chemical Handling).	Sept.														
4.	Place 6 machines for commercial trial.	July 1994 - Feb. 1995	TEMDO													
5.	Manufacture chemical mixing and spraying unit.	June 1994 - July 1994	TEMDO/CTA													
6.	Manufacture 10 further machines of this type.	Dec. 1994 - May 1995	TEMDO													
7.	Order for 20 further machines in collaboration with extension service and TFA.	May 1995 - July 1995.	TEMDO													
8.	Design training course for machine operators.	June 1994 July 1995	TEMDO.													
9.	Run training course for 6 operators & 20 operators.	July 1994 & June 1995	TEMDO TEMDO													
10.	Trial typical farmers seed with both machine types and associated biological tests.	Nov. 1994 Jan. 1995	TPRI/TEMDO TPRI													
11.	Attending agricultural Trade Fairs in other African countries to demonstrate the technology.		TEMDO/CTA													

OPEN

APPENDIX 2

COST OF MANUFACTURING PROTOTYPES OF SEED DRESSING APPLICATORS

	STD. PARTS	MACHINING & FABRICATION	T O T A L	MANUFACTURING COST	RECOMMENDED SELLING PRICE
1. TEMDO Machine - PTO Driven.	492,000	213,000	705,000	850,000 1700 US\$	1,100,000 2200 US\$
Pilot Manufacture	351,000	209,000	560,000	650,000 1300 US\$	850,000 1700 US\$
2. SILSOE Machine - pedal driven.					
Pilot manufacture	103,000	169,000	272,000	350,000 700 US\$	450,000 900 US\$

APPENDIX 3

ECONOMIC ANALYSIS OF THE OPERATION OF SEED TREATERS:

	TEMDO MACHINE Tractor Driven		SILSOE MACHINE Pedal Driven	
	CTA	TEMDO	CTA	TEMDO
Cost of 'Fernasan' D	1755/500g	1755/500g	1755/500g	1755/500g
Application rate	3g/kg	3g/kg	3g/kg	3g/kg
Chemical cost	10.5 shs/kg	10.5 shs/kg	10.5 shs/kg	10.5 shs/kg
ARMOTIZATION OF THE M/C CAPITAL COST:				
- Cost of machine	1,000,000	850,000	500,000	450,000
- Batch size	25 kg	25 kg	5 kg	5 kg
- Payback period	1 year	1 year	1 year	1 year
- Number of batches treated.	60 per day	100 per day	100 per day	100 per day
- Duration of treatment season.	50 days	75 days	50 days	75 days
ARMOTIZATION OF CAPITAL:				
	13/= per kg.	4/25 per kg.	20/= per kg.	12/= per kg.
REVENUE COST OF MACHINE:				
- Operator cost	1000 per day	1	-	1000 per day
- Tractor hire costs	36000 per day	-	-	-
ARMOTIZATION OF REVENUE:				
	25/= per kg.	14/8 per kg.	2/= per kg.	2/= per kg.
TOTAL COST OF TREATMENT:				
	48/5 per kg.	29/55 per kg. Say 30	32/5 per kg.	24.5 per kg. Say 25

The above comparative table for the CTA's figures and our figures shows that the cost of treatment has now gone down to 30/= per kg. for the tractor machine and shs. 25/= for the pedal machine from shs. 50/= (32.5 shs. respectively).

A figure of shs. 50/= per kg. for treatment of 1kg. of seeds could be taken for commercial operations. Profit is then 20/= and 25/= per kg. or shs. 3,750,000/= and shs. 937,500/=. Cost of treated seed for the former will be shs. 150/= only.

APPENDIX 4

ECONOMIC ANALYSIS - USING SEED TREATERS FOR PRESERVATION

(TSHS).

	TEMDO MACHINE Tractor Driven	SILSOE MACHINE Pedal Driven
Cost of Actellic Super	250/100 g.	250/100 g.
Application rate	100g/100kg-1g/kg	1g/kg
Chemical cost	-	-
Amotization of M/c Capital Cost:		
Cost of Machine	850,000/=	450,000/=
Batch size	25 kg.	5 kg
Number of Batches treated	100 per day	100 per day
Duration of treated season	100 days	100 days
Payback period	1 year	1 year
Amotization Capital	3/40/kg	9/kg
Revenue Cost of M/C		
- Operator cost	1000/day	1000/day
- Tractor hire cost	36000/day	-
Amotisation of Revenue	14/80/kg.	2/kg.
TOTAL COST OF TREATMENT	20/70/kg.	13/50/kg.
Recommended Commercial Treatment rate:	Shs. 30/kg.	Shs. 30/kg.
Profit after one year:	2,500,000/=	825,000/=
Price of Preserved grain.	60 + 30 = shs.90/kg.	

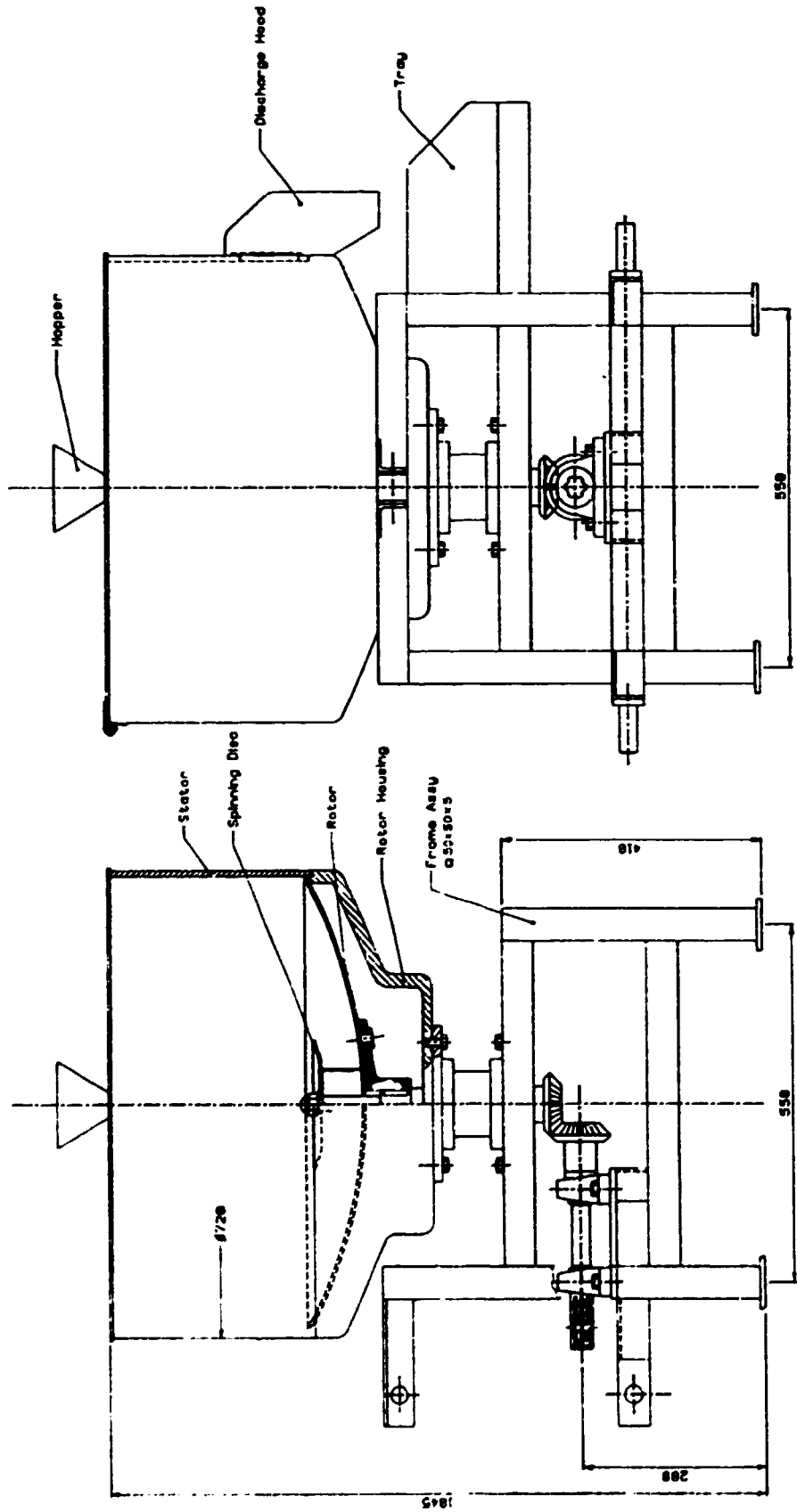
Appendix 5

WORK PLAN FOR DEVELOPMENT OF MOBILE SEED TREATER

S/N	ACTIVITY	DURATION											
		1993						1994					
		J	F	M	A	M	J	J	A	S	O	N	D
1.	Information collection and evaluation	██████████											
2.	Preparation of design layouts							██████████					
*3.	Design evaluation and Training in Engineering Design.							██████████					
4.	Design revision and Preparations of parts/details drawings.							██████████					
5.	Fabrication of prototype							██████████					
6.	Prototype testing and modifications							██████████					
7.	Batch level manufacture of prototype.							██████████					

* Not yet done, to be rescheduled accordingly.

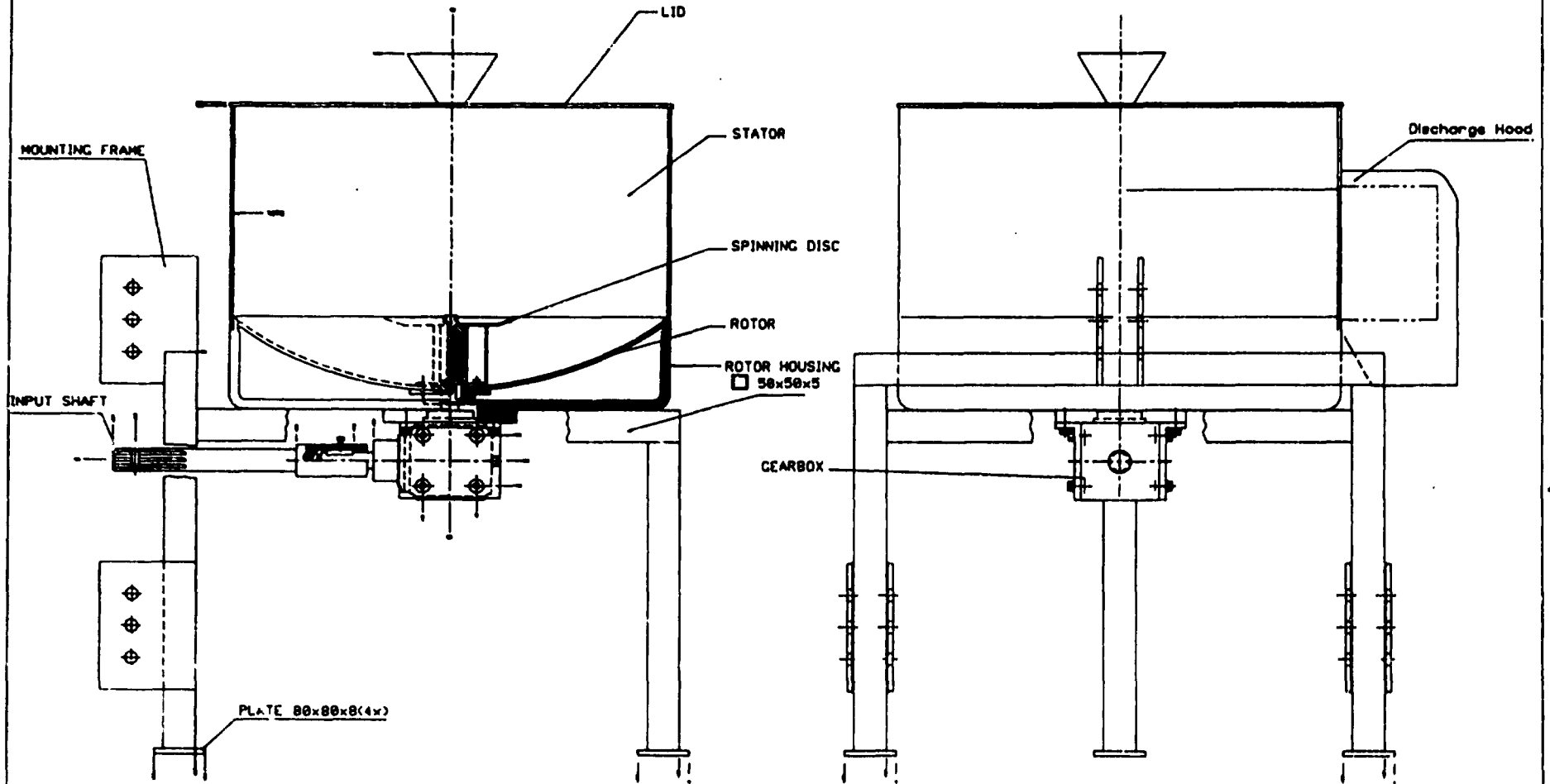
APPENDIX 6



PROPOSED TRACTOR MOUNTED SEED TREATER

6-044

APPENDIX 8



Part No	Part name	Qty	Material	Specification	Remarks
Projection	Scale	Date	Designed	Drawn	Checked
	FIT	941214	Baitani	Ulomi	
			Approved	Dimensions	Sheet No
				mm	1/1
TRACTOR MOUNTED SEED TREATER					
1st Revision					
 P.O. Box 8111 Addis Ababa Tel: 887-7975, 8229 Fax: 887-7758				Drawing No	
				UNDP-PTA	6-044