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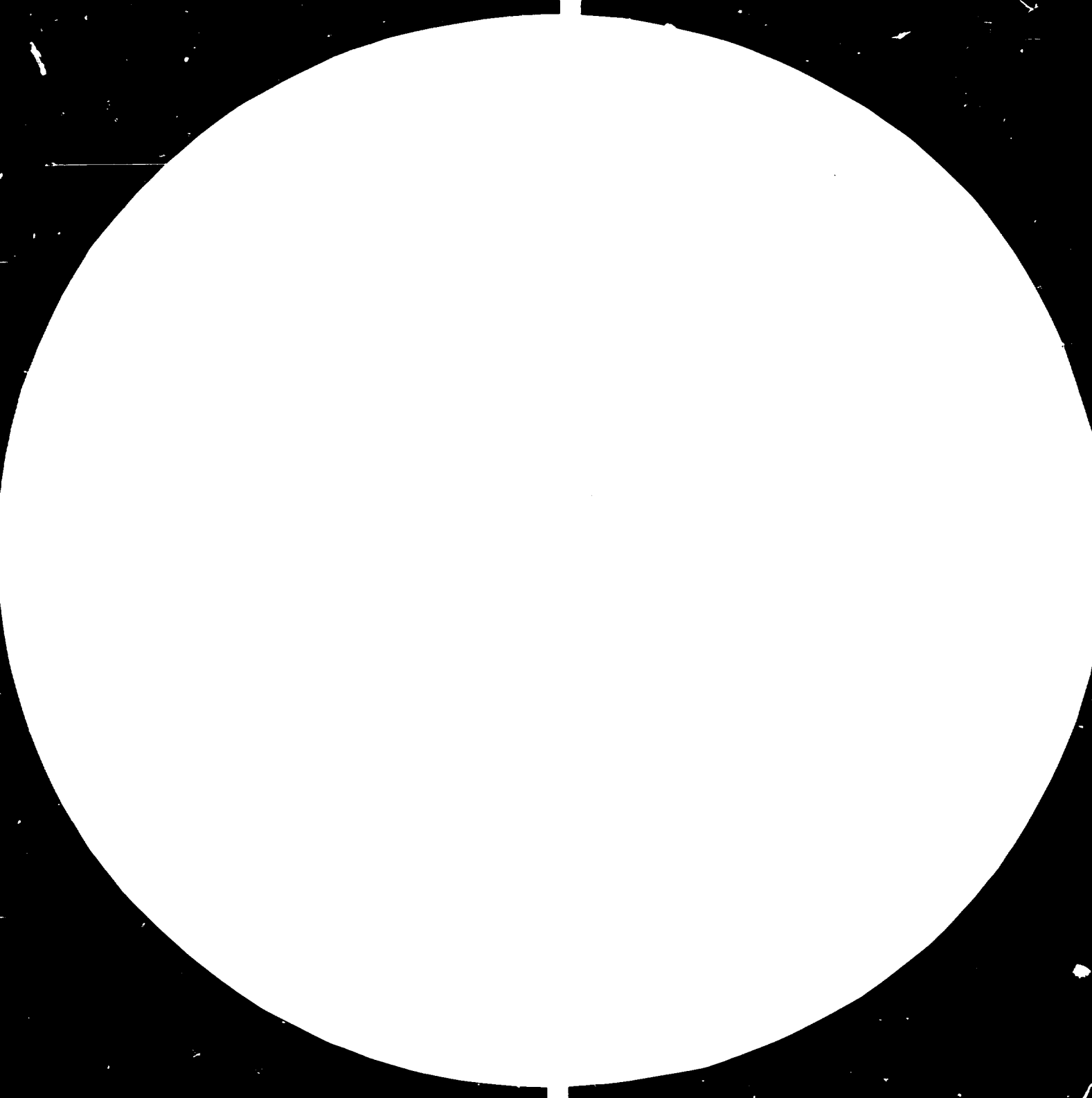
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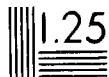
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REPORT
ON
TEST AND PRODUCT PERFORMANCE EVALUATION
of
POTATO DIGGER - MODEL KBH-2M

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

(The views expressed in this report are personal to the authors)

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SUMMARY AND RECOMMENDATIONS

- Potato is an important food crop, and government of Iraq has taken up a programme for the extension of area under this crop. Amongst the different agricultural operations required for its production, the high labour requirements in the harvesting of the crop call for mechanization of this operation. Therefore, samples of a two row tractor mounted potato digger, model KBH-2M imported by the State-Company for Mechanical Industries in ISKANDARIYA (SCMI) was taken up for tests and evaluation at the Greater Mussayib Project where the necessary fields and other facilities were available.
- Optimum performance observed include a digging efficiency of about 95 percent of potatoes from the rows with 87 to 98 percent of the dug potatoes separated from the soil and left on the surface in windrows for easy collection. Very dry soil conditions, un-uniform depth of furrows and presence of weeds presented difficulties in the efficient use of the digger. Taking these factors into account, on an overall analysis of the performance of the implement, it offers scope for introduction in Iraq. The possibility of adapting it for the harvesting of dry-onion, turnip, beet, peanut etc., (harvesting of which are yet to be mechanised in Iraq) by fitting suitable screens and digging blades would further improve its utility.
- The immediate potential demand for the implement is estimated at 30 numbers. Estimating that as a result of promotional measures being taken by the government, during the next 5 to 7 years, the total area under the crop would increase to 25,000 donums or more, the annual demand for diggers may be estimated at 20 to 25 numbers. Adaptation and introduction of the implement for the harvesting of onion, turnip etc., would increase the annual demand in Iraq to 50 to 60 numbers (para 4.1 to 4.2.5)
- Some of the neighbouring Arab countries have large areas under potato crop and an export market for Iraq made diggers can be developed. Existing practices in harvesting, type of equipment if any used, their source of supply, price structure, marketing net work, etc., in these and other neighbouring countries require a detailed study.
(para 4.2.6)

- Immediate requirements of diggers and complementary equipment such as potato planters, cultivator hiller etc., by the Ministry of Agriculture and Agrarian Reform, agricultural projects, co-operative farms etc., may be ascertained and as a first phase of a programme for production build-up, the immediate requirements may be met out of imports with the essential modifications incorporated in them, or the modifications carried out by the Iskandariya factory. (para 5.1-5.2)
- Further development work should include modifications to the digger to adapt it for harvesting of onion, turnip, etc., and development of a simple design. (para 5.3-5.4)
- Samples of potato planters, haulm choppers and other complementary equipment which are essential to be introduced and form part of a mechanization system should be imported for tests and evaluation and introduction. (para 5.5.1 - 5.5.3)
- For the efficient performance of diggers for the harvesting of potatoes and other crops and for enabling the use of tractors for weeding, fertilizing, plant protection etc., a row spacing best suited for the inter-row use of tractors and implements will have to be used and popularised. Row spacing presently used in respect of some of the crops will have to be modified. For narrow row-spaced crops, a band method of planting will be necessary. This pre-requisite may be intimated to the different agricultural projects. SCMI may also arrange to procure narrow wheels for adapting "ANTER" tractors for inter-row cultivation of crops for sale as an optional accessory. (para 5.5.6 to 5.5.7)
- The different component activities leading to successful introduction of diggers out of assembly/production of SCMI as may become feasible are to be preceded by tests, modifications, user evaluation, market survey and introduction of complementary equipment. Most of these activities are season bound. Taking into account the inter-relationship between the various activities, a time based workplan for the Testing-Development and Research Division in the Iskandariya factory is recommended in the report. (para 7.1 and page 18)

-- Since modifications to adapt implements to local conditions, continued product improvement based on tests and evaluation, assessment of demand trend are essential pre-production activities, import and sale of potato equipment as well ~~as well~~ as other new equipment offering scope for manufacture/assembly may also be taken up by the Iskandariya factory as an important part of its programme for diversification of production of agricultural machines and implements. Such an activity besides facilitating a faster build-up of ^{would also enable introduction of} local production/ implements with modifications to adapt them for local conditions commensurate with the needs of the agricultural sector. (para 4.2.6)

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REPORT ON
TEST AND PRODUCT PERFORMANCE EVALUATION
of
POTATO DIGGER - MODEL KBH-2M

I. INTRODUCTION

1.1 Sample of a two row vibrating tractor mounted potato digger model-KBH-2M imported by the State Company for Mechanical Industries in Iskandariya (SCMI) was taken up for tests and evaluation for assessing its suitability for agricultural conditions in Iraq and its scope for assembling and manufacture in the SCMI.

1.2 This report covers briefly the results of tests and trials, analysis of design and trend in demand, modifications essential to improve performance and sale potential, and recommendations for the introduction of the implement and complementary equipment leading to a phased programme for assembly and production build up of the implement in the Iskandariya factory.

1.3 The tests on the potato digger were conducted in the Greater Mussayib Project, and details of tests performed were reported in the report of the testing committee^(*) with which the authors have collaborated. Therefore, details of results which have relevance to modifications and a phased production build-up are given emphasis in this report.

1.4 Potato is an important food crop with supplemental use for industry. It fits in a crop rotation in irrigated farming, and is a very profitable crop yielding maximum food per unit area. Further, it is relatively easy to be mechanised.

(*) Committee constituted by the Ministry of Industry by order
No. 1623-5/1/888

In 1970, only about 475 donums^(*) were under this crop, and by 1974, it is estimated that about 15000 donums or more will be put under this crop. Given the necessary equipment to reduce crop production bottlenecks, the area under this crop would increase substantially. Hence complementary equipment essential to be introduced for mechanising harvesting are also discussed briefly.

II. DESCRIPTION OF THE IMPLEMENT.

2.1 Model KBH-2M potato digger is a 3 point hitch tractor mounted two-row digger for simultaneous digging and separation of dug potatoes from the soil, and for leaving it on the soil surface for reducing labour requirements in manual methods of harvesting.

2.2 Its parts consist of (Refer Fig.1) two L shaped blades and a front wheel which are connected through a linkage to serve as a protective device against stones, two oscillating screens, one behind the other, a cutting and receiving blade fitted to the front screen, a deflector for potatoes, a power shaft drive, a gear box and cam drives for transmitting the oscillating motion to the screen from the tractor power take-off shaft, frame and rear gauge wheels.

2.3 In operation, the soil along with the potatoes loosened by the blades, passes over to the oscillating screens on which the potatoes get separated from the soil and are delivered to the deflecting bars which leave the potatoes along with the unbroken clods on the soil surface for easy hand picking.

(*) One Donum = 0.25 hectare = 2500 square meters.



POTATO DIGGER
(Model KBH - 2M)

Brief Specifications.

Manufacturer. --- Tractoroexport-Moscow-USSR

Model --- KBH-2M

Hitch.

Upper hitch.

Width between inner faces of yoke----- 59.4mm
Width between outer faces of yoke----- 84.0 mm
Diameter of hitch pin hole ----- 25.4 mm

Lower hitch.

Diameter of hitch pin ----- 28.0 mm
Diameter of cotter hole ----- 13.6 mm
Cotter hole distance ----- 47.2 mm

L-shaped blade.

Width of blade ----- 10.0 cm
Thickness ----- 2.0 cm
Width inside; between L blades ----- 127.0 cm

Blade fitted to the vibrating screen.

Width of the blade inside -----112.5 cm

Screens

Two numbers- cradle mounted, one behind the other.

Front screen

90.0 cm long, with 22 rods of 11.0 mm diameter
with a gap of 3.3 cm between rods.

Rear screen

112.0 cm long, with 23 rods of 11.0 mm diameter
with a gap of 3.5 cm between rods.

Power drive to screen.

The power drive is from tractor power-take-off shaft through a telescopic shaft with safety clutch and universal joints connecting a bevel geared reduction gear box. The driven shafts from the gear box are provided with cam drives connected to the oscillating screens through two rocker arm shafts.

Frame

Welded construction.

Overall dimensions

Length	-----	326.0cm
Width	-----	173.0cm
Height	-----	132.0cm
Weight	-----	926.0kg

III. RESULTS OF TESTS AND TRIALS.

3.1 The two diggers were used in the month of May and June '72 in the Reshaid area of the Greater Mussayib Project. One of the diggers was used with a Byelarus MPZ-50 tractor for digging 93 donums, while the other after modifying the splined end of the cardan drive to adapt it for fitting to the splined P.T.O shaft of "Anter 70" tractor(which is assembled by the SCMI) for digging about 45 donums.

3.2. Test conditions

The field soil and crop conditions were as indicated below.

Field.

Level, laid out for furrow irrigation with irrigation channels 80 to 150 meters apart.

Soil

Light clay loam, with 3.5 to 5% moisture. Low soil moisture resulted in excessive clod formation while digging.

Crop

Variety -- Bintje. Ridge sown with a row to row spacing of 76cm. Height of ridges at the time of harvest was 10 to 16cm. The crop was not defoliated and the field was weedy. Distance between plants was 20 to 50cm. Tubers were 3 to 16cm deep in the soil from the top surface of the ridge.

Yield - 1 to 2.5 tons per donum.

3.3 Procedure for tests.

Observations made on the performance of the implement include:-

- (1) The functioning of the different components and assemblies.
- (2) Output in donums.
- (3) Efficiency in digging and separation of potatoes from soil and haulm(stalk) and weeds.
- (4) Damage to potatoes.
- (5) Ease in handling and maintenance.

3.4 For assessing the efficiency in digging, from row strips selected at random, observations were made on the weight of the potatoes:-

- (a) Visible on the surface of the soil for picking by manual labour.
- (b) Dug by the digger, but were covered by loose soil due to inadequacy of sieving action of the oscillating screen.
- (c) Remaining undug in the soil.
- (d) Damaged due to cuts and severe bruising or peeling of skin.

Summary of observations made

Efficiency in digging

3.5.1 A series of trials were carried out with the two diggers. During the growth period of the crop, intercultivation for weeding and for earthing-up and re-shaping of the ridges were not made. Therefore, with the L-blades and front wheels fitted, it was difficult to get the required depth of operation where the furrows were not deep. Besides there were occasional clogging of L-blades by weeds. This difficulty was overcome by operating the digger after removing the L-blades and front wheels of the digger. Under field conditions which were not optimum, about 10% of the potatoes remained undug, and damage to potatoes ranged from 5 to 9% (Ref. Appendix 1)

3.5.2 Where the field conditions were satisfactory and the required depth of digging could be maintained about 97% of the total potatoes in the field were dug, with 87 to 98% of the potatoes sieved from the soil for picking. (Ref. Appendix-2)

Damage to potatoes by peeling of skin was negligible. Damage due to cuts was between 3 and 4 %.

3.5.3 Comparison of performance of the test digger, with that of a two row elevator type power-take-off driven digger of standard design, under the same field and crop conditions had shown that the efficiency of the test digger KBH-2M was almost similar(Ref. Appendix-3).

3.6 . . Output.

Speed of operation varied from 1.6 to 3.24 kmph. Including time taken at head lands and occasional stoppages, output varied from 1.0 to 1.5 donums per hour.

3.7 Functioning of different components.

The L-blades are fitted to the frame with their cutting edge at right angles to the direction of travel and hence were getting clogged with weeds and had to be cleaned occasionally.

Depth of digging could be adjusted through the tractor 3 point linkage and it was observed that the use of the hydraulic cylinders and linkage provided on the implement was not necessary.

Except for the breakage of few bolts and damage to lift link, there were no breakdowns.

3.8 Handling characteristics.

Considering the design of the implement, it was not difficult to hitch and unhitch the implement. Provision exists for making all the essential field adjustments including the slope of the screen.

The implement is heavily built and it is necessary to provide lightly built tractors with front wheel weights for improving stability of tractor-implement combination during operation and transport.

3.9 General Assessment.

On an overall analysis of the performance of the implement, it offers scope for introduction under conditions in Iraq with modifications discussed in paragraph 5.2.

Because of the possibility of fitting screens with different openings, it also offers scope for adapting it for harvesting other root crops and peanut.

For the satisfactory working and introduction of the implement, complementary implements such as potato planters, intercultivators with ridging attachments etc. should also be introduced (Ref. Para 5.5.1)



POTATO DIGGER KBH-2M IN OPERATION

IV. DEMAND TREND.

4.1. Immediate demand.

Area under potato crop in Iraq is low. In 1974 about 17500 donums will be put under this crop. Out of this, estimating that about 6000 donums will be harvested by potato diggers (some of the Govt. farms are already possessing potato diggers) the potential immediate demand is estimated at about 30 numbers.

4.2. Likely demand during the next 5 to 7 years.

4.2.1 Even in some of the highly mechanised countries potato diggers are extensively used even though these are gradually being replaced by potato harvesters. In assessing the long term trend in demand for potato diggers, this fact has to be considered. Potato is raised in Iraq both in the Spring and Autumn seasons. Delayed harvesting of the Spring season crop, with the rise in atmospheric temperature during the harvesting period of June to mid July causes heavy damage to the potatoes. At the same time early harvest causes excessive damage due to bruising especially if the crop is graded mechanically. In a harvesting season of 4 to 5 weeks, thus the optimum period available for harvesting is often 3 weeks or less. High labour requirements for picking of potatoes windrowed by diggers and the general shortage of labour during the harvesting season therefore would make it necessary for the Govt. operated farms and projects with large areas under this crop to use potato harvesters. However, the larger handling of potatoes on

conveyors and elevators in potato harvesters tends to increase loss of potatoes due to damage. The damage tends to be high under poor field and crop conditions. In the absence of information on performance of different types of harvesters, in Iraq, results of tests obtained by the Farm Machinery Testing Station in England (NIAE) are given in Table-1 for reference (page 11)

4.2.2. Observations made on the digger in the Mussayib Project show that the average output for picking potatoes per man hour of hired worker is 40kg whereas on a harvester, as per the results indicated in the table a minimum of 600kg per man hour is obtainable when the yield is about 10 tons per donum (40 tons/hectare. But when the yield is 4 tons/donum (the average yield that may be expected under the local conditions) the time required to harvest a donum remaining almost the same, the labour output per man hour on the harvester will reduce to about 240 kg. Thus, the reduction in sale value due to the higher rate of damage to potatoes by using the harvester would offset the savings in labour cost. Therefore, use of harvesters, till such time processing facilities for the quick disposal of damaged potatoes are developed will mostly be on large mechanized farms where there are acute shortage of labourers, and diggers preferred on medium^{sized} farms and farm units using family labour.

4.2.3 Estimating that in five to seven years, the area under potato crop in Iraq would increase to 25,000 donums, of which, on about 5000 donums harvesters will be used, annual requirement of diggers including replacement needs are estimated at 20 to 25 numbers.

Table - 1

Comparative performance of potato digger
and potato harvester

	Digger	Harvester		
		(1) Single row	(2) Double row	(3) Average of 15 harvest- ers
Initial cost (£ U.K)	350-500	1200-1900	2500-3500	
No. of men required on sorting table	picking by hand	2 to 4	4 to 6	
Foreign matter (dirt & plant material) in the harvested potato (%)	Negligible	1 to 12	1 to 7	
Output				
Downums/hour	1 to 1.5	0.4 to 0.52	0.56 to 1.32	
Tons /hour		3.6-5.2 (Av. yield 32 to 42.8 tons per hectare)	6.2 - 13.1	
Tons/man hour (picking/sorting)	0.04	0.6 to 0.85	1.7 to 7.5	0.66
Damage (Percent)				
Severe	3 to 4	1 to 19	1 to 19	16.9
Minor (Skinning)	Negligible	5 to 19	5 to 15	55.3

Note. Performance of single row and double row harvesters compiled from Test Reports Nos 616 & 617 issued by NIAE, England in 1970. Data on the performance of 15 harvesters are in respect of harvesters which were used during the International Potato Harvester Demonstration held in Lincoln in Oct. '70 and reported by a farm machinery manufacturer.

- .. Performance of digger is based on optimum performance observed during tests.
- ✓ While potatoes hand picked from the windrows will be relatively clean, in the use of diggers, loss of 5 to 8 % of potatoes due to poor sifting action especially in dry cloddy soil can be expected.
- Output in tons per man-hour in respect of the digger is based on observations made in the Mussayib project when hired workers have been used for picking in fields with a yield of 1 to 2.6 tons per acre.

4.2.4 Likely demand for diggers for harvesting of Onion root crops, and peanut.

With virtually no implement available for mechanised harvesting of onion, turnip, radish etc., the potato digger with the modifications indicated in paragraph 5.3 offers scope for adaptation and introduction for harvesting of these crops. Area under these crops during 1969/70 and '70/71 were as under.

Table - 2 (©)

Crop.	Area in donums.	
	69/70	70/71
Dry Onion.	49664	62583
Turnip	12192	12758
Beet	3780	4228
Carrot	3248	3448
Radish	3061	10543

4.2.5 The above shows that including the requirements of diggers for additional areas that will be brought under the potato crop, based on the progress for adapting the implement for harvesting the above crops, an annual demand of 50 to 60 numbers can be expected.

4.2.6 Export potential.

Area under potato crop in some of the neighbouring Arab countries indicated in the table below show that there is scope for developing an export market. The existing practices in harvesting, type of equipment used and their source of supply in these and other neighbouring countries require a detailed study.

(©) Annual Abstract of Statistics, 1970 & 1971, Issued by the Ministry of Planning, Republic of Iraq.

Area under potato crop in some of the Arab countries^(c)
during the year 1971.

<u>Country</u>	<u>Area</u> (in 1000 hectare)	<u>Average yield</u> (in 100 Kg/hectare)
Jordan	1	40
Lebanon	9	94
Syriya	6	108
Algeria	35	66
Libya	2	60
Morocco	28	107
U.A.R (for 1970)	30	163
Tunisia	4	200
Sudan	2	118

Table - 3

V. RECOMMENDATIONS FOR INTRODUCTION

5.1 For meeting the immediate requirements of potato diggers in Iraq, the following phased activity is recommended.

- i. Furnish results of tests and technical literature on the implement to the Ministry of Agriculture and Agrarian Reform, agricultural projects etc., for ascertaining their requirements.
- ii. Based on assessed firm requirements, arrange import of diggers with a surplus margin of 30 to 50 percent to meet additional demands that may develop and modify them or import the diggers with the modifications incorporated in them.
- iii. Simultaneously, arrange for the trial and introduction of potato planters, cultivator hiller, and haulm pulverizer, discussed in paragraph 5.4

(c) FAO Production year book 1970 and 1971.

5.2 Modifications required on the diggers that may be imported for meeting the immediate requirements.

These consist of :-

5.2.1 Splined end of the cardan drive should be of 6 splines so that the implement can be operated with "Antar" and other tractors provided with 1 $\frac{3}{8}$ inch, 5 splined P.T.O shaft.

5.2.2 Hydraulic cylinders and linkage for depth adjustment are not essential when the tractors are provided with a 3 point linkage and hydraulic system having automatic draft and position control.

5.2.3 L - Blade, front wheel and linkage.

Since the potato diggers will be used in Iraq mostly in areas without stones and with these parts fitted, it will be difficult to obtain adequate depth of digging in fields with shallow ridges, these are not essential. But, rigidly mounted blades may be developed and fitted for reasons indicated below.

- (1) In hard soil conditions usually obtained during the harvesting season of spring crop, a soil loosening blade will reduce the impact load on the cam drives, rocker arms and other drive components and improve their durability.
- (2) In wet soil conditions, it will reduce the lumping action of soil improving the efficiency in separation of soil by the screen.
- (3) In fields with obstructions, the blade will act as a protective device.

The rigidly mounted blades should have (a) provision for adjusting its height, (b) the cutting edge of the blade instead of being at right angles to the direction of travel, its open ends shall be inclined inward by 10 to 15 degrees to provide self cleaning action from weeds and other plant material.

5.3 Modifications to adapt the digger for harvesting onion and other crops.

The two vibrating screens on the digger have fixed spacing between the bars. To improve efficiency in soil separation under different soil and crop conditions and to adapt the digger for harvesting of onions and other root crops, the bar spacing may be made adjustable

so as to obtain a gap of 2.5 cm to 5 cm. This can be achieved by using spacers of 0.5 cm thick on removable screen bars fitted to the screen frame.

5.4 Development of a simple design.

With the elimination of the front wheel, L-blades and linkage for them as well as the hydraulic cylinder and linkage for depth adjustment, the frame of the digger and the hitch pyramid shall be of simple construction.

The reduction of overhang of the implement would improve its manoeuvrability. This could be achieved by changing the position of the gear box by about 20 cm forward and lowering it by about 15 cm. This, besides shifting the center of gravity of the implement forward would also result in a reduced angle of the rocker arms connecting the oscillating screen.

To permit interchangeability of components used on different implements in production in the Iskandariya factory, the rear gauge wheels of the digger could be substituted by the wheels and axles in production in the SCMI for the cultivator model-150

5.5 Preparatory steps to be taken for introduction.

5.5.1 Introduce potato planters and cultivator-hiller

For the efficient use of of the digger and its satisfactory performance, planting has to be done in straight uniformly spaced rows, and ridges re-shaped during the growth period of the crop. Introduction of potato diggers and development of a market for it, should therefore, include a programme to supply and assist in the use of potato planters and inter-cultivation implements. Any effort to introduce diggers without the above complementary equipment which forms part of an equipment combination essential to be used for successful mechanization would result in poor performance and customer complaints.

5.5.2 The USSR manufacturers are marketing two and four row planters (model CHP-2 and CH-4A). Two to four numbers of both the models and 15 numbers of cultivator-hiller (KOH-2.8II which has already been tested and found suitable) may be ordered.

Since these numbers are only indicative, based on the firm immediate requirements and some reserve for meeting new demands that would develop from the different agricultural projects, the numbers indicated above may be adjusted.

5.5.3 Carryout trials on haulm choppers and introduce them .

While harvesting autumn season potato crop an early frost would ordinarily result in a natural defoliation of the crop which besides improving the separating efficiency of the digger would also result in the thickening of the potato skin reducing the skin damage due to bruising during harvesting and post-harvest handling operations. But in the case of spring season crop, chopping of stalks and weeds are essential to improve the separation efficiency of the digger. Out of the two methods of elimination of green foliage and vines; mechanical and chemical defoliation, even though under certain crop conditions both defoliation and haulm chopping may become necessary, till such time adequate information on the best suited agro-implement practices for conditions in Iraq become available, mechanical methods are to be preferred. Use of haulm chopper with blower would be advantageous because it frees the land from stalks and ^{it} can also be used for other crops including harvesting of tops with forage value.

The USSR collaborators of SCMI market "Universal haulm chopper" and two to three numbers of these may be obtained for trials and tests.

5.5.4 Simultaneously, work on development of a potato planting attachment for the digger already developed in the Iskandariya factory (recommended in report No. 8-72) may be taken up.

Modification of row-spacing of crops.

5.5.5 Row spacing of potatoes. Row spacing presently used in Iraq range from 70 to 90 cm. For the use of diggers, it is essential that a row spacing of 70 to 75 cm is used. This requirement may be intimated to the agricultural projects etc.

5.5.6 Row spacing of Onions and root crops.

To extend the use of the digger for the harvesting of the above crops as well as for enabling the use of tractors for inter-cultivation jobs, it is necessary to modify the row spacing presently used in Iraq which for some of the crops is as follows:

<u>Crop.</u>	<u>Row spacing presently used in Iraq.</u>
Dry onion	30 to 35 cm.
Turnip	30 to 40 cm.
Beet (vegetable)	30 cm and above
Carrot.	30 cm . . .

As against the above, a band method of planting in which narrow rows are alternated with wider rows is essential. Two choices of row spacing for a tractor wheel track setting of 150 cm.; the rows falling within the digging width of the digger blade (127 cm.) is given in the figure on page 17.

5.5.7 Advance action to have new plantings in the various agricultural projects with row spacing adapted for use of tractors for harvesting and inter-cultivation and also to procure narrow tyres (size 10x32 or nearest) with rims and wheel discs suitable for "Anter tractors" may be taken.

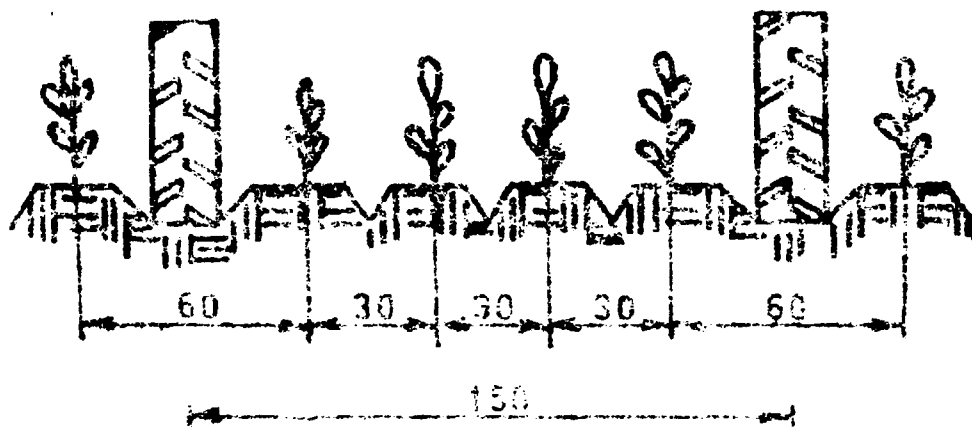


FIG 1-A

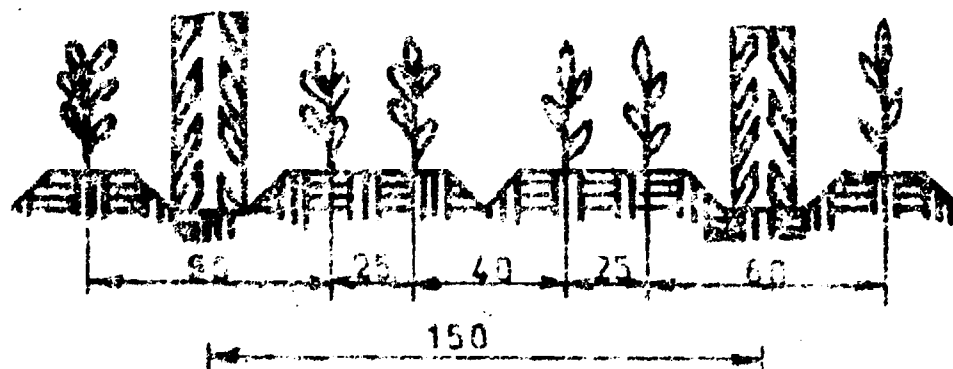


FIG 1-B

ROW SPACING OF NARROW ROW SPACED CROPS ADAPTED FOR INTER-ROW USE OF TRACTORS FOR INTER-CULTIVATION AND HARVESTING

(Illustrations above show two possible combinations of row spacing of crops with 30 to 40 cm in which narrow rows are alternated with wider rows for use of tractors with 150 cm wheel track setting)

VI. PLAN FOR FURTHER WORK AND GENERAL RECOMMENDATIONS

7.1 A plan of work that may be taken up by the testing development division in co-ordination with the marketing division indicating the timing and linkage between development, testing and marketing support activities leading to introduction of diggers and complimentary equipment fully adapted to agricultural conditions in Iraq is given on page 19.

7.2 The management of the Iskandariya factory in consultation with the Ministry of Agriculture and Agrarian Reform should assess the requirements of potato diggers as well as complimentary equipment for partial or full mechanization of potato cultivation. Such an assessment should take into account the plans of the government for increasing the area under the crop during the next 5 to 7 years. This would facilitate advance action in the selection and evaluation of other complimentary equipment such as graders, conveyor tractor mounted sprayers and dusters etc. and also for studying feasibility for adaptation development of suitable designs for progressive manufacture in the Iskandariya factory.

7.3 For successful introduction of new equipment, tests and modifications to adapt the equipment to local conditions and technical guidance on agro-implement practices are necessary. Over and above, supply of new equipment will have to be backed by after-sale service facilities including assured supply of spare parts. In view of the above and since market development and assessment of demand trend should form a component activity of a programme for diversification of production, import and sale of equipment offering scope for manufacture and those forming a part of a mechanization system may also be organized by the Iskandariya factory.

continued....

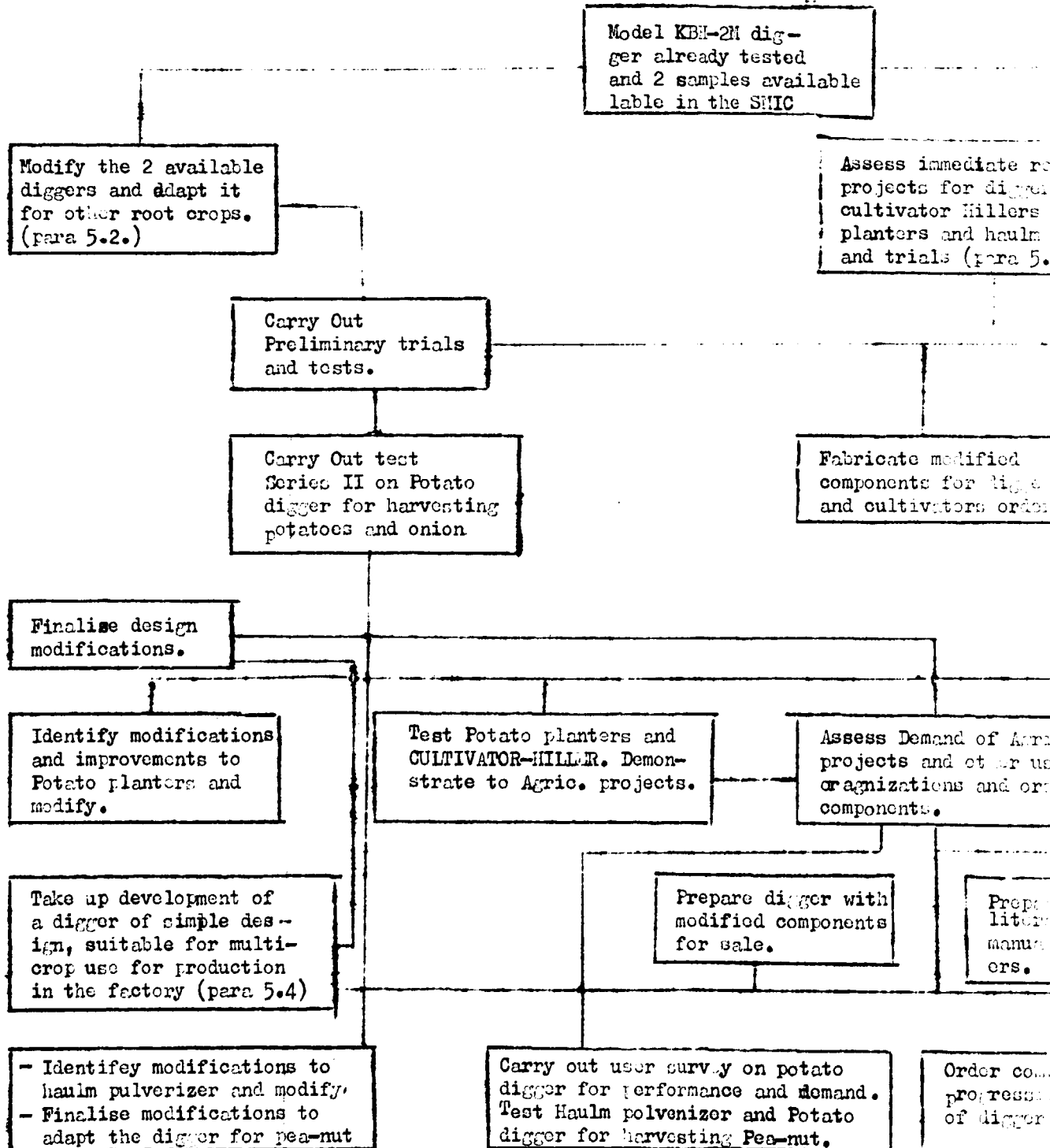
PLAN OF WORK
AND LINKAGE OF ACTIVITIES
FOR THE INTRODUCTION AND PRODUCTION BUILD-UP OF
POTATO DIGGERS AND COMPLEMENTARY EQUIPMENT

Design-Development

Testing and
user survey

Assembly or
production

Marketing
activities



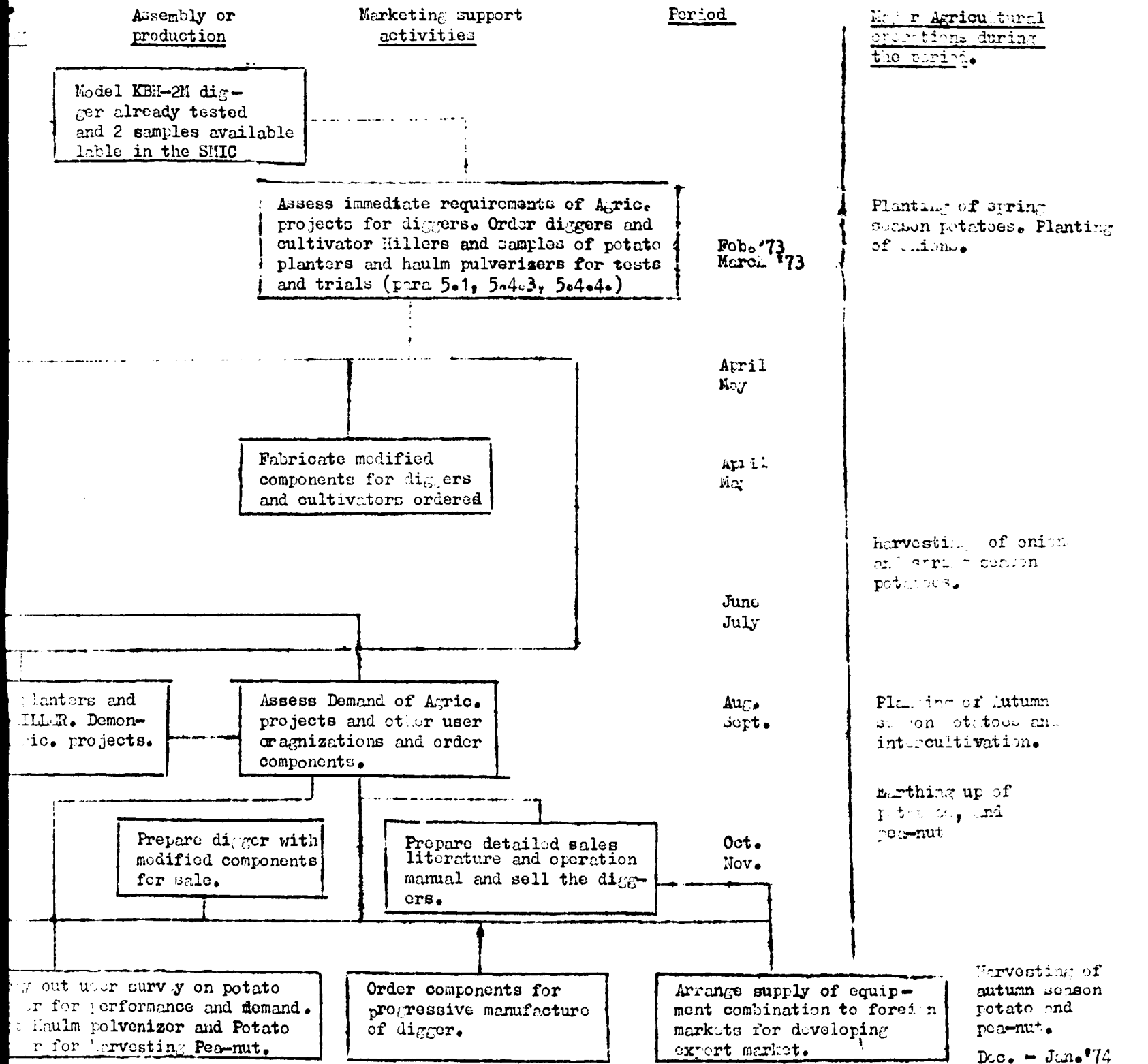
TARGETS
 By January '74

POTATO DIGGERS FULLY ADAPTED FOR LOCAL CONDITIONS
AND FOR HARVESTING ONIONS, AND PEANUTS AND FULLY ADAPTED
PLANTERS AND HAULM PULVERIZERS. DEVELOPMENT OF A
SIMPLE MULTI CROP DIGGER

Demand trend for diggers and com
eqpt. assessed for planning ass
tion and sale.

AND LINKAGE OF ACTIVITIES

INTRODUCTION AND PRODUCTION BUILD-UP OF
DIGGERS AND COMPLEMENTARY EQUIPMENT



PRINCIPAL
ACTIVITIES ADMITTED
OF A

Demand trend for diggers and complementary eqpt. assessed for planning assembly/Production and sale.

Market developed and after sale service facilities organized including steps for developing export market.

Marketing of mechanization work of long for increasing under potato crop
arrangement for harvest
of potatoes.

PERFORMANCE OF POTATO DIGGER KBE-2M

Date of trial 8-7-72

Place of trial - Mussayib
Project.

	Unit.	Trial number		
		1	2	3
(a) Weight of potato dug. & on soil surface	Kg.	8.7	8.3	11.3
(b) Dug but covered by loose soil and not visible.	Kg.	1.0	0.9	1.7
(c) Total potato dug.	Kg.	9.7	9.2	13.2
(d) Efficiency in separation $\frac{a}{c} \times 100$	%	89.69	90.2	87.12
(e) Potato remaining in the soil un-dug.	Kg.	1.6	0.9	2.4
(f) Total potato in the soil	Kg.	11.3	10.1	15.6
(g) Digging efficiency $\frac{c}{f} \times 100$	%	85.84	91.1	84.6
(h) Damaged potato	Kg.	0.5	0.7	1.2
(i) Damage in percent of potato dug	%	5.15	7.61	9.09

PERFORMANCE OF POTATO DIGGER KBH-2M

Place of trial - Greater
Mussayib Project.

	Unit.	Date of trial					
		3/7	4/7	5/7	10/7	11/7	13/7
(a) Weight of potato dug and on soil surface	Kg.	10.75	13.74	37.3	13.22	22.25	14.13
(b) Dug but covered by loose soil	Kg.	1.2	2.0	4.5	1.72	0.75	0.24
(c) Total potato dug.	Kg	11.95	15.74	41.8	14.94	23.00	14.37
(d) Efficiency in separation $\frac{a}{c} \times 100$	%	89.9	37.4	89.29	83.4	96.74	98.5
(e) Remaining in the soil undug.	Kg	0.32	0.5	1.3	0.67	0.55	0.03
(f) Total potato in the soil	Kg.	12.17	16.24	43.1	15.61	23.55	14.4
(g) Digging efficiency. $\frac{c}{f} \times 100$	%	97.2	96.9	96.9	95.5	97.57	99.5

(e) During the trial L-blade and front wheel were not fitted to the digger

COMPARATIVE PERFORMANCE OF DIGGER KBH-2M
AND A TWO ROW ELEVATOR DIGGER

	KBH-2M		Comparison Digger	
	trial number			
	I	II	I	II
(a) Weight of potato dug and on the surface of the soil (Kg)	8.3	6.3	5.2	6.7
(b) Dug but covered by loose soil (Kg)	1.9	1.0	1.2	1.3
(c) Total dug (Kg)	10.2	9.3	6.4	8.0
(d) Efficiency in separation (percent)	81.37	90.22	81.25	83.75
(e) Potato remaining in the soil un-dug. (Kg)	1.2	0.9	0.6	0.7
(f) Total potato in the soil (Kg)	11.4	10.2	7.0	8.7
(g) Digging efficiency. (percent)	89.47	91.48	91.43	91.95

The comparison digger was a semimounted P.T.O driven elevator digger with bar pointed shares.



