FARM IMPLEMENTS & TRACTOR ATTACHMENTS SUITABLE FOR SRI LANKA

by

P.I.N.A. Fernando and Tsunenobi Miki

Introduction

ATRDC

The Appropriate Technology Research and Development Centre is under the Industrial Development Board of Sri Lanka which is functioning under the Ministry of Rural Industrial Development of Sri Lanka. This Centre was officially opened in February, 1985, but it started its activities somewhere in January, 1984. This paper deals mainly with the work carried out by ATRDC in the field of agriculture machinery.

This is a centre established by the Sri Lankan Government in collaboration with the Japanese Government for developing the appropriate technologies for Sri Lanka. So far we have developed windmills, gas fuel generators, agricultural implements, tractor attachments which are suitable for Sri Lanka.

Historical back ground and other conditions in the country

Agriculture had been the main livelihood of Sri Lankans since the very ancient times. Ancient kings have built so many large tanks and canals for irrigation purposes. Of the agriculture also the ancient Sri Lanka thrieved mainly on low land farming.

The tophography of the country is such that the central part is hilly surrounded by flat land. Rivers are flowing into the sea right round the island, except in the furthest northern province. There are two rainy seasons for the country. This comes with north-east monsoon and south-west monsoon. Some areas of the country cultivate twice a year using rain fed water during two seasons called 'Yala' and 'Maha' seasons. Other areas cultivate using water from rivers and tanks.

Recently, the Government of Sri Lanka started a project called 'Mahaweli Project' (named after the largest river in Sri Lanka) for the purpose of generating electricity for industrial sector and domestic use and to develop irrigation systems for farming. Therefore, the optimum use of farm machinery and agricultural tools must be achieved to suit the reality of this era. And research and development of farm machinery and agricultural tools will also be taken into consideration by Sri Lanka during this period.

In the past, farmers used mammoties and worked manually. Later, they started using buffaloes, plough and attachments. At earlier periods, wooden plough was used and later iron plough. Recently, the tractor was introduced. At first, the four-wheel-tractor became popular, but later it was replaced by the two-wheel-tractor. At present, both types of tractors are being used equally. Mostly, four-wheel-tractors are owned by businessmen and they hire them to farmers. Also, businessmen used the four-wheel-tractor together with a trailor for transporting agricultural as well as non-agricultural goods. The holdings of an average

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farmer in Sri Lanka is less than half a hectare. Therefore, it is not economical for the average Sri Lankan farmer to own even a two-wheel-tractor because there is not enough work right through the year. The two-wheel-tractors are owned by rich and middle class farmers having holdings more than two hectares. Any way, in Sri Lanka at present two-wheel-tractors are becoming more popular compared to four-wheel-tractors.

The National Farm Mechanization Committee of Sri Lanka has decided to develop agricultural operations on old technologies available in the country and also, go for higher or medium technologies. For example, it wishes farmers to carry out agricultural operations manually, using animals and using machinery. Country will face two problems if complete mechanization is attempted.

a) Poor farmers will not be able to afford it.
b) The country will import crude oils and all the machinery.

Therefore, the foreign exchange spent earlier on importing rice will not be sufficient to import machinery, spares and fuels.

The country should therefore, attempt partial mechanization and should try to produce as much machinery as possible in Sri Lanka. This is what ATRDC and some other Institutions in Sri Lanka are trying to do. In doing so, Sri Lankan industrial sector also will get benefited.

Work done by the ATRDC

Hand tools

There are large number of farmers still using hand tools for agricultural operations. Examples are mammoty, sickle etc. But variety of traditional hand tools used in the country are limited. Here we have one standard mammoty for all purposes which was imported from England and is now being produced in Sri Lanka by the Sri Lanka Hardware Corporation. There are a few other mammoties (as shown in figure 1 - 14) used for low land farming which vary in shape and size only by soils in various areas (annexture 1 gives the soil map of Sri Lanka). The mammoty most widely used for up land farming is the standard all purpose mammoty mentioned above. In up land farming bush clearing is also done by one standard tool called 'kaththy' which is used on large trees as well as on small bushes. We use axes also for felling very large trees. For gardening we use swing knives 'veesi kethi' which has two cutting edges both of which will be used for slashing while swinging the knife over the weed to be cut. For harvesting in the paddy fields farmers use sickles which are different in shape compared to the Japanese counterpart.

To the above situation we first tried the following implements - Bichchu mammoty - four blades and three blades, Kanabora mammoty, Hira mammoty, Joren mammoty, Furo mammoty, bush clearing sickles and grass sickles (these implements are shown in figure 15 - 25).

By distributing the above implements among farmers in eleven areas the response of the farmers were obtained. The above eleven areas covered most of the farming areas of the country. Thereafter, Bichchu three-prong and four-prong mammoty and the Hira mammoty were selected after studying the reactions of the farmers, as well as the condition of the local Blacksmithy. All the three kinds of mammoties mentioned above are suitable for upland farming in areas where the soil is soft. Especially, Hira mammoty is prefered for ridging and weeding while Bichchu mammoty is suitable for digging in both upland and paddy fields. Bush clearing sickle is also acceptable favourably by the farmers but the production is difficult at local level due to the lack of technology and facilities. Bichchu mammoties are fabricated using the discarded vehicle leaf-springs by forging the parts and welding. Hira mammoties are fabricated using soft steel sheets, and sometimes case hardened.

The above mammoties are modified accordingly and got them fabricated by the Sri Lankan blacksmiths. In addition to the above, the standard mammoty was reconditioned from the discarded part of the same mammoty as shown in figure 26. In this re-conditioning the mammoty handle holder which is expensive and difficult to fabricate was re-used together with the remaining blade part of the mammoty shown in figure 27 and the process of reconditioning was done in the manner as shown in figure 28, step by step using arc welding. For this, in addition to the worn-out mammoties, soft steel sheets and/or discarded leaf springs are used. The mammoties fabricated as shown above are now being popularized among the farmers of the country. For this purpose, seminars and demonstrations were organised for farmers and blacksmiths in the hilly part of the country where the soil is soft.

Steps were taken by us to train blacksmiths in the forge welding technique which is practised widely in Japan. This technique will be very useful in fabricating agricultural implements. Also, we train a good number of blacksmiths on how to use the belt hammer machines as it will make the effort by the blacksmith less in doing a job of work and hence increase the productivity and consumes less charcoal. It is economical to use this machine and gives a product with a better metallurgical structure. The above work of training blacksmiths was undertaken because blacksmiths in Sri Lanka are an integral part of the rural social system who supply agricultural implements to the farmer according to the latter's requirements. In addition to teaching blacksmith on how to operate the belt hammer, we have launched a programme of familiarizing the operation of the belt hammer and manufacturing belt hammers locally.

Pumping water

We have also developed a wood charcoal gasifier which could run a kerosene engine of 3 - 4H.P. to pump water for lift irrigation. This is an area which needs attention badly because the farmers have to pump water from tanks and irrigation canals to their elevated paddy fields and from canals and wells to vegetable plots. We have carried out various field tests on this and now the durability tests are being carried out. Yet for the moment it is economical to use this for pumping water for total heads lower than 4 meters. This is because the government of Sri Lanka is supplying kerosene, the rival of the gasifier at a subsidized rate. Therefore, the future of this gasifier will depend on the kerosene price in the country or government energy policy. It must be mentioned that there is a risk of deforestration in the mass scale use of this gasifier. The contradictory aspects of this gasifier namely the deforesting problems where the dry zone farmers tend to fell trees in the forest for making charcoal for the gasfier and cheapness of the gasifier as a source of energy should be considered at the national level by the national planners. Steps such as proper forest management to replace the trees being fallen could be considered.

In addition to this, the Centre is also developing a gasifier operating on any combustible materials easily available in the country which are otherwise going waste. For example, various parts of coconut trees, waste material of coconut industry etc. This gasifier will also be used for lift irrigation purposes. The economy of this gasifier compared with the kerosene is not clear yet, as tests are still underway. But definitely this will create no deforestation problem. We are testing the gasifier for various waste materials and one problem we came accross was the size of the particle to be fed to the gasifier. Some waste materials need fair amount of exertion to bring them down to required particle size by chopping manually. Farmers might not be eager to chop material exerting

themselves and spending time on it. At present we are concentrating more on easily broken-up materials such as coconut shell. It should be mentioned that the dryness of the material also is very important in this gasifier. For correct operation of the gasifier, the material should be dried-up.

Tractor attachments

The two-wheel-tractors are more suitable for Sri Lankan farmers due to their smaller sized plots and to carry out inter-cultivation in the up-land where there are permanent crops. The Centre decided to develop a plough, a seeder and a weeder as attachments for the two-wheel-tractor . because these attachments are favourable ones for farm cultivation system, and for domestic production at rural small and medium scale factories in Sri Lanka.

Plough

We have designed and completed fabrication of a turn-wrest plough. The design is very much similar to the imported Japanese plough, the Takakita plough. But the necessary variations are incoporated in the design to facilitate easy production in a smaller workshop in Sri Lanka. In designing ploughs, there is a difference in thinking between the western type plough and the Japanese one for two-wheel-tractor. Our design adopted the theory of Japanese ploughing method with turn-wrest mechanism by Dr. Jun Sakai (Prof. of Kyushu University, Japan). Many imported Japanese ploughs are working in two-wheel-tractors in this country, and are continuing to increase now. So our target is to design and fabricate a plough equal in quality but cheaper in price to Takakita or Matuyama imported plough in the frame work of Sri Lankan industry. In this we have avoided, for example, pressing operations where a press machine and dies will have to be bought by the manufacturers especially for the purpose. Instead thick mild steel sheets were suitably webbed to give the strength. Without using high precision machinery and special technology, we developed the manufacturing know-how to fabricate parts with high precision when completed and exchangability of each part by the use of a simple Jig. Only the welding equipment, the lathe machine, drilling machine and the hand tools were used in fabricating this plough. This plough was tested in the field and it was found suitable for tractors of 5 - 7H.P. size. During these operations, we found out the following defective practices of Sri Lankan farmers.

a) They hardly care about the weight balance between the plough and the tractor. By using a smaller plough they exert themselves very much in keeping the plough down to the earth all the time.
b) They plough the plot in a traditional manner as shown in figure 29. Thus, the following disadvantages will be there.

i. The operator has to always exert himself in directing plough where he wants by operating the clutch for turning more than in the continuous return ploughing method. This gives excessive clutch wear. This defect is not there in the Japanese method of ploughing which is called the continuous return ploughing as shown in figure 30.
ii. The soil being thrown always to one side, will build-up at certain places and have valleys at other places.
iii. Also some parts of the field will not get ploughed properly.
iv. These differences in levels will hinder the farmer from correctly levelling the field after ploughing. These defects are not there in the continuous return ploughing method.

Seeder

So far power seeders were not much used in Sri Lanka. The popular method is broad-casting by hand. Broad-casting does not give an even distribution of seeds. Later nurseries and trans-planting was introduced to Sri Lanka by Japanese. The transplanting was done manually.

The power seeder that is being tested by the Centre is based on the seeder used sometime back in Japan in combination with the two-wheel-tractor. Here again design is modified so that it could be fabricated in a smaller workshop in Sri Lanka. In this, the seeds in the hopper will be delivered controlled by a rotating roller with necessary holes and grooves to suit the spacing at which the seeds should be dropped. The roller is rotated by a chain drive coupled to a wheel which touches the earth and rotates as the tractor moves forward. Modifications were done to this machine by the result of actual field tests on driving wheel, stabilizer, seed dropping chute and seed roller including the method of manufacture and materials. They were done to suit seeds, soil and system of cultivation, and considering the possibility of domestic production at a small workshop in Sri Lanka. One model was brought from Japan and another modified machine was fabricated in the Centre workshop. Field tests were carried out and were found to be encouraging. In future, we wish to eliminate the chain and have a direct drive.

Weeder

Weeder as a tractor attachment was never used in Sri Lanka. For paddy fields, specially, the chemical weedicides are used expensively. For paddy fields few farmers used manually operated hand weeders where transplantation had been done in a row. Some others use the method of pulling weed out manually without the help of any of the above. Cutting down of seeds in the paddy fields before ploughing is done by swing knives and mammoties. There had been an era in Sri Lanka where the weeding of paddy lands was emphasized to the farmers by the government. The school children and the regular army were mobilized for the purpose.

In upland the weed is controlled by weedicides and also by using swing knives, kaththeys and mammoties etc. Manually, and also by ploughing the land using tractors. The Centre is developing a rotary mechanical weeder to be attached to the two-wheel-tractor. The weeder is not developed yet. When developed, this will help weeding of paddy fields and coconut estates where there are problems at present.

Agricultural Machinery & Equipment Developed by other Sri Lankan Organisations

At this juncture, I think it is important to discuss some of the agricultural machinery and equipment that have been developed by other Sri Lankan organisations. The Farm Mechanization Research Centre of Sri Lanka situated at the place called Maha-Illuppallama which is operating in collaboration with the German Government has developed a quite a number of agricultural machinery and equipment, out of which the outstanding ones are:

a) Manually operated transplanter.
b) Manually operated seeder.

In operating the transplanter the farmer walks backward pulling the transplanter together with him by a handle. When this same handle pushes forward, operation of bringing the plants from the machines to the field occurs. This machine is manufactured by industries small as well as large in the country. The FMRC inspectors visit such factories and stamp each and every machine with a tag bearing FMRC name and a serial number to prevent the manufacturers selling substandard products.

The seeder is operated by pushing in front of the man and the man walks forward. The operation of the machine is more or less similar to ours but has a flexible facilities for uneven ground.

The National Farm Mechanization Committee is now concentrating on developing an animal driven plough. Also of

using a single animal in place of two animals now used for ploughing. The animal used in Sri Lankan field is buffaloe. The animal drawn plough used at present in Sri Lanka has not undergone any changes at least for about 50 years. The FMRC also contemplates on long term as well as short term problems for training animals and getting a suitable breed of animals for Sri Lanka, from the existing animals in Sri Lanka.

Conclusion

Today, the agriculture and the rural metal industries related to the farm machinery in Sri Lanka is approaching a turning point. Large number of farmers are settling down in the areas where irrigation water is supplied by the Mahaweli Scheme. But there is a problem of farm labour in Sri Lanka. There is excessive labour force in the country, but that labour is not willing to do farming. But they are willing to find jobs in the industrial sector.

Therefore, efforts such as those of ATRDC and FMRC will give a chance for the industries producing farm machinery to expand and thus, solve two problems at the same time. This will absorb idle labour to the industrial sector and also release the labour force or filling the gap of lack of labour force in the agriculture sector by supplying it the machinery.

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7. Japan's sickle how and plough edited by cooperation of Great Japan Agricultural Association (Dai Nippon Nah-kei) issued by Foundation of Agro Political Investigation Committee.

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4. Mr. Iida (In-charge-of blacksmithy and hand tools for agriculture).
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6. Mr. Sukigara (Advisor for seeder).
7. Mr. Kunioka (Advisor for developing the gasifiers).
8. Mr. Shibata (Advisor for developing the weeder).
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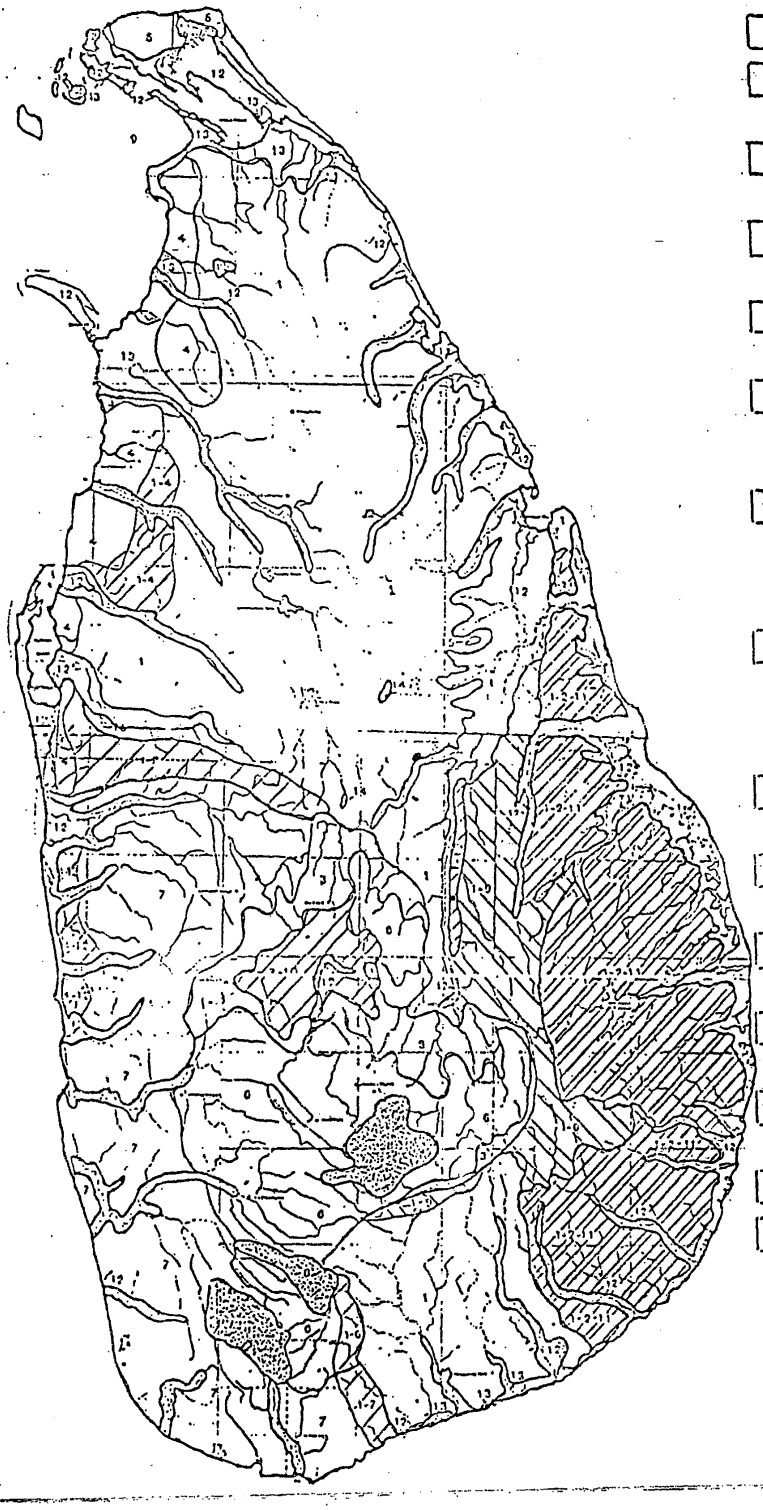
Annexture-1

SHOWING

APPROXIMATE DISTRIBUTION

OF GREAT SOIL GROUPS



LEGEND

1 REDDISH BROWN EARTHS

2 NON-CALCIC BROWN SOILS

3 REDDISH BROWN LATERITIC SOILS

4 RED - YELLOW LATOSOLS

5 RED - YELLOW LATOSOLS (Calcic Sub - Group)

6 RED - YELLOW PODZOLIC SOILS (Modal)

7 RED - YELLOW PODZOLIC SOILS (Sub - Group with Plinthite)

8 RED - YELLOW PODZOLIC SOILS (Sub - Group with Prominent A1 Horizon)

9 IMMATURE BROWN LOAMS (Dry Zone Sub - Group

10 IMMATURE BROWN LOAMS (Wet Zone Sub - Group

11 REGOSOLIC ALLUVIAL SOILS

12 REGOSOLS AND ALLUVIAL SOILS

13 SOLODISED SOLONETZ AND SOLONCHAKS

14 RENDZINA SOILS

15 GRUMUSOLS

OF ENGINEERS SRI LANKA

FIGURE 1 - SINHALA UDALLA (SINHALA Mammoty)

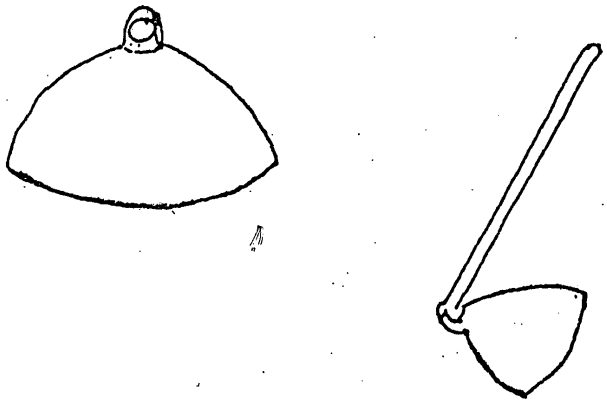


FIGURE 2 - MATARA UDALLA (MATARA Mammoty)

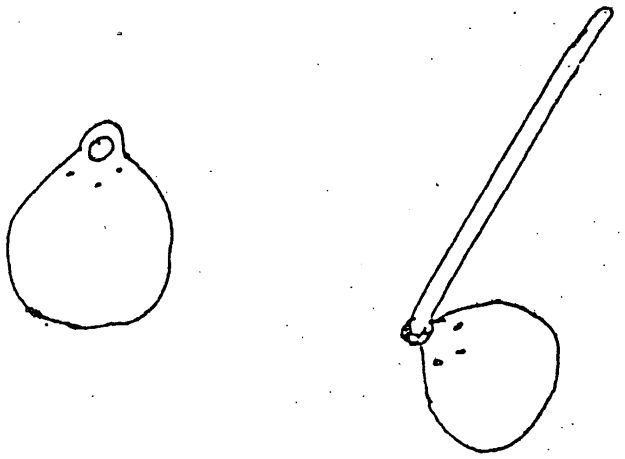


FIGURE 3 - WELIMADA UDALLA

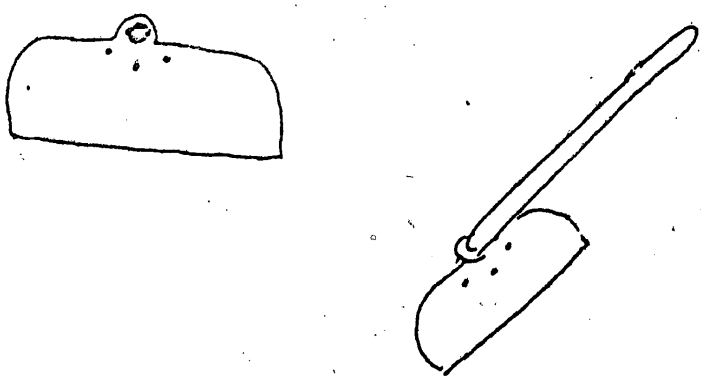


FIGURE 4 - KUTANI UDALLA

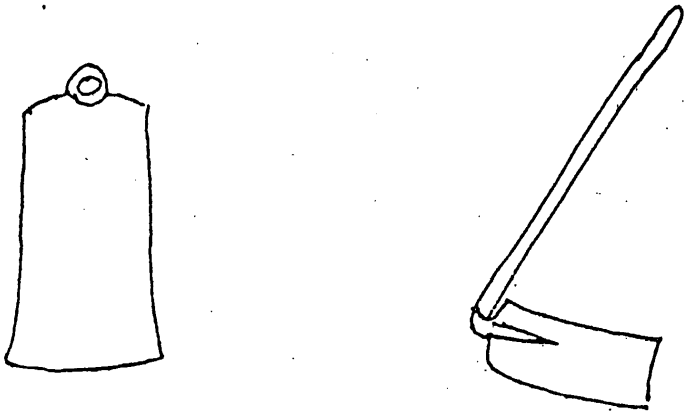


FIGURE 5 - TRIANGULAR MAMMOTY

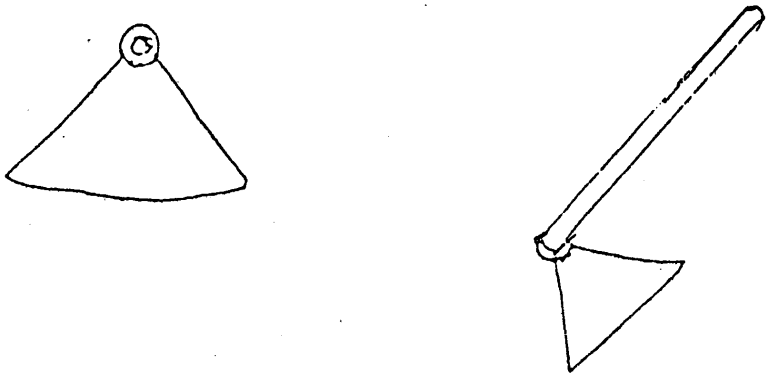


FIGURE 6 - PORU UDALLA (Harrow Mammoty)

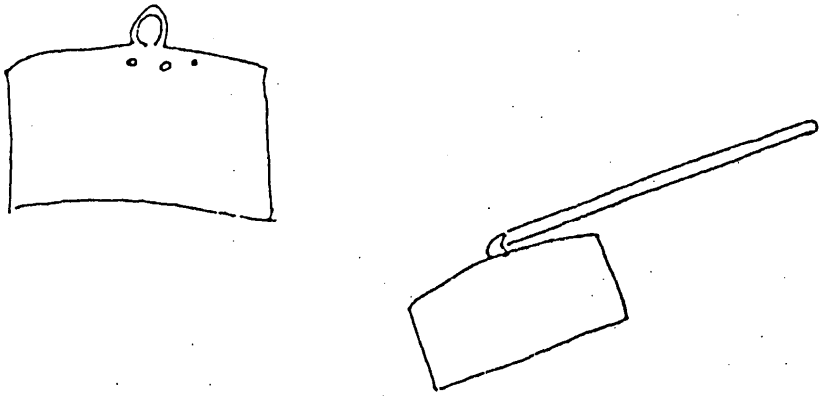


FIGURE 7 - REPAIRED Mammoty(9"x9")

FIGURE 7A - LOCALLY MADE MAMMOTY (9"x5") Blacksmithy product

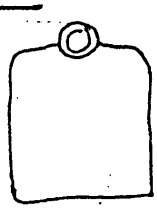


FIGURE 8 - SORANDI (Weeding implement)

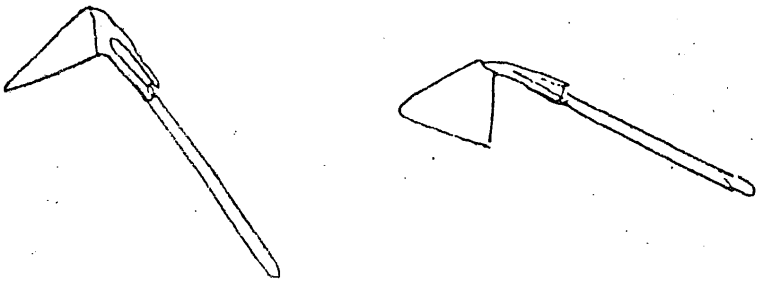


FIGURE 9 - HAND SPADE & HAND PORK

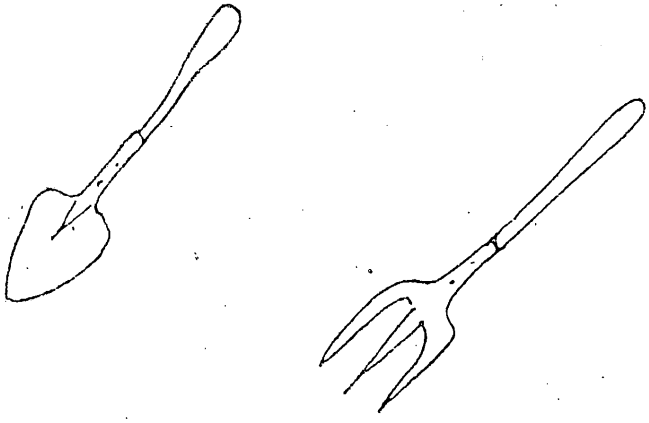


FIGURE 10 - DATIGOIYAWA (PaddyRake)

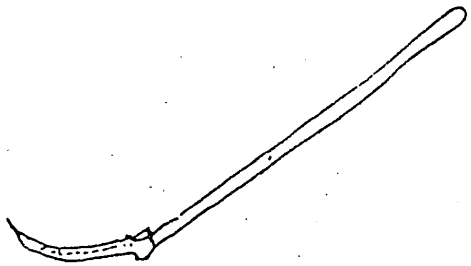


FIGURE 11 - KATTI (Bush clearing knife)

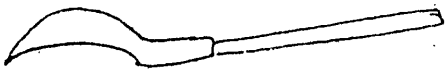


FIGURE 12 - MAHAPIHIYA (Wood cutting knife)

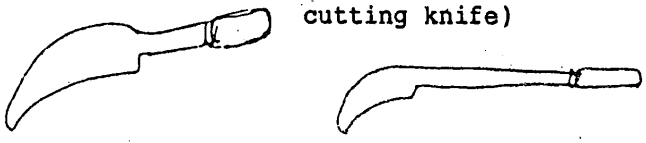


FIGURE 13 - VISI KATTI (Flying Knife)

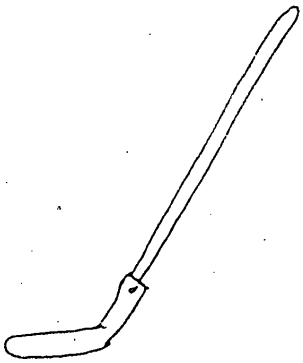
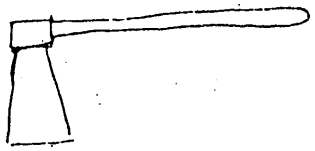
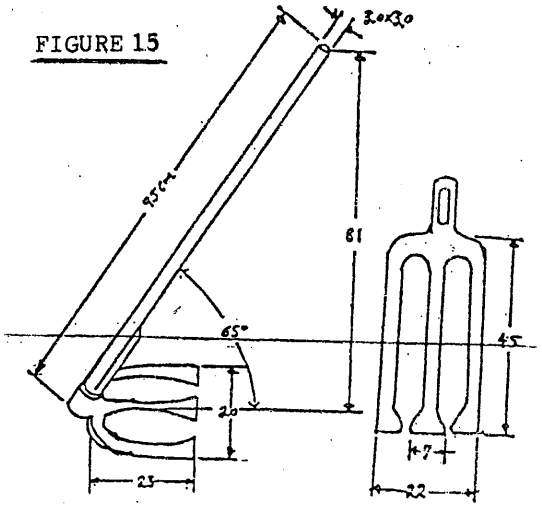


FIGURE 14 - PORAWA (axe)



BICHCHU MAMMOTY (OR THREE BLADES MAMMOTY)

FIGURE 15



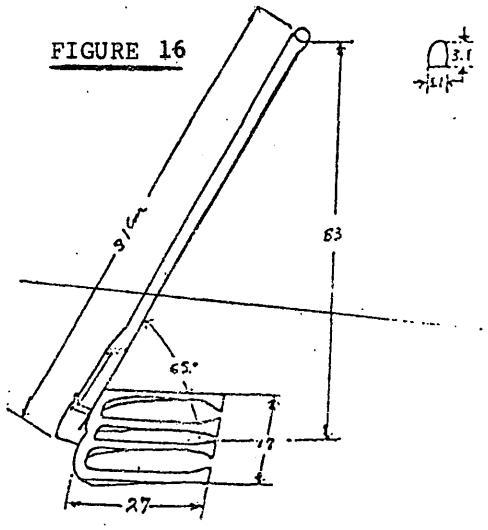
USES:
* Intercultivation
* Breaking soil blocks after ploughing

FEATURES:
* Light and easy to work with
* Good penetration
* The cutting edges are made of carbon steel and repairable by forge welding when worn out.
* Mild steel body

SHORT COMINGS:
* Not suitable for the land where weed is growing thick

BICHCHU MAMMOTY (OR FOUR BLADES MAMMOTY)

FIGURE 16



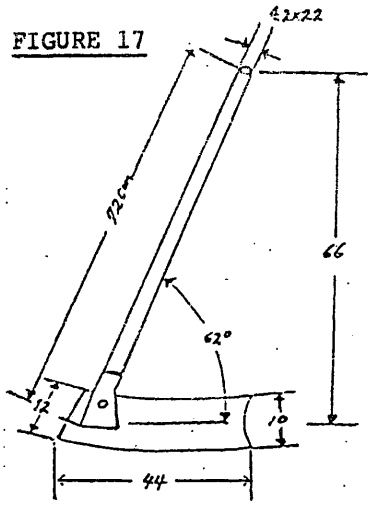
USES:
* Ploughing and breaking soil blocks at paddy and upland field.
* Intercultivation etc.

FEATURES:
* Workable in various kinds of soil conditions
* Mild steel body is easy to make
* The carbon steel cutting edges are repairable when worn out

SHORT COMINGS:
* The same as three blade mammoty

KANABURO MAMMOTY (STAINLESS MAMMOTY)

FIGURE 17



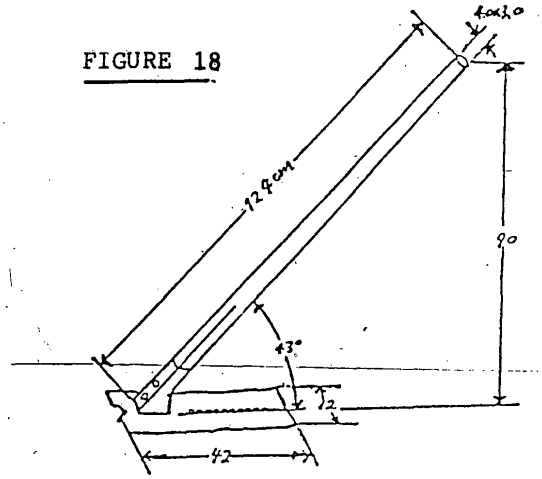
USES:
* Plastering of paddy field bunds
* Ridging at vegetable plots

FEATURES:
* Light and easy to handle
* Handles maximum of volume of mud
* The cutting blade is made of carbon steel and easily repairable
* Free from stain

SHORT COMINGS:
* Expensive
* The same as Furo Mammotty

HIRA MAMMOTY (OR LIGHT MAMMOTY)

FIGURE 18



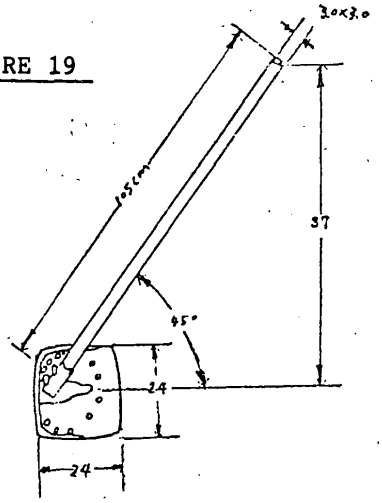
USES:
* Weeding in vegetable plots
* Intercultivation in vegetable plots

FEATURES:
* Good for light soil only
* Extremely light and easy to handle
* Inexpensive
* Mild steel body
* The cutting edge is made of carbon steel and easily repairable

SHORT COMINGS:
* Whole structure is not very strong

JOREN MAMMOTY

FIGURE 19

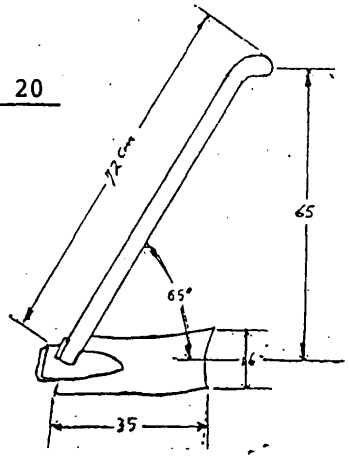


USES:
* Plastering bands
* Clearing drainages

FEATURES:
* Easy to work in the water because of the holes

FURO MAMMOTY

FIGURE 20



USES:
* Scraping and plastering bands
* Ploughing paddy fields (when deep)
* Intercultivation and ridging for up land crop

FEATURES:
* Balance is good in the water because of the wooden body
* Iron blade can be replaced

SHORT COMINGS:
* Not suitable for upright working position

TO - MAMMOTY (OR DIGGING MAMMOTY)

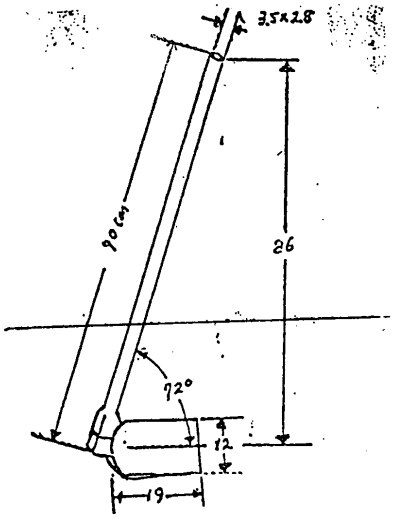


FIGURE 21

USES:
* Digging pits and trenches at hardest soil
* Planting trees
* Manuring coconut

FEATURES:
* Good penetrating power
* Strong and sharp
* Light in weight
* Mild steel body is easy to make
* When the carbon steel cutting edge is worn out, a new piece is forge welded easily

SHORT COMINGS:
* Can't dig out much volume

SAW SICKLE

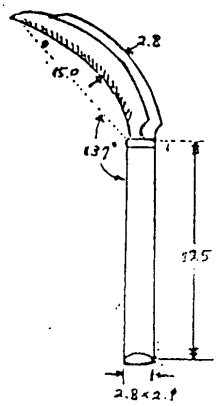


FIGURE 22

USES:
* Reaping paddy etc.

FEATURES:
* Sharp and strong
* Highly efficient for teeth are machine-cut

SHORT COMINGS:
* Shape of blade is not suitable for broadcasted paddy

HOME GARDEN SICKLE

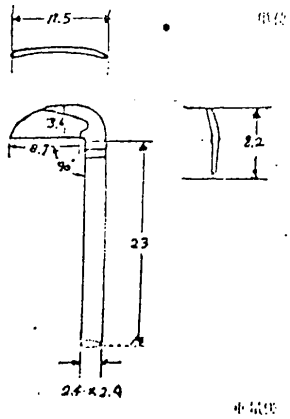


FIGURE 23

USES:
* Wedding at vegetable plots

FEATURES:
* Good for clearing around the plants and between the rows
* Ideal for home gardens
* Cuts the roots well

SHORT COMINGS:
* Frequent sharpening is needed

BUSH CLEARING SICKLE (LARGE SIZE)

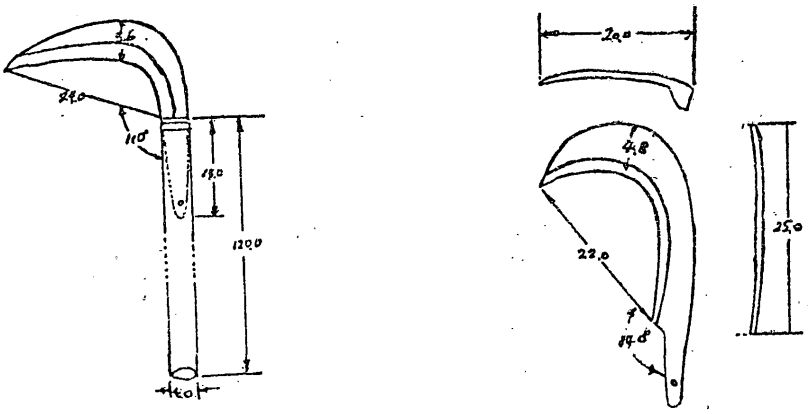


FIGURE 24

USES:
* Clearing the bush and weeds
* Cutting down the branches of the trees

FEATURES:
* Light and easy to handle
* Cuts well even tough bushes
* Highly efficient
* The cutting blade is repairable by forge-welding a new piece of carbon steel

SHORT COMINGS:
* Blade is breakable against the large stem of bush
* Frequent sharpening is needed

GRASS SICKLES (MEDIUM THICKNESS) (LARGE, MEDIUM, SMALL)

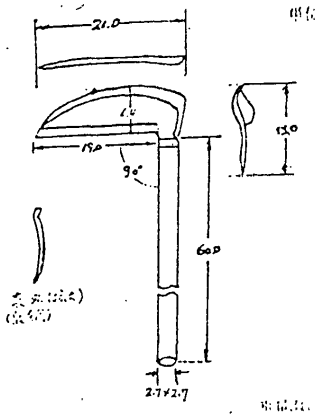


FIGURE 25

USES:
* Cutting green fodder
* Clearing small bush
* Weeding

FEATURES:
* Sharp like razor
* The blade is repairable by forge welding a new piece of carbon steel

SHORT COMINGS:
* Blade is not tough enough against very hard objects
* Frequent sharpening is needed

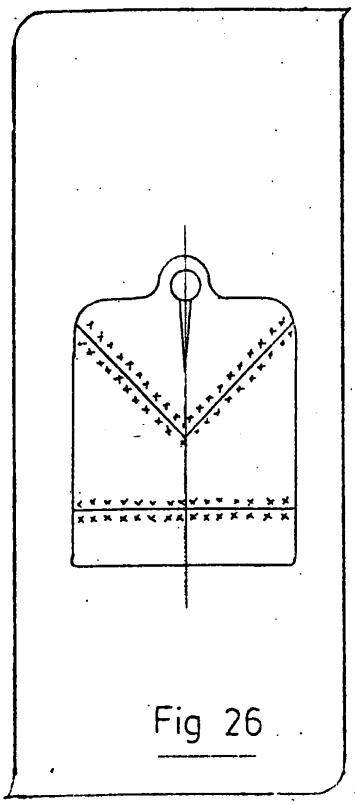


Fig 26

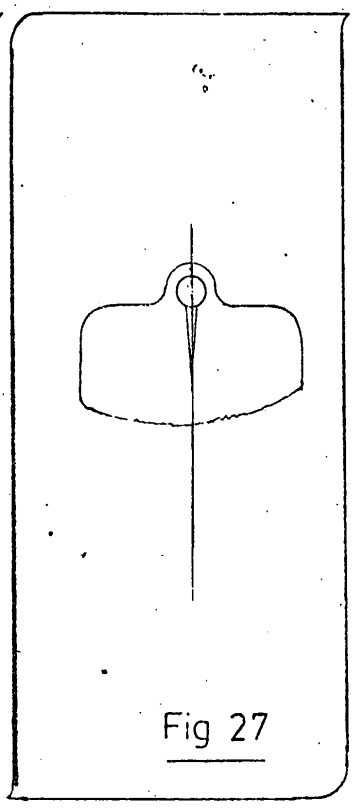


Fig 27

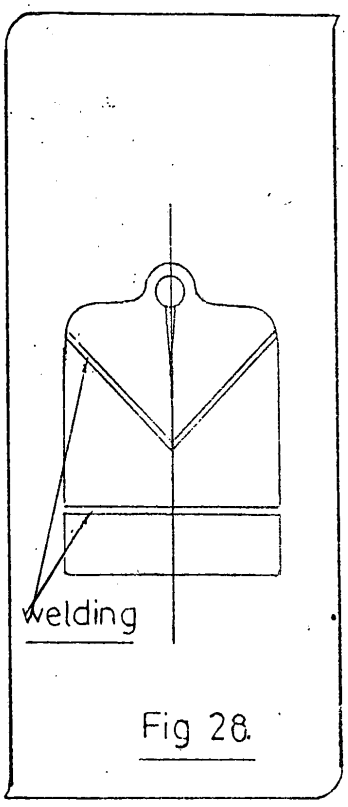


Fig 28

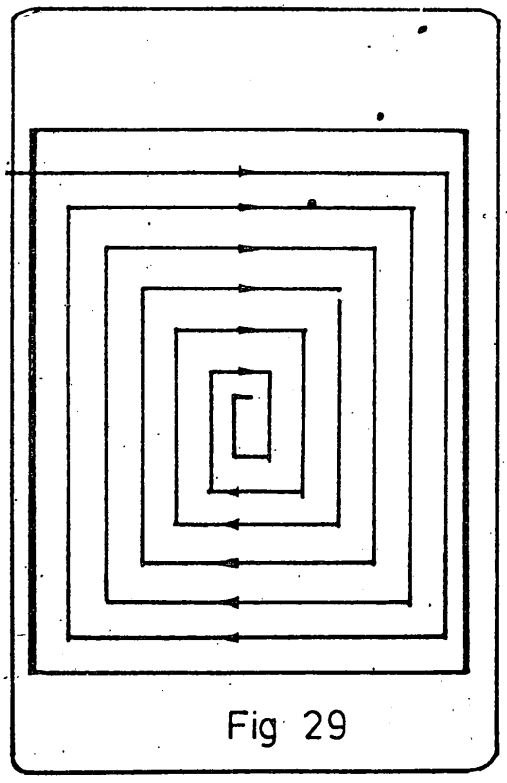


Fig 29

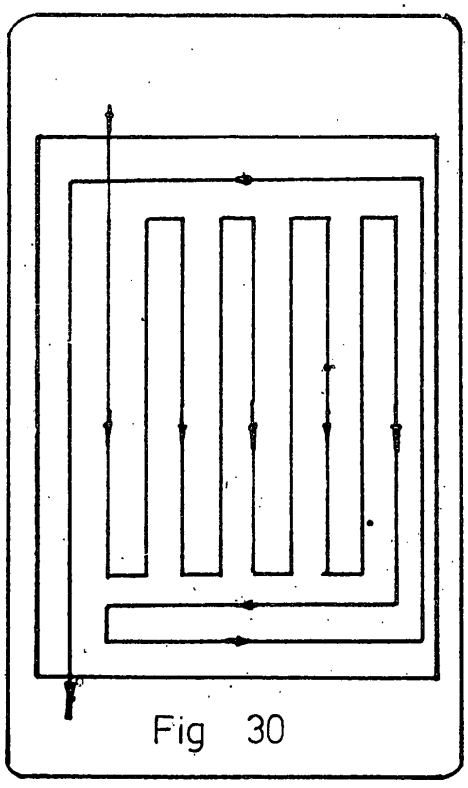


Fig 30