APPROPRIATE MECHANIZATION

FOR THE CLIENTS OF THE

INVIERNO PROJECT

TDY Trip Report to

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BEST AVAILABLE

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THE INTERVENTIONS IN THE CURRENT SYSTEM

(AN EXECUTIVE SUMMARY)

Four major interventions are proposed for the farming region. These interventions will be a second generation of development which will apply a multiplier effect to the seed-fertilizer-management technology now being installed through the INVIERNO supervised credit program. This second generation can be introduced with modest adaptations of the credit instruments and services now established in the INVIERNO program. In this expansion, INVIERNO's role will become increasingly interdependent with the performance of other agencies. The general climate for a progressive relationship appears favorable at all points where such relationship was tested.

These recommendations have been deliberately set in terms of concepts and principles for considerations in selecting a course of action. The next stage of the process is consideration, and acceptance or revision of these recommendations. With that decision the concepts and principles may be elaborated into a detailed program of work and plans for implementation.

I. Animal-Drawn Implements

Improved designs of plow, a disk harrow and a ridger-cultivator have been recommended for immediately increasing the productivity of available animal power. This intervention should be relatively low-cost, quickly implemented and provide a quick return. Unfortunately, this technology appears to have a limited potential that falls far short of necessary requirements.

To exploit this technology a field demonstration program is needed as well as the development of local sales-service entrepreneurs at the community level. The identification of the needed entrepreneurs and the provision of needed finances for establishing these new businesses seems a reasonable inclusion in the INVIERNO development approach. The necessary demonstration programs appear equally feasible.

II. Tractor Hiring

Thirty-five to fifty hp tractors and tillage tools appear to be the best means for supplementing animal power at least on the larger, more level and accessible plots of the project area. Control of these

tracts with tractor power, or at least the initial work of plowing, should free bullock power for assignment to the more irregular and difficult tracts with a combined benefit in productivity. These same tractor units could be applied to road and land improvements during the season when they would normally be idle from field work. Cost estimates indicate a very favorable competitive position for tractor hiring.

These recommendations outline a tractor hiring service of private operations located in the local communities. It is visualized that another credit program would be developed by INVIERNO, along similar lines, to establish these community services. Credit supervision by INVIERNO and economic competitive forces are expected to ensure the farmer's well being in respect to this service.

III. Small Tractor Evaluation

Farmers are expected to become increasingly critical of the limitations of tractor hiring and increasingly eager for farm management independence as they gain more experience with the potential of intensive farming. Because the farms are small, these farmers will find their best possibilities for independent power in small tractors. However, very little is now known regarding the selection and use of such tractors. It will take 3-5 years to generate the necessary information to guide farmers in future use of either tractor hiring or conversion to private power.

A tractor evaluation program has been recommended to provide this information. This program would be undertaken in a manner insulated from the two programs mentioned above.

IV. Service Operations

In raising the quantity of power and subsequently raising farm productivity a number of other possible constraints are of concern. Some of these are already apparent to some farmers and a few have already acquired technology to break the constraints of this "third generation." Irrigation pumps, threshers and grain storage are typical of this group. There is little basis for predicting either the critical nature of these technologies or the appropriate dimensions. Demonstration and trials of a few alternatives would provide a considerable advance in respect to these technologies. Once the parameters of appropriateness were defined for these technologies they could be considered in terms of ways and means for extensive application.

There are also a group of technology related services that may prove to be constraints. Civil engineering of roads and water control structures, for example, may be very important to extensive use of tractors in road maintenance and farm pond construction. Farmers may require technical help in identifying sites for irrigation wells. Or another example is the need for entrepreneurs in the manufacture of threshers, irrigation pumps, field leveling machinery, etc. While these items are not constraints now, there is good reason to anticipate that any or all of these items could have some restrictive effect within the next five years. INVIERNO's charter has the latitude to monitor these types of farm needs. Corrective action along the lines of the animal-drawn implement program or tractor hiring program would seem to be the best approach for these items also.

The body of this paper provides some suggestions for limited trial of these technologies.

The agricultural enterprises of the project area are differentiated in terms of a number of attributes, i.e., farm size, type of soil, mix of crops, farm labor supply, access to markets, manageability, etc. In this situation the specification of appropriate technologies mandates that several kinds of tools and methods of applications are necessary. Unfortunately, many of the farming enterprises of the region are unique and evaluation is necessary to define what items are likely to be the best tools and equipment for the target farmers.

One of the most exciting aspects of this situation is the opportunity for pioneering in a well integrated program of appropriate technology development for small farmer agriculture.

I. Agricultural Potential

The INVIERNO project papers and evaluations provide thorough documentation of the agricultural and other characteristics of the area. These documents serve as the basic descriptive references for this set of recommendations. (Appendix A provides abbreviated Project Background Information.)

Field observation, and the project data, point to farm power and equipment as a crucial production constraint. (The itinerary is shown as Appendix B.) As one drives through the countryside, the common characteristic visible in most all fields is excessive weed growth with many parcels of land uncultivated although of apparently equal quality to the land in standing crops. This patchwork of good stands, weedy stands and apparently neglected land perhaps in nearly equal proportions suggests grossly underutilized potential. If weeds depress production by 25% and the uncultivated land area is 30%, there

is a potential 80% increase in production available simply by providing the power and equipment to correct these two problems. (This calculation is shown in Appendix C.)

Farmers' comments in responses to questions about farming practices verify, in fact, amplify the seriousness of the farm equipment constraints. One farmer, interestingly a woman, indicated that she owned 60 manzanas of land (42 HA) of which 20 manzanas would be cultivable, but she was only able to cultivate four manzanas. In the fields she had under cultivation--there was an abundance of weeds and an irregular stand--obviously resulting from poor initial land preparation and practically no cultivation of the maize crop rows. All of the farmers visited knew the price that would have to be paid to hire animal power for land preparation. Most of them knew of a rate for tractor hiring, but they also commented that tractors were not close enough to be useful. From all indications the farmers "felt need" is consistent with the observed power constraint.

Farmers also had some concept of quality of land preparation. In a number of responses individuals stated that they would like to plow deeper and get the land ready quicker. These are technically sound practices, although it will be necessary to collect the experimental data on various tillage practices for the soils of the region to establish the magnitude of such benefits. There is good reason to believe that the farmers' intuitive judgments will be substantiated in the research plot.

The limitations of the area also stand out vividly. The terrain is extremely irregular and therefore, the plots of cultivable land are small, dispersed and irregular in shape. There is a large portion of the land that is inaccessible by any means other than by a narrow trail. Some of the land now cultivated is perhaps too steep to be classified as cultivable. And a general lack of infrastructure such as roads, communications, schools, etc., have serious implications.

The most important observation, however, is that the farmers of the INVIERNO project area are taking advantage of the new facilities provided to them by INVIERNO for raising production. They react as entrepreneurs, admittedly wish limited resources, and show a considerable interest in new practices asking quite sound questions in terms of their individual farms.

In terms of applying improved agricultural tools and equipment, the three general characteristics are: (1) underutilized production capacity, (2) serious topographical limitations, and (3) progressive

attitude. One can hardly ask for a more challenging environment to work out the parameters of an appropriate technology.

II. Infrastructure Interdependence

The design parameters of an appropriate technology of necessity include infrastructure features. An interdependent relationship is sometimes referred to as a question of the "chicken and the egg" or in current slang as a "catch-22 situation." In other words, farmers don't use better farm tools because they aren't produced, or better farm tools aren't produced becaused farmers don't use them. In fact, neither of these simplifications are reasonable. There are always some curious interested individuals. For example, one of the farmers we visited had used a steel plow (Care-type) for 12 years, another farmer had a 3-1/2 hp Briggs-Stratton pump and a third was using a 9 hp diesel engine-driven thresher to harvest his bean crop. However, the majority of the farmers, nearly all of them, indicated in their responses that they would need education, roads, markets, etc. to make much change in their farming operations.

Roads and markets are indeed vital if the farmer is to have a means of realizing a benefit from extra production or to get the inputs to enable production. Fortunately, there are roads in the area and while they are of marginal capability, they are adequate to serve a considerable number of farmers, certainly sufficient for the start-up of an extension--demonstration program in changing technology. The INVIERNO socios are an adequate target group numbering more than 5,000.

The farmer needs to be using better seeds, more fertilizer, and better management in order to make it practical to improve his tools and equipment. The attributes contributing to success in the "first generation of agricultural development" are necessary for use of machinery, although not sufficient. In the second generation, there is an additional set of infrastructure factors such as existence of fuel supplies, service shops, trained mechanics, credit programs, trained operators, etc. Here again, is a Catch-22 situation, that is really not so bleak for the project area. There are tractor suppliers and service centers in Matagalpa now and the companies indicate estimates of increased potentials in the area in the future. All three of the companies which were contacted indicated that they had set-up or were building service centers in Matagalpa and had road service vehicles for more remote equipment. They also indicated that Nicaraguan farmers were able to become good operators in training programs of a few days to one week.

III. Tillage - The Short Term Constraint

As described in Section I, the most serious constraint on production is the power and equipment to improve tillage. This problem is a more crucial constraint as the farmers raise the level of seed-fertilizer management input. There are three alternatives for improving the farmers' power and equipment: (1) increasing the number of work animals and improving animal-drawn implements, (2) supplementing animal power with hired tractor power, and (3) replacing animal power with tractor power. Each of these alternatives have merit for the INVIERNO area as will be described below, but they are not mutually exclusive. The farming operations of the area are a composite ranging from very small operations through large operations. Terrain and accessibility are also constraint factors in application for tractor technologies. In other words, an appropriate technology for the INVIERNO project area is not a particular kind of tool, but a set of tools with specifications for their application and use within the spectrum of enterprises that make up the project.

The data on farm-size, in this case as in most others, is the best place to begin the analysis of the mix of equipment. The distribution of INVIERNO clients by farm size is shown below.*

Farm Size (Manzanas)	Number Number	%	Area Cultivated (Manzana/Farm)
0-5	1,777	49	1.8
5-10	777	22	2.8
10-20	486	14	3.2
20 +	598	16	3.8
overall	3,668	100	2.5

*This information taken from INVIERNO report "Numero de Prestamos Y Area Promedio Financiada pro Prestamo Segun Tamano de Finca por CEDE." See Appendix D.

The increase in INVIERNO client numbers in subsequent seasons is expected to include a trend of slow increase in farm area under the program for all sizes of farm, but for the following analysis the available data will be utilized. Common opinion indicates that a pair of draft oxen are used to till 2-5 manzanas of land per farm. On a comparative basis, tractor power would be used at the rate of 1 mz. per engine hp. although if the tractor were a specialized unit such as a tractor for tillage only, it would likely have a capacity somewhat more than 2 mz. per horsepower per season. Restructuring the farm size distribution according to categories of appropriate farm power leads to the following tabulation as estimated for the total project area of 20,000 total farms.

Power Unit	Cultivated Farm Size	No. of Farms	%	Land Area %***
Hired	0-2	5,500	25**	15
Animal	2-5	5,000	24**	21
5-10 HP	5-10	4,400	22	24
10-15 Hp	10-20	2,800	14	17
25 Hp	20 +	3,200	16	23

**Estimated by dividing the 0-5 mz. group in equal sub-groups.
***This column was constructed by estimation and the calculations are shown in Appendix E.

From the above calculations, it is observed that in terms of food production potential these various categories of farms are of equal importance as they command essentially equal shares of the total farm land. From the column indicating numbers of farms, we also notice that the potential market for equipment is in the range of 300-500 units per year of each of the various sizes. As a matter of perspective, the total tractor sales in Nicaragua have been in the vicinity of 300 units per year for the last few years. One concludes from this analysis that there may be an adequate market in each of these several categories to justify the R & D necessary for the particular machinery and infrastructure best suited to that size of enterprise. Obviously, this analysis is little more than a very tentative hypothesis about the future equipment mix. To improve the estimate, we need to consider greater compilation of information about the performance of farm machinery in the context of the enterprises of the region.

Three conclusions can be drawn from this analysis for near term planning. First, animal power will continue to be an important source of power in the future. Second, hired power will also be important. The most economical source of hired power is the largest unit that is maneuverable within the field sizes, we would anticipate this demand to expand the potential for the 25 hp unit. Third, the application of these two relatively known technologies, animal power and hired tractor power, is relevant to 60-65% of the land area and farm numbers of the project area. It can also be added that the experience of applying these technologies will enable refinement of the basis for estimating the most appropriate mix of hardware and enable significent expansion of productivity while further investigations are undertaken.

A. Improved Animal Implements

A three-implement set is recommended which might double the work output of a pair of draft animals. In other words, a pair of animals using this set of implements could prepare a seed-bed that would compare with the tillage of 4-5 plowings with the common plow rather than the customary 2-3 plowings. There is expected to be an additional yield benefit from subsequent better weed control during intercultivation.

The Moldboard Plow. A plow which shears off a furrow and inverts the soil is expected to give a considerable improvement in weed control. It will probably be easier to pull than most of the country plows. Two styles offer potential. The chain-pull, steel-beam plow such as the CARE-type or the French design under study by INVIERNO staff is a good design for larger work animals. The Shabash plow is considerably less expensive and quite adequate for the majority of farmers. Details on the Shabash plow are in Appendix F.

Disk Harrow. Introduction of the disk harrow as a seedbed finishing tool is an advance in technology directed mainly to secondary tillage of tractor plowed land. There are also areas planted to beans that may be adequately tilled by only the disk harrow. The machine is comparatively expensive, yet in terms of cost per unit of capacity it is an economical choice for those uses where it is appropriate. The six-disk style illustrated in Appendix G, is recommended, however, there are quite a number of other designs reported in FAO and other sources.

Furrower-cultivator. Weed control in maize, sorghum and beans will require row cultivation. A furrower is also a simple sturdy machine which can be fabricated and can be used in much the same way as the Shabash plow. In some areas it might be better to use shovel or sweep cultivators. These items are illustrated in Appendix 4.

In order to use the cultivator with greatest effectiveness, it will be necessary to have relatively straight, uniform rows which will require improvement in planting technique. Of the various prototype planting machines on the market, none seems particularly well suited for application in the project area. A technique of row marking and hand planting is recommended and further details are provided in Appendix I.

Hand cultivation will continue to be required to fully clean out the weeds within the row. The tools now in use appear to be quite adequate.

B. Tractor Hiring

There are numerous farms and fields within the INVIERNO project area that could be plowed with a 35-50 hp tractor and disk plow. In some areas a moldboard plow might be suitable and more economical, but there seems to be resistence to the moldboard plow. Use of tractors for plowing would easily and rapidly expand the power available to the farmer and thereby increase the animal power available to the land not accessible to tractors. Estimates ranging from 20-40% were given for the land area that might be added to cultivation if additional power was available.

The use of the tractor for operations, in addition to tillage, is more speculative. Tractors could be used for seedbed preparation and it would also be possible to use tractors for threshing, crop drying, general haulage and numerous other operations. The conditions of the project area suggest two tasks in addition to plowing as of greatest benefit. These tasks are road maintenance and land improvement. The estimated annual work load for a tractor could be 50 days of tillage, 50 days of road maintenance, 75 days of land improvements and 25 days of miscellaneous services. This would result in total use of 1,500-2,000 hours per year. INVIERNO calculation of operating and depreciation costs were C$53.44 per hour for a 70 hp tractor at 2,000 hours per year. (Appendix J.) Adding implement costs and loan amortization in 3 years would not increase total costs above C$175.00 per hour. (Appendix K.) As a point of reference, farmers were asked the price of hired bullocks and hired tractors. Current tractor costs of C$200 per hour are considered quite reasonable in competition with animal at C$100 per manzana for tillage one time. Tractor output is estimated at 1 manzana per hour and of better work.

The extensive dispersal of farms in the project area, connected by very poor roads and with practically no other communication produces a unique set of management problems for a tractor hiring operation. This situation is further complicated by the unpredictability of weather and seasonal factors in the unusually rugged terrain. It will be extremely difficult for individual farmers to anticipate the

optimum time for the use of the tractor and nearly impossible to send word any distance when conditions are right. In other words, it appears to be essential to locate the tractor within the community. Of course, in these circumstances there is practically no centralized management that could be effectively provided tractors located in individual villages. The community is typically composed of 40-60 farms currently cultivating 2-4 manzanas or a total of 80-240 manzanas. If we assume as above that only 50% is now accessible to tractors and that tractors would be utilized at the rate of 1 mz. per 1 hp, we are talking about 1-3 tractors community.

Cooperatives have often been established as the management unit whereby a number of small farmers could utilize tractors and other lumpy investments. Unfortunately the records of cooperative ventures are too frequently failures. An adaptation of the INVIERNO credit system providing supervised credit and integrated with farm input credit could simultaneously solve the problems of capitalization and management incentives.

C. A Development Approach - Short Term

Discussions with manufacturers and suppliers of farm equipment provide evidence of interest in this new market for agricultural equipment. They are not well-informed nor are they moving boldly to establish themselves, but they appear to be in a position to expand their operations and services. The expansion of these operations for animal implements and tractor hiring can be facilitated by a supervised credit and technical assistance operation design along the lines INVIERNO has developed for small farmers. For these programs the entrepreneurs will be community residents, like their farmer neighbors, but with some mechanical and commercial aptitude and too little land to make a satisfactory living.

1. An Animal-drawn Implement Operation

There are three actions necessary to establish a dependable supply of improved-animal-drawn equipment in the project area. These actions could be accomplished by a small task group over approximately a three year period. From the calculations above, the annual production level for this industry would be more than 500 sets of equipment per year and probably more than C$1.5 M per year

of gross sales. Spare parts, hand tools and other items could considerably expand this commercial activity in the future.

(a) Prototype Production

One or more manufacturers with apparent future interest in the product line must be identified and contracted for the production of perhaps ten prototype sets. These units would be primarily for the purpose of confirming that the performance in the various soils of the region is satisfactory. The greater the number of prototypes produced, the more quickly the information can be compiled. The simplest technique for getting such information is to carry the machines to farmers at the time they are preparing their fields and ask the farmer to use the machines for at least a small portion of their land, and then record their opinion about the machine. The progressive attitudes of farmers that were observed during this tour of the project leads me to expect that such a prototype trial would rather quickly provide a quite reliable judgement of the machines' suitability.

b. Demonstration to Farmers and Identification of Entrepreneurs

Farmers must be informed of the new machines' price and, equally important, they must be able to get the machines without undue difficulty. A demonstration program for farmers could be quite effectively carried out using the prototype machines or subsequent adaptations. A target might be to use the new method of land preparation on one manzana in each community and continue these plots for two years. Each of the ten original sets might be able to establish 2-4 such plots providing considerable exposure of the new technology in the project area.

It is as important to stimulate entrepreneurship during the course of these demonstrations as it is to motivate farmers in the use of new technology. It is doubtful if the established workshop contracted to produce the prototypes will have the marketing organization or resources to develop an organization that would have retail outlets accessible to the small farmers

of the project area. For this equipment, it would be desirable to have a blacksmith or small sales and repair shop in every third or fourth community. The demonstration program must stimulate and identify the individuals of each community with a little mechanical ability and commercial interest. The demonstration program should be designed to seek out these individuals at the same time it is informing the farmer of the merits of the new practice.

c. Financing the New Entrepreneurs

Just as the farmers will need a financing program to purchase the new tools, the potential entrepreneurs will need a financing plan to offer the necessary sales and service facility. Something on the order of 60 day financing for shipments of 5 units, maybe rising to 15 as the entrepreneurs establish a credit and business record. This form of credit would actually be at very low risk, for INVIERNO through its knowledge of farm plans, etc. will have advance information on planned purchases of equipment and can make the necessary loan retirement transactions directly in its computer. The manufacturers agents could service these new entrepreneurs with most of their technical assistance needs and the balance of know-how of service to the local community could be quite readily acquired from the INVIERNO Agromoc.

The entrepreneurs will become more skillful mechanics and will seek to increase their own income over time. These new businesses may undertake to buy components and fabricate some parts as well as assemble the machinery locally. They may also expand the range of items and offer other services. Any and all of these adaptations would be good and provide real services now absent in the communities of this area.

2. Tractor Hiring Operations

The establishments of tractor hiring operations for tractors can be separated into two phases. The establishment period when the tractors will be operated at part of their capacity will not be profitable for private operators. Tractor plowing would seem to develop quite rapidly, given the familiarity that farmers expressed and might reach full demand in as little as two seasons.

Road maintenance and land improvement operations on the other hand are estimated to take four years to reach the full work load largely because of the time required to complete the necessary engineering field work, plans and job staking as well as train the tractor operators in these other techniques. The use of a few demonstration tractors can carry the major burden of the initial uneconomic period and might be used to speed the establishment of all three types of work. However, the proposed technology is a sufficiently bold innovation that projection (of times, costs, rates, etc.) for these initial phases is speculative. To get better planning information, we need performance information from equipment in the field.

(a) The Tractor Demonstration Phase

Four or more tractors placed strategically in each of the five regions and used for demonstration plowing, road grading and land improvement could probably provide 80% of interested farmers with an opportunity to see the equipment in operation. It is reasonable to assume that by no later than the third year of such a program at least one socio in every community will have begun using a plow, and the other services. These demonstrations could be undertaken with several kinds of plows and tillage implements and with different techniques of operation establishing the best practices for each locality. More details of the planning aspects of the tractor demonstrations program are provided in Appendix L.

As in the animal implement demonstration program, the tractor demonstrations should have both the objective of motivating farmers to utilize tractors and also of estimating the interest of potential operators. Those individuals of little or no land-holding and who display unusual interest in tractors and their operation quite often are easily recognized during the course of a demonstration program. This type of interest should be carefully noted and followed up as it is a basic attitude of a good operator. With a healthy interest in mechanical things, it will be possible to train an individual in as little as a week to be a good operator for the basic tillage and road grading work.

b. Establishing Entrepreneurs in Tractor Hiring

The agromoc is in an exceptional position to facilitate the establishment of tractor hiring services. The agromoc is familiar with the farm plans of the community and he can readily estimate the total work load demand for a locality. Also, his familiarity with the people of the community probably enables him to identify individuals who have the potential to become successful tractor operators. If the agromoc can offer a credit facility to the potential entrepreneur, he would also be in a position to monitor the real performance of the tractor hiring service in much the same manner as he monitors farming operations. The situation in the project area is unusually suited to private ownership of tractors. Many communities will have a work potential for two or more tractors and with additional tractors available in neighboring communities there will be a high competitive factor which should ultimately benefit the farmer both in terms of price and quality of service.

Obviously a below average farmer with mechanical abilities etc., can offer practically no collateral with which to secure a loan of the usual terms. However, working from the farm plans of his neighbors, an interested individual should be able to secure a number of agreements which collectively could provide a reasonably reliable indication of his profit potentials as a tractor owner. The agromocs in his technical assistance to the farm operators could readily verify such agreements. The financing of inputs for farmers and the financing of tractor payments could be further integrated in the computer transactions in INVIERNO making the entire transaction a rather carefully controlled and secure investment. A notable advantage is that INVIERNO would be insulated technically from the numerous petty arguments that are typical between farmers and managers of hiring services.

As an additional form of collateral INVIERNO might require that the potential entrepreneur satisfactorily complete a one-week operator's training program thereby proving his mechanical ability. Such training might as a matter of routine be provided by equipment suppliers and priced with the tractor, implements and supplies in the initial purchase.

This adaptation of the INVIERNO's approach to supervised credit and integrated technical assistance would have a multiplier effect on the returns achieved in providing credit for farm inputs.

(c) Engineering Services

Technical assistance for land improvements and road maintenance will be required by farmers and the tractor operators. This assistance will be engineering design of structures, staking out the work and supervision of construction. Many simple land leveling, road and other tasks can be easily done by a moderately skilled equipment operator but there are also features of the terrain that will require the attention of experienced engineers. There are a number of options for providing the supporting engineering services.

IV. Medium Term Problems

Careful appraisal of the typical farm enterprise adjustments to a doubling of production leads to the conclusion that three types of technology need improvement. These technologies are (1) crop storage, (2) crop harvesting and (3) irrigation. Among these three the priorities vary from location to location and from farm to farm in the project area. Time did not permit a thorough analysis of either the problems or the solutions. The following comments are intended to suggest the line of further approach rather than the specifics of the solutions.

A. Storage

There are estimates of loss as large as 40% of the crop. However, there is a significant portion of the crop that moves through quite modern marketing facilities. The storage problem is most serious for comparative small units to be used for storage of grain for home consumption to allow greater marketing independence. Because of crop diversification, the farmer may require storage for 2 or 3 grains in lots from 200 kg to 400 kg and for periods of a few weeks to one year.

Metal storage structures similar to these popular in Guatemala offer potential. (See Appendix M.) The cost of storage per unit of material stored is comparatively high for small unit storage, but costs of transport to a more economical central storage and return can be even

higher with the poor roads etc. of the project area. To accommodate the diversity in sizes of farms and cropping pattern, it will be necessary to provide several sizes of storage.

In order that grain retain high quality in storage, it is necessary to reduce the moisture content to 13% or less and ensure that the grain is thoroughly cleaned before placing in the storage bin. Present harvesting practices generally conform to these objectium, but not necessarily in every harvest. Better practices of drying and cleaning should be introduced with storage to ensure the good performance of an improved storage structure.

One innovation in storage would be to incorporate a solar air- heating arrangement and advance the harvesting and threshing dates. As an alternative the farmer might contract for delivery at harvest and accept adjustments in price according to moisture content as delivered to large-scale units. There is also a possibility of designing community dryers associated with centrally located but individually owned or rented storage. Considerable analysis will be necessary to identify the optimums, but in the present context of anticipated increased production, the design of an appropriate structure and handling system is an important task.

Because of the limited design information for the conditions of Nicaragua it would be reasonable to place a few structures for carefully supervised use and monitor their performance. Designs similar to the bulk feed bins (Appendix N) could be compared with conventional practices for the major crops and in 10 sites in 3-5 regions. In two years it would be possible to analyze quite thoroughly the costs and returns of alternative storage practices.

B. Harvesting

During the harvest season there is a threat of rain which includes risk of serious crop losses. The amount of these losses of course rises directly as the yields of crops increase. It naturally follows that as farmers become concerned about such larger losses they will think more seriously of rapid harvesting, threshing and placement in storage. The field visits included one farmer who owned a small engine-driven thresher and he indicated that he already had all of the work he could handle in the season of both bean and corn harvest. Stationary thresher technology is required for the extremely irregular terrain. The collection of material from the field, transport to the threshing site and temporary storage in preparation for threshing will involve modification of harvest practises, but no serious problems.

The introduction of a rasp-bar thresher would enable the farmers to harvest earlier and reduce field losses. In some cases earlier harvest would enable double cropping. However, earlier harvest will also require an improved drying system. An engine-driven fan, similar to the engine used on threshers, could be used with a solar heat collector and attached to a special storage bin. Local trials will be necessary to work out the guidelines for operating practise of this technology.

C. Irrigation

We met one farmer who owned a 3-1/2 hp irrigation pump and another who was very much interested in building a farm pond to be used with irrigation. There is evidence of water stress. However, there is little information on rainfall patterns, ground water resources and the other parameters necessary for design of irrigation systems. The generation of this basic data should be placed at a very high priority.

However, there are obvious sites for productive wells and farm ponds, which could be readily exploited using simple setups such as the irrigation pump observed and using tractors and scraper as proposed for introduction in Section III-B.

Soil and water management by land shaping or grading is a technology which can be applied with both tractor and animal power. Farmers and equipment operators could make quite significant improvement in the land by simple planning of grading and leveling. The equipment of this technology is illustrated in Appendix O. Also included in Appendix P are handbooks used by the U.S. Soil Conservation Service and illustrative of a type of information that would be used by equipment operators interested in a thorough job.

V. Small Tractor Technology for the Long Term

Farmers have a strong attitude of independence. This is not an irrational attitude as each plot of land is often unique and every farming operation has its distinctive land, labor and capital resources. To maximize his returns the farmer must often make timely decisions according to weather and other unanticipated factors which may be quite different from those of ths neighbors. This necessary management attitude runs counter to the management goals of tractor hiring operations. The tractor hiring manager seeks to plan ahead to maximize the use of equipment finds it difficult if not impossible to change the whole schedule to accommodate the farmer whose fields are "not quite ready."

In the first stages of introduction of a new practice or technology the use of a custom service offers a number of advantages. The farmer can try out the process without mastery of the operating skills or without investment in the equipment. The farmer can use the process in his operation as he adjusts his enterprise and phases into the new practice. And in some cases he can observe one or two different makes or styles of machine during successive years to study at close range which machine is best for his operation. But in practically all diversified farming operations as the new practices becomes integrated into the farming operation the farmers obtain their own tools in order to gain maximum independence in their applications. Quite often this means individual ownership of a smaller size and apparently less economical machine than would be available from a custom service. The farmer's decision is based upon the expectation that the benefits of timely operations within his enterprise structure outweigh the losses of economy in the purchase of the smaller machine.

Taking these characteristics into account, one anticipates that in perhaps five years some farmers will want individual tractors and equipment. Because their farms are small they will need smaller tractors. The comparatively poorer mechanical efficiency of these smaller tractors will not be an over-riding constraint. Unfortunately, we do not know enough about the performance parameters of small tractors generally or the agricultural enterprises of the target to predict just when and what decisions will be made in selection of small tractors.

To establish the performance characteristics of small tractors, it will take 3-5 years of investigation in typical farming operations. A carefully structured evaluation program in the context of real farm operations with typical mixes of crops, soils and other factors would provide the overall indicators that farmers will consider in their management.

A. Equipment for Evaluation

As suggested in the analysis of Section I, there are three tractor sizes of apparent significant potential. For these sizes there are different configurations which appear to offer best performance. Implements are available for each of the three models to enable each tractor unit to completely replace the animal or hired power technology.

(1) The tractor types are:

1 - 5 hp - 2 wheel - walking type (Appendix G)

2 - 10 hp - 2 wheel - riding type (Appendix R)

3 - 15 hp - 4 wheel - riding type (Appendix S)

The basic implements set would be:

1 - plow

2 - disk horrow

3 - Row cultivator

4 - Trailer

Optional Implements for study might be:

1 - rototiller

2 - seeder

3 - sprayer

4 - pump

5 - thresher

6 - dryer

B. Cooperating Farmers

A carefully selected group of progressive farmers is necessary to cooperate in this evaluation. Their farms must be reasonably typical and accessible. In assigning equipment to farms a ratio of 1 manzana per engine horsepower appears reasonable. The farmer, in addition to being interested in taking advantage of tractors, must be willing and able to keep a modest set of performance records. The observation during this field trip of an engine-driven thresher and pump, the improved plows and generally enlightened farmer attitude suggests that this requirement can be met.

It is suggested that tractors be placed with three farmers in four communities per region and in all five regions of the project area. In addition, it is advisable to have some back-up tractors that would be substituted for field tractors during analysis of problems, modification

or when necessary repairs are not on hand. It would also be useful to have a few machines for demonstration and more through testing without interruption of the program of field work. From these criterion the tractor set-up would be;

60 tractor units for farm operations

30 back up units

15 demonstration and testing units
105 total units

Each of these categories would be filled equally by the three types of tractors in the program.

C. The Evaluation Program

The farmer would be given the necessary training to operate the tractors and implements in a manner of complete independence. He would be encouraged and assisted in operating the equipment in the most productive manner possible for the resources of his enterprise. All fuel and oil costs would be paid by the farmer, but he would not be charged rent for the use of the equipment in exchange for his time and effort in completing records and other work necessary to cooperate in performance analysis. The farmer would permit reasonable access to the equipment by the staff for purposes of inspection and measurement, but this would be done to interfere minimally with necessary field work. If the farmer was interested in undertaking new practices within the apparent capacity of the machine, he would receive any assistance that could reasonably be provided by the staff. Repairs and modifications would be undertaken as expeditiously as possible, but with every effort to maintain a complete record of cause and effect for reference in future design reviews. On a regular basis the staff would compile and summarize all performance data in preparation for the final project analysis.

This staff would include engineers with experience in the operation of small tractors for test and research purposes. Most of the staff could be locally recruited and adequately trained for the respective assignments in the initial phases of the project.

The final report would summarize:

a - Operating performance in terms of capacity, efficiency and economy.

b - Essential design parameters of small tractors and implements for acceptable performance.

c - Potential benefits of the technology and essential requirements for introduction of the technology.

GENERAL PROJECT ADMINISTRATION INFORMATION

Project Budget

INVIERNO

1. Creating the Institute		
a. Organization and Institution Building	$ 1,200	$ 4,400
b. Training	1,000	300
c. Adaptive Research/Small Farmer Technology	800	200
Sub-Total	$ 3,000	$ 4,900
2. Integrated Agricultural Development		
a. Delivery Systems - Regional and Rural Assistance Centers	$ 350	$ 2,300
b. Agricultural Credit Program	3,200	3,750
c. Home Garden and Nutrition Program	400	400
d. Land Sale Guarantee Program	550	550
e. Cooperative Development Program (Inputs and Marketing)	1,300	3,800
Sub-Total	$ 5,800	$ 10,800
3. Access Road Betterment Program	$ 1,300	$ 1,000
4. Municipal Development Program	900	650
5. Small Rural Enterprises Development Program	1,000	1,000
6. Selected Rural Community Development Activities	-	250
TOTAL	$ 12,000	$ 18,600

Total Amount Authorized thus far for reimbursement $6,255,966

Total Amount Reimbursed $1,988,630

Office Structure

	Communities Served
National Office - Managua	
Region V Office - San Ramón	
"CEDE" - San Ramón	44
Centro de Desarrollo Sub-CEDE - Esquipulas	
Sub-CEDE Wasaka	
CEDE Jinotega	49
Sub-CEDE Pantasma	
Sub-CEDE La Pita del Carmen	
CEDE Condega	59
Sub-CEDE San Sebastián de Yali	
CEDE La Trinidad	52
CEDE Matiguas	27
CEDE Masatepe - Region II	59
	290

Personnel Distribution

Central Office	100
Regional Office	14
CEDE/SUB-CEDEs	
Matiguas	30
San Ramón	40
La Trinidad	30
Condega	33
Jinotega	30
Masatepe	30
Training Component	25
	322

Note: Critical element of agriculture delivery service support system is the INVIERNO Agromoc - 97 are now assigned to CEDE offices.

Organizational Chart

Please note attachment.

BACKGROUND

1972 - 1974	National Agriculture Committee formed and agriculture rural development sector assessment conducted.
May 1975	Instituto de Bienestar Campesino-INVIERNO created with mandate to "promote the social economic progress of the rural sector to permit its population an integrated sustained and continuous improvement directed to obtain a more effective participation of this population in the economic, social, cultural and political life of the nation."
July 1975	USAID Project Paper presented to AID/W.
September 1975	Rural Development Sector Loan Agreement signed.
January 1976	Initial Loan Condition Precedent met.
March 1976	First agriculture credit loan to small farmer client authorized.
February 1977	Region II operations initiated.

TARGET GROUP

I. Region V

Resulting from UNASEC Survey 1972-1974, Region V was chosen over other Regions as initial target area for INVIERNO Project for following factors:

Largest number of rural residents - 253,000

Largest number of rural small farmers with less than 20 manzanas - 17,373

Lowest per rural family annual income rate - $548

Total Cultivable land is only 25% of total land available, of which only 7% is suitable for intense annual cultivation

II. INVIERNO Community - Factors for Selection

Less than 300 homes, but more than 20 , all of which are within a radius of 5 Kms.

25 Km. radius distance from INVIERNO CEDE.

Has permanent access from the CEDE during rainy season

Shows at least medium potential for agriculture production

III. INVIERNO Client - Factors for Selection

Must live from farming as his principal occupation

Must reside permanently in the community where he is making loan application

Must have positive references provided by Agromoc, neighbors, and Comité de Consulta

Must have access to land (50% of socios don't own land)

Must have less than 99 manzanas

Note: 16% of INVIERNO's total number of clients had access to holding from 20-99 manzanas but the average of these only were able to plant 5.3 manzanas because of lack of labor, capital and technology to exploit properly all available.

This group that planted around 5 manzanas of basic grains, cultivating it twice/year, will make an average net family income of only close to $600.

Also, it should be noted that planting one hectare of a basic grains crop provides the client family with but a $40- $70 average family income (this figure excludes average labors costs).

PROJECT COMPONENTS

I AGRICULTURE CREDIT PROGRAM

Statistical Overview

First Planting 1976

Clients Authorized	Clients Served	Communities Served	Total Area Financed	Total Amount Loaned	Average Area/ Client	Average Loan/ Client
2,882	2,430	151	10,773 mz.	$606,714	3.7 mz.	$210

3,747 loan applications were actually processed.

7% of clients were women.

Average of 19 clients/community

Second Planting 1976

Clients Authorized	Clients Served	Communities Served	Total Area Financed	Total Amount Loaned	Average Area/ Client	Average Loan/ Client
3,666	2,862	181	9,027 mz.	$469,857	2.5 mz.	$209

Apante Planting 1976

517	339	181	579 mz.	$87,000	2.6 mz.	$255

Notes Regarding 1976 Credit Activities

- $3.2 million has been authorized by AID for reimbursement of which $1,217 has been disbursed.
- 5,631 loans have been taken out with over 5,000 clients from 181 communities for a total amount loaned of $1,116,571.
- Average holding financed is 2.9 mz., 83% of clients' holdings smaller than 20 mz.
- Average amount loaned per manzana was $57.
- Over 95% of portfolio was for financing basic grains -- corn and beans.

- Discounting serious drought which damaged 62% of total value of original production estimates, production yields were higher among INVIERNO clients than the national averages during an average (non-drought) year.

Comparative Production Yields

INVIERNO Clients	Non-INVIERNO Campesino
17.6 qq/mz. corn	11.8 qq/mz. corn
8.1 qq/mz. beans	7.9 qq/mz. beans

First Planting 1977

	Clients Authorized	Communities Served	Total Area Financed	Total Approved Authorizations	Average Loan Authorized/ Client	Average Area/ Client
Region V	5,917	224				
Region II	1,310	62				
Total	7,227	286	20,246 mz.	$3,308,285	$457	2.8 mz. 1/

1/ Within Region V, 80% of holdings less than 5 mz. and in Region II, 94% are less than 2.9 mz.

II TRAINING/EXTENSION/SOCIAL PROMOTION ACTIVITIES

Comments

Expatriate technical consultant in training contracted for 18 month period.

1977 INVIERNO in-service and participant training plan budgeted has been prepared and approved.

$572,382 has been authorized by AID for reimbursement, of which $16,040 has been disbursed.

Activities

In-service training -- 11 courses to 427 INVIERNO participants.

Agriculture demonstrations from the 82 community level training plots, 2,796 field demonstration classes to 79,000 small farmer participants. Average class consisted of 29 campesinos.

Group organization -- 300 community leaders / INVIERNO "collaborators" have received instruction. Originally 131 community organizations with 3,453 participants were organized. They participated with INVIERNO in the following types of community action projects:

Area	Type of Project	Activity	Communities Served	Number of People Served
Health	Latrines	Installation	25	3,783
	Vaccination	Vaccinate	91	21,947
	Water Supply	Mini-systems & well	3	520
	Environmental	Fumigation	17	3,153
	Nutritional	Family Gardens	9	140
Education	School Improvement	Repair & construction of schools	9	520
Roads	Road Improvement	Repair a/o building of new roads	14	5,300

In addition, 70 "grupos de productores" with 4,898 members have been assisted, plus 21 "clubes de amas de casa" with over 400 members and more recently 44 "juntas comunitarias" which will serve as the future INVIERNO model for community organizations have been initiated.

$115,026 has been authorized by AID for reimbursement, of which $81,656 has been disbursed.

III APPLIED RESEARCH/SMALL FARMER TECHNOLOGY

Newly initiated project is first Nicaraguan applied research project to provide small farmer in Region V with varieties tested for their needs and conditions. Via contract with INTA with an approved first year budget of almost $100,000, 11 Matagalpa-based agriculture research technicians have been hired and 9 demonstration plots have been initiated.

Also the ROCAP-funded Small Farmer Production Systems Project with CATIE and the Chinese Nationals Agriculture Technical Mission assigned to INVIERNO are assisting in the implementation of the project.

$232,975 has been authorized by AID for reimbursements, of which $40,000 has been disbursed.

IV FAMILY GARDENS

Responding to the nutritional deficiencies as perceived by rural women, a pilot project with initial funding of $5,000 has been initiated in San Ramón, with 7 "clubes de amas de casa" with about 40 female participants. After providing them with detailed instructions from subjects such as transplanting tomatoes to organic fertilizers, these "first time" farmers have demonstrated well their experiences, and are readying themselves for their first harvest. A Peace Corps volunteer and Chinese Team technicians are providing supporting assistance.

$10,110 has been authorized by AID for reimbursement.

V LAND SALE GUARANTEE

INVIERNO, DIPSA and the Ministry of Agriculture have spent much time in reviewing the first drafts of the project's implementation document. The final document is to be received for Mission review by mid-July. INVIERNO will initiate a pilot phase

of this project in late August, and subsequent to a later evaluation from which necessary adjustments will be undertaken, full implementation will be undertaken.

VI COOPERATIVE DEVELOPMENT AND MARKETING

INVIERNO's initial cooperative development project was with the Jinotega Potato Growers Coop of 45 members which INVIERNO reorganized, and assisted in purchasing 115 tons of potato seed from Maine.

In Sébaco, a Horticulture Marketing Coop comprised of most of INVIERNO horticulture growers was organized. A refrigeration plant and storage facility have been installed. INVIERNO's consumer cooperative plan which will replace INVIERNO's activities related to input supply and marketing activities has been presented to USAID for review.

Pilot operation will be initiated in Matiguas and La Trinidad in September.

Project supportive TA from the Servicios Técnicos del Caribe have been chosen, and a contract will be signed in August.

$111,879 has been authorized by AID for reimbursement.

INVIERNO's marketing assistance program for their clients' harvest has been most successful. Serving as a clearing house/broker -- they have been able to get higher than INCEI price support prices for their basic grains production.

For example, 1976 price comparisons are noted:

	INCEI Prices	14% Average Loss Factor Charged by INCEI	INVIERNO Average Prices
Corn	₡45/qq	₡38/qq	₡44-50/qq
Beans	₡105/qq	₡97/qq	₡104/qq

Proof of clients' interest in INVIERNO marketing mechanism is that of 80,000 qq. of beans harvested, only 2,800 were sold via INCEI. The rest was through the INVIERNO system.

VII RURAL ROAD IMPROVEMENT AND FEEDER ROAD CONSTRUCTION

Equipment bids for road construction fleet have been opened and awards are soon to be made.

Project site locations have been identified and project construction will be initiated in September.

$881,000 has been authorized by AID for reimbursement.

VIII RURAL MUNICIPAL DEVELOPMENT

The implementation arrangement -- INVIERNO as financier and the Ministry of Government (MOG) as the provider of TA and training has been approved. The MOG has hired their new people and has provided training exposure in Brazil, Guatemala, Venezuela and Costa Rica.

The following projects have been presented and work is to begin soon: Matiguas - $40,000, market; Masaya - $150,000, slaughterhouse, and Ciudad Darío - $25,000, paving project.

$10,100 has been authorized by AID for reimbursement.

IX SMALL RURAL ENTERPRISE

During a 4 month pilot phase in Jinotega, 83 small business operations were approved for financing, totaling $107,000. The average loan was for $1,385 with none of the loans surpassing $3,500. Resulting from this successful initial phase of the project, the project has been expanded to La Trinidad, and by the end of 1977, will be functioning in all INVIERNO offices. A total authorization amount for $440,000 has been granted.

FUTURE 1977 ACTIVITIES

Conduct evaluative/analysis of agriculture credit program.

Initiate AgroMoc Training programs at CYMITT and CIAT.

Conduct joint Loan-required evaluation of 1977 operational year.

Conduct evaluation of INTA/INVIERNO applied research program - CATIE to assist.

Initiate case study INVIERNO Integrated Rural Development with TA/DR assistance.

Evaluate Family Garden Project.

Initiate Land Sale Guarantee Program.

Initiate Consumer Cooperative Project - "Tienda Campesina".

Contract supporting technical assistance team.

Initiate Rural Roads project.

TENTATIVE AGENDA

John Balis
AID Small Farmer Machinery Expert

August 3

5:40 p.m.	Arrival PAA Bathrick to meet. Give overview and discuss agenda.

August 4

8:00 a.m.	Visit with Rural Development Division
9:00 a.m.	Visit with Ing. Gustavo Gómez C., INVIERNO's General Manager
9:15 a.m.	Meet with Ings. Barea, Reyes, Cárdenas, et.al. to discuss:
	Ag activities and constraints by INVIERNO socios Discuss equipment and tools and cropping practices employed Review INVIERNO data regarding tractor studies, costs and improved INVIERNO plow
12:30 p.m.	Depart for Matagalpa
2:30 p.m.	Meet with INTA/INVIERNO team regarding production system and visit plots
	Spend night in Matagalpa

August 5

8:00 a.m.	Visit with Lic. René Martínez, Regional Manager and Lic. Roberto Martínez, CEDE Manager and discuss agriculture conditions Region V
8:30 a.m.	Meet with Chinese technicians to discuss use of small tractors
9:00 a.m.	Meet with Administrador Rural Personnel and discuss program
9:30 a.m.	Depart to visit Matiguas and INVIERNO communities enroute
	Return to Matagalpa in evening

August 6

7:30 a.m.	Leave Matagalpa for La Trinidad

8:15 a.m.	Meet with Lic. Dennis Medina, CEDE Manager
8:45 a.m.	Visit surrounding communities and return to Managua in afternoon
August 7	To be organized
August 8	
8:00 a m.	Depart for León to visit IMPLACASA to view INVIERNO designed plow
11:00 a.m.	Return to Managua
1:00 p.m.	Visit Lic. Mario Pfaeffle regarding proposed INVIERNO tractor rental plan
2:00 p.m.	Begin visit with local suppliers: John Deere, David Brown, International Harvester, et. al.
August 9	
8:00 a.m.	Meet with INTA, Dr. Oscar Hidalgo and Ing. Silvio Echeverría regarding project interest
10:00 a.m.	Meet with INVIERNO Working Group to review observations and recommendations
1:30 p.m.	Continue visiting suppliers
August 10	
8:00 a.m.	Begin drafting final report -- suggested points would include comments regarding: animal power, hand tools and mechanical power systems presently employed
	Recommendations regarding improved systems or alternatives
	Recommendations regarding INVIERNO's improved plow
	Recommendations regarding effective use to determine which type of mechanized system most appropriate given variable conditions
	Recommendations regarding implementation of appropriate farm machinery plows for INVIERNO
	Comments regarding specific INVIERNO points presented first day

August 11

9:00 a.m. Conclusion of various experiences presented to Ing. Gustavo Gomez, INVIERNO General Manager

August 12

9:00 a.m. Conclusion of various experiences presented to Art Mudge, Mission Director

Continue on Report

ANALYSIS OF FARM PRODUCTION PRACTISES

Present Production Practises -

Cultivated Conventionally - 35%
- seasonal tillage
- moderate weed control
- comparatively uniform crop stands.

Weedy - 35%
- excessive weed growth due to either delayed planting or poor weed control practises
- yellowing of crop and uneven stands.

Uncultivated - 30%
- areas of apparently equivalent quality soil to both of the above
- some problems of topography with evidence of water ponding and poor drainage.
- estimated production in weedy areas is 75% of production in the conventionally cultivated areas.
- production in conventionally cultivated areas is expected to benefit from deeper tillage, more timely tillage and better weed control. However, there is little data for undertaking such estimates.
- estimates of untilled areas vary considerably from locality to locality ranging from 20% to 50%.

Therefore--
If all areas could be brought to production level for conventional cultivation:

Conventional	.35	=	.35
	.75 x .35	=	.26
			.61

Improved	.35
	.35
	.30
	1.00

Increased production 49 unit or 164% of current production for region or area.

If the assumption is made that improvements in conventional practises were to enable increases in yields of an additional 10% through deeper plowing and better weed control, then the production potential is 110 units, increase is 59 units and improvement over current production is 180%.

INSTITUTO DE BIENESTAR CAMPESINO
I N V I E R N O

NUMERO DE PRESTAMOS Y AREA PROMEDIO FINANCIADA POR PRESTAMO SEGUN TAMAÑO DE FINCA POR CEDE

DATOS POSTRERA 1976 1/

CEDE / TAMAÑO	SAN RAMON			MATIGUAS			JINOTEGA			LA TRINIDAD			CONDEGA			T O T A L		
	SOCIO		Area	SOCIO		Area	SOCIO		Area	SOCIO		Area	SOCIO		Area	SOCIO		Area
	Total	%	Prom.	Total	%	Prom.	Total	%	Prom.	Total	%	Prom.	Total	%	Prom.	Total	%	Prom.
Menor 5	275	55	1.4	196	52	1.8	390	45	1.9	307	37	1.9	609	59	1.8	1,777	49	1.8
5 - 10	107	21	2.2	45	12	3.0	196	23	2.9	207	25	3.2	222	22	2.6	777	22	2.8
10 - 20	55	11	2.0	37	10	2.3	141	16	3.2	158	19	4.0	105	10	3.0	496	14	3.2
Mayor de 20	67	13	2.4	101	26	2.8	135	16	4.3	167	19	5.1	88	9	3.1	558	15	3.8
TOTAL CEDE	504	100	1.8	379	100	2.3	862	100	2.7	839	100	3.3	1,024	100	2.2	3,608	100	2.5

FUENTE: CENSO INVIERNO 1976. PyC.

1/: Incluye duplicaciones de socios.

FECHA : Noviembre 11, 1976.

APPENDIX "D"

APPENDIX "E"

ESTIMATION OF % OF TOTAL LAND AREA
UNDER COMMAND OF VARIOUS FARM SIZE
CATEGORIES

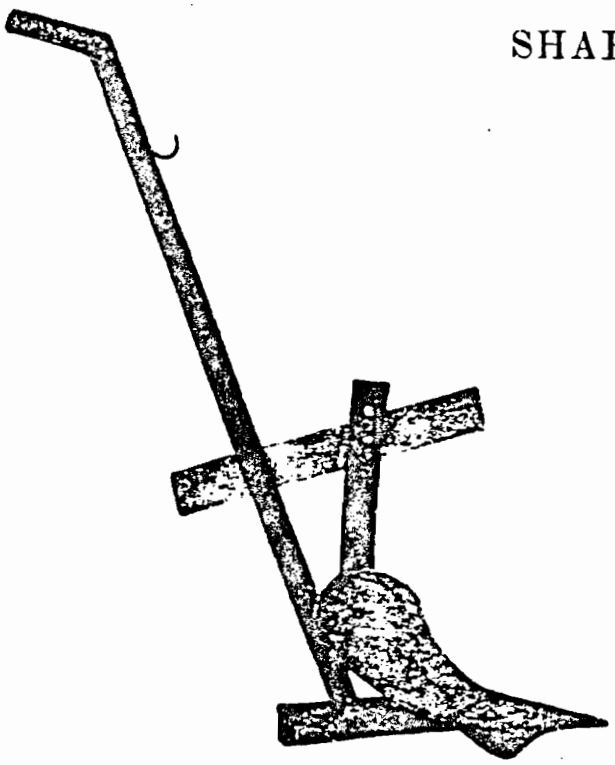
FARM SIZE CATEGORY (mz)	AVE CULT.* LAND AREA	NUMBERS*** IN FULL PROJECT
0-2	1.4**	5,500
2-5	2.2**	5,000
5-10	2.8	4,400
10-20	3.2	2,800
20+	3.8	3,200

* Taken from data of Appendix D.
** Estimated.
*** Estimated using constraint proportion of full project at 20,000 farming operations.

Total Area****	% of Area
7,700	15
11,000	21
12,320	24
8,960	17
12,160	23
52,190	100

**** Product of columns 2 and 3 above.

SHABASH PLOUGH



India's most popular and largest selling, SHABASH plough is a small, cheap and single purpose mould-board plough. Easily operated by a pair of medium size bullocks, it makes a 6" furrow to the depth of 4" to 5."

It can plough 3/4 of an acre in a 10-hour working day and thus can easily manage annually about 10 to 12 acres. It gives an excellent performance on wet land and light soils. It also turns under weeds, trash and stubble and is used for ploughing fallow land to keep weeds under control.

Among its inimitable qualities are :

- Sturdy all-steel body
- Light weight
- Hard-wearing, high carbon steel share
- Generous throat clearance
- Light draft
- Conveniently placed handle

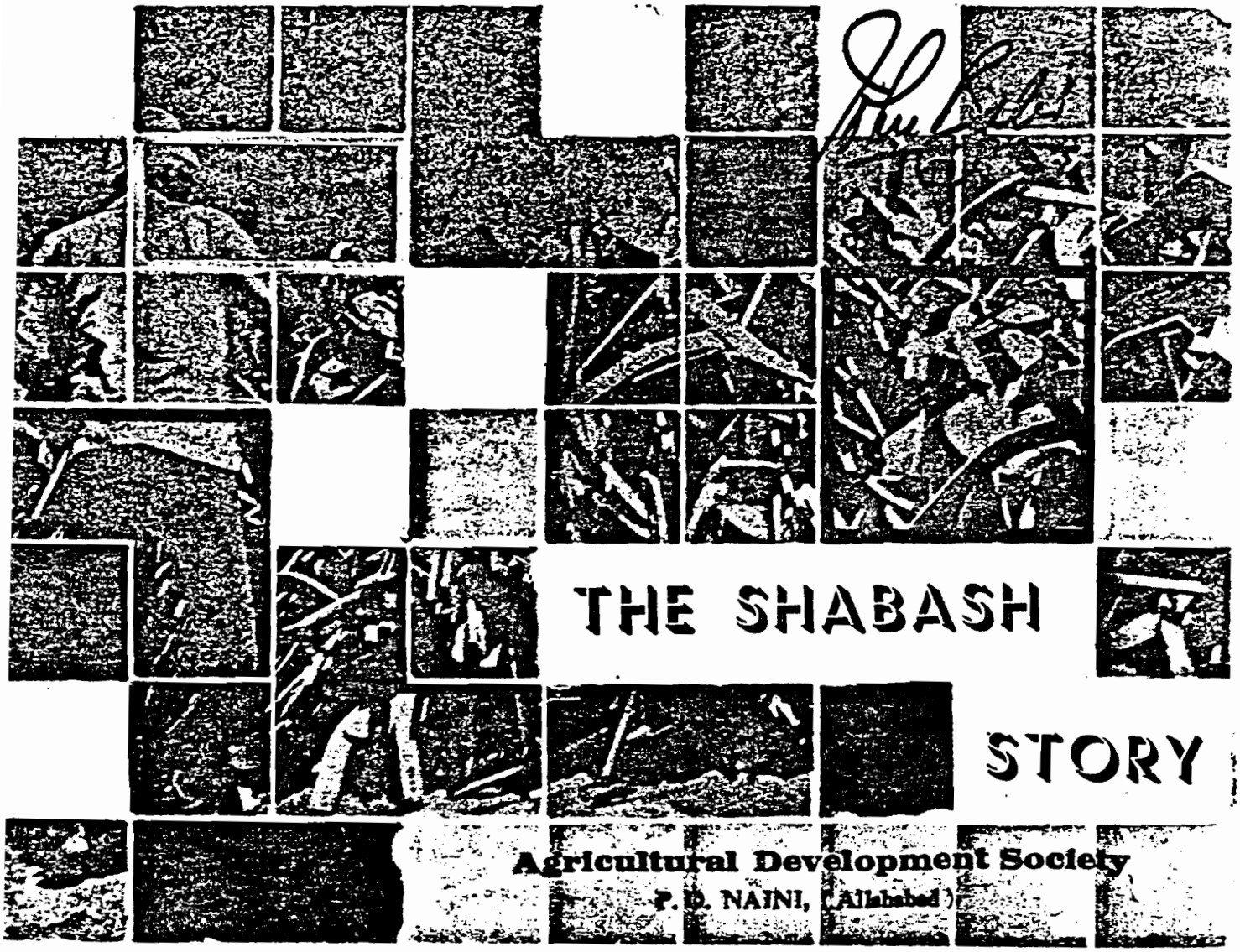
It is accompanied by a free spanner.

SHABASH plough is also available with left hand mould board, at no extra cost.

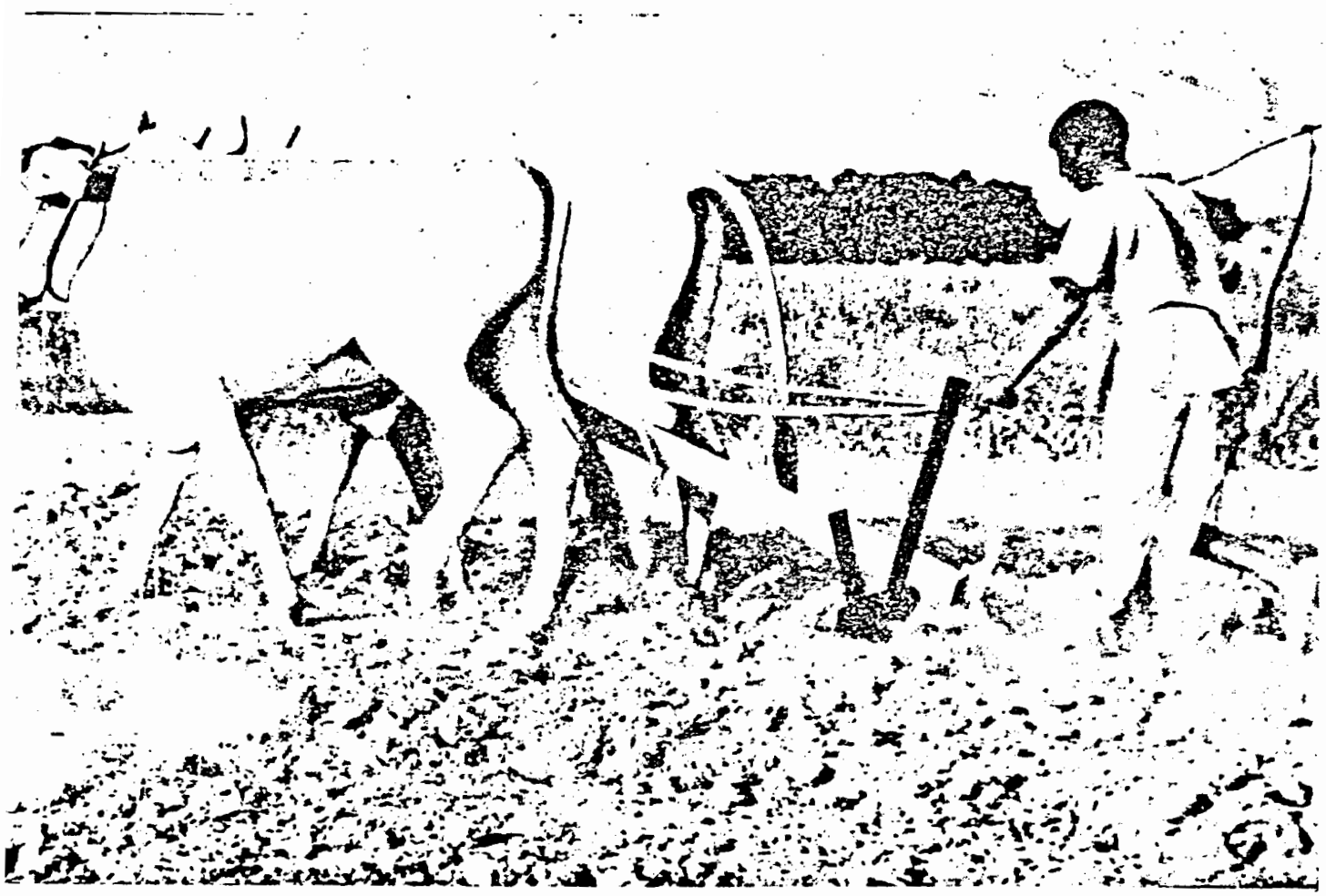
INDIAN FARM EQUIPMENTS

P. O. NAINI ALLAHABAD

APPENDIX "F"


THE SHABASH
STORY
Agricultural Development Society
P. O. NAINI, (Allahabad)

APPENDIX "F"



SHABASH PLOUGH IN THE FIELD

.. ... Star performer of Indian farms

Good ploughing is also aimed at preventing and destroying the competitive weeds and other unwanted vegetation, as well as insects, their eggs, larvae and breeding places. It leaves the soil in such a condition that air circulates freely and it retains moisture from rain and leaves the surface in a condition to prevent erosion by winds.

On India's notoriously low-yielding farms, the peasants' lot for generations has been one of hard work and low returns. One of the important reasons for more toil and less productivity is the use of out-dated, primitive and inefficient implements. Increasing farm output is, therefore, inconceivable without an improved plough.

As early as the 1920s, Mason Vaugh, an American missionary, realised that improvement in tillage implements cannot wait for the tractors to arrive. Using his talents as an agricultural engineer, he designed a bullock-drawn plough that was efficient, hard-wearing as well as within the reach of an ordinary farmer. This was "Shabash" plough—the star performer of the Indian farms.

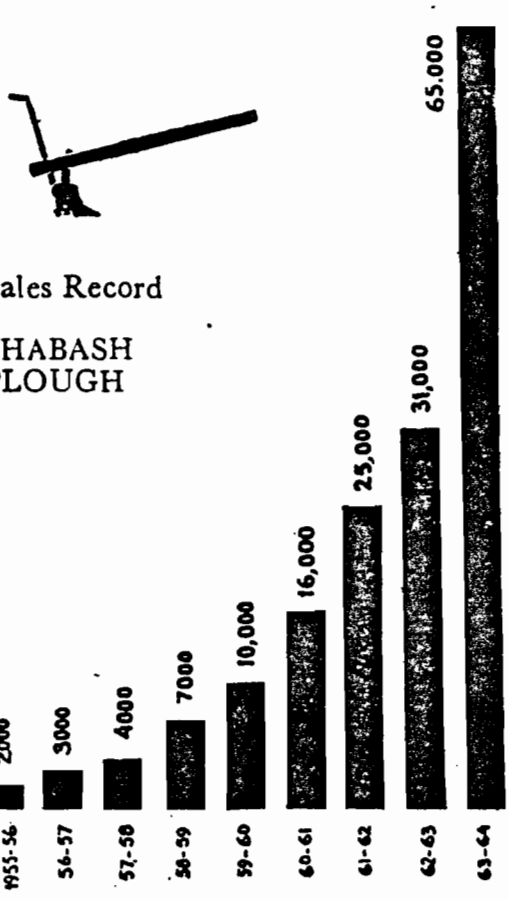
"Shabash" plough has distinct advantages over the *deshi* (indigenous) plough. Being a mould board plough, it cuts the soil smoothly and inverts it to cover vegetation; soil gets better aeriation and absorbs maximum moisture. In India the optimum ploughing season is very short, sometimes not more than ten days. Every year, during this brief but vital period, the farmer has to run a race with the time, and has to marshal all his resources—of men and animals. With a *deshi* plough he has to make six to eight trips of his tiny field to prepare a good seed bed. With a Shabash plough, he can achieve this in a single trip. Thus by reducing the operation time considerably, Shabash plough makes a signal contribution to the timeliness of operation.

In 1954, the Agricultural Development Society was founded, with high ideals of serving the Indian farmers through the improved agricultural implements. One of the first items to come out of the ADS implements' factory was Shabash plough. And ever since it made its debut on the Indian farm, Shabash has remained the firm favourite of the farmer. This remarkable vote of confidence of the farmers has been won by its inimitable qualities—

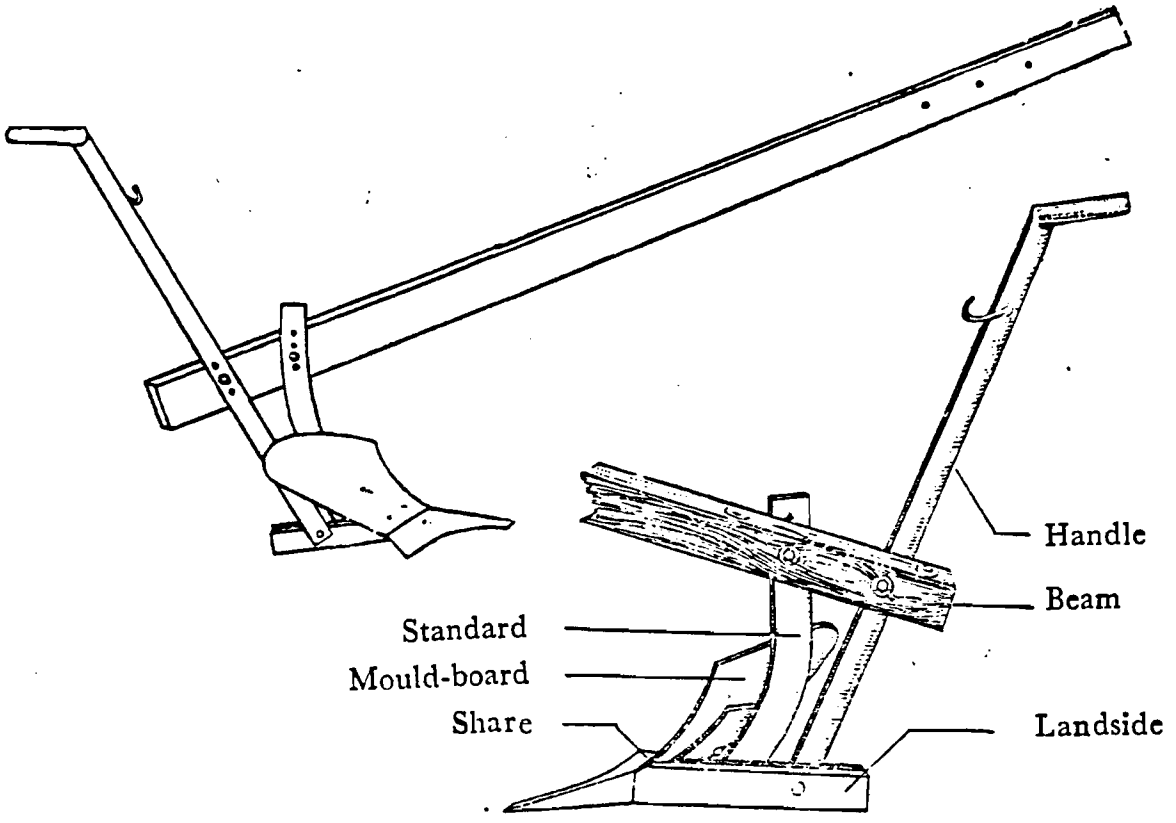
in design, material, construction and performance, and is reflected in the sharp and steady rise in its sale year after year (*see graph*). Its rugged construction, low maintenance cost and long life are the trusty guarantees that farmers value.

Shabash plough is pre-eminent in design and construction. It is the outcome of years of development on the farms, engineering experience and expert craftsmanship. Its design flows from strict utilitarian logic.

Shabash plough's job-tested design ensures long trouble-free service. It is built on principles of lasting validity–quality, true craftsmanship and advanced production techniques.



SHARP RISE IN SALE
.....Farmers' vote of confidence



PARTS OF SHABASH PLOUGH
.....Strict utilitarian logic

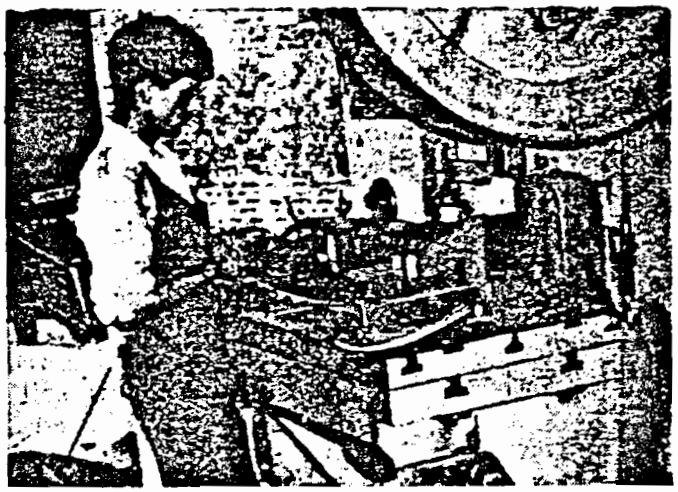
The share of the Shabash plough forged from high-carbon steel, by "drop-forge" process, penetrates the soil deeper, faster and thorougher—features rarely found in another plough. Shabash is the first—and the only—bullock-drawn plough in the country to have this super-strong share.

Specially designed to survive many years of hard services, the share can be sharpened by a village blacksmith. All other parts–except the wooden beam—are made of mild-steel to ensure low cost, light weight as well as durability. The mould-board is designed to turn the optimum quantity of soil, without excess soil pulverisation. The depth of ploughing can be adjusted between 4" to 6". The sturdy handle is conveniently located for guiding the plough. The long beam is made from good quality *sal* wood.

The entire Shabash plough weighs just 15 kilograms (approximately 33 lbs.) while the steel parts weigh only 8.50 kilograms (approximately 19 lbs.). With a Shabash plough a pair of medium-sized bullocks can comfortably plough 3/4 of an acre in a ten-hour working day. Thus Shabash can manage about 10 to 12 acres of ploughitng annually. Shabash ploughs are also available with left hand mould-boards to cater to the special needs of some areas such as Rajasthan. These are some of the specialities that farmers salute.

36V671

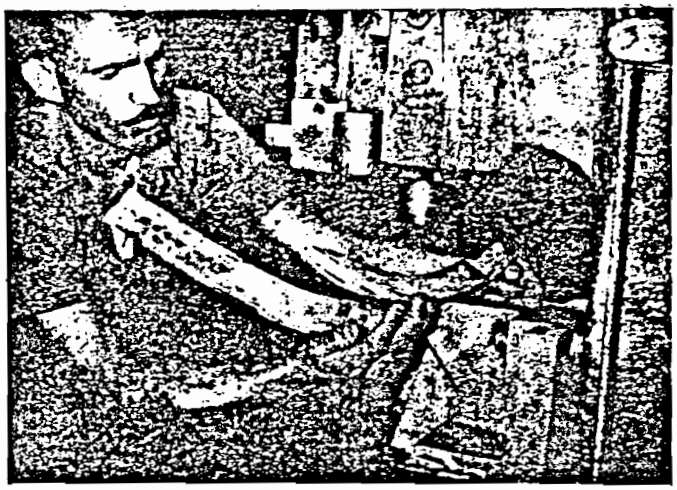
Shares are forged by Drop-Forge Hammer



Mould-boards are pressed in modern presses

In the modern ADS factory, giant "Drop-Forge Hammer" forges inimitable high-carbon steel shares. Mould-boards are moulded in the modern presses to uniform size and shape.

"Frog" and Landside are electrically welded



Mechanical rivetting ensures uniform rigidity

"Frog" and landside-the backbone of a plough-are electrically welded to ensure extra strength and light weight. Holes are punched and rivets are slotted into them by mechanical operation, and this ensures uniform rigidity of all Shabash ploughs.

In the modern ADS factory the multiple skill of over a hundred workers produce thousands of Shabash ploughs every month. Deft hands take meticulous care in the manufacturing process. Ploughs coming out of the assembly-line are subjected to exacting inspection standards to ensure high, uniform quality.

And what comes out of the assembly-line is only the beginning. The real story starts on the farm. Today on India's far-flung farms more and more happy farmer families are talking of—and buying—Shabash ploughs. This

SHABASH PLOUGH
BEING INSPECTED
...Exacting standards of excellence

READY FOR DESPATCH
.....Only the begining

remarkable plough today serves in thousands of Indian farms. Tested by Departments of Agriculture of several States, it has withstood the toughest tests. It outperforms other ploughs many times over and every acre they plough accentuates the difference.

Shabash is a sound investment. It takes drudgery out of the farming and does the job most dependably at the lowest cost. It pulls easier and is conducive to harder work for longer hours. Therefore, once idle acres can now be ploughed by Shabash. The farmer gets more ploughing capacity for his money.

For handling the bolts and nuts of Shabash plough, a spanner is required and most Indian farmers do not have one handy. In order to obviate the farmers' difficulty, every Shabash plough is now accompanied by a free spanner-one of the many pleasant surprises in store for a Shabash buyer.

Little wonder, therefore, that every day hundreds of thousands of discriminating farmers start their good mornings with a Shabash plough–a name that means high quality at a low price that is within the reach of the farmer.

SECOND
REVISED
IMPRESSION

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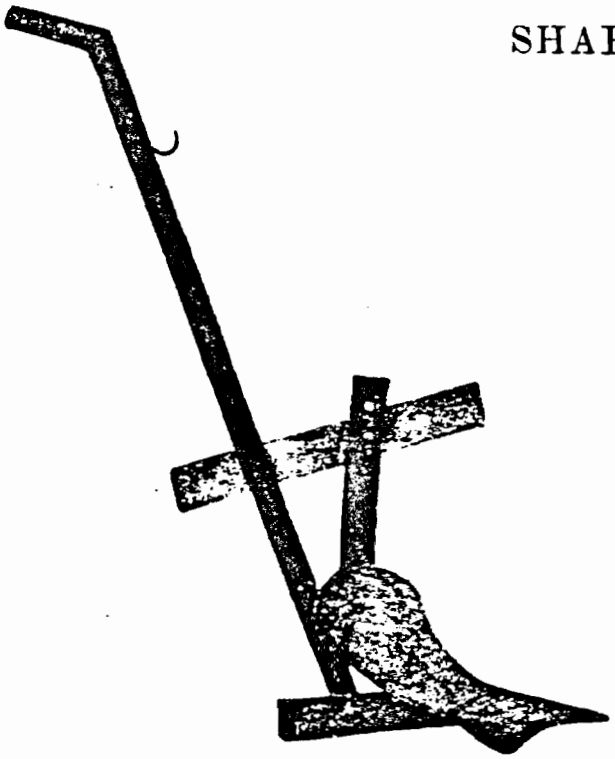
SHABASH PLOUGH



India's most popular and largest selling, SHABASH plough is a small, cheap and single purpose mould-board plough. Easily operated by a pair of medium size bullocks, it makes a 6" furrow to the depth of 4" to 5."

It can plough 3/4 of an acre in a 10-hour working day and thus can easily manage annually about 10 to 12 acres. It gives an excellent performance on wet land and light soils. It also turns under weeds, trash and stubble and is used for ploughing fallow land to keep weeds under control.

Among its inimitable qualities are :

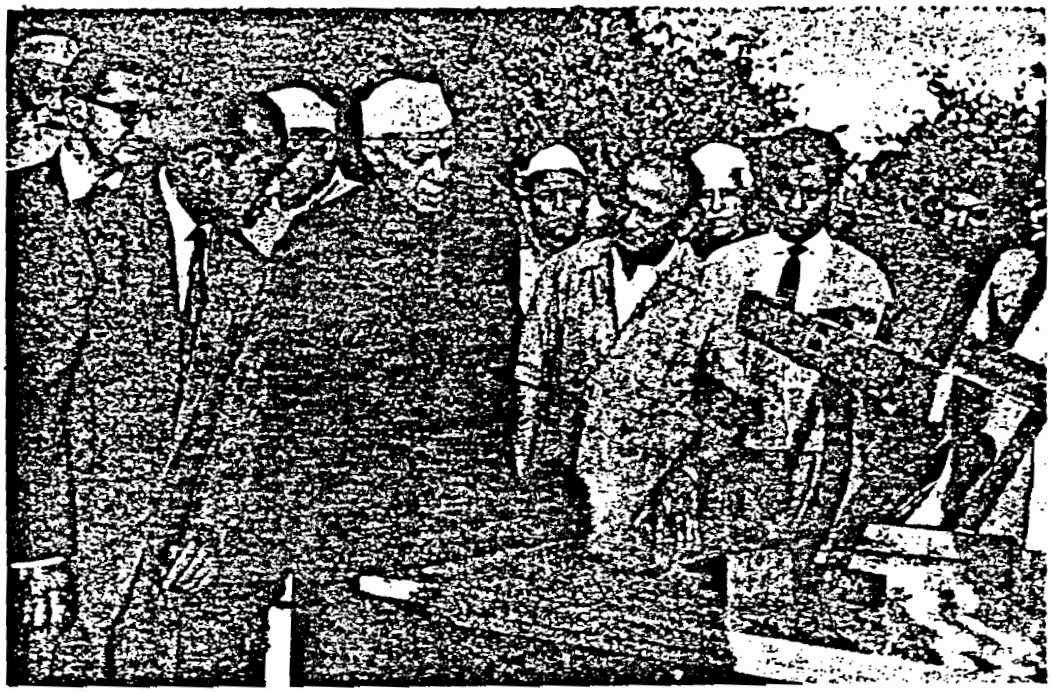
- Sturdy all-steel body
- Light weight
- Hard-wearing, high carbon steel share
- Generous throat clearance
- Light draft
- Conveniently placed handle

It is accompanied by a free spanner.

SHABASH plough is also available with left hand mould board, at no extra cost.

INDIAN FARM EQUIPMENTS

P. O. NAINI ALLAHABAD



NEHRU WITH SHABASH PLOUGH

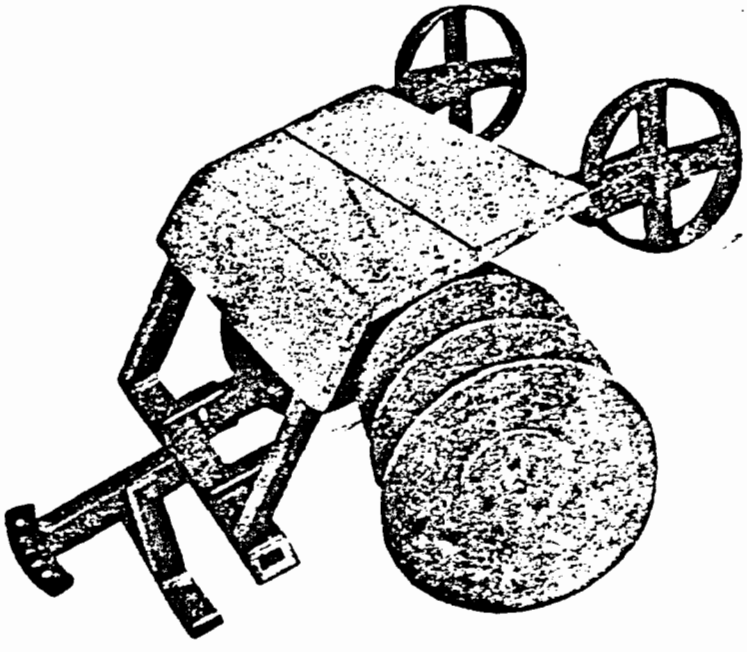
...Soaring popularity

"What kind of plough is used in agriculture is the basic test of our progress. If the old plough continues to be used, it is a defeat, a hundred percent defeat, no matter how one explains it. A society changes as a result of the method of production.....The Indian farmer will change not because of the fertilizer he uses, but because of the plough he uses. You can not expect any thing of the person who is using a plough which is a thousand years old. It amazes me that even after 12 years of Independence, there should be millions of those old ploughs in India. Even at some loss I should make a bonfire of them; just to induce the people to feel that it means discontinuance of old things."

—Jawaharlal Nehru

Maya Press Private Ltd. Allahabad.

"BIJLI" DISC HARROW



This new disc harrow is rugged in construction, simple in operation and utilitarian in design, with easy adjustments and minimum wear and tear. A pair of medium size bullocks can easily pull it. It levels the ground evenly and makes a deep seed bed at a fast rate. In a 10-hour working day it harrows about 3-4 acres of land with 2"-4" depth by double discing, depending upon the type of soil conditions.

It has six steel discs, each 16" in diameter and 5 mm. thick, arranged in two bumper type gangs mounted on a tool bar by just two bolts.

It has a wooden, platform-type seat which is placed very low to prevent overturning. Its transport wheels are fixed at the back of the platform. For transportation, it is turned over.

Its special features are:

▷ Light draft, uniform harrowing and even depth, ensured by deliberately eliminating the shovels between gangs.

Two big oil impregnated, dust protected, enclosed wooden bearings with oil holes. When worn out, these wooden bearings are cheaply replacable.

▷ Depth adjustments for shallow, medium and deep settings.

▷ Adjustable wooden beam to fit to all sizes of bullocks.

▷ Shims provided in the bearings to adjust periodically, the wear in the bearing by taking out one or two strips at a time.

INDIAN FARM EQUIPMENTS

P. O. NAINI ALLAHABAD

APPENDIX "H"

SELECTED BULLOCK DRAWN

TILLAGE IMPLEMENTS

BY

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1971

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Selected Bullock Drawn

TILLAGE IMPLEMENTS

Methods of tilling the soil before planting a crop (seedbed preparation) will vary somewhat with soil type and field conditions, wind and water erosion problems, cropping pattern, and available time.

Tillage is far from being an exact science, and a definite set of specifications cannot be established. In general, the purposes of tillage are as follows:

1. To control weeds. This is by far the most important reason for soil tillage.
2. To develop a granular or crumbly soil structure which allows infiltration and retention of moisture, adequate air circulation, rapid germination of seed, and free root development.
3. To dispose of surface crop residue and trash. While leaving residue on or near the surface can reduce wind and water erosion, complete coverage is often necessary to control certain insects or to prevent interference with planting and inter-cultivation operations.
4. To incorporate and mix manure or chemical fertilizers into the soil.

Numerous tillage implements are being manufactured in India. Some of them are designed to operate in the sandy loam soils of north India and are of little value in soils containing clay. Many are of such poor design and quality that the farmer who purchases them is indeed unfortunate ! However, some useful implements are available suitable for general use in Andhra Pradesh.

Implements discussed in this publication have been selected from those available in the country and are considered to be practical implements of reasonably good design and quality. They have been tested throughout Andhra Pradesh and have been found to perform well on light and medium soils. They are also satisfactory on the heavy soils provided moisture content is such that the soils crumble when tilled. There is a much narrower range of moisture content for proper tillage of heavy soils than for lighter soils, and therefore more difficulty in preparing them for planting.

This publication deals only with tillage implements for rainfed and light irrigated crops. However, puddling of soil for rice production is also considered in the "Disk Harrow" section.

THE VICTORY PLOW

A deep, well-pulverized seedbed is the basis for high yielding crop production. The moldboard plow is used throughout the world as the basic primary tillage implement because of its ability to invert and pulverize the soil. Through this action, soil is loosened to allow free root development and penetration; weeds, grasses, and crop residues are buried; rainfall is absorbed and retained ; and certain insects and disease organisms are destroyed.

The victory plow is a short-beam (chain hitch) moldboard plow which cuts a furrow slice about nine inches wide and from four to seven inches deep, depending on adjustments made. It is patterned after the "Ransom" plow from England.

Fig. 1. The moldboard plow cuts, lifts, inverts, and pulverizes the soil.

Parts of the Victory Plow

The victory plow consists of three major units:

The handles

Handles are bolted to the beam and are used to guide the plow.

The bottom

The bottom is made up of the *plowshare* which acts as a wedge to cut through the soil; the *moldboard*, which turns, inverts, and pulverizes the soil; and the *landside*, which transmits side pressures, caused by the action of the share and moldboard, to the furrow wall. These three parts are bolted to the *frog*, which, in turn, bolts to the beam.

The beam

The beam transmits the pull from the bullocks to the plow bottom. The *hake*, *regulating bar and clamp*, and *draft rod and ring* are attached to the beam to allow vertical and horizontal hitch adjustments. The *gage wheel* also attaches to the beam when used.

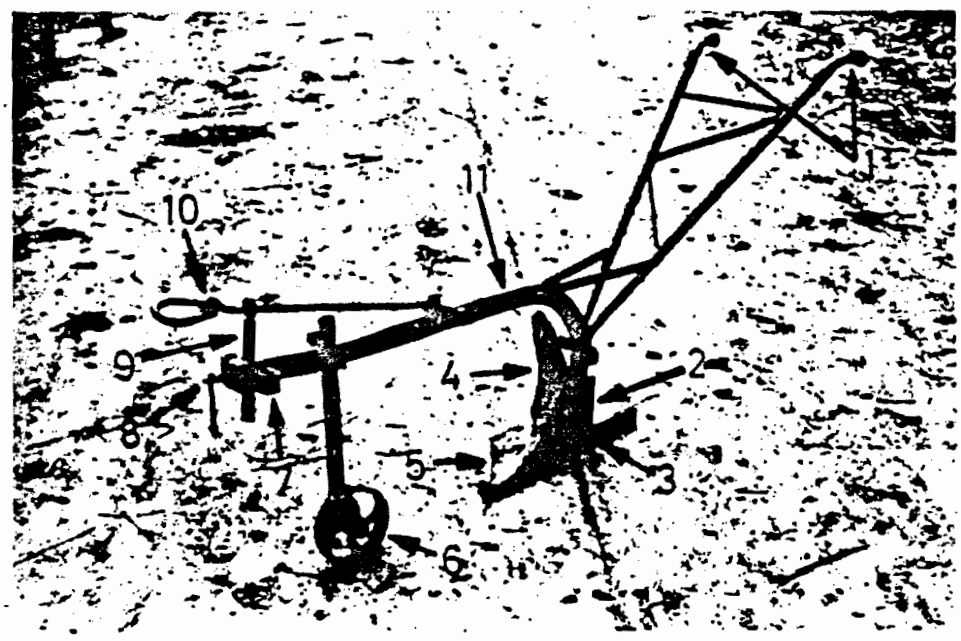


Fig. 2. Parts of the victory plow: 1. handles 2. frog 3. landside 4. moldboard 5. plowshare 6. gage wheel 7. hake 8. clamp 9. regulating bar 10. draft rod and ring 11. beam.

Plow Adjustments

To allow the victory plow to penetrate to the desired depth and take the proper width of cut, two adjustments are provided on the plow hitch. Both adjustments are made by shifting the position of the regulating bar in the hake.

Vertical hitch adjustment

Regardless of the position of the regulating bar, the line of draft on a moldboard plow is always in a straight line from a point about two inches in from the landside where the moldboard and share meet (known as the *center of pull*), through the hitch and chain, to the bullock yoke (Fig. 3).

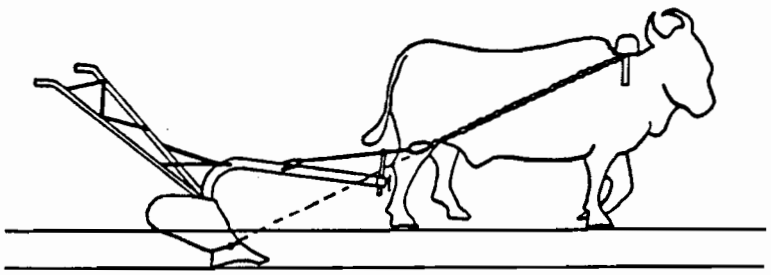


Fig. 3. The line of draft is always in a straight line from the center of pull, through the hitch, to the bullock yoke. The regulating bar is raised or lowered to obtain the correct vertical hitch.

Therefore, if the regulating bar is set too high in the hake the front of the plow beam will be forced down, which causes the share point to be "nosed down", draft will be high, and soil will not slide off the moldboard.

If the regulating bar is adjusted too low (raising the front of the beam), the plow may not enter the soil or very shallow plowing will result.

To properly adjust the vertical hitch, set the plow at operating depth, then raise or lower the regulating bar in the hake so the heel of the landside clears the bottom of the furrow by about 1½ inches.

After this initial adjustment, the chain can be shortened slightly (which raises the front of the beam) to reduce depth of plowing, or lengthened slightly to increase plowing depth.

In practice, vertical hitch adjustment is generally made on a trial and error basis. The plow can be operated without the regulating bar and draft rod by attaching the hitch chain directly to the hake. However, the chain will be rather long, which may cause the operator some difficulty in controlling the bullocks.

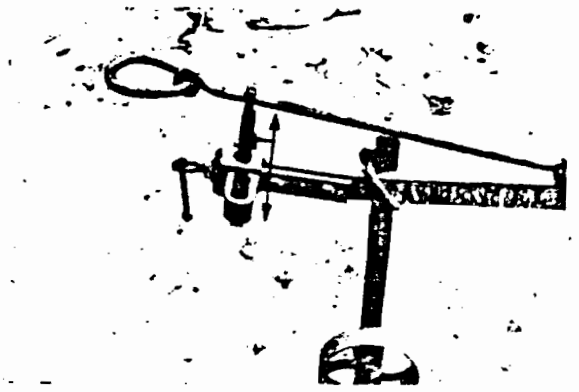


Fig. 4. The regulating bar is raised or lowered for proper vertical hitch adjustment.

Since the pull from the bullock yoke is transmitted to the plow by means of a chain or rope, a slight push forward (not down) on the handles will cause the plow to increase its depth. This is helpful when soil or moisture conditions of the field varies.

Horizontal hitch adjustment

By adjusting the regulating bar horizontally, the proper width of cut can be maintained with little effort on the part of the operator.

Fig. 5. The regulating bar is shifted to the left or the right in the hake to decrease or increase the width of cut.

The regulating bar is moved to the left in the hake to decrease the width of cut, and to the right to increase the width of cut.

Field Operation

Ordinarily, only one plowing with a victory plow, followed by harrowing, is required for seedbed preparation, as compared to four to eight plowings with the desi plow. This provides a considerable savings in time and labor, which is especially impor-

tant in multiple-cropping systems. One acre can be plowed in about ten hours with the victory plow.

The victory plow can be drawn by an average pair of bullocks on light or medium soils ; on heavy soils large bullocks will be required.

To eliminate a number of dead furrows and to save time, the plow should travel completely around the field finishing the job in the center (gathering method), rather than making many narrow strips ("kondras") as is commonly done with the desi plow.

Although two handles are provided on the plow, the operator generally uses his left hand (on the right plow handle) to guide the plow and his right hand for driving the bullocks.

The victory plow is sufficiently heavy to penetrate easily in most soils when moisture conditions are satisfactory. However, weight can be added if necessary when plowing sod or very heavy soils. To add weight, a rock or a bag of sand can be tied between the handles and the beam (weight should be directly over the plow bottom).

A gage wheel is supplied with the victory plow. It is seldom useful in the field and should be removed for best results.

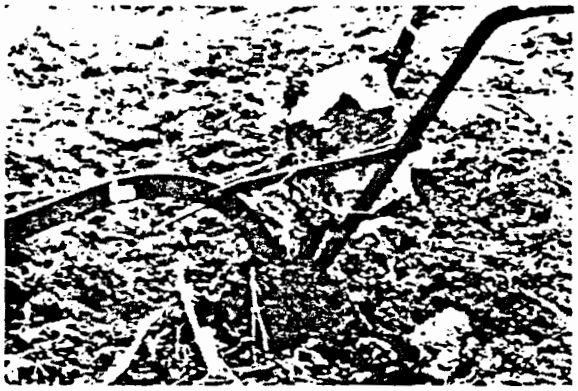


Fig. 6. When plowing under adverse soil conditions, weight may be added to improve penetration.

Plowing more than six inches deep is generally not beneficial unless it shatters a hardpan, a thin impervious layer of fine soil particles at plow sole depth.

To do a good job of plowing, soil moisture must be adequate, the plowshare must be kept sharp, the polish must be maintained on the moldboard, and the plow must be adjusted properly.

Soil Moisture Requirements

Soil moisture condition at plowing time is an extremely important factor with regard to draft as well as quality of work.

If the soil is too dry, the plow may not penetrate or will turn up large clods of earth. A dry soil causes excessive draft and accelerates wear of plowshare edges.

When soil is too wet, there may again be difficulty in penetration, the plow will probably not scour (soil will not slide off the moldboard), and if the soil contains clay it will not crumble when inverted, but will turn up large slabs of earth.

If a soil containing clay is saturated with water and allowed to dry, it passes through the following conditions: sticky, plastic, crumbly, and hard (cemented). The crumbly stage is the ideal condition for plowing, and all other tillage operations as well. Lighter soils may come to the crumbly condition within a few days after rain or irrigation, whereas heavy clay soils may require 7 to 10 days or more.

Plowshare

The plowshare slices through the soil and thus receives more wear than any other part of the plow. When one acre is plowed to a depth of six inches, nearly 650 tons (650,000 kg.) of soil is sliced, lifted and inverted in about 10 miles of travel.

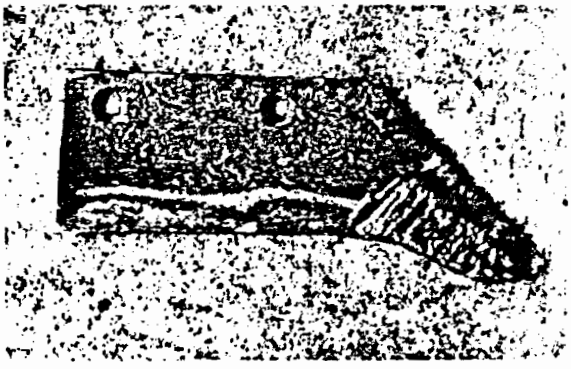


Fig. 7. Hardsurfacing materials are applied to the plowshare point on the top side.

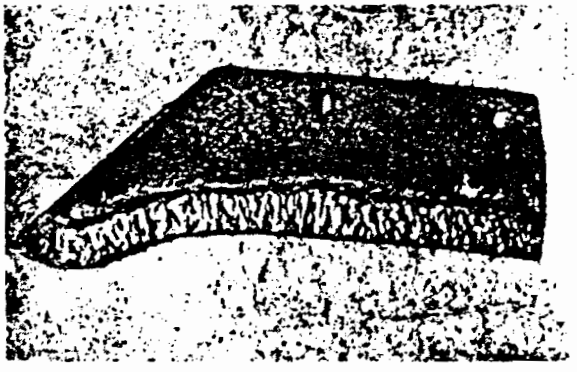


Fig. 8. The entire length of the cutting edge of the plowshare is hardsurfaced on the bottom side.

Shares on bullock drawn plows are generally worn out completely and discarded rather than being sharpened, even though a dull share increases draft.

Several shares should be kept on hand for replacements. Shares can be made by local blacksmiths if a new factory-made share is provided for a pattern. The original shape must be maintained or the plow will not operate properly in the field.

Life of plowshares can be greatly increased at little expense by having a weldor apply a thin layer of very hard metal on the cutting edge and point of the share with an arc welder (Figs. 7 and 8). This treatment is known as "hardsurfacing" or "hardfacing". A special electrode, such as Advani-Oerlicon Superesist or Cemarc Hardweld 550, is used in this process.

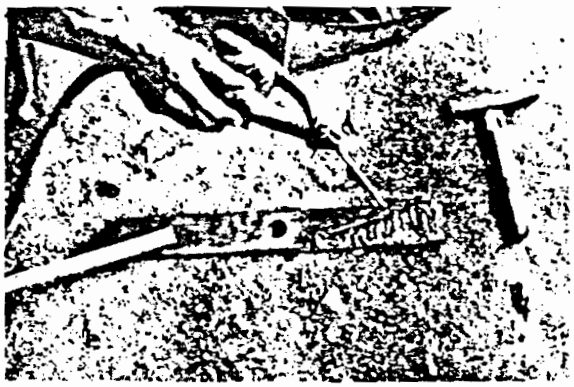


Fig. 9. The face and bottom edge of the landside should be hardsurfaced as shown.

The face and bottom edge of the landside can also be hardsurfaced to prevent wear.

Hardsurfacing applied on the moldboard is generally not recommended as it often causes scouring difficulties.

Maintenance

The major expense of using a victory plow is in replacing plowshares. This expense is easily justified, as it is a waste of time and energy to attempt to use dull or worn out shares.

A worn out landside can be rebuilt to the original condition with an arc welder, fabricated by a local blacksmith, or purchased from the manufacturer. Moldboards should be replaced from factory stocks when worn out as exact curvatures must be maintained.

Fig 10. Checking alignment of the bottom. The share point should extend about two inches to the left of the beam.

Although the plow is strongly built, if the point hits a stone or stump the beam can become bent so that the entire bottom is out of alignment. Alignment can be checked by placing a straight-edge vertically on the left side of the beam down to the share point. The share point should extend about two inches to the left of the beam (Fig. 10) when alignment is correct. If the beam has been bent, a blacksmith can heat and bend the beam to its original position.

Storage

When storing the plow, the moldboard, landside, and share should be coated with grease or waste oil to prevent rusting. With this protection, soil will not stick to these parts when plowing is resumed, and life of the implement will be increased.

With proper care and maintenance, and occasional replacement of worn out parts, a victory plow will give satisfactory service for many years.

THE DISK HARROW

There are few farmers who would not profit by owning and using a disk harrow. It is used to good advantage before plowing to pulverize the soil surface and mix crop residues (or green manure) with the topsoil. Its major use, however, comes after plowing to pulverize clods, firm the seedbed, and prevent or destroy weeds.

One of the most satisfactory methods of preparing a seedbed is to disk, then plow, then disk again. In sandy soils, farmers sometimes prepare land for planting by disking alone.

The disk harrow discussed in this publication was developed at Allahabad Agricultural Institute, and is popular in parts of northern India.

Fig. 1. The disk harrow in operation. The operator can ride when extra depth and cutting action is required.

Parts of the Disk Harrow

Two basic units make up the disk harrow.

The gangs

There are two gangs of disks which throw soil in opposite directions. Each gang consists of three *disks* held six inches apart by *spacers* (spools). Cast iron *bumpers* counteract the opposing side-draft of the two gangs when the disk harrow is in operation. The entire gang is held together by a *gang bolt*. The *gang fork*, which attaches the gang to the tool bar, contains the wooden *bearing* and disk *scrapers*.

The frame

The frame, as a whole, includes the *transport wheels, operator's seat, tool bar, and quadrant* (for vertical hitch adjustment). The *foot rest* and *beam* attaches to the quadrant. Holes are provided in the tool bar for disk angle adjustment.

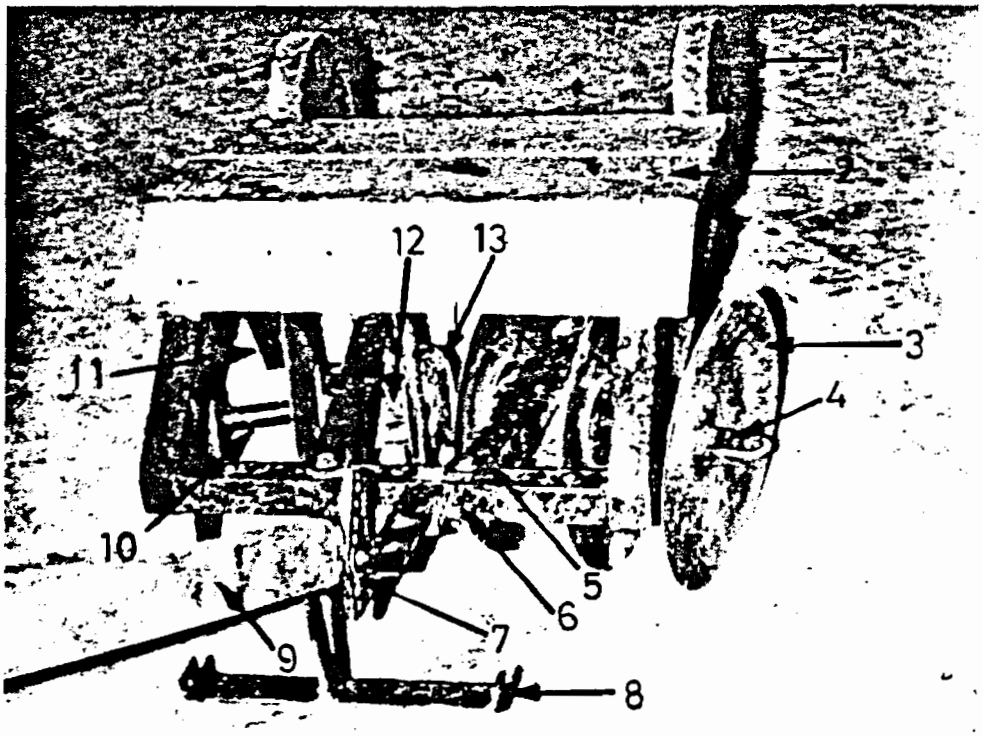


Fig. 2. Parts of the disk harrow 1. transport wheel 2. operator's seat 3. disk 4. gang bolt and nut 5. gang fork 6. tool bar 7. quadrant 8 foot rest 9. beam 10. spacer 11. scraper 12. bearing 13. bumper

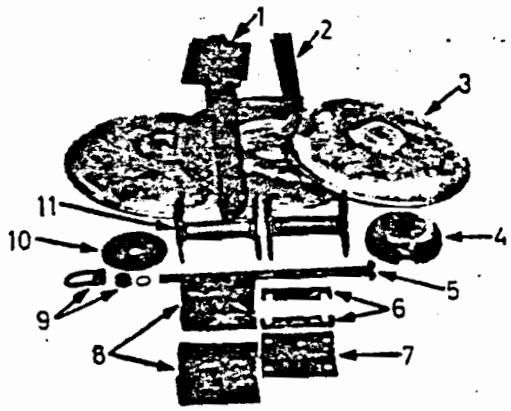


Fig. 3.
Disk gang parts. 1. bearing block & gang fork 2. scraper 3 disk 4. bumper 5. gang bolt 6. shims 7. bearing cover plate 8. wooden bearings 9. gang bolt nuts 10. gang washer 11. spacer (spool)

Disk Harrow Adjustments

Vertical Hitch

To do a good job, the disk harrow must penetrate evenly over its entire width. The hitch is adjustable vertically by changing the position of the wooden beam on the quadrant so that both gangs of the disk harrow are level during operation. As the quadrant bolt and beam are shifted to the upper holes, outer disks will penetrate deeper: in the lower holes, penetration of center disks increases. This adjustment is made with the beam attached to the bullock yoke.

If vertical hitch adjustment is incorrect the outer disks will not penetrate to the same depth as the center disks and it will not be possible to keep the surface of the field level. To some extent, lengthening or shortening the beam at the bullock yoke will change the vertical hitch.

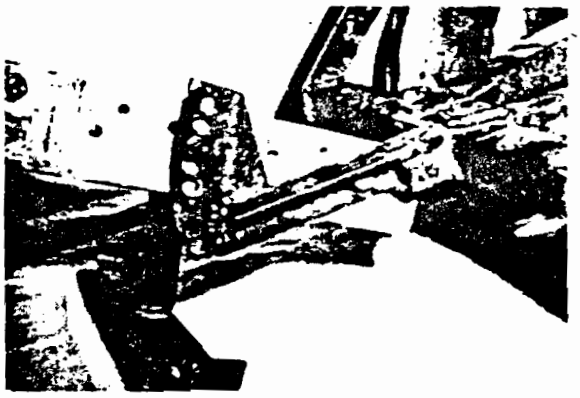


Fig. 4. By changing the position of the beam on the quadrant, all disks can be made to penetrate to the same depth.

Angle and weight adjustments

The degree of soil pulverization and depth of penetration is determined by the angle of the disk gangs, sharpness of the disks, and total weight applied to the disks.

The angle and weight necessary depends on soil moisture conditions and soil texture, and the amount of surface trash to be cut.

Ordinarily, disk gangs are kept at the maximum angle (23 degrees). However, the angle can be changed by moving each gang fork on the toolbar to any of the three holes provided (Fig. 5).

Both gang forks must be in the same relative position on the toolbar.

In general, the greater the angle of disk gangs, the more thoroughly soil is pulverized and the deeper the disks will penetrate.

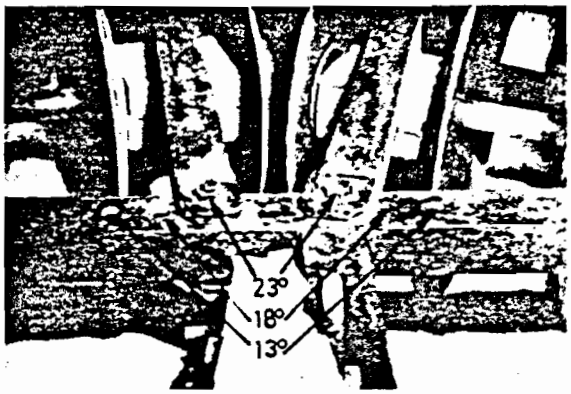


Fig. 5. Angle adjustment of the gangs is made by moving the gang forks on the tool bar.

When more depth and cutting action is required, the operator can ride on the disk harrow, as shown in Fig. 1, thus adding weight.

Field Operation

The bullock drawn disk harrow has two gangs of disks placed end to end which throw the soil in opposite directions. Because of this action, a single disking will leave the soil slightly ridged. Soil tilth can be improved and ridges can be eliminated by overlapping half the width of the disk harrow each pass (double disking).

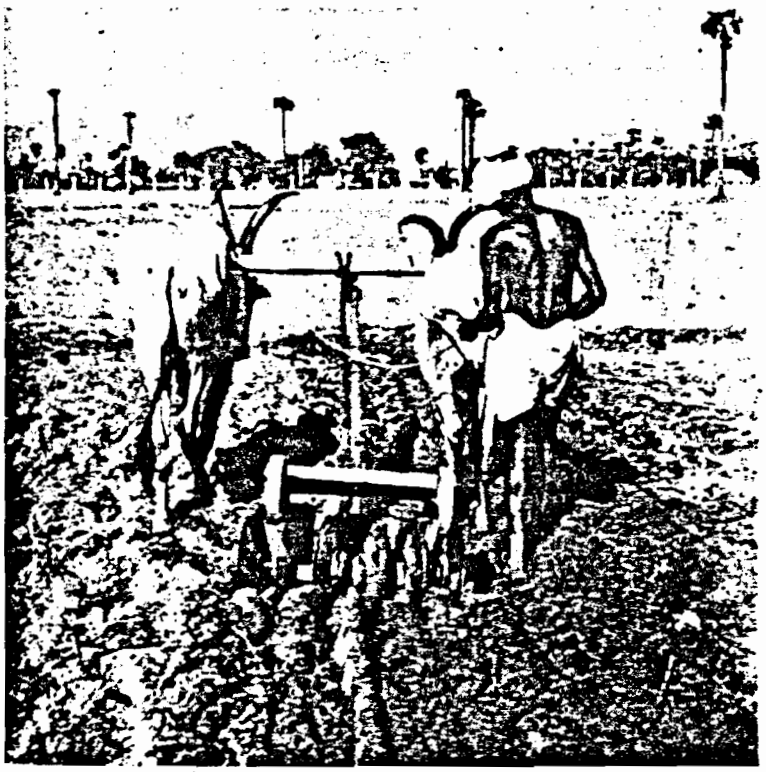


Fig. 6. Disking in land previously plowed with a moldboard plow. In sandy soil the operator need not ride on the disk harrow. Note that the disk farthest to the right is cutting the center strip left during the previous round (overlapping half the disk harrow width), leaving the field level.

The disk harrow should travel the same direction as the moldboard plow, going completely around the field and ending the operation in the center.

Disking should be done soon after plowing before clods become dry and hard, or when clods are in a crumbly condition a few days after a rain.

Puddling with the Disk Harrow

In rice production, the disk harrow can be used soon after flooding the field as a green manure trampler and puddler. No previous plowing is necessary. Disking the length of the field and then crosswise generally completes the puddling operation. Tests

Fig. 7 Puddling with the disk harrow. When small bullocks are used, two pairs will probably be required. If soils are such that bullocks sink deeply, it will not be possible to puddle with the disk harrow.

indicate that puddling can be completed in about one-fourth the time required by the desi plow.

If bullocks are small, two pairs will be required as draft is increased somewhat over disking dry soil. This operation is most successful on lighter types of soils. On heavy soils, draft increases and two pairs of bullocks will probably be necessary. If animals sink deeply into the mud, it will not be possible to use the disk harrow.

The field should be levelled with the local "jumbu" after puddling.

Transport

To transport the disk harrow, turn it over so that it rests on the transport wheels. It is not necessary to unhitch the bullocks to do this. When returning the disk harrow to the working position, it is well to remember that the disks can be damaged by dropping them on a hard surface.

Fig. 6. Disk harrow in transport position.

Maintenance

Disk bearings should be lubricated with motor oil at least twice a day while in operation. The disk harrow must be in the transport position to oil the bearings as the oil hole is found in the bearing cover plate. After considerable use, shims provided in the split wooden bearings can be removed to compensate for wear. Disk bearings can easily be replaced by a carpenter when worn out.

Transport wheels require an occasional oiling.

Bolts must be kept tight. If the nuts on the gang bolts are allowed to become loose, damage to the disks and gang bolts will result.

Although seldom necessary, cutting edges of the disks can be sharpened by grinding them on an emery wheel.

Storage

To prevent rust, apply a coating of grease or waste oil to the disks when the disk harrow is not in use. Thoroughly lubricate the bearings before storage.

Store the disk harrow in a dry place with the machine placed in the transport position.

THE SPIKE TOOTH HARROW

The spike tooth harrow, also known as a peg tooth or drag harrow, stirs the soil with short stiff pointed teeth. It is a finishing implement to use just before planting (after using the moldboard plow and disk harrow) as it thoroughly smooths and compacts the topsoil, fills up large air spaces, breaks up lumps and clods, and destroys small weeds. It is sometimes pulled directly behind the plow while the soil is still moist, eliminating the disk harrowing operation.

The spike tooth harrow is very effectively used after rains to break the soil crust and to destroy small weeds. It can be used to cover broadcast seeds, and with the teeth set lightly can be used for cultivating small plants such as maize, cotton, and jowar.

Soil moisture must be present for the spike tooth harrow to operate effectively. It is not useful for breaking clods after they have become dried and hard.

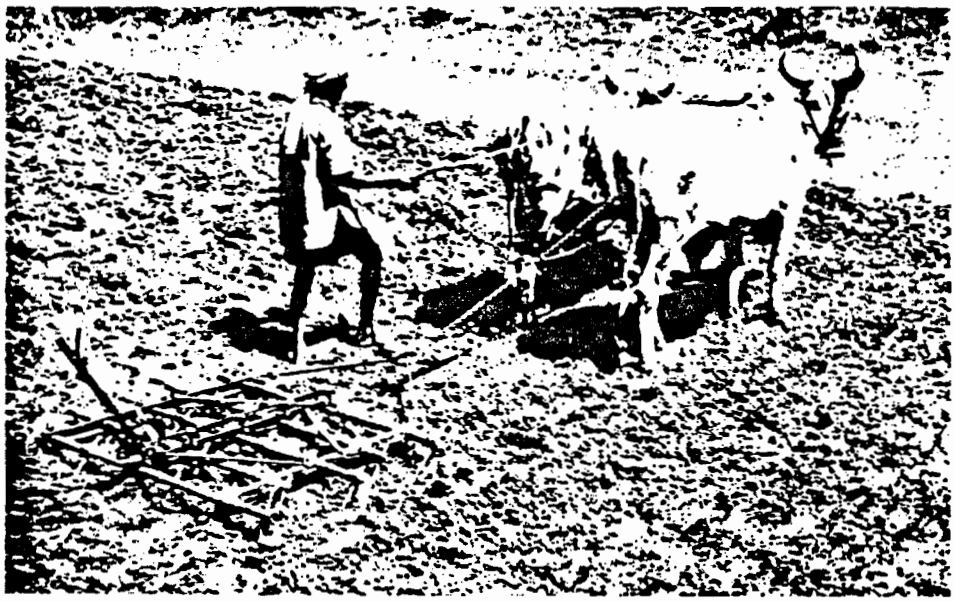


Fig. 1. The spike tooth harrow is used just before planting. Note the small angle given the teeth, and that the harrow is travelling crosswise to the direction of plowing.

Bullock drawn spike tooth harrows are available in three foot (18 teeth), four foot (25 teeth), and five foot (30 teeth) widths. Teeth are spaced and clamped on the five crossbars so as to cut two inches apart.

From three to six acres a day can be covered with a spike tooth harrow, depending on the size of the harrow and the strength of the bullocks. Small bullocks can easily pull the spike tooth harrow as draft is low.

Parts of the Spike Tooth

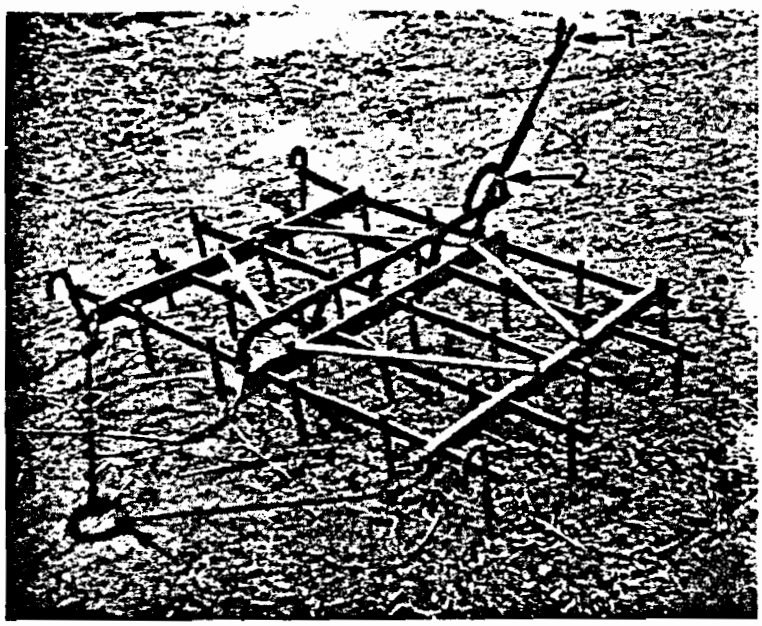


Fig. 2. Parts of the spike tooth harrow: 1. lever 2. lever quadrant 3. frame section 4. crossbar 5. spike (attached to crossbar with U bolt) 6. runner peg 7. hitch assembly

Field Operation

The spike tooth harrow is a simple implement to adjust and operate. Slant of the teeth, adjusted by means of a lever, is set for the degree of cultivation desired. Generally, the teeth are angled back somewhat, which gives a crushing and stirring effect and allows the teeth to clean themselves of trash. For breaking larger clods and smoothing rough surfaces, teeth may be set nearly vertical and weight may be added to the harrow (Fig. 3).

It is best to operate the spike tooth harrow crosswise or diagonally to the direction of plowing and disking to leave the field more nearly level.

Fig. 3. Weight can be added to the spike tooth harrow to increase its clod-crushing effect.

The length of the hitch chain or rope must be sufficient to allow the front teeth to penetrate to the same depth as the rear.

Maintenance

The teeth tend to be self-sharpening, and the only daily maintenance required is to see that bolts are kept tight.

When runner pegs become worn, they can be rebuilt with an arc welder. If hard-surfacing materials are applied (as on plowshares), life of runner pegs can be increased considerably.

Transportation

Four runners pegs (one on each corner of the harrow) are provided for transportation of the harrow to and from the field.

Tillage implements described in this publication are available from the following manufacturers:

Victory Plow: KARSHAK INDUSTRIES
18-7-664 Boiguda, Laldarwaza, Hyderabad 2

COSSUL & COMPANY
Industrial Area, Fazal Ganj,
Kanpur (U. P.)

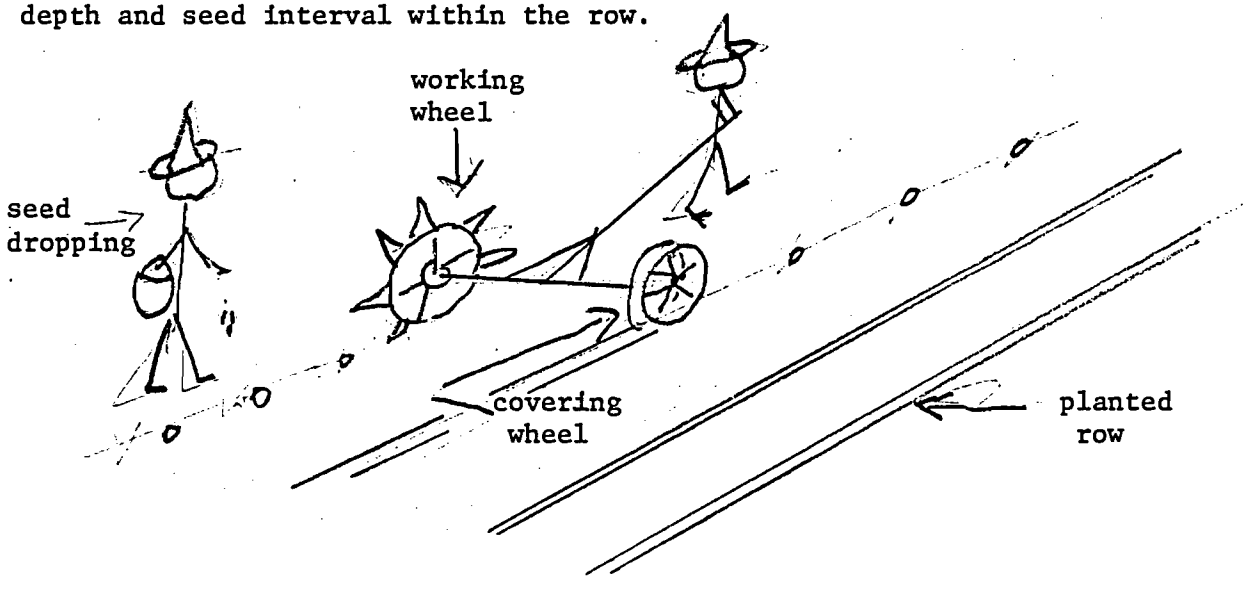
Disk Harrow: SWASTIK MANUFACTURERS LTD.
128, Mahatma Gandhi Road North,
Secunderabad-A.P.
(supplied with high carbon steel disks)

KARSHAK INDUSTRIES
18-7-664 Boiguda, Laldarwaza, Hyderabad 2
(supplied with hardsurfaced mild steel disks)

Spike Tooth Harrow: COSSUL & COMPANY
Industrial Area, Fazal Ganj
Kanpur (U. P.)

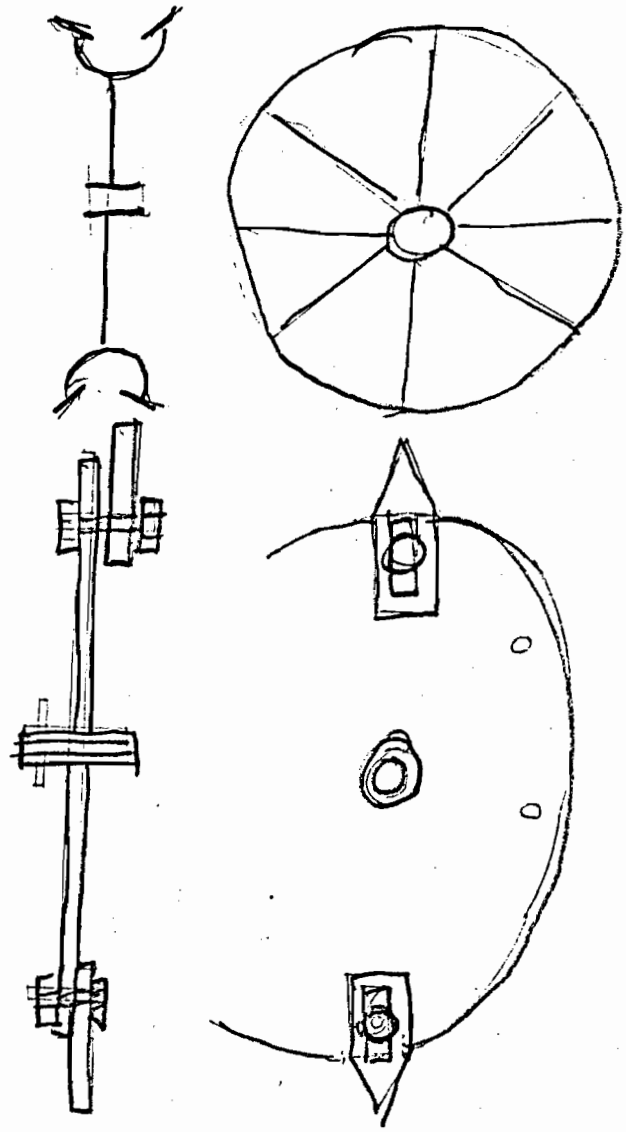
HAND PLANTING TECHNIQUE

The use of the disk harrow for secondary tillage will leave a level, uniform seedbed without furrows for seeding. A simple two-wheel device is suggested which would mark rows of uniform spacing, open the soil for seed placement, and press the soil over the planted seed. Planting with this device would require two persons, one to pull the row marker and the second to drop the seeds. The marker could be made with adjustments for row spacing, planting depth and seed interval within the row.



APPENDIX "I"

covering wheel

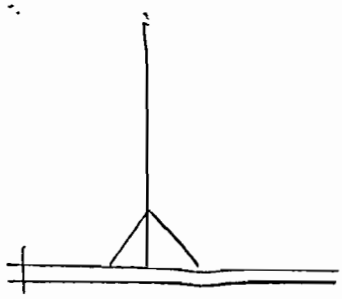


planting wheel

- number of hole farmers farmers and spacing according to requirements of crop
- depth also adjustable to crop
- machine could be made as one piece unit with fixed dimension for particular crop

frame

- axle drilled at intervals for changing of row interval.



APARTADO 2421

INSTITUTO DE BIENESTAR CAMPESINO

APPENDIX "J"

MEMORANDUM

A : Ing. Waldo Hooker
Director de PYC

De : Ing. Douglas Buschting
Director del PPA

Ref : Información para evaluar el proyecto de alquiler de maquinaria y Equipo

Fecha: Marzo 19, 1977

En relación a la solicitud que me pide en la forma IBC-No. 210 "Información para evaluar el proyecto de alquiler de Maquinaria y Equipo", me -- permito manifestarle que le hemos hecho algunas sugerencias de acuerdo a las normas que se usan en la evaluación de la maquinaria agrícola, especialmente tractores, hemos elaborado estimación en base a hora de uso -- debido a que los tractores marcan el trabajo en horas y en los cálculos de operación de los mismos hemos seguido los sistemas de la Organización de los Mercados de Maquinaria Agrícola (OCDE), internacionalmente aceptado y aplicado en el mercado de maquinaria agrícola de Nicaragua.

Para aclarar dudas le incluyo un instructivo para calcular dichos costos y un ejemplo, lo mismo que un cuadro sobre las diversas marcas y modelo con potencia de 70 H.P., hacia 12.5 H.P., que se encuentran actualmente en el país.

El precio inicial está excepto del 3% impuesto local (J.L.A.S).

ARCHIVADO 12 ABR. 1977

16 Calle S. E. 12 y 13 Avenida

Managua, D. N.

En el futuro le ruego que dialoguemos antes de iniciar encuestas sobre este tipo de trabajo, para lograr una mejor coordinación que beneficie al campesinado.

Atentamente,

---

cc: Ing. Francisco Barea
Archivo.

PROGRAMA DE PRODUCCION AGROPECUARIA

INFORMACION NECESARIA PARA EVALUAR EL PROYECTO DE ALQUILER DE MAQUINARIA O EQUIPO

osto Inicial	Marca	Modelo	Potencia H.P.	Depreciación anual	Mantenimiento por hora Costo de poseción + Costo de operación	Labores que Efectúa	No. días por Mz. para la labor Man.	Buey.	Mag.	Costo/Mz. para la labor Man.	Buey.	Ma
0.000	David Brown	885	48	2.000 horas	6.18 25.00=31.18	arado-gra-deo-Siembra	-	8 hors.	2 hrs.	-	60	50
9.000	David Brown	990	58	2.000 horas anual	6.10 + 23.00 = 29.1	arado-gra-deo-siembra	-	8 hrs.	1 1/2 hrs.	-	60	50
5.625	Jhon Deere	2130	79	2.000 horas	14.38 39.06 = 53.44	arado-gra-deo-siembra	-	8 hrs.	1/2 hora	-	60	50
9.680	Jhon Deere	1020	49	2.000 horas	9.20 30.00 = 39.20	arado-gra-deo-siembra		8 hrs.	1 hora	-	60	50
6.000	David Brown	995	64	2.000 horas	6.70 31.00 = 37.70	Arado-gra-deo-siembra		8 hrs.	1 hora	-	60	50
7.000	David Brown	1210	72	2.000 horas	7.80 32.00 = 39.8	arado-gra-deo-siembra	-	8 hrs.	1 hora	-	60	50
3.000	Ebro	470	71	2.000 horas	6.40 33.00 = 39.4	arado-gra-deo-siembra		8 hrs.	1 hora	-	60	50
8.500	Massey-Fer-gunson	265	69	2.000 horas	7.00 35.00 = 42.00	arada-gradeo siembra-cha-poda.		8 hrs.	1 hora	-	60	50

APPENDIX "J"

Costo Inicial	Marca	Modelo	Potencia H.P	Depreciación anual	Mantenimiento por hora Costo de poseción + Costo de operación	Labores que Efectúa	No. días/Mz. para la labor Man.	Buey.	Maq.	Costo para Man.
22.450	Satoh	Beaver	15	2,000 hrs.	3.00 11.00 = 14	arada-gradeo	-	8 hrs.	4 hora	-
51.250	H.I.	444	45	2,000 hrs.	4.65 25.00 = 29.65	arada-gradeo Chapoda	-	8 hrs.	1 1/2 hrs.	-
81.950	H.I.	574	68	2,000 hrs.	7.50 32.00 = 39.50	arada-gradeo chapoda	-	8 hrs.	3/4	-
92.950	H.I.	674	78	2,000 hrs.	12.00 33.00 = 45.00	arada-gradeo chapoda	-	8 hrs.	1/2	-
39.850	Kubota	L-285	30	2,000 hrs.	3.61 17.16 = 20.77	arado-gradeo siemb. chapoda.	-	8 hrs.	3 hrs.	-
38.650	Kubota	L-225 D.T.	24	2,000 hrs.	3.55 15.03 = 18.58	arada-gradeo siemb.-Cultiv Chapoda.		8 hrs.	3 hrs.	-
31.500	Kubota	B-6000R	12.5	2,000 hrs.	3.55 10.83 = 13.76	arado-gradeo chapoda-siemb		8 hrs.	1/2	-

Elaborado en el Programa de Producción Agropecuaria.
mlm.

APPENDIX "J"

Precio de compra.

Es el total de los códigos de especificaciones de norma en la columna de lista de precios. Se le añade costo de flete, impuestos, etc. para obtener precio local de ventas.

Valor neto.

Se calcula el valor neto para obtener luego el costo de depreciación por hora. El valor neto es igual al precio de compras menos el precio de las llantas. Se restan las llantas debido a la posibilidad que se compren dos o tres juegos de llantas durante la vida de la máquina.
El reemplazo de llantas se considera como costo de "operación" y no de depreciación.

Costo de Posesión.

Costos de depreciación. El costo de depreciación se obtiene dividiendo el valor neto del tractor entre la vida útil del mismo. Se define la vida útil como el uso de 2,000 horas anuales, por un período de 5 años, o sea un total de 10,000 horas de vida útil como norma general.

Costo de Intereses, Seguro e Impuesto por hora.

Se obtienen multiplicando el total de las tasas de intereses de financiamiento (14%) más la tasa de seguro (3%) más la tasa de impuesto (3%) (Total 20%).

Por la inversión promedio, y dividiendo el resultado entre las horas de uso anual (2.000 horas).

Costo de posesión por hora; es la sumatoria de los costos de depreciación por hora más los costos por hora de intereses, seguros e impuestos.

Costos de operación por hora.

Esta formado por los costos de combustibles, lubricantes, filtros, llantas y operador, todo en función de un hora.

Costo de llantas por hora.

Se obtiene dividiendo el precio de venta de las llantas del tractor entre el promedio de vida de llanta. La experiencia en Nicaragua indica una vida promedio para las llantas de 5.000 horas.

Costo de mantenimiento y reparaciones.

De acuerdo a la experiencia nicaraguense en el campo agrícola, los costos de mantenimiento y reparaciones en condiciones promedio de trabajo ascienden a un 95% del costo de depreciación.

La suma total de los costos de reemplazo de las llantas, de reparación y mantenimiento y los consumos varios nos dan el costo de operación por hora.

El total de los costos de posesión y de operación por hora nos da el costo total de operación por hora.

18/3/77

cph.-

ARCHIVADO 12 ABR. 1977

COSTO DE POSECION Y OPERACION POR HORA DEL TRACTOR JD MOD 2130 C/ DE 79 H.P.

Precio de compra de la máquina de contado	C$79,840.00
2.2% Impuestos locales	1,756.48
TOTAL	C$81,596.48
Menos: 10% de reventa o canje	8,000.00
Valor neto para amortizaciones	C$73,596.48

Costo de Poseción:

1) Amortización C$73,596.48 / Período de horas de vida 10,000.00 = C$ 7.36

2) Intereses:

Tasa anual 16% sobre saldos
Más 1% de Comisión y gastos legales

C$81,596.48 x 16% 1er. año	C$13,055.44
C$40,798.24 x 16% 2nd. año	6,527.72
Comisión, timbres, prenda y gastos legales	1,285.96
	C$20,896.12

Uso estimado 1,500 horas
Total en 2 años 3,000 horas C$20,869.12 / 3,000.00 = C$6.96
Total Costo de poseción por hora C$14.32

Costos de Operación:

3) Combustible: Consumo y costo
4 galones x hora a C$3.68 C$14.72

4) Lubricante
Motor
Capacidad 1.5 galones
Cambios cada 100 horas
Total 15 cambios en
1,500 horas x 1.5 galones = 22.5 galones x C$30.00=$675.00 / 1,500 = $ 0.45

Transmisión e Hidraulico
Capacidad 7.4 galones
Cambios cada 1,000 horas
Total 2 cambios durante
1,500 horas x 74 galones = 14.8 galones x C$32.00=C$473.60 / 1,500 = $ 0.31

Grasa 0.05 lb x hora x C$ 4.28 = $ 0.21

5) Filtros a usarse en 1,500 horas
Filtro de lubricante (T19044)
2 cambios cada 100 horas durante
los primeros 200 horas total 2 cambios
y cambios cada 200 horas, total 9
cambios a C$32.25 c/u = $\frac{C\$290.25}{1,500}$ = $ 0.20

Filtro de Combustrible (AT 17387)
Filtro primario 3 cambios
Cada 500 horas x C$41.25 c/u = $\frac{C\$123.75}{1,500}$ = C$0.09

Filtro secundario un cambio
cada 1,500 horas x C$41.25 = $\frac{C\$41.25}{1,500}$ = $0.03

Filtro de aire (AT20728)
cada 1,500 horas x C$195.55 = $\frac{C\$195.25}{1,500}$ = $0.13

Filtro de la transimisión e hidraulico (AR 28271)
Un cambio a los primeras 50 horas y
tres cambios cada 500 horas total
cuatro cambios a C$57.55 c/u = $\frac{C\$230.20}{1,500}$ = $ 0.16

6) Llantas y neumáticos
Costo de cambio de 2 llantas
delanteras #7.50 x 16 capas
a C$500.00 c/u = C$1,000.00
Neumáticos C$49.00 c/u 98.00
C$1,098.00 = $0.24
duración estimada 4,500. horas

Costo de cambio de 2 llantas
Traseras #18.4 x 30 de 6 capas
a C$ 3,094.00 c/u = C$ 6,188.00
Neumático C$ 250.00 c/u 500
C$ 6,688.00 = C$ 2.23
Duración estimada 3,000 hrs

7) Reparaciones
90% del valor de depreciación
C$ 73,596.48 x 10% = C$ $\frac{73,596.48}{10,000}$ = C$ 7.35

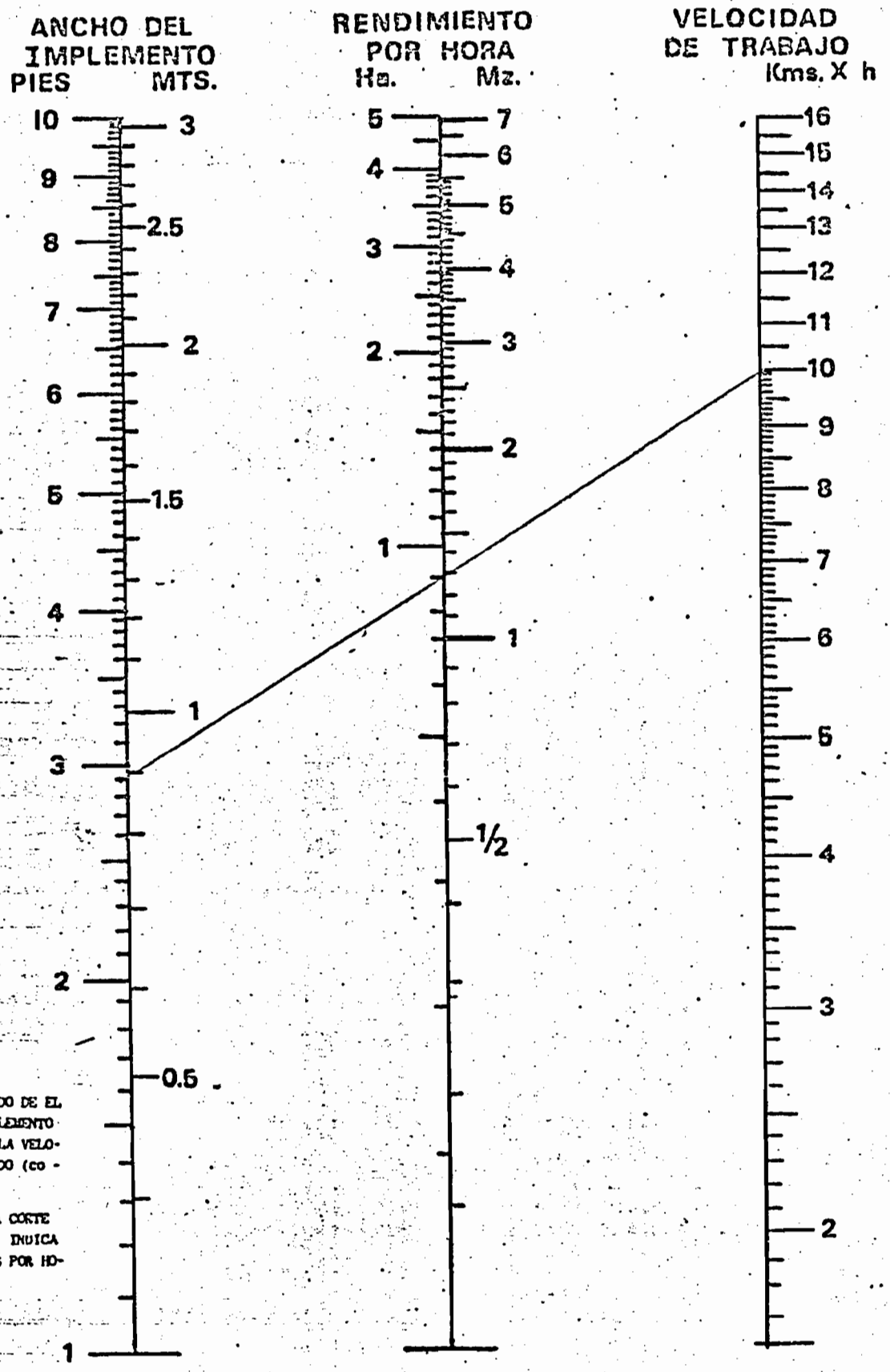
8) Salario por hora del operador Incluyendo comida	C$ 4.00
Salario por hora del ayudante incluyendo comida	C$ 2.50
9) Otros gastos como: Transporte, hilaza, etc	C$ 2.00
Costos totales por hora de operación	34.62

Resumen:
1er. año

Costos totales por hora de poseción	C$ 14,32
Costos totales por hora de operación	C$ 34,62
Costo total por hora de tractor	48,94
Depreciación media	4,50
	53.44

NOTA:

Los cálculos son aproximados, pues varían de acuerdo a la labor que se realice, el precio del combustible, el manejo del tractor, etc. Lo hemos realizado con fines de orientación.



LINEA PARTIENDO DE EL
RTE DEL IMPLEMENTO
quierda) A LA VELO-
A A SER TIRADO (co -
ha).

NDE LA LINEA CORTE
DEL CENTRO. INDICA
D DE MANZANAS POR HO-
A DE TRABAJO.

ESTIMATE OF TRACTOR HIRING FEES

Tractor - 70 Hp

(JD Model 2130)

Cost C$81,586.48

Tractor Ownership and Operating Costs C$53.44/Hr.

(Appendix J.)

Implements at 1/2 tractor cost C$28.92/Hr.

Loan Amortization

4 yeras, 2,000 His

Total value of

Tractor	81,586.48	
Implement	81,586.48	
Other	8,158.65	
	171,331.61	or C$21.42/Hr.

C$103.78/Hr.

APPENDIX "L"

THE DEMONSTRATION PROGRAM FOR TRACTOR HIRING

Season 1 - 4 Tractors in each of 5 Regions.
Plowing - 3 per tractor
Road grading - 1 km per tractor in each of 3 communities

Land Improvement - 2 mz per tractor in each of 3 communities.

Season 2 - 4 Tractors in each of 5 Regions.
Plowing - 6 per tractor with at least 2 in the 3 farms of previous season
Tillage - 3 per tractor
Road grading - 3 km per each of 3 communities per tractor and possibly add 2 communities

Land Improvement - 4 mz per tractor in 4 communities.

Season 3 - 8 Tractors in each of 5 regions.
Plowing - 10 demos of 1 mz each for each tractor
Tillage - 5 demos of 1 mz each for each tractor
Road grading - 1-3 km on regular maintenance schedule

Land Improvement - 4 mz per tractor and 1 farm pond per tractor.

MARCA	MODELO	POTENCIA	GLNS. POR HORA G.	CAPACIDAD DE TRABAJO	ENT.	SALIDA	MOTOR	PRECIO	TIPO	USO DIARIO	CONSUMO	DISTRIBUIDORA
Barnes	25 C.U	55 =H.P	10,000	10 Mzs.	4"	5"	Briggs-Stratton	11.000	Contrí-fuga	6 horas	1 gln./ hora	McGregor
Barnes	5 G.	3 H.P	5,000	2 Mzs.	1.5"	1.5"	"	2.250	"	6 "	1 gln./ 3 Hra.	McGregor
Maddlan	7 M	3 H.P	5,500	2 Mzs.	2"	2"	Peter	2.310	"	6 "	1 gln./ 2.5 Hra.	Ludeca
Modelan	5 M	2 H.P	4.000	1 Mz.	1 1/2	1 1/2"	Lister	2.200	"	6 "	1 glns/ 3 hrs.	Ludeca
Modelan	18 M	7 H.P	1.500	3 Mzs.	3"	3"	Peter	5.900	"	6 "	1 gln./ 2 hrs.	Ludeca
IHM	5 M2	2 H.P	4.000	1 Mz.	1 1/2	1 1/2	Briggs-stratton	2.300	"	6 "	1 gln./ 3 hrs.	Jhon Mays
IHM	8 M2	3 H.P	4.500	1.5 Mz.	2"	2"	"	2.650	"	6 "	1 gln./ 2.5 hr.	Jhon Mays
IHM	10 M2	3 H.P	5.000	2 Mzs.	2"	2"	"	3.325	"	6 "	1 gln./ 2 horas	"
IH[illegible]	25MGID	10 H.P	18.000	15 Mzs.	4"	4"	Peter	18.500	"	6 "	1 gln/ 1 1/2 hr.	"

NOTA: Para las condiciones del socio de IBC, en el mercado local de bombas, solo existen actualmente las mencionada. No se incluyen las mangueras de succión y descargue en el precio, ya que dependen de las distnacia de toma y de ubicación, el tamaño necesario. Generalmente las bombas pequeñas pueden trabajar hasta 25 pie en la succión.

APPENDIX "J"