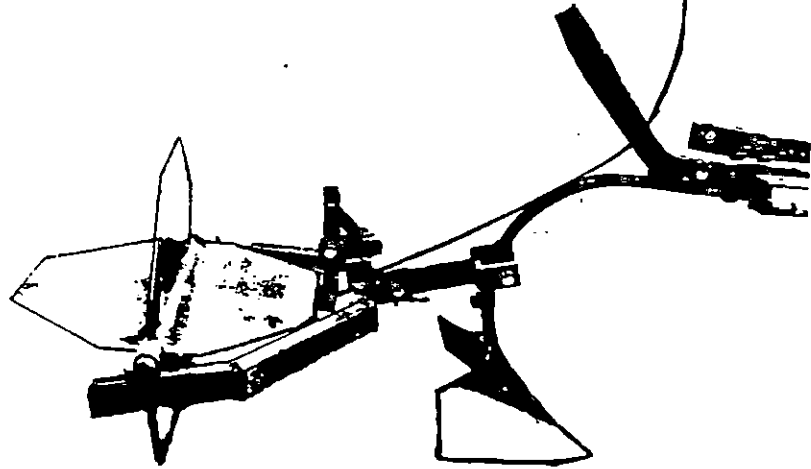


"TRAP" PROJECT  
TIED-RIDGING WITH ANIMAL POWER

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## I. INTRODUCTION

Tied ridges, introduced in Burkina Faso by the IITA/SAFGRAD Maize Agronomy Program, have been shown to reduce runoff, increase soil water reserves and markedly increase grain yields of maize, cowpeas, sorghum, millet and cotton in the predominant soils of Burkina Faso. The work conducted by SAFGRAD Scientists and other institutions in the last 7 years in the Sudan Savanna as well as previous research in the Northern Guinea Savanna of West Africa and under East African conditions, shows that in semi-arid environments where rainfall is limited and soil water infiltration rates are conducive to rainfall water losses by runoff, cultural practices that reduce runoff are essential for more stable yields.

Although tied ridges can be made by hand and still be economically profitable, a mechanical device adapted to animal traction would make tied ridges still more attractive to farmers.

The IITA/SAFGRAD Maize Agronomy Program started looking into this problem since 1981. Special funds received from USAID/SAFGRAD in 1983 permitted to develop and test on a large scale a particular ridge-tier device adapted to the animal traction equipment available in Burkina Faso. Additional funding came from the IITA/SAFGRAD Maize Agronomy Program and the "Fonds de l'eau et Equipement Rural" (FEER).

## II. PROJECT GOALS

The goals of the TRAP Project are the following:

- a) Develop ridge-tying implements for use with animal power.
- b) Identify constraints to the adoption of tied ridging with animal power.
- c) Conduct agronomic trials on tied ridges made by animal power.
- d) Cooperate and liaise with national and international agencies to facilitate the transfer of ridge-tiers to Burkinabé farmers.

## III. PREVIOUS FINDINGS

The use of animals for field work is increasing in Burkina Faso and they will be the most significant force in implementing the soil and water conservation techniques vital to a sustainable agriculture in this region. Tied ridges can be made by animal power using an adaption of a design by Lyle and Dixon (1977). Their "Tripping Shovel Device" was scaled down to fit behind ridgers available in Burkina. The hydraulic tripping mechanism was replaced by a bicycle break lever assembly. The device has 4 flat shovels that roll on an axis. This rolling is controlled by a catch mechanism that is activated by the bicycle break lever on the handle of the ridger. When the device is attached behind a ridger, one of the shovels pulls loose

soil along the furrow until the operator releases the catch mechanism. When he does this the next shovel rolls over the pile of soil in the furrow, slightly packing it into a "tie". The catch mechanism stops the roll and the process begins again. (See Fig.1). Plans are available from IITA.

Two versions of this device were developed to take advantage of the power differences between donkeys and oxen. The donkey model weighs 11 kg and has shovels that are 40 cm wide at the base, tapering to 16 cm at the outside; production costs is about 14,000 CFA. The parameters for the oxen model are: 17kg, 55 cm, 20 cm, and about 16,000 CFA, respectively. Preliminary testing showed that the donkey version could make 13 cm deep tied-ridges in rows 50 cm apart. The oxen model could make 16 cm deep tied-ridges in rows 70-80 cm apart. Data from SAFGRAD/FSU shows that after ridges are made, tying them by hand requires 75 man hours per hectare. The IITA/SAFGRAD TRAP ridge-tier and a donkey reduces this time requirement to 32 man-hours per hectare. Using a horse, an ox or a pair of oxen further reduces the time requirement to tie to zero because the ridges and the ties can be made at the same time. On-farm tests showed that farmers who were familiar with tied ridges made by hand and who used animal traction were interested in tying ridges with animal power. (IITA/SAFGRAD Annual Report, 1984). In addition to farmers, other development agencies were interested in testing the IITA/SAFGRAD TRAP ridge tier.

These findings have implications for the design of agronomic trials, economic research and any further investigation of technical constraints pertaining to tying ridges with animal power. It is not enough that a mechanical device can tie the ridges or that tied ridge plots yield more than plots without tied ridges. It is also essential that tied ridging "fit into" what a farmer already does in a way that minimizes, or at least does not increase, the risks involved in farming in the Semi-Arid Tropics.

#### IV. SCOPE OF WORK FOR 1985

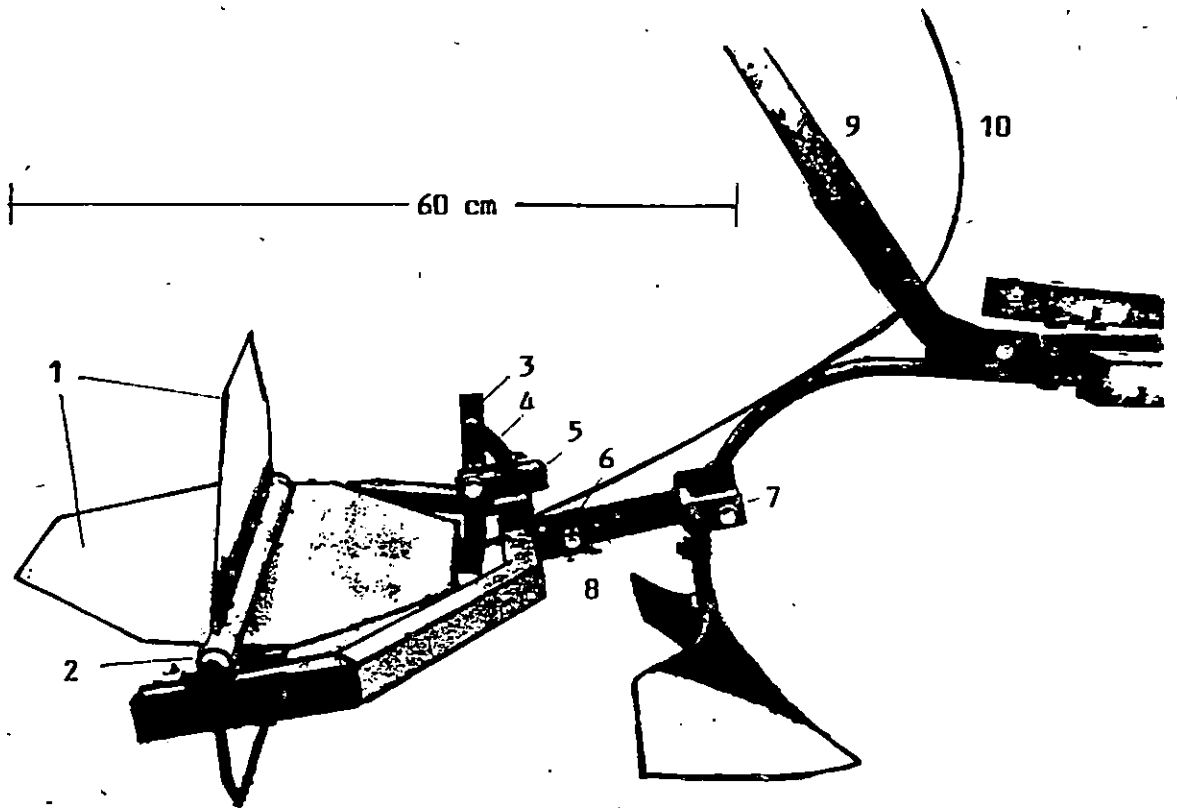
The work carried out in 1985 was focused on:

- a) Testing the system of tying ridges with animal power at the farmers' level.
- b) Evaluating technical aspects of the IITA/SAFGRAD TRAP ridge tier.
- c) Assessing farmers' feedback on ridge-tying.
- d) Making improvements in the IITA/SAFGRAD TRAP ridge tier.
- e) Investigating other devices that may be appropriate for tying ridges with animal power.

Fig.1.

THE IITA/TRAP RIDGE-TIER

(Donkey Version)

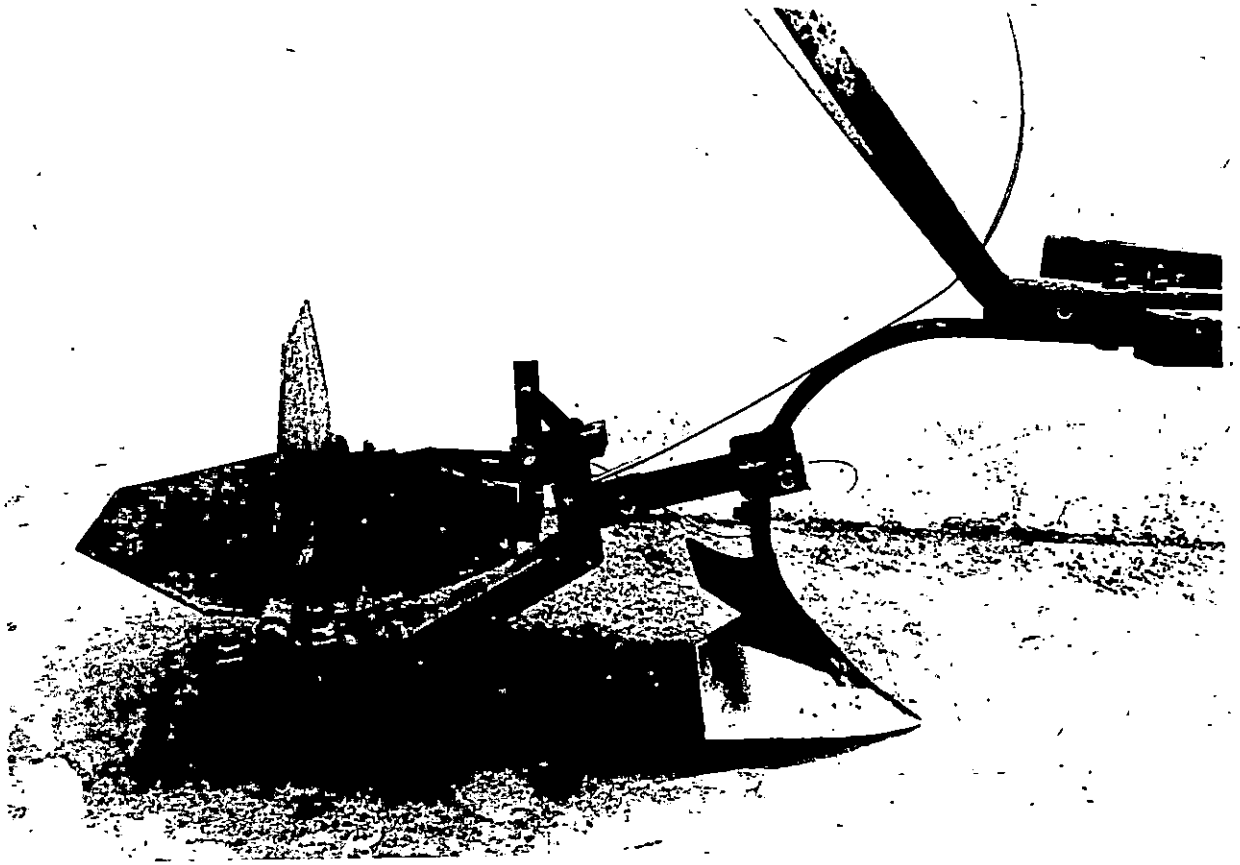


- |  |  |
|--|--|
| 1. Shovels   | 6. Shovel angle Adjusting Bolt                         |
| 2. Axle Bearing (Pipe)   | 7. Coupler   |
| 3. Latch Lever   | 8. 30 cm Ridger that allows soil to flow over the top. |
| 4. Rubber Band (Inner Tube Strip)  | 9. Handles of "houe Manga" (FAO donkey weeder)         |
| 5. Latch Adjuster (for correct angle and to compensate for wear in bearings, shovels and latch). | 10. Bicycle cable to Brake Lever                       |

Fig.1.

THE IITA/TRAP RIDGE-TIER

(Donkey Version)



The "Centre Nationale d'Equipement Agricole" manufactured 60 oxen and 75 donkey ridge-tiers for the cost of the materials and labour only at (12.000 CFA each). The TRAP Project made these available to five agricultural research institutions and seven development organizations. The TRAP Project provided technical assistance in the form of training sessions and site visits to consult on problems and gather information from primary users on their subjective feelings about using the device.

Research Institutions (ICRISAT, FSR-SAFGRAD, IRAT-CIRAD and the World Bank Pilot Project for Agricultural Development) are conducting independent research and testing, using their own protocols and facilities. This accounts for 36 donkey and 41 oxen IITA/SAFGRAD TRAP ridge tiers that are being critically scrutinized for technical problems, agronomic and economic effectiveness and appropriateness for farmers. The development agencies are testing 30 donkey and 7 oxen ridge-tiers using a protocol developed by the TRAP Project to test farmers' reaction to the device. All agencies were informed that (1) this was a very new technology in Burkina, (2) it was essential that it be evaluated by farmers and (3) results be made available to IITA/SAFGRAD as soon as possible at the end of the 1985 season to facilitate future programming and research. (See Table 1 and Fig. 2 and 3 for the names of organizations and locations of tests).

## V. THE TRAP SUB-PROJECT FOR DONKEYS

### 1. Methodology

The purpose of this sub-project was to get immediate and continuing feedback from farmers on aspects of tying ridges with donkey power in order to address technical problems as they arise, to assess constraints to the adoption of tied ridges, and to demonstrate to farmers the system of tied ridges with minimal disruption to his normal farming practices. Areas of specific concern were:

- a) Fatigue factors related to activating the trip mechanism by hand.
- b) Fatigue factors related to turning around at the end of the field.
- c) Fatigue factors related to the animal and its working time.
- d) Technical limitations of the IITA/SAFGRAD TRAP ridge tier. What parts showed wear, broke down, or required excessive time to adjust or maintain.
- e) The general effectiveness of the tied ridges made by donkey traction.

Table 1. LOCATIONS OF THE IITA/SAFGRAD TRAP RIDGE-TIER IN BURKINA 1985

COOPERATING AGENCY	ZONE	VILLAGE	COOPERATOR	N° of RIDGE T.	
				Donkey	Ox(en)
ICRISAT	Yako	Ouonon	Jan DeKoning	5	
	Yako	Kobilla		3	3
	Boromo	Koho			5
	Boromo	Sayero			5
	Djibo	Djibo			1
World Bank Project Pilot de Developement Agricole	Yako	Componson	Ouédraogo Nabyouré	1	1
	Yako	Lilboure Ladre		1	1
	Yako	Tincille		1	1
IRAT-CIRAD	Koudougou	Saria	Dugué Patrick		12
FSR/SAFGRAD	Ouaga	Nedogo	Lee Schaber	8	
	Manga	Poedogo		8	
	Fada	Diapangou		8	8
IITA/SAFGRAD	Ouaga	Kamboinse	Jeff Wright	5	
		Pabre		1	
		Wapassi		1	
		Basiyam			1
Fonds de l'Eau et de l'Equipement Rural (FEER)	Ouaga ORD	Tintilou	Yaméogo Valentin	2	
		Boulsin	Tondé Etienne	2	
		Tinsouka	Sawadogo Daniel	2	
		Bazoule	Nikiema Adrén	2	
		Sourgoubila	Wangarawa Paul	2	
		Rango	Koubepoua Sandona	2	
		Gaskay	Zongo Emmanuel	2	
Ouédraogo Pierre , Agronomist, Ministry of Agriculture, Bureau of Experimentation.		Kikilma	Ouédraogo Bona	2	
		Nagamtenga	Ouédraogo André	2	
		Die	Zongo T. Patrice	2	
		Pagatinga	Porgho Salif	2	
		Soglezi	Ouédraogo Michel	2	
ORD de Kaya	Kaya	Kaya	El Quist	1	1
ORD du Sahel	Aribinda	Aribinda	Frits Wegerif		1
ORD de Yatena	Ouahigoua	Ouahigouya	Yaméogo Christophe	1	
ORD de Volta Noire	Dedougou		Nuttens, François		1
ADRY	Tenkodogo	Ouargaye	Tjeert Deimen	1	4
PFP	Fada	Fada	Gahm Owen	1	
		Piéla	Quire, Salif	2	
FGA Training Center, Ouaga		Kamboinsé			1
IBRAZ Resear Station	Ouaga	Kamboinse	Koita		1
Total				72	47



Fig.2.

TEST LOCATIONS OF THE IITA/SAFGRAD  
TRAP RIDGE-TIERS IN BURKINA FASO  
1985

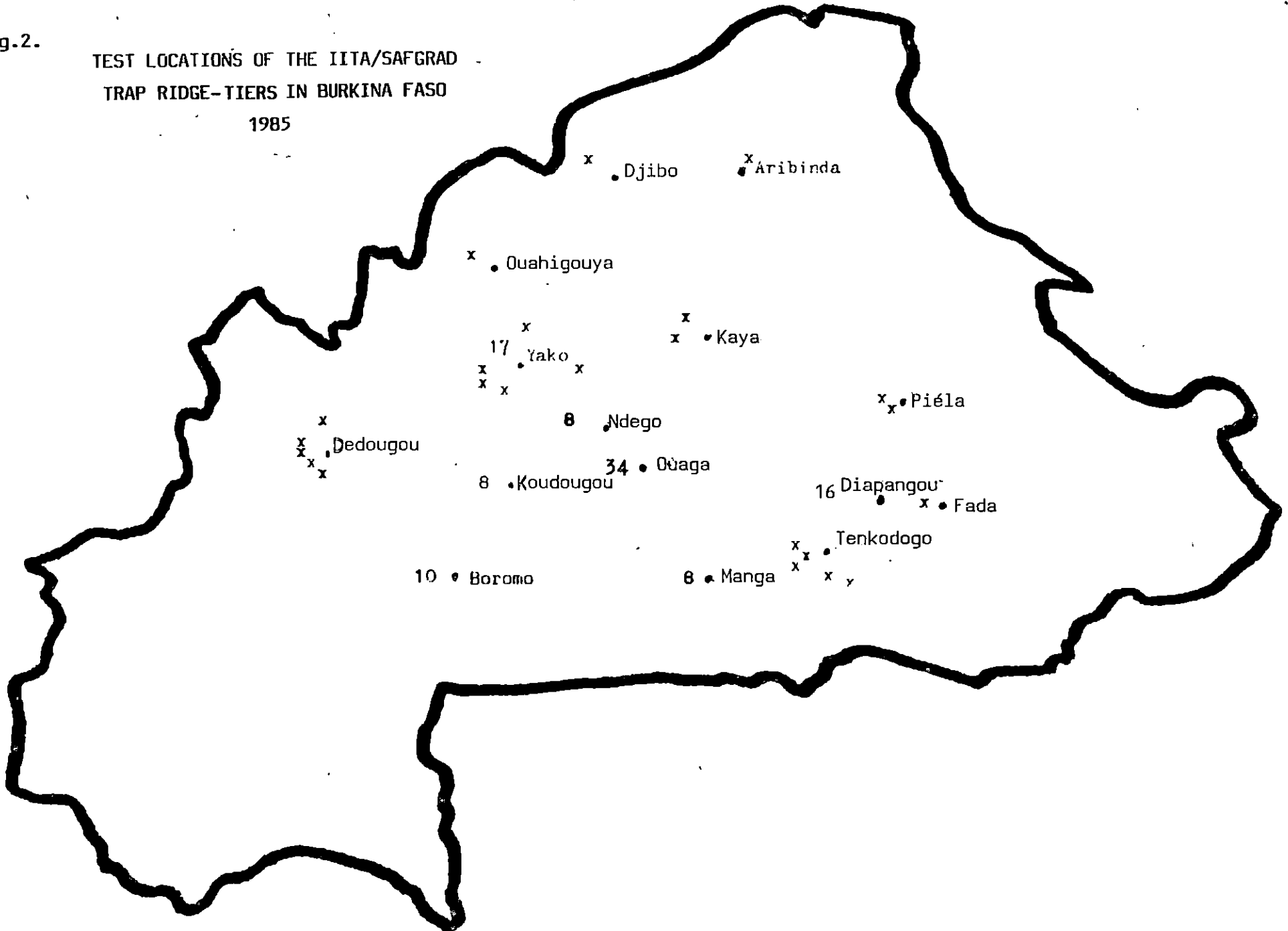
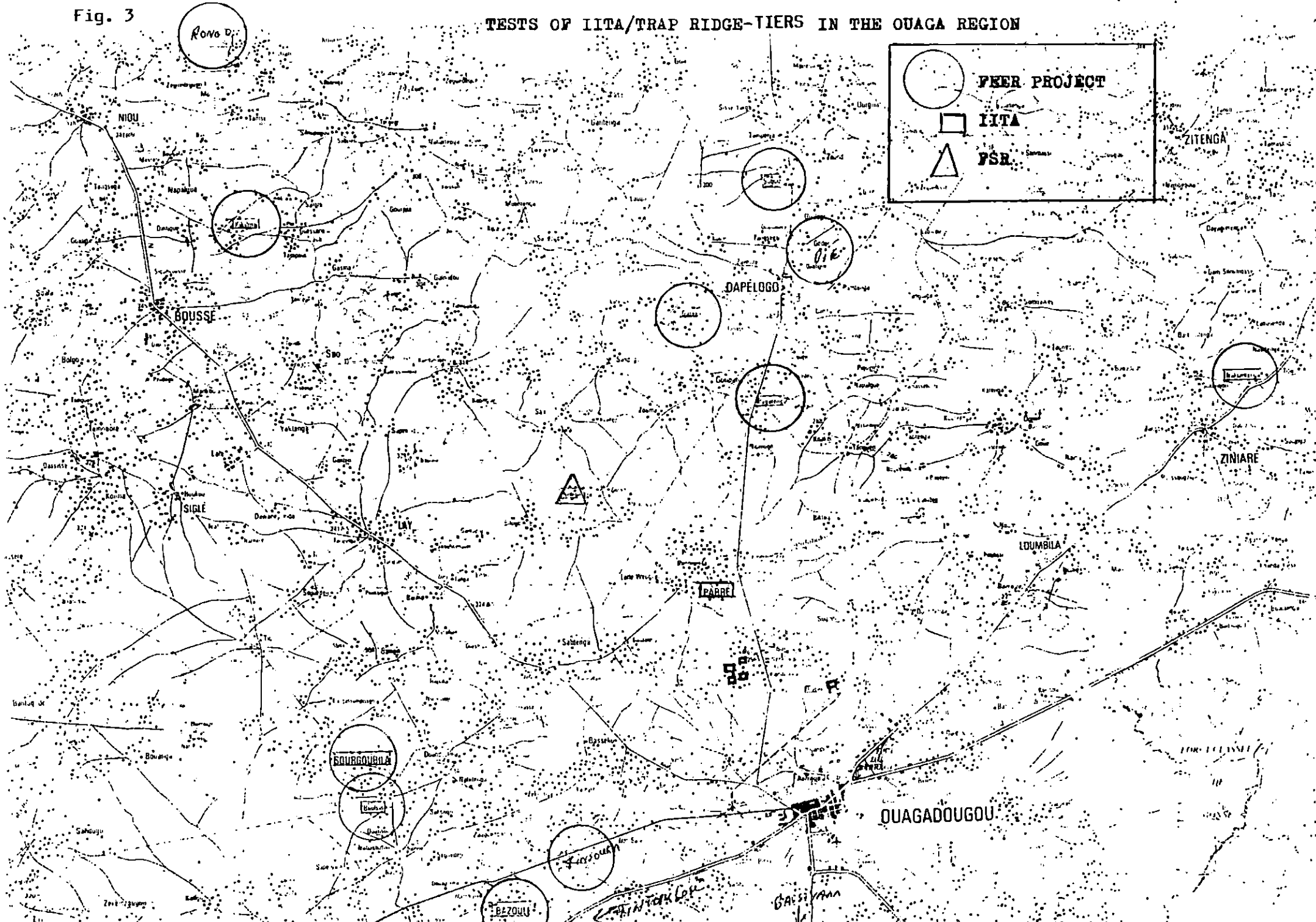


Fig. 3

TESTS OF IITA/TRAP RIDGE-TIERS IN THE OUAGA REGION



31 farmers were chosen from 15 villages within a 60 km radius of Ouagadougou. All of these farmers use donkey traction and own a "houe Manga", the FAO weeding tool. 24 of these farmers from 12 villages are participating in the "Projet de Valorisation des Sites Anti-Erosifs" being conducted by Fonds de l'Eau et Equipement Rurale (FEER). The other 7 farmers were chosen because of their familiarity with tied ridges made by hand. (Several practiced the technique on their own maize plots).

Farmers chose their own test sites with help from the TRAP project. The criteria for the test site were that: (1) it was relatively uniform in soil type, (2) it was on the upper parts of the toposequence, and (3) it was large enough to give the farmer sufficient experience with the ridge tyer (1 hectare or more). The test was fertilized evenly. The farmers in the FEER project used 400 kg/ha of Burkina phosphate plowed in before planting and 50 kg/ha of urea 6 weeks after seeding. The other farmers used 100 Kg/ha of cotton fertilizer (14-23-15) applied at plowing, if they plowed, or at first weeding. Fertilizer was given to farmers. Farmers planted in 50-60 cm rows (normal for donkey users). Farmers in the FEER Project planted on the contour.

The test site was divided into two plots. One plot was "traditional", i.e. managed in the way the farmer normally did. The other plot was "traditional plus tied ridges made by animal power at weeding time".

Farmers were loaned a 30 cm ridging shovel for their houe Manga and an IITA/SAFGRAD TRAP ridge tier. Farmers were given training in attaching and adjusting the ridge tier for the best performance and instructed to make tied tidges that were approximately 13 cm deep with "ties" every 2 meters. Farmers used a variety of crops, row spacings, timings of weeding and ridge tying etc., based on their own knowledge of soils, weather and crops. Farmers were also instructed to use the ridge tier on other fields and/or lend it to their neighbours. In most cases a rain gauge was located within 1 km of the test site.

Several methods were used to gather information and data. Not all methods were used by all farmers:

- a) Interviews with farmers while he was making tied ridges or shortly thereafter.
- b) Direct measurement of the height of the tied ridges.
- c) Direct measurement of the time required to construct tied ridges in the test plot.

- d) Direct measurement of rainfall.
- e) Rainfall intensity was ascertained by interview. "It all fell in an hour" or "it rained all day".
- f) A Final interview conducted in the local language.
- g) The ORD "Encadreures" also responded to a question concerning how relevant tied ridges made with animal power were for farmers in his region.

## 2. Results and Discussion

### 2.1 Fatigue factors related to activating the trip mechanism by hand.

A farmer using donkey traction and a 50 cm row spacing and making "ties" every 2 meters must press the bicycle break lever 10,000 times per hectare or approximately 1,000 times per hour. The force required to press the lever is 2.7 kg at the lever end and the throw of the lever is 6 cm. This activity caused no problems among the participants in the sample. There was a short learning period of 10 minutes or so to master the lever and to learn to release it quickly after pressing it. There were several farmers who made ties every meter (20,000 times per ha). They had no complaints about their hands getting tired. One reason why this activity was not a serious constraint could have been that the donkey got tired before the operator (see below).

### 2.2 Fatigue factors related to turning at the end of fields.

Fields for donkey users are generally small and irregularly shaped. Turning at the ends of these fields can require as much time as that required to do the tillage operation. The handles on the FAO hoe Manga are located 86 cm from the ground. This is comfortable for steering, but it is awkward in turning at the end of the field. With a ridging shovel mounted on the rear position, the hoe Manga weighs 9.1 kg at the handles. With the ridge-tier attached, it weighs 18 kg at the handles and in addition, the operator must lean forward, bending at the waist, to avoid hitting his legs with the ridge tier that is extending rearward 60 cm into his work space.

The extra weight was a major complaint from all farmers who had never made tied ridges by hand and from some farmers who had made tied ridges by hand. The weight plus the length of the device caused back fatigue and occasional injuries to the feet and shins while making the turn at the end of the field.

### 2.3 Fatigue factors related to the animal and its working time.

A 150 kg donkey has a pull force of 1/6 of its weight or 25 kg. It can maintain this force for 4 hours a day. Weeding requires about 20 kg of force and farmers will work their donkeys for 6 hours a day at this task. Ridging 13 cm deep and 45 cm wide (in soils with adequate moisture) requires 30 kg of force. This is approaching the limits of what a donkey can do. The addition of the ridge tier necessitates another 9 kg of force bringing the combined activity of ridging and tying to 40 kg.

There was a range of responses to the question of "how many hours per day can your donkey make and tie ridges?". Answers ranged from 1 hr. 30 min. to 3 hrs. All farmers felt that the combined activities of ridging and tying were too much work for their donkey to do on a regular basis. If they were to continue the practice of tied ridges, they would separate the two activities. All farmers who used the device for more than the demonstration period, used the two pass method : cultivating or ridging first and then coming back again with a smaller ridging shovel and the IITA/SAFGRAD TRAP ridge tier .

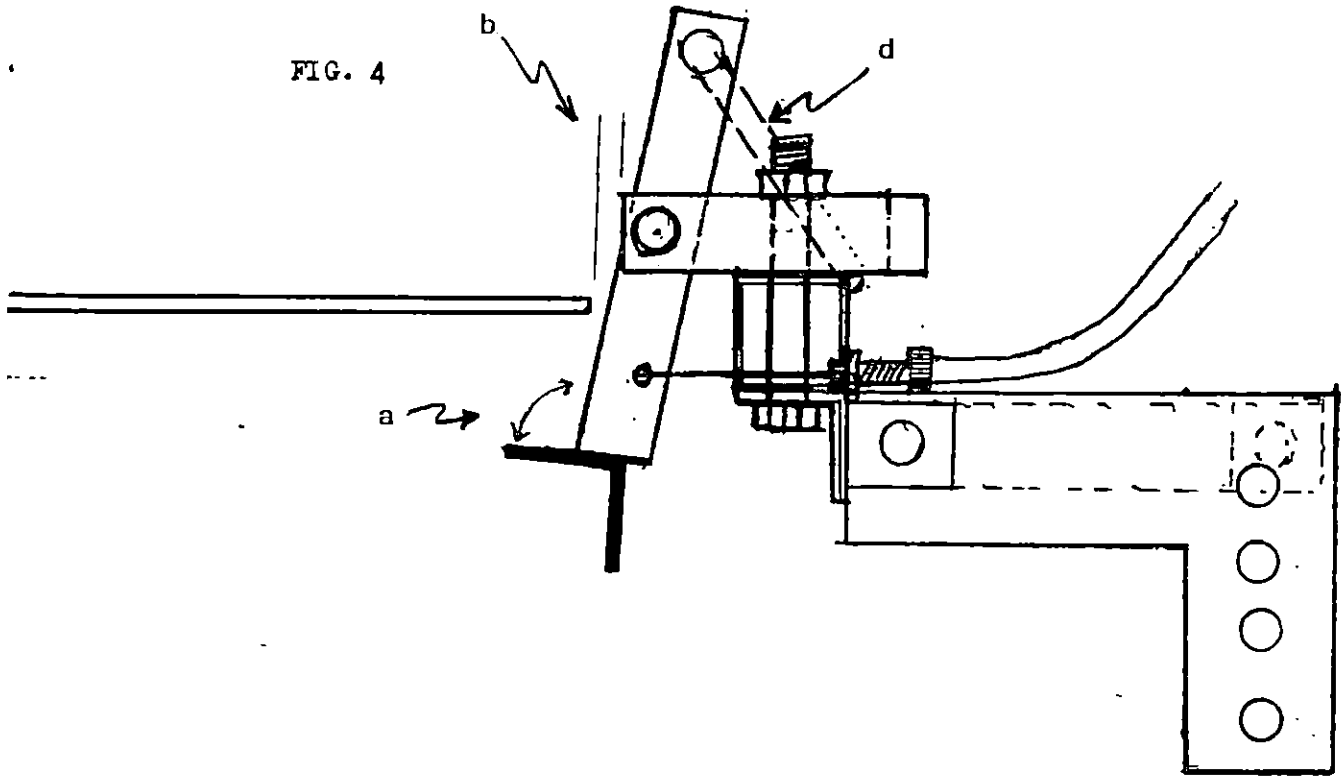
### 2.4 Technical limitations of the IITA/SAFGRAD TRAP Ridge Tier.

The donkey ridge tier must be tripped about 10,000 times per hectare. This requires a pull force on the lever of 2.7 kg and the lever end moves 6 cm. The cable moves 1.5 cm. The force on the latch is 5 kg. These forces directly affect cable life, lever life and latch wear. The axel for the shovels turns 2,500 revolutions per hectare under a continuous load of 9 kg. The cable needs to be precisely adjusted to assure optimum performance. This requires two 10 mm spanners.

Although several cables broke, new ones were easily found in the village. However the major problem was reinstalling the new cable and adjusting it. This requires a 10 mm wrench, which is very rare away from urban areas. Adjustment of the cable was the most difficult task to perform and the most frequently necessary. Other factors for proper operation of the latch mechanism are (See Fig. 4):

- a) The angle of the latch plate itself. It should contact the shovel in a flat position.
- b) The distance from the latch to the shovel edge. It should be as close as possible without interfering with the roll of the shovels. This is adjusted by the latch adjuster.

FIG. 4



- c) The latch plate should be square with the shovel edge. This is also adjusted by the latch adjuster.
- d) Tension on the rubber band. It should be just enough to stop the roll of the shovels. Excessive tension can cause fatigue while pressing the lever and puts undue stress on the cable.

## 2.5 The effectiveness of the tied ridges made by the Donkey TRAP Ridge Tier

Important factors are:

- a) Time of construction: the earlier the better if rainfall is erratic and limited. But tied ridges made when the crop is close to full canopy cover will be better protected against melt down by the rain.
- b) Physical properties of the soil.
- c) Location on the toposequence.
- d) Spacing of the ties and the size of the catchment basin.
- e) Quantity of soil in the ties. The more soil in the ties, the less susceptible they are to the erosive effects of rainfall.
- f) Slope of the field.
- g) Rainfall pattern. Intense rains cause erosion and melt down of tied ridges. The rate of this melt down depends upon the above mentioned factors. The rainfall pattern is also important from an agronomic perspective: If rainfall is regular, the yield effect from tied ridges will be less than if the rainfall comes in intense storms followed by drought periods.

The IITA/SAFGRAD TRAP ridge tier for donkey was designed to make ties 13 cm high every 2 m in furrows 13 cm deep and 50 cm wide. Catchment basins of these dimensions will capture a rainstorm of about 40 mm. However, the depth of these catchment basins diminishes as the ridges and the ties melt down with rainfall.

In general, farmers constructed tied ridges 6 to 8 weeks after planting. They ranged from 8 cm high to 13 cm high depending on the soil and the strength of the donkey. Farmers working in the sandier soils made higher tied ridges than those farmers working in gravelly or clay soils. For example in a sandy soil at Kamboinse a farmer (Zundi Souliman) made ridges that were 13 cm deep and ties 12 cm high 90 cm apart. After 100 mm of rain, they had melted down to 8 cm high. By contrast, in a gravelly soil at Wapassi, another farmer (Zundi Amadou) made ridges that were

only 8 cm high and ties 10 cm high. He spaced the ties every 4 . . . . . After 100 mm of rainfall they had melted down to 6 cm for the ridges and 7 cm for the ties.

Melt down factors suggest that maintenance of tied ridges is important, especially if their initial height is below about 20 cm. Tied ridges should be made at each weeding (twice a season) and even at plowing for those farmers who plow before planting. Data on the agronomic effectiveness of tied ridges made by animal power will be available from ICRISAT, IRAT-CIRAD, FSR-SAFGRAD and the World Bank.

#### VI. THE TRAP SUB-PROJECT FOR OXEN

The TRAP Project worked with oxen at the Kamboinse Research Station and at Bassiyam in cooperation with an FJA Village organizer. TRAP also measured tied ridges and interviewed the primary users of the ridge tiers at the Saria Research Station. No formal tests were conducted by TRAP on oxen power. Formal testing is being carried out by ICRISAT, IRAT-CIRAD, FSR-SAFGRAD and several ORD's. Data will be available at the end of the season on the agronomic and economic aspects of tying ridges with oxen. Based on available information, the TRAP experience is as follows:

##### 1. Fatigue factors related to activating the trip mechanism by hand.

The shovels on the oxen model are larger than those on the donkey model and consequently they can gather a greater mass of soil. This puts more pressure on the latch and therefore requires more force to press the break lever. It takes 4 kg of force to press the lever. In 75 cm rows one must press the lever about 7,500 times per hectare. Primary users did not feel that this was a problem.

##### 2. Fatigue factors related to turning at the end of the field.

The weight at the handles of the CNEA ridger with the ridge tier attached is 21 kg. Added to this is the difficulty of leaning over the ridge tier while turning. This was a major complaint from all users of this combination of equipment and will be a serious constraint to the adoption of the IITA/TRAP ridge tier by oxen users.



3. Fatigue factors related to the oxen and their working time.

A pair of oxen of 300 kg each has a pull force of 65 kg. They can maintain that for 6 hours per day. Making ridges that are 20 cm high and 70 cm across requires 55 to 75 kg of force depending on the physical properties of the soil. The addition of the IITA/TRAP ridge tier adds another 19 kg to the force requirement, bringing the total to 75-95 kg of force to ridge and tie 20 cm deep. The extra force to make the ties with the ridge tier was not a constraint because the ridging depth could be adjusted to suit the strength of the animals. At Bassiyam, for example, where the animals were small, the tied ridges were 14 cm deep 65 cm across. At Saria, where the oxen are strong, tied ridges were 17 cm deep and 80 cm across. If oxen farmers wished to make tied ridges of greater depth or width, they would have to use the two pass method .

4. Technical limitations of the IITA/SAFGRAD TRAP Ridge Tier for Oxen

The technical limitations are essentially the same for the oxen model as for the donkey model and are related to adjusting the cable length. Cable life will be shorter on the oxen model because of the extra stress on the latch and the extra force needed to press the lever. Proper adjustment of all latch components is essential to prolong cable life. Stress on the axle bearing surface is greater on the oxen model due to the greater mass of soil pulled by the shovels. The effect of this stress could not be evaluated because none of the devices were used extensively enough to show wear.

5. Effectiveness of tied ridges made by a pair of oxen.

For a row spacing of 75 cm and a tie spacing of 100 cm, tied ridges 17 cm high can fully capture a rain storm of about 80 mm or more. Rainfall events during the rainy season will melt down the tied ridges. The extent of this melt down is a function of soil texture, rainfall intensity and soil protection by canopy. If tied ridges at least 10 cm deep could be maintained throughout the growing season, runoff would be greatly reduced or even eliminated. Farmers using oxen-made tied ridges have thus the possibility of controlling runoff losses since melting down of tied ridges under the soils found at the Kamboinse Research Station is about 50% (by volume) in an average year.

## VII. DEVELOPMENT ON OTHER RIDGE-TIER DEVICES

The IITA/SAFGRAD TRAP ridge-tier was appropriate to test the viability of the principle of animal-powered tied ridging. However, it may not be the ideal ridge-tier for Burkina. The major limitations have been noted and are related to the weight and length and the hand tripping mechanism (adjustments and cable life). The need to use the two-pass method with the donkey ridge-tier may also discourage adoption by farmers. There are a number of ridge-tiers from the USA that "trip" or roll-over based on the weight of the soil collected by the shovel. The major advantages to these devices is that they have very few moving parts (the rolling shovels only), requires no adjustments and are durable. The disadvantage is that these devices trip randomly every 1 to 3 meters which may cause difficulty when walking behind them.

The TRAP Project built a prototype for testing under Burkina conditions. TRAP added extensions to two opposite shovels and removed the catch mechanism from a donkey TRAP ridge tier. The extension on the shovel stops the roll of the shovel and allows it to gather soil from the furrow until the quantity is sufficient to push it back. As it rolls, the following straight shovel lifts the device over the pile of soil leaving a tie. The opposite shovel with an extension hits the furrow and the process begins again.

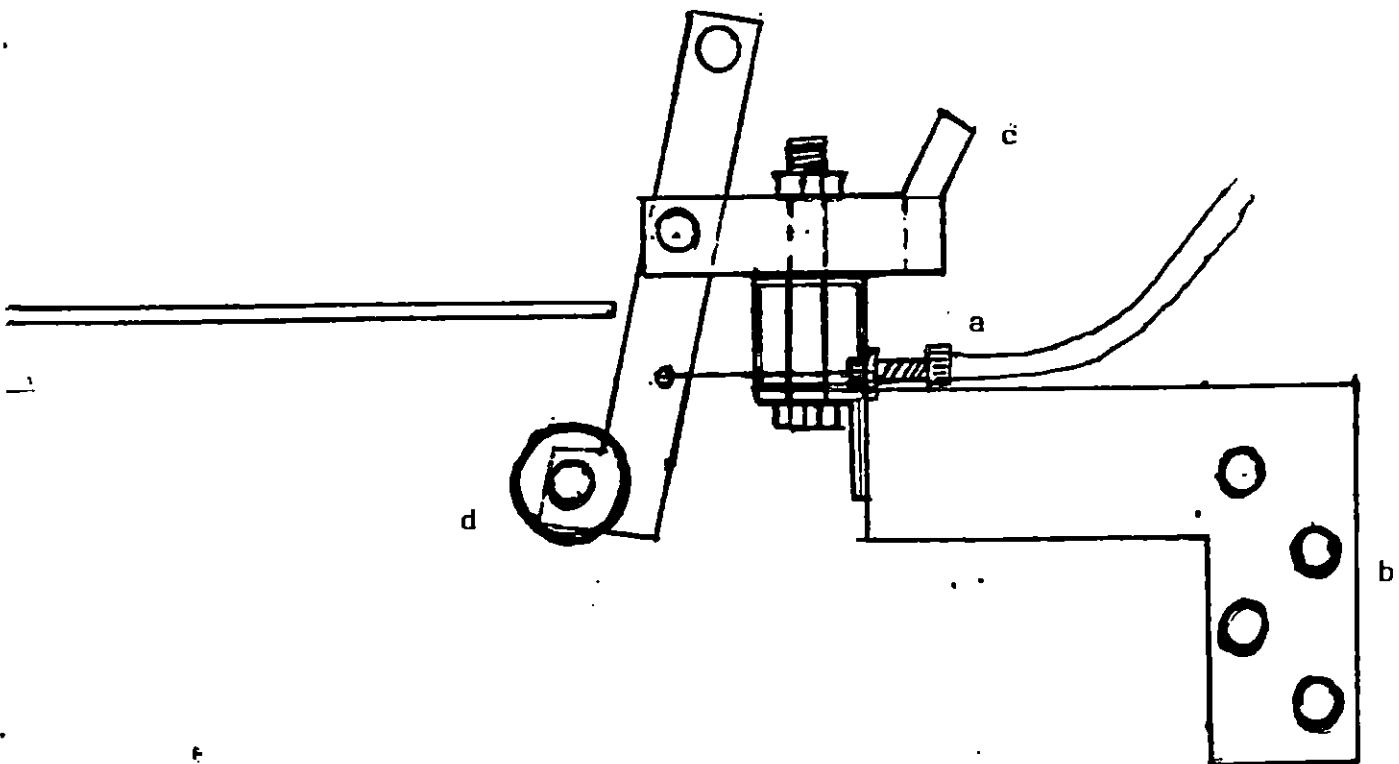
Testing showed that this device, when used with a 30 cm ridging shovel, made ties that were from 4 cm to 12 cm high and spaced from 1 to 3 meters apart. Continued testing and farmer feedback on this device is recommended.

## VIII. RECOMMENDATIONS

### 1. Technical Changes.

If work is continued on the IITA/SAFGRAD TRAP ridge tier, there are some small design changes that could be made to improve its performance. These are (see diagram below):

- a) Add a cable length adjuster. This can be accomplished by drilling a larger hole through the frame where the cable passes through and installing a Peugeot CT Mobylette break adjuster (50 CFA F).
- b) Change the position of the mounting holes on the oxen model. This will allow easier mounting on curved shank equipment.
- c) Add a small lip to the latch slider for attaching the rubber band.
- d) Add a rolling latch to the oxen model to make it easier to release. A Mobylette's wheel bearing is ideal but it costs 750 CFA. (A used one may work).
- e) Use lighter steel for the shovels on the donkey model. The steel is currently 4 mm thick. Steel 3 mm thick would be adequate. Lighter steel should also be tried on the oxen model.



- f) A new oxen model intermediate in size and weight between the oxen and donkey models (made with lighter steel) should also be tried.

## 2. Recommendations for the use of the IITA/SAFGRAD TRAP Ridge-Tier.

These devices work only in loose soil. They are not meant to dig or to scrape the sides of well made ridges. Consequently, they do not perform well behind quality ridgers (Emcot) or ridgers that are not adjustable for width. The name "Ridger-Tier" has caused some confusion among people who have not seen the device demonstrated by experienced personnel. The device makes "catchment basins" by pulling along loose soil and then depositing the soil to make the ties or dams. It is therefore, necessary to use a small (30 cm) ridging shovel running at the desired depth. For oxen this depth is 12 cm and for donkeys the depth is 8 cm. The small shovel allows loose soil to flow over the top and the device can gather up this soil to form ties.

Bearing this principle in mind, many of the problems concerning the weight of equipment for ridging and tying for oxen can be ameliorated by using lighter equipment for ridging. A hoe Manga equipped with a 30 cm ridging shovel and the oxen ridge-tier can make tied ridges that are 15 cm deep. This system was used at Bassiyam before planting with excellent results.

For one donkey, ridging and tying at the same time is a heavy work load. These operations are best done separately.

Modifying the hoe Manga by drilling shank mounting holes in front of the wing adjuster allows the mounting of the ridging shovel to be moved forward 27 cm. When the ridger-tier is attached, it is no longer in the way of the operator, while walking or turning at the end of the field. Also the center of gravity is moved forward, making the ensemble of the ridger and the ridge-tier much easier to lift at the end of the field. If there is sufficient interest in the IITA/SAFGRAD TRAP ridge-tier, this modification could be proposed to APICOMA, the primary producer of hoe Manga .

## 3. Policy Recommendations.

Based on the results from the TRAP demonstrations, there seems to be enough farmer interest in tying ridges with animal power to continue research and development. However, these results should be weighed with the agronomic and economic results from the other researchers and development agencies before formalizing a direction for continued research. To facilitate this, SAFGRAD should hold a meeting on "Tied ridges with the IITA/SAFGRAD Ridge Tier: Problems

and potentials". Participants would be representatives of all the organizations and farmers that tested the device the first year.

Based on its experience, the TRAP Project would like to offer a few suggestions for future programming:

1. Develop improved versions of the IITA/SAFGRAD TRAP ridge-tiers based on the recommendations presented in this report.
2. Continued testing with the same farmers (if they are interested) to evaluate the role of experience in tying ridges.
3. Begin on farm tests in areas where farmers have been ridging for a long time, e.g. Kombissiri.
4. Make the IITA/SAFGRAD TRAP ridge-tiers available to ACPO's and other countries in areas where tied ridges have been found effective.
5. Allow the "Centre Nationale d'Equipement Agricole" to sell ridge-tiers to anyone. Currently only IITA/SAFGRAD can authorize construction.
6. Arrange for village steel workers to copy the IITA/TRAP ridge-tier in order to evaluate the economics and the problems associated with the production and repair away from urban areas.
7. Continued research on other devices for tying ridges or other systems that are less expensive than the IITA/TRAP ridge-tier. The TRAP Project concentrated all its efforts on the development of an animal-powered ridge tier based on the "Tripping Shovel Device" by Lyle and Dixon. Future work should also consider other principles or approaches (available or to be developed) for making tied ridges.

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X. APPENDIX

BILLONS CLOISONNES CONSTRUITS PAR TRACTION ANIMALE  
ESSAIS PAYSANS , 1985

PROGRAMME IITA/SAFGRAD D'AGRONOMIE DU MAIS

NOTE AUX COOPERATEURS

Objectifs:

Les objectifs de cet essai en milieu paysan consistent à:

1. Recevoir un "feedback" des paysans Burkinabé en ce qui concerne leur évaluation subjective des billons cloisonnés construits par traction animale (TRAP).
2. Evaluer objectivement les limites techniques de la cloisonneuse développée par l'IITA/SAFGRAD.
3. Mesurer l'efficacité agronomique des TRAP dans différentes conditions géographiques, édaphiques et climatiques.

Afin de réaliser ces objectifs, le paysan doit utiliser cet équipement de manière extensive, savoir quelles ont été les différences de rendement entre les billons cloisonnés et sa méthode "traditionnelle" et être disposé à répondre, à la fin de la saison des cultures, à quelques questions relatives à son expérience en matière de billons cloisonnés construits par traction animale. Il importe d'avoir un grand champ pour:

1. Tester les facteurs de fatigue des animaux et du paysan.
2. Tester la durabilité de la cloisonneuse IITA/SAFGRAD.
3. Donner au paysan suffisamment d'expérience avec la cloisonneuse pour qu'il puisse l'évaluer.

Dispositif:

Compte-tenu de ces objectifs sus-cités, aider le paysan à choisir un champ de grande dimension (un hectare environ) relativement uniforme et relativement plat. Fertiliser ce champ uniformément à une dose de 100 kg d'engrais coton par hectare. Etre sur place pour cette opération très importante afin de s'assurer qu'elle est correctement exécutée.

Diviser le champ en deux parallèlement au contour (perpendiculairement à la pente). Une moitié sera "Traditionnelle" et l'autre moitié consistera en "Billons cloisonnés construits par traction animale trois à cinq semaines après le semis". Jouer à pile ou face pour déterminer si la moitié inférieure ou supérieure du champ sera consacrée aux billons cloisonnés. (Voir cette position au point 11 de la description du champ). Semer sur le contour.

Pour les données de rendement à la récolte, choisir un point de la ligne de démarcation et tracer deux sous parcelles adjacentes de 30 m sur 30 m. Relever les données de rendement sur celles-ci. Ne pas oublier de recueillir minutieusement les données pluviométriques.



BILLONS CLOISONNES CONSTRUITS PAR TRACTION ANIMALE  
ESSAIS PAYSANS, 1985

PROGRAMME IITA/SAFGRAD D'AGRONOMIE DU MAIS

QUESTIONNAIRE SOCIO-CULTUREL

1. Nombre de personnes dans le ménage?
2. Nombre de personnes du ménage travaillant au champ.
3. Nombre de ceux qui ne travaillent pas au champ (trop âgés, trop jeunes).
4. Depuis combien de temps ont-ils des animaux de trait?
5. Depuis combien de temps utilisent-ils des animaux de trait?
6. Depuis combien de temps ont-ils l'équipement?
7. Depuis combien de temps utilisent-ils l'équipement?
8. Quel équipement ont-ils?
9. Où ont-ils eu connaissance des billons cloisonnés.

REPOSE A LA CLOISONNEUSE

1. La cloisonneuse était-elle trop lourde pour votre animal ?
2. La cloisonneuse était-elle trop lourde pour vous?
3. La cloisonneuse était-elle trop compliquée à utiliser au champ?
4. La cloisonneuse était-elle trop compliquée à réparer ou à fixer?
5. La cloisonneuse s'est-elle cassée?
6. Où s'est-elle cassée?
7. Vous est-il arrivé de vous blesser en l'utilisant?
8. Avez-vous eu de la difficulté à marcher derrière la cloisonneuse?
- 9.
- 10.
- 11.

REPOSE AUX BILLONS CLOISONNES

1. Le sarclage était-il plus difficile avec les billons cloisonnés?
2. La récolte était-elle plus difficile avec les billons cloisonnés?
3. Au niveau de vos cultures, avez-vous constaté des différences entre les parcelles de billons cloisonnés et les parcelles où il n'y en a pas eu?
4. Pensez-vous qu'il y a eu une différence de rendement?
5. Voudriez-vous continuer avec cette pratique de billons cloisonnés?
6. Accepterez-vous de payer maintenant 15.000 francs pour la cloisonneuse IITA/SAFGRAD?

OBSERVATIONS DIVERSES QUE L'ENQUETEUR TROUVE PERTINENTES: en ce qui concerne le caractère approprié de cette cloisonneuse ou des billons cloisonnés pour les paysans de sa région.

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# TRAP PROJECT, TIED RIDGING WITH ANIMAL POWER

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