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# FINAL CONTRACT REPORT

## GUATEMALAN SMALL FARMER

Soil Conservation Regions I and V Project

520-T-026

by:

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PASA AG 233-1-77
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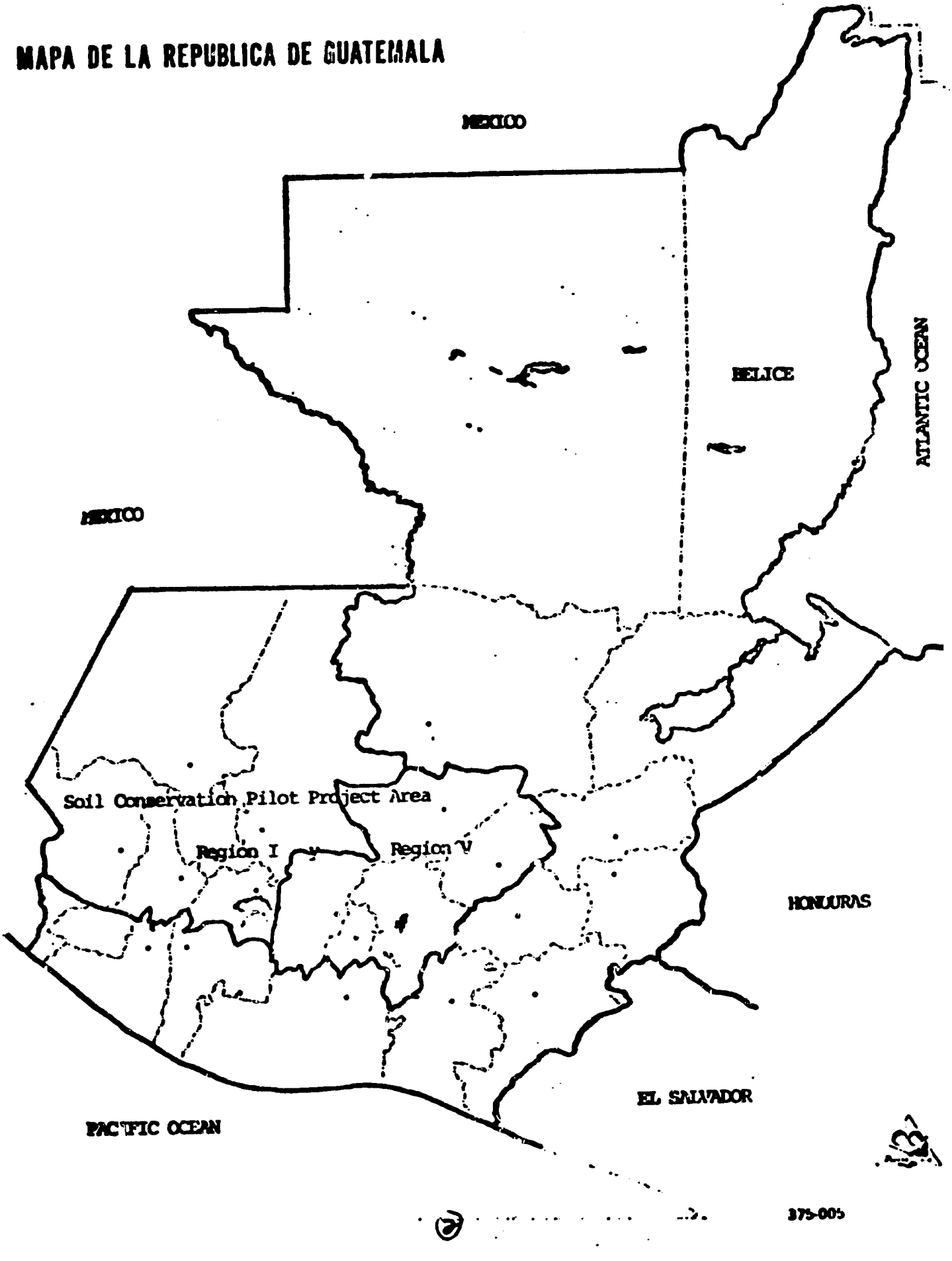
Guatemala
27 June, 1980

# MAPA DE LA REPUBLICA DE GUATEMALA




375-005

## PROJECT AREA DESCRIPTION

Guatemala is approximately the same size as the state of Tennessee. There are 33 volcanoes varying in heights from 1,027 meters (3,369.4124 ft.) to 4,220.36 meters (13,845.1026 ft.) above sea level, the highest point in all of Central America. There is a six months' dry season (Nov.-April). The rainy season (May-Oct.) produces 230-5000 milimeters (9-196 inches) of rain usually related to elevations above sea level.

The small farmers, (less than 10 hectares) Soil Conservation Highland Project area varies from 600 meters (1,968.498 feet) to 4220.36 meters (13,845.1026feet )above sea level.

Even though there is a 6 months' rainy season, only June, July, and August equal or exceed the evapo-transpiration needs of the crops produced. Corn is the basic diet with black beans providing the major portion of their protein. Most of the time the beans and corn are interplanted. Wheat is produced mainly for a cash crop as the Government has stabilized the price. Some bread is consumed during the fiestas by the small farmers. Vegetable production is increasing where terracing and irrigation systems have been constructed. The soils of Guatemala are divided into nine groups (1), (2), and (3), three of which occur in the soil conservation project area consisting of 69 different soils (4). The groups of Ando soils occur on rolling to hilly uplands on volcanic materials mostly volcanic ash, in the southern part of the project area. They have brown loamy surfaces and brown or yellowish brown sub-soils containing slightly more clay than the surface soil. They are moderately fertile soils but are deficient in phosphorus, and some minor elements. Ando soils are subject to severe erosion and the unweathered volcanic ash is exposed in many places. Most of the Ando soils are forested, some are in pasture, with the balance being used intensively for cultivated crops of corn, black beans, wheat and very few vegetables.

In the northwest corner of the area on the limestone plains and hills, the soils are mainly Terra Rossas and Rendzinas. The Terra Rossas are red clays, whereas the Rendzinas are black or dark brown clays; both are shallow and, in contrast to like soils in other parts of the world, both have surfaces high in organic matter. Throughout the area occupied by these soils are extensive areas of karst--rugged limestone surfaces generally devoid of soils and with many sink-holes, ridges, and peaks. Most of the Terra Rossas and Rendzinas are forested or in pasture but where depth of soil permits, cultivated crops and coffee are grown. At least 70% of the area's mountains and steep slopes are dominantly Lithosolic soils. These soils have little potential for farming due to the shallowness to the underlying rock or steepness of slope. The farmers who live in this area have to cultivate these steep poor lands to scratch out their living. Therefore, we as technicians have the obligation and responsibility to show them how to cultivate their steep lands and at the same time conserve their soil and water resources.

## WHAT'S THE TRUE PROBLEM?

Guatemalan farmers have been exposed to Soil Conservation measures for many years and maybe for centuries. Why, then haven't thousands of hectares of adequate conservation measures been installed? Why haven't farmers learned from others who have applied conservation work? Could it be, because the conservation practices offered were designed too difficult? Most small farmers in the highlands cannot read or write. Therefore when charts, tables or designs "on paper" are presented, a "Mental Block" is immediately formed because they know that they cannot read or understand the designs.

**OBJECTIVES:**

The main objectives of Soil Conservation Project were:

1. Provide ADEQUATE, SIMPLE, EXCELLENT QUALITY, soil conservation practices that could be passed on by word of mouth.

2. To eliminate runoff, (except the extreme storms).

3. Allow sufficient storage and time for infiltration to occur.

**PROGRAM DEVELOPMENT**

The Government of Guatemala with the help of an USAID loan developed a Soil Conservation Program, considering the above objectives. The highlands are divided into two regions, (see Project Map). Guatemala was to appoint a three-man soil conservation team for each region to set up and operate a pilot soil conservation project.

The Advisor arrived in Guatemala on January 27, 1977. The first Guatemalan counterpart employee was not appointed until August of 1977. The Advisor was provided a vehicle to use throughout the project. Also gasoline and maintenance was provided, however, many times with great difficulty involving heavy red tape. The start of the project was very slow. The first conservation project was formed and construction began in March of 1978, even though all of the proper official Government signature approvals were not completed until May 19, 1978.

All soil conservation project construction had to be completed by June 30, 1978 which was the latest date that the crops could be planted. For all practical purposes the true soil conservation project work was not able to begin until November or December of 1978, after the years crops were harvested. In the meantime, the Guatemalan teams were beginning to take shape. Many of the conservation principals were produced by the Advisor. However, the Guatemalan technicians did not accept all of the Advisor's suggestions shown in the pamphlet attached. Together the two regional teams and the Advisor developed ADEQUATE, SIMPLE, EXCELLENT QUALITY soil conservation practices and a program to fit the needs of the Guatemalan small farmers.

Two hundred thousand (200,000) small farmers living in the 10.1 million hectare area (25 million acres) cultivate, by hand, fields with slopes up to 80%. Various types of land acquisition eventually formed large land holders on the more gentle slopes. This left the steep highland soils for many of the small farmers who on the average farm less than one-half of a hectare (0.46 hectare or 1.15 acres).

The Universal Soil Loss Equation (8) shows that on a given R factor of 20, Sandy clay loam (2% organic matter), 150 foot length of slope occurring on a 12% slope, corn with the residue removed, spring turn plowed conventionally, moderate production continuously fallowed, tilled up and down the slope produces 6.49 tons per acre (16.03 tons per hectare) soil loss.

The same conditions only increasing the slope to 60% produces an estimated soil loss of 82.6 tons per acre (204.1 tons per hectare).

Increasing the R factor to 350 on 12% slope with all other factors equal to the above example, produces an estimated 113.58 tons per acre (280.64 tons per hectare). Now when only the slope is increased to 60% and all other conditions remain the same, it increases the soil loss to 1,445.5 tons per acre (3,571.8 tons per hectare). Under these kinds of conditions, the Guatemalan technician's only logical adequate alternative is BENCH TERRACES. The percent of slope is then 15% reversed back into the mountain and the length of the slope is less than two meters. Interpolation shows that this produces a maximum of 5.16 tons per acre (12.76 tons per hectare). Remember that the soil movement is only to the back of the terraces which is less than two

meters away. The farmer does not actually lose this soil from his field. Therefore, he can manage this soil movement easily.

THE "KISS" METHOD

The highlands' 69 different kinds of soils, 80% slopes and high rate of illiteracy forces the team members to adopt the "KISS Method" (Keep It Simple Sir) to:

- Develop their conservation planning guidelines;
- Educational Program;
- Soil Conservation designs, and
- Engineering equipment.

HELP ESTABLISH PRIORITIES

Almost everyone knows that erosion occurs, BUT HOW MUCH? The soil conservation team members use a sprinkler can to simulate rainfall over a demonstration box. Four fields are shown, proped up to a 30% slope. This helps the farmers establish priorities on the four types of soil conservation measures shown: bench terraces, contour planting, diversion ditches (Guatemalan style), and no treatment. They can measure and compare:

- The amount of runoff and
- The amount of soil erosion which occurred as both are collected in four bottles.

The use of mulch is also demonstrated on the bench terraces. To date, terracing has always been chosen by the farmers as their preferred conservation practice.

BASIC DATA NEEDED FOR CONSERVATION PLANNING

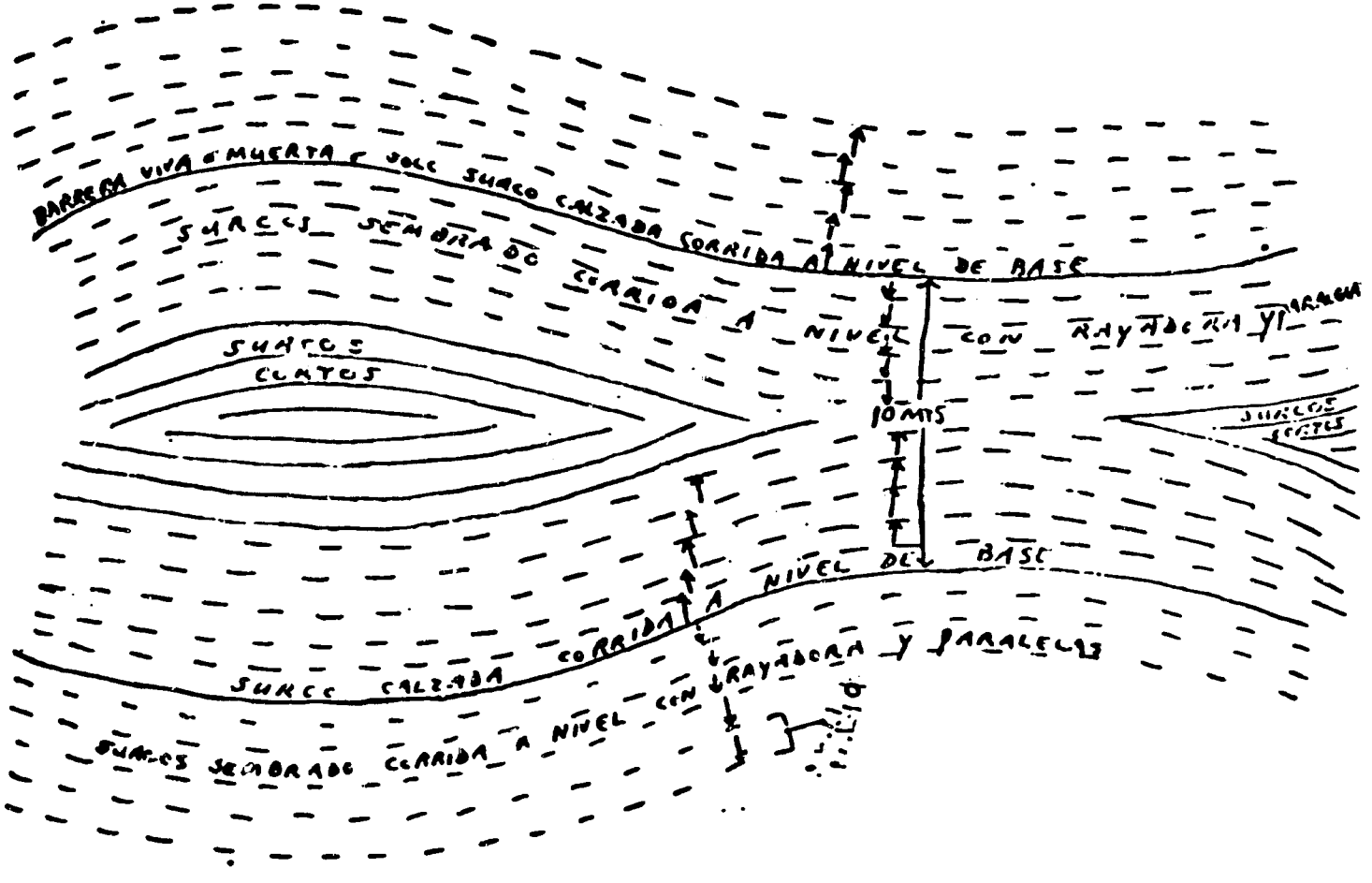
The proper use of Contour farming is a very easy method which indicates WHAT, WHEN, WHERE, and WHICH conservation practices are necessary. Certain crops cultivated in Latin America are hilled up (listed) during the process of cultivation, fertilization and weeding. This habit of hilling, sometimes over 30 cms. in height, provides an excellent opportunity for the farmers to plant on the contour with very little additional work. In one or no more than two years, a small farmer can contour plant all of his cultivatable fields.

Every ten meters, a farmer will mark a contour base line row, using his "A" frame level, across his field. Parallel to this level base line, he then plants five parallel rows up hill and down hill. The unlevel, short rows are fitted into the remaining spaces. The farmers' planting, cultivating and hilling each row forms many absorption ditches on the contour. Each row is only expected to handle the rain that falls between each row.

CONTOUR PLANTING

The contour planting and hilling up practice will eliminate 80-90% of the erosion occurring on even the very steep volcanic mountainous soils. The following four factors allow the hilled-up contour farming practice to effectively control the erosion caused by water or cause failure:

- Infiltration rate of the kind of soil.
- Intensity and duration of the rainfall.
- Steepness and length of the slope.
- The Human Factor (the exactness of the level rows and the height of the hilling-up process.




CONTOUR PLANTING

(SIEMBRA CALZADA CORRIDA A NIVEL -- )

If the farmer will contour-farm his entire farm, he can very easily use this system as a planning indicator of where and when to start building his level bench terraces. When the Contour rows begin to fail (break and erode) due to one or any combination of the four factors mentioned above, then this is his indicator that a more adequate conservation practice is required.

## LEVEL BENCH TERRACES

The farmer, remembering that he must stop the velocity of water and store the water until it soaks into the soil, knows that he must start constructing his terraces a few rows uphill from where his contour rows have broken during the heavy rains. This approach provides flexibility and allows the small illiterate farmer to adequately plan high quality bench terraces required for his farm, only where they are needed.

Guatemalan farmers have proven to themselves that level bench terraces produce the most adequate erosion control and the greatest immediate economic return on their invested time. In 1978 and 1979, 274 farmers in Region I tested the production results comparing their traditional farming method (no conservation treatment), with their newly constructed level bench terraces. A few farmers reported a decrease in production on terraces. However, the AVERAGE INCREASE IN PRODUCTION, the first year produced immediate economic returns.

Amazingly, terraced land increased first year harvest yields (planted on less land). Again, 274 farmers reported that on the average their production yields increased in 1979 as follows:

1. Corn: 141% increase 2.Potatoes: 98% 3. Beans: 95% 4. Wheat 81%

These results were compared with their traditional planting methods during the same year.

Remember that each terrace is only asked to absorb all of the rain that falls on itself. An adequately designed and constructed terrace is exactly level along the front edge of the terrace and the base of the slope. The cultivated bench must be inclined into the mountain enough to store and soak in the rainfall that lands on each terrace. The amount of unlevelness depends on the kind of soil. The entire backslope of each terrace must be protected by planting grasses, perennial plants, or with a rock wall. See the illustration shown in the attached Soil Conservation Pamphlet. Napiergrass (Pennisetum purpureum) commonly called Merker, Elephant or Carter grass (5) and (Setaria geniculata) (6) are the major grasses used from sea level up to 2,200 meters (7,217 ft. f.a.s.l). Orchard grass (Dactylis glomerata) a cool-season grass is effective up to the highest cultivated elevations in Guatemala (4,220 meters or 13,845 feet above sea level). Local production tests show, that all three grasses equally produce 8-10 tons of forage per hectare. For the highest protein content, harvest of the grasses occurs 4 times during the growing season (every 45 days). Cattle feed, compost and mulch materials comprise the major uses of these grasses. Of course any of the hundreds of other grasses or perennial plants that are found in Guatemala, that provide slope and vegetative barrier protection are acceptable. The Guatemalan farmers have also devised a method to save the topsoil without double digging, as shown in the attached pamphlet.

## IS IT POSSIBLE TO INCREASE OUR AREA OF PRODUCTIVE LAND?

The Guatemalans are, in fact, increasing their land area by means of terracing. When the slope is 30%, the farmer increases his productive acreage by 25%. In other words, for every four hectares of bench terraces, the

farmer constructs, he gains the fifth hectare of land. These terraces require almost triple the present labor, but once constructed, maintenance is very minimum. Flatter slopes result in less than 25% increase; however steeper land when terraced produces more than a 25% increased area. The reverse of the theory, "A straight line between two points is the shortest distance" produces the increased acreage. Grasses used for livestock feed or cut for mulch materials are seeded on the steep terrace slopes. The farmer could not sacrifice any of his land to plant grasses before terracing. Yes, it is true, that less land is available for planting the cultivated crops. Also the amount of seed and fertilizer must be reduced to prevent lodging.

FARMERS MAKE THEIR OWN ENGINEERING LEVEL

Three strong corn stalks, native hemp material used for tying and a rock are the only materials needed to build an adequate engineering level. The team members teach the farmers how to construct, calibrate and use his level, as illustrated in the Soil Conservation Pamphlet attached. Then any farmer can survey, design, construct by hand, with a large hoe and check his construction with enough perfection to store and allow sufficient time for infiltration of the rainfall.

USE OF ORGANIC MATTER

Tropical soils burn up organic matter very rapidly. Decomposition of organic matter in the tropics, presents a serious problem by tying up the available plant nutrients, when it is incorporated into the soil. Therefore, the following is recommended for all crops which will stand mulching:

• Composting requires too much labor and management. Therefore let's process plant food an easier way.

• Gather all of the organic materials that are available and place them on top of the soil and around the plants, as mulch. The mulch must be thick enough to prevent weed growth and conserve moisture. This Method will prevent the tying up of the available nutrients that are in the soils, because no interaction takes place.

• The native earth-worms will come to the moist surface and process the wet organic matter into rich plant food for the farmer's crops (9). Charles Darwin identified more than 1600 varieties of earthworms in the world. (7).

• Also, the high intensity rains will soak through the mulch and into the soil rapidly, without causing erosion.

LONG-TERM RETURNS?

Most people say that "Soil Conservation work takes many years to see the results." Maybe the conservation measures offered earlier were only partially conserving their soil and other resources. Therefore, these measures could not produce enough immediate visible results.

At the end of Advisor"s contractual time, the Guatemalan Soil Conservation 520-T-026 project has successfully become a Grass Roots project, that is from the small farmer upwards clear to the Minister of Agriculture. The Regional Chiefs are so pleased with the project results that they have assigned, loaned, and/or trained 35 technicians in Region I and 28 technicians in Region V. Many of the two Regions' 150 Promotor Agricolas are trained also, and are in charge of over 100 communities who have small and some large groups of small farmers constructing soil conservation practices in the highlands of Guatemala. More than 550 Guatemalan farmers constructed over 230 hectares of terraces by hand with a large hoe, in 1978 and 1979.

All structures withstood the rainy seasn well, which included four hurricanes back to back (31 days and nights of constant rain).

## SUMMARY

If simple soil conservation designs can be passed on from farmer to farmer by word of mouth, the Guatemalans hope that this conservation approach will spread like a grass fire. Some of the visible results of the program to date are:

- Increased the farmer's productive area.
- Introduced new crops, grasses, as cattle feed or mulch material.
- Farmer saved energy by cultivating less land area.
- Farmer used less fertilizer and seed.
- Increased crop yields substantially .
- Increased the farmers' income.
- Improved the structure of the soil
- Increased retention of soil moisture.
- Helped provide a better ecological balance.

The Guatemalan 520-T-026 Soil Conservation Project's Philosophy, Methodology, and Soil Conservation practices recommended for controling and preserving their nation's soil, water, and other natural resources are explained and illustrated in their Soil Conservation pamphlet attached. It is recommended that this pamphlet be used as a training tool for all employees of the agencies within the agricultural sector, schools, universities, etc.

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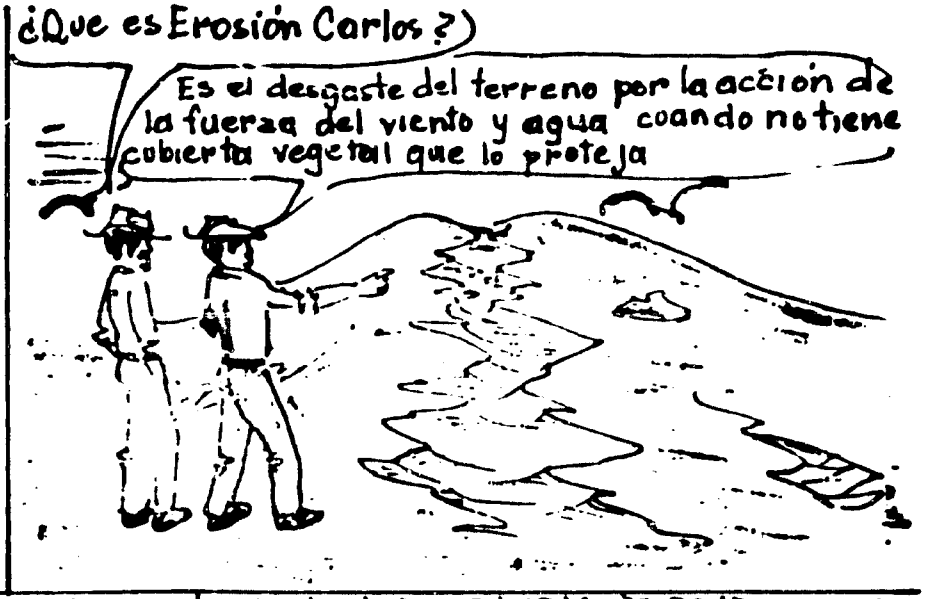
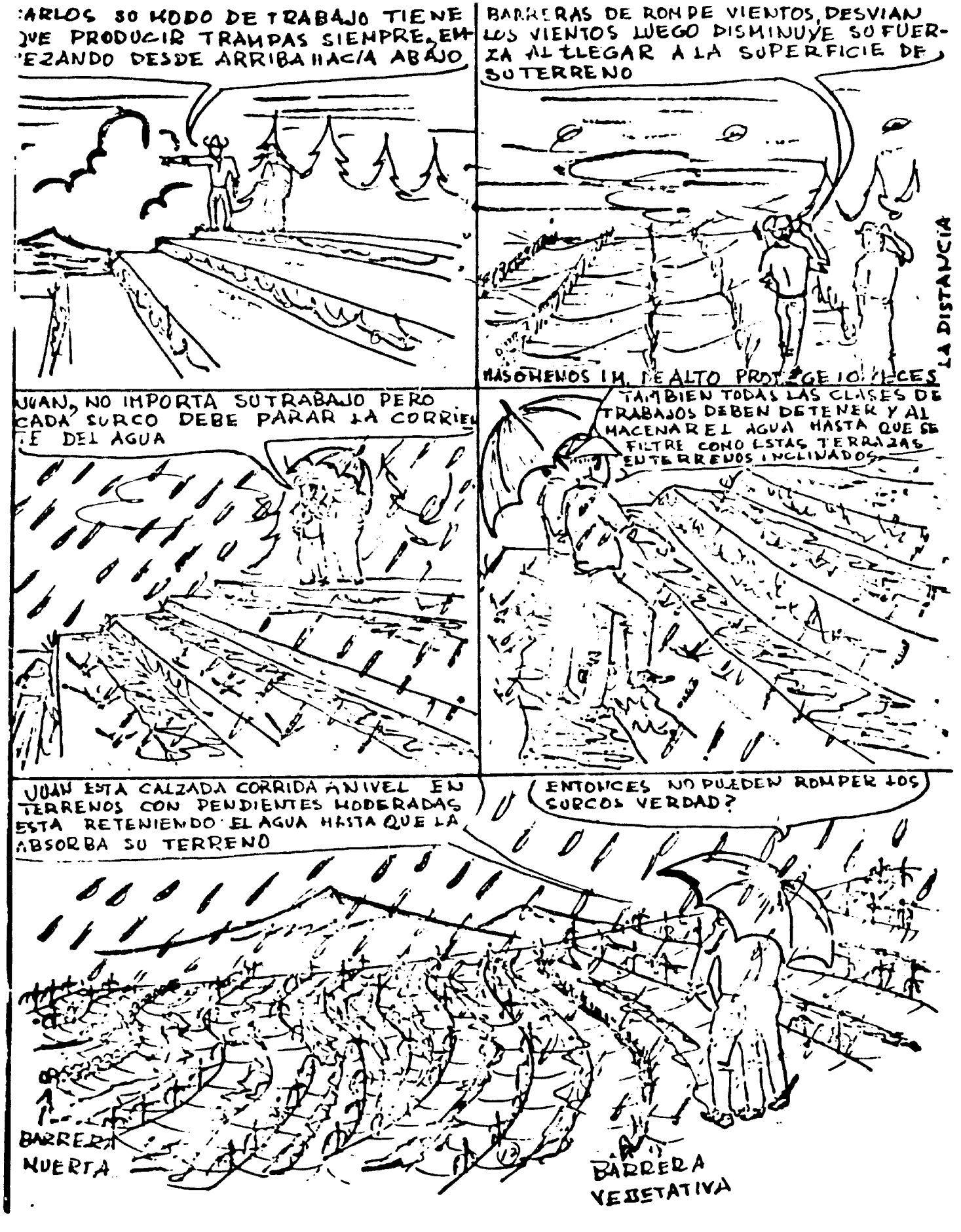
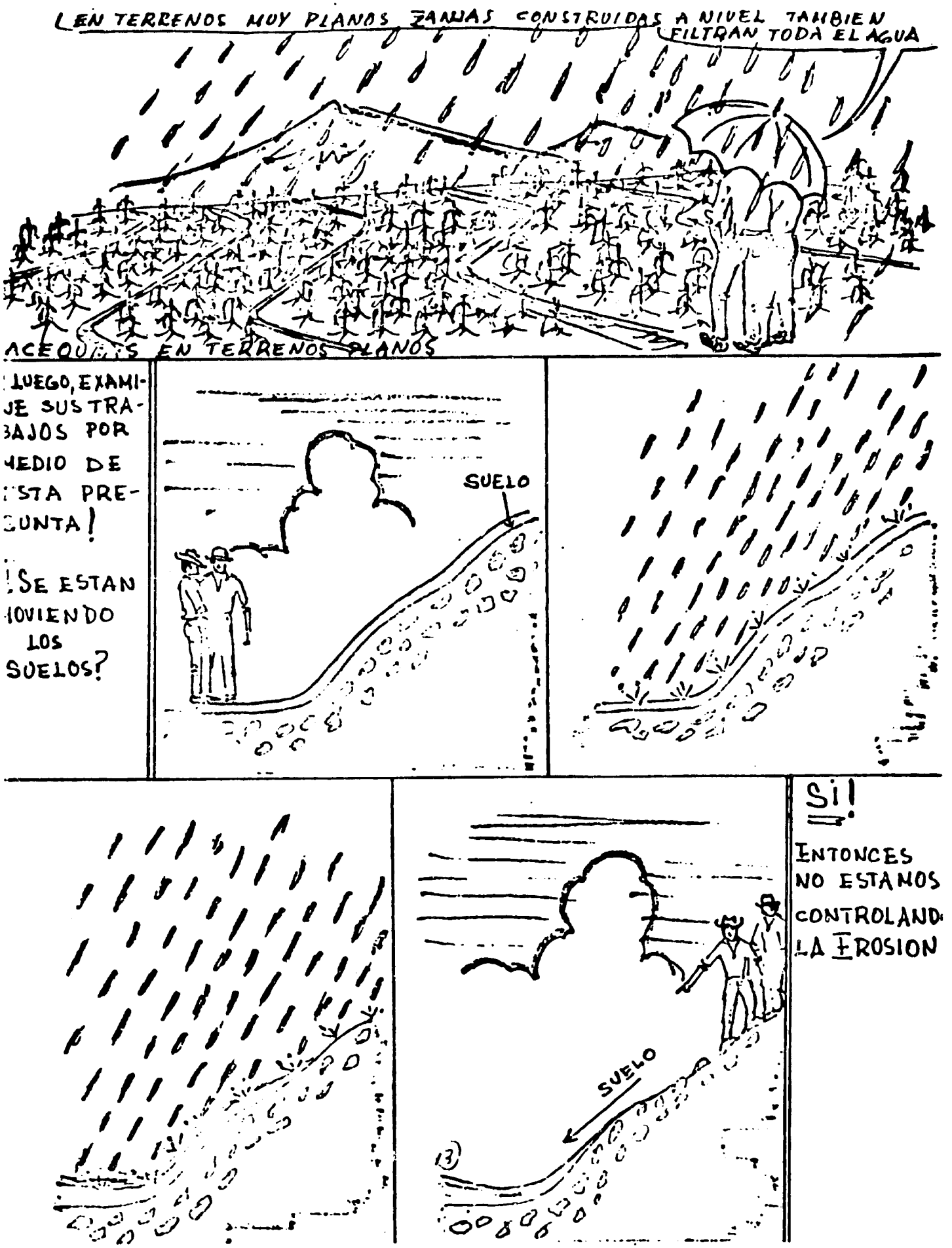
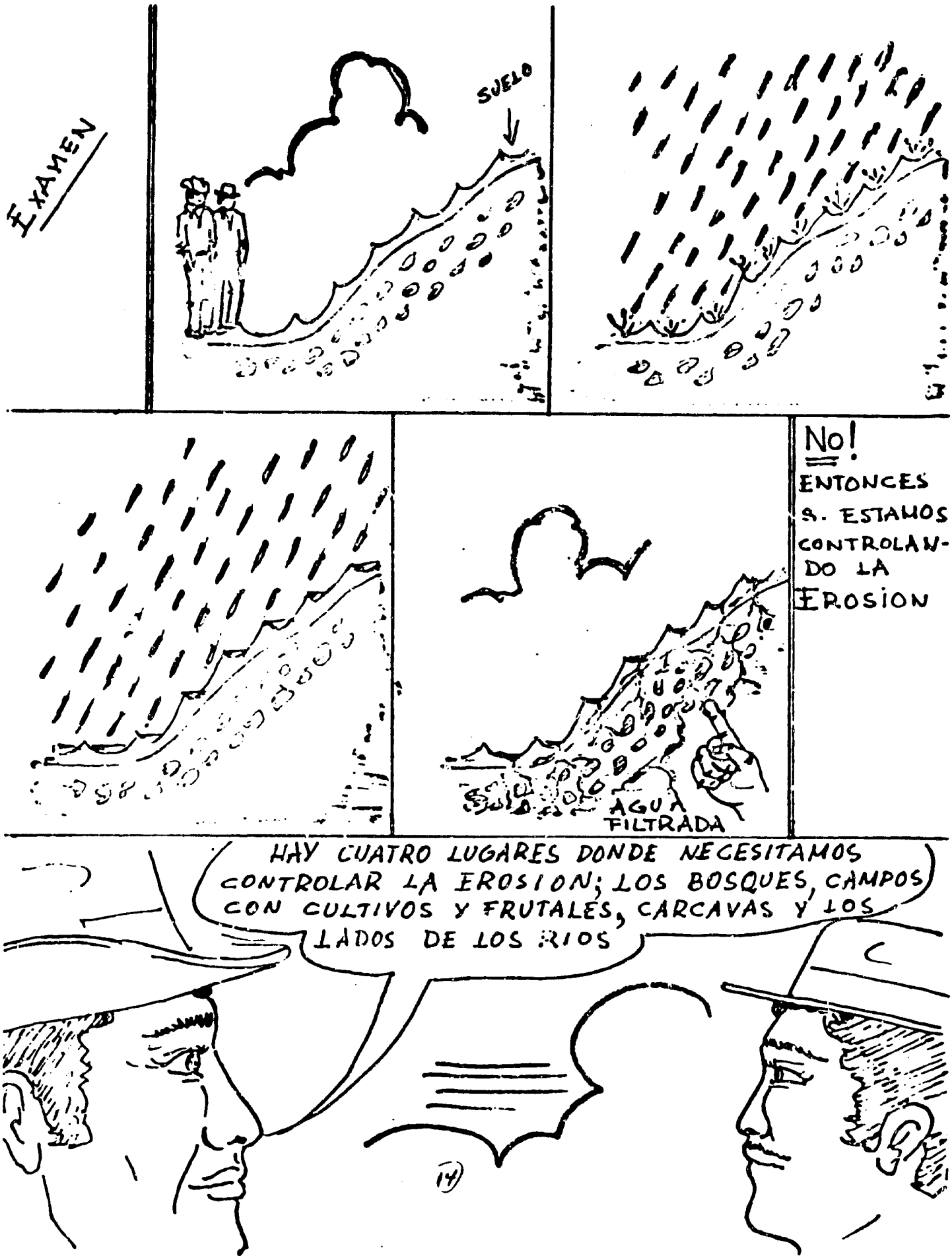
# Que es Erosión y como se controla

Por: Ing. Jerome E. Arledge
Ilustración: Gustavo Pineda




CARLOS SU MODO DE TRABAJO TIENE QUE PRODUCIR TRAMPAS SIEMPRE, EMPEZANDO DESDE ARRIBA HACIA ABAJO
BARRERAS DE RONDE VIENTOS, DESVIAN LOS VIENTOS LUEGO DISMINUYE SU FUERZA AL LLEGAR A LA SUPERFICIE DE SU TERRENO
MASO MENOS 1M. DE ALTO PROTEGE 10 VECES LA DISTANCIA
JUAN, NO IMPORTA SU TRABAJO PERO CADA SURCO DEBE PARAR LA CORRIENTE DEL AGUA
TAMBIEN TODAS LAS CLASES DE TRABAJOS DEBEN DETENER Y ALMACENAR EL AGUA HASTA QUE SE FILTRE COMO ESTAS TERRAZAS EN TERRENOS INCLINADOS
JUAN ESTA CALZADA CORRIDA A NIVEL EN TERRENOS CON PENDIENTES MODERADAS ESTA RETENIENDO EL AGUA HASTA QUE LA ABSORBA SU TERRENO
ENTONCES NO PUEDEN ROMPER LOS SURCOS VERDAD?
BARRERA MUERTA
BARRERA VEGETATIVA


EN TERRENOS MUY PLANOS ZANJAS CONSTRUIDAS A NIVEL TAMBIEN FILTRAN TODA EL AGUA
ACEQUIAS EN TERRENOS PLANOS
¡LUEGO, EXAMINE SUS TRABAJOS POR MEDIO DE ESTA PREGUNTA!
¿SE ESTAN MOVIENDO LOS SUELOS?
SUELO
SUELO
¡Si!
ENTONCES NO ESTAMOS CONTROLANDO LA EROSION
13


EXAMEN
SUELO
No!
ENTONCES S. ESTAMOS CONTROLANDO LA EROSION
AGUA FILTRADA
HAY CUATRO LUGARES DONDE NECESITAMOS CONTROLAR LA EROSION; LOS BOSQUES, CAMPOS CON CULTIVOS Y FRUTALES, CARCAVAS Y LOS LADOS DE LOS RIOS

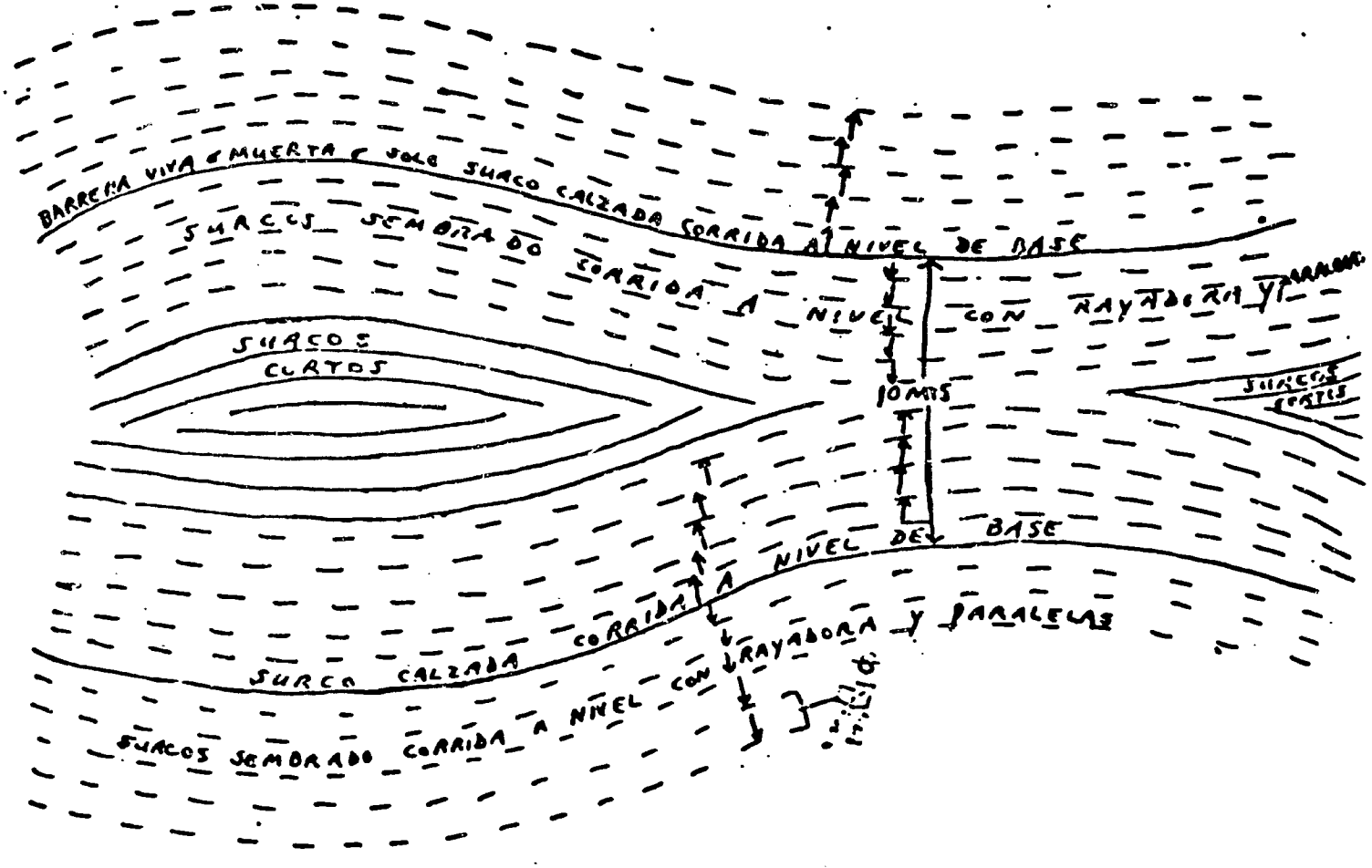
CARLOS ¿QUE TIPOS DE TRAMPAS RECOMIENDA USTED PARA EVITAR EL PROBLEMA DE LA EROSION?

ES IMPORTANTE EL MANEJO DE BOSQUES. LA CONSTRUCCION DE ZANJAS DE ABSORCION (A NIVEL) CADA 10 METROS DE DISTANCIA, NO DEJA EL AGUA SALGA A SUS CAMPOS, ADEMAS, CRECE MAS RAPIDA LA MADERA Y LEÑA POR LA FILTRACION DEL AGUA
RIO SECO

LAS TERRAZAS CONSTRUIDAS EN FUERTES PENDIENTES DE LOS TERRENOS CULTIVABLES ABSORBE LAS LLUVIAS
RIO DULCE

TAMBIEN AL SEMBRAR Y CALZAR A NIVEL, CADA SURCO FUNCIONA COMO UNA ZANJA DE ABSORCION. SI NO SE ROMPEN LOS SURCOS ENTONCES SE EVITA LA EROSION Y EL MOVIMIENTO DE SUELOS Y ABONO

SURCOS CORTOS
BARRERA VIVA O MUERTA A NIVEL DE BASE




CONTOUR PLANTING

(SIEMBRA CALZADA CORRIDA A NIVEL -- )

LAS CARCAVAS SON DE BAJA PRIORIDAD, PERO SI CONTROLAMOS CON DIQUES PODEMOS CULTIVARLAS TAMBIEN

PARA AYUDARNOS CON EL DISEÑO DE LOS DIQUES CONSIDERAMOS LAS SIGUIENTES PREGUNTAS:

- PARA QUE QUEREMOS CONSTRUIR DIQUES?
- PARA DETENER EL CRECIMIENTO DE LA CARCAVA?
- PARA INFILTRAR EL AGUA?
- PARA DETENER LOS SUELOS?
- PARA FORMAR UNA TERRAZA?
- DE QUE ANCHO SERA LA TERRAZA?
- DE QUE ALTO QUEREMOS LOS TALUDES O DIQUES?

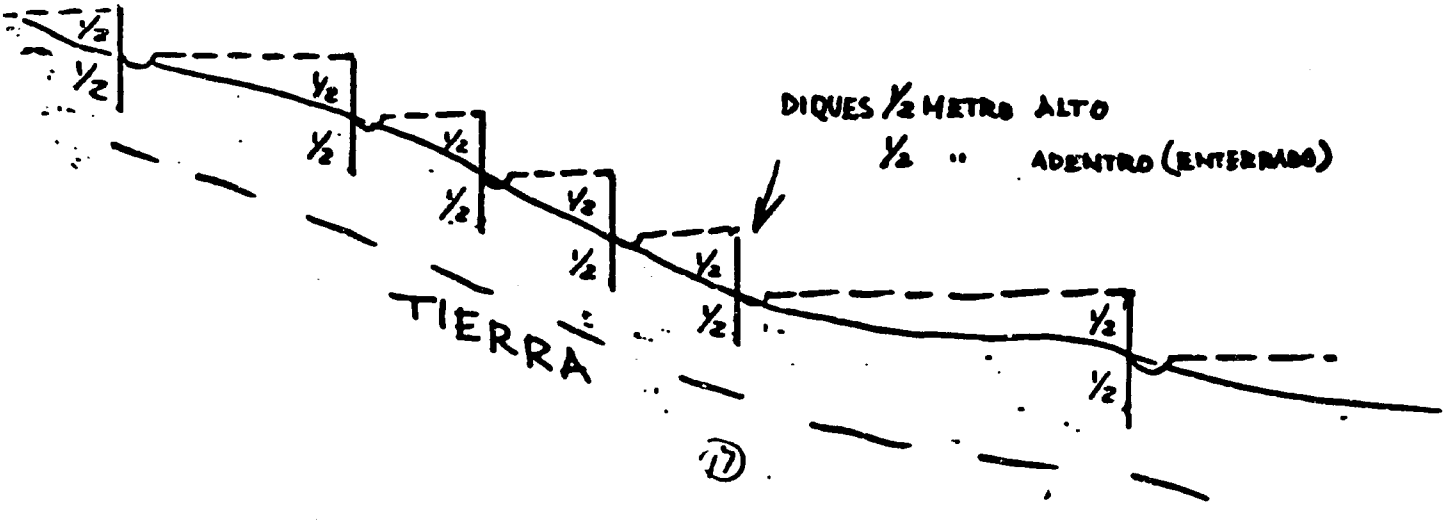
ESTOS DIQUES ESTAN CONSTRUIDOS POR ARRIBA CON NIVEL EN "A"

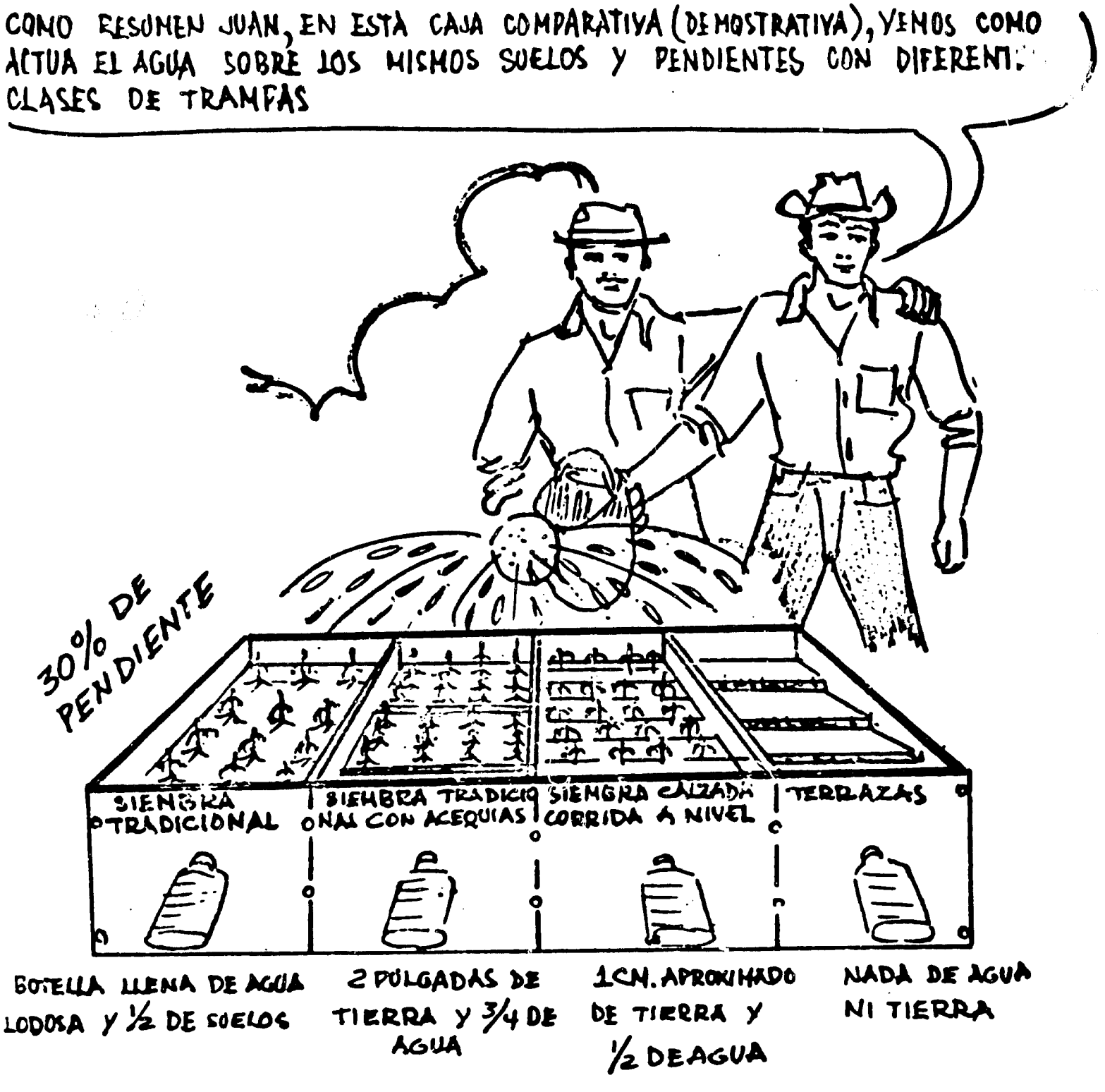
VISTA AEREA

RAMAS O RASTROJO PARA SOSTENER.

POSTES DE 1/2 METRO DE ALTO Y 1/2 M. ADENTRO TRAZADO A NIVEL

VISTA LONGITUDINAL




COMO RESUMEN JUAN, EN ESTA CAJA COMPARATIVA (DEMOSTRATIVA), VEMOS COMO ACTUA EL AGUA SOBRE LOS MISMOS SUELOS Y PENDIENTES CON DIFERENTES CLASES DE TRAMPAS
30% DE PENDIENTE
SIEMBRA TRADICIONAL
SIEMBRA TRADICIONAL CON ACEQUIAS
SIEMBRA CALZADA CORRIDA A NIVEL
TERRAZAS
BOTELLA LLENA DE AGUA LODOSA Y ½ DE SUELOS
2 PULGADAS DE TIERRA Y 3/4 DE AGUA
1CM. APROXIMADO DE TIERRA Y ½ DE AGUA
NADA DE AGUA NI TIERRA

COMO PRIMER PASO HAY QUE HACER UN NIVEL TIPO "A", CON TRES CAÑAS DE MILPA, UNA PIEDRA, MECATE Y UN MACHETE

SE AMARRAN LAS DOS CAÑAS LARGAS BIEN APRETADO PARA QUE NO SE MUEVAN

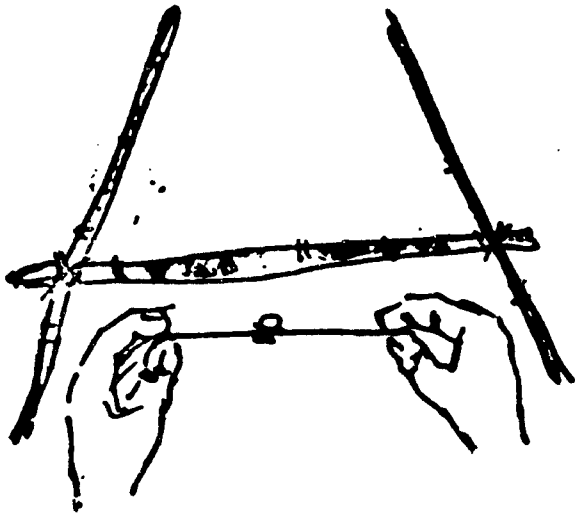
LUEGO SE AMARRA LA CAÑA CORTA (SIN MEDIDAS)

AHORA SE AMARRA LA PITA (MECATE) CON LA PIEDRA EN LA UNION DE LAS CAÑAS LARGAS
AMARRAR
PIEDRA

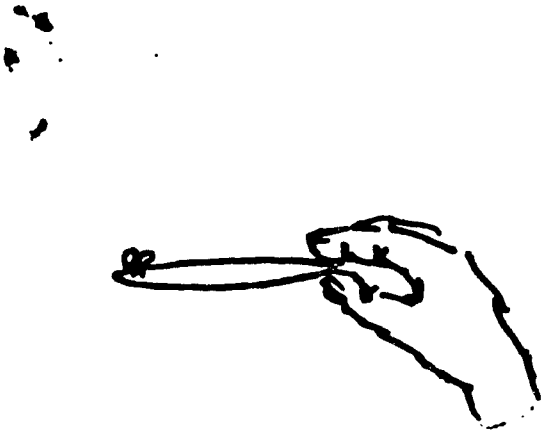
PARA CALIBRARLO, SE PONE EL NIVEL SOBRE UN TERRENO INCLINADO MARQUE EL LUGAR EN QUE QUEDA C/PATA Y PONGA UNA MARCA POR EL LUGAR QUE PASA LA PITA CON LA PIEDRA
MARCA
MARCAR

DELE VUELTA AL NIVEL DE MANERA QUE LA PATA DERECHA QUEDE DONDE ESTABA LA IZQUIERDA Y EN EL LUGAR DE LAS MARCAS EN EL SUELO Y DE NUEVO SEÑALE EL LUGAR POR EL QUE PASA LA PITA CON LA PIEDRA
MARCA ANTERIOR
MARCA

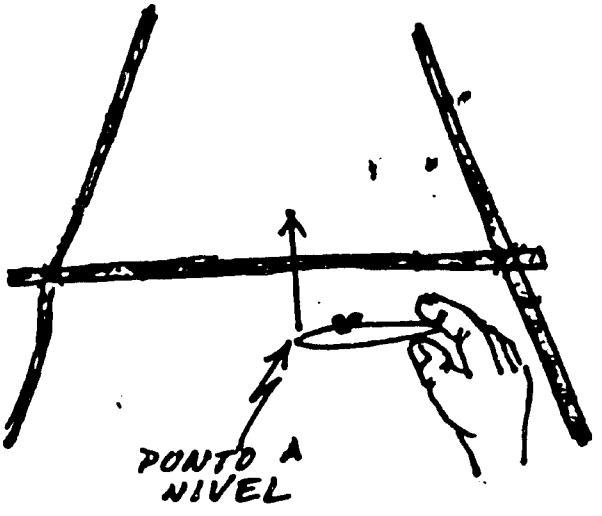
LUEGO SE SACA LA MITAD ENTRE LAS DOS MARCAS DE LA CAÑA CORTA



SE DOBLA POR LA MITAD



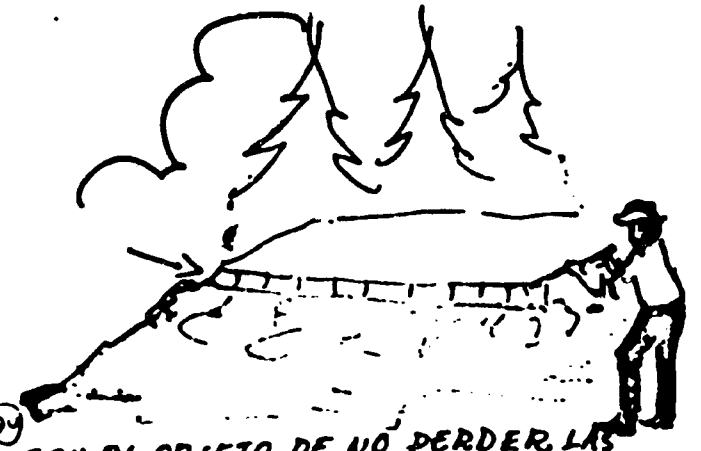
ESTO NOS DARÁ EL PUNTO A NIVEL




PARA NIVELAR JUAN, SE PONE EL NIVEL SOBRE EL TERRENO DONDE SE QUIERE TRAZAR LA LINEA A NIVEL, SE MANTIENE UNA PATA DEL NIVEL FIJA Y LA OTRA SE MUEVE ARRIBA O ABAJO DE LA PENDIENTE HASTA ENCONTRAR EL PUNTO A NIVEL

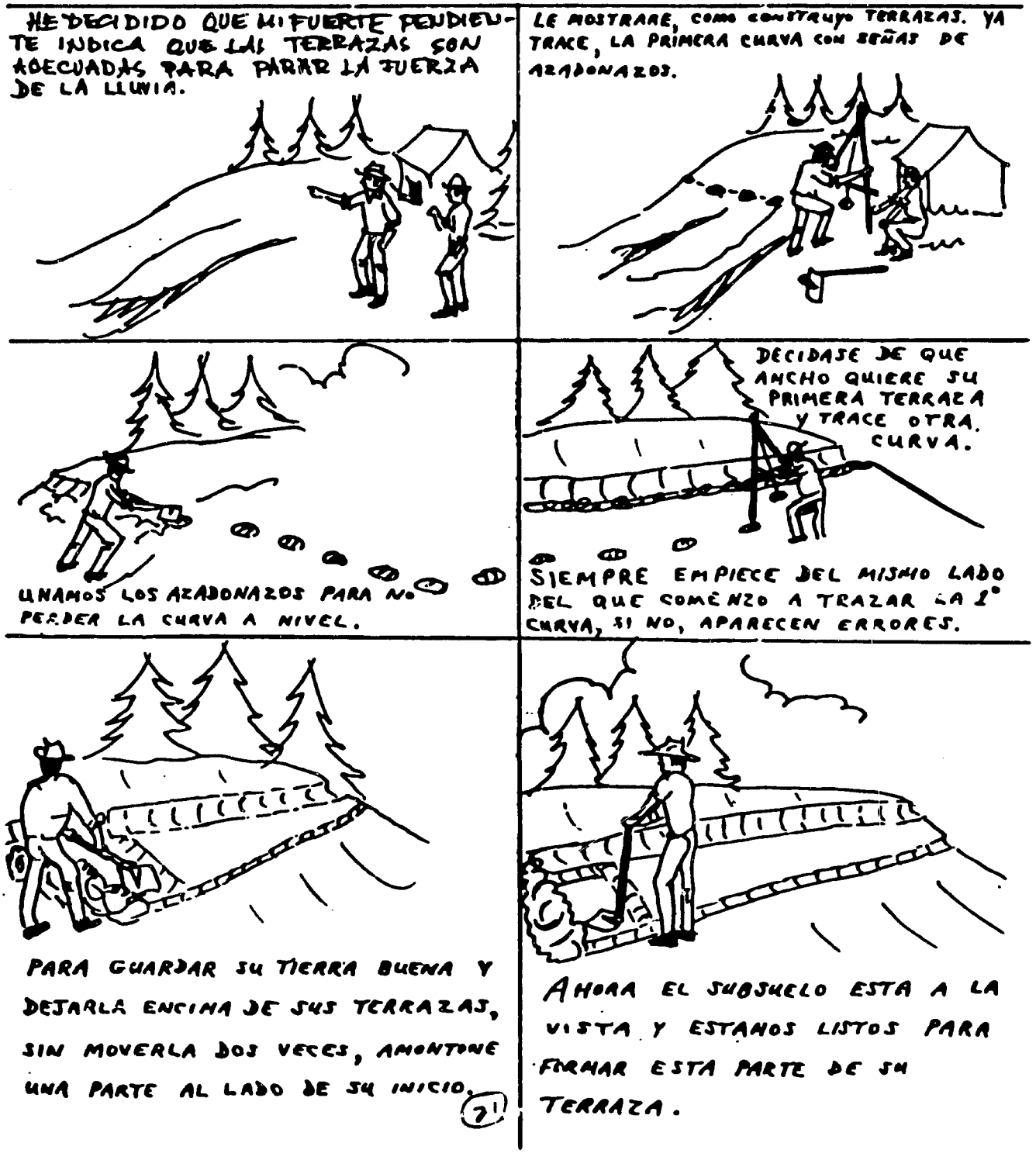
HACER MARCAS POR LAS QUE PASA LA LINEA HECHA CON EL NIVEL "AZADONAZOS"

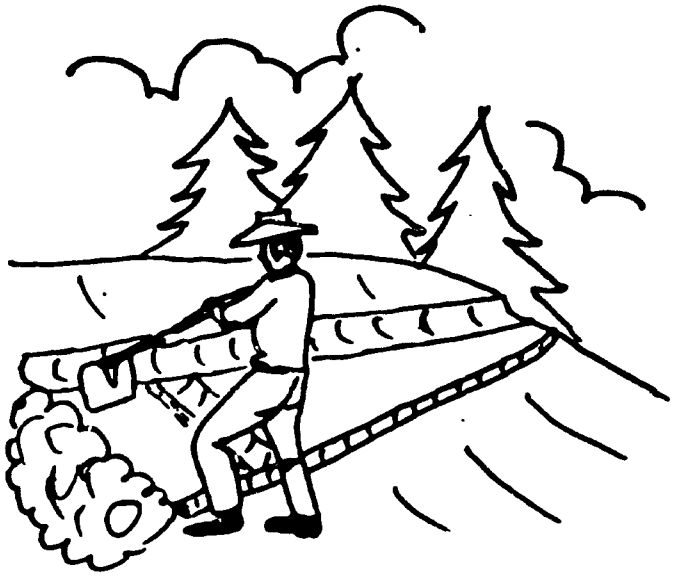
PARA TRAZAR UNA LINEA CON EL NIVEL EN "A" TIENE QUE EMPEZAR DESDE LA PARTE MAS ALTA DEL TERRENO, PARA ASEGURAR QUE NO HAYA CORRIENTE DE AGUA [illegible] DESTRUIR EL TRABAJO.



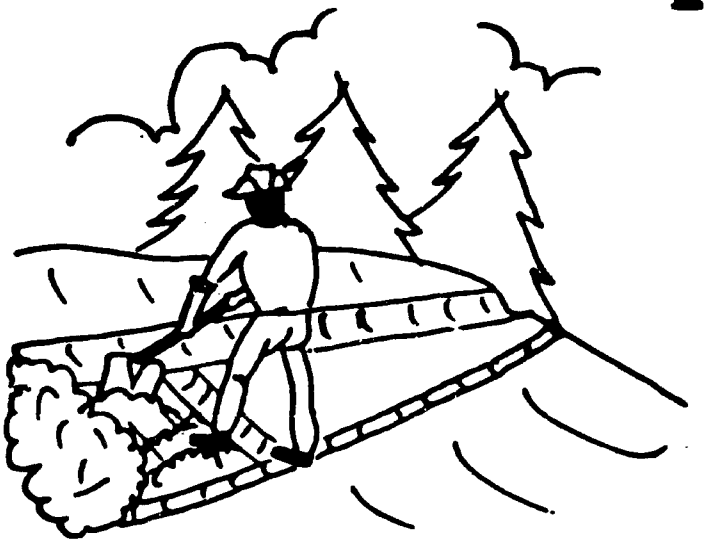
CON EL OBJETO DE NO PERDER LAS MARCAS DE AZADON DE LA LINEA A NIVEL HACEMOS UNA LINEA CONTINUA ENTRE LOS AZADONAZOS

¿HAGO CURVAS A NIVEL?
¿HAGO TERRAZAS?


HE DECIDIDO QUE MI FUERTE PENDIENTE INDICA QUE LAS TERRAZAS SON ADECUADAS PARA PARAR LA FUERZA DE LA LLUVIA.
LE MOSTRARE, COMO CONSTRUYO TERRAZAS. YA TRACE, LA PRIMERA CURVA CON SEÑAS DE AZADONAZOS.
UNAMOS LOS AZADONAZOS PARA NO PERDER LA CURVA A NIVEL.
DECIDASE DE QUE ANCHO QUIERE SU PRIMERA TERRAZA Y TRACE OTRA CURVA.
SIEMPRE EMPIECE DEL MISMO LADO DEL QUE COMENZO A TRAZAR LA 1° CURVA, SI NO, APARECEN ERRORES.
PARA GUARDAR SU TIERRA BUENA Y DEJARLA ENCIMA DE SUS TERRAZAS, SIN MOVERLA DOS VECES, AMONTONE UNA PARTE AL LADO DE SU INICIO.
AHORA EL SUBSUELO ESTA A LA VISTA Y ESTAMOS LISTOS PARA FORMAR ESTA PARTE DE SU TERRAZA.

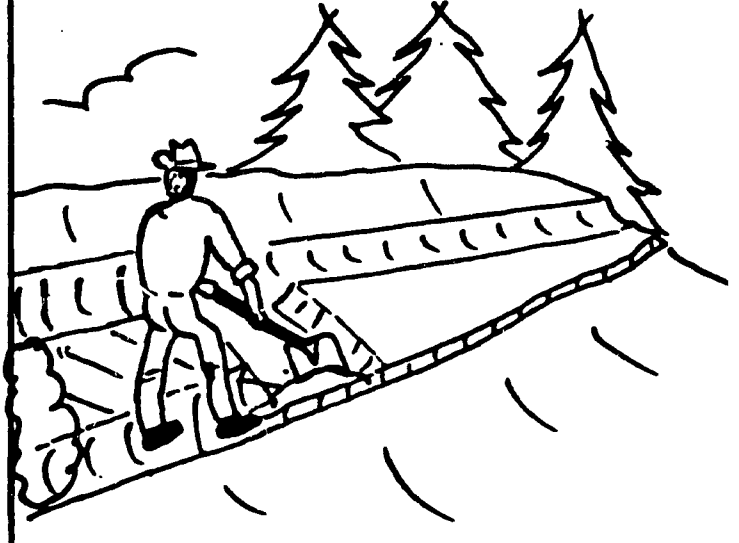


EN BASE DE SU PRIMERA CURVA A NIVEL EMPIECE EL CORTE DEL TALUD (PERO NO MAS ALTO DE DOS METROS Y CHAFLANEADO).



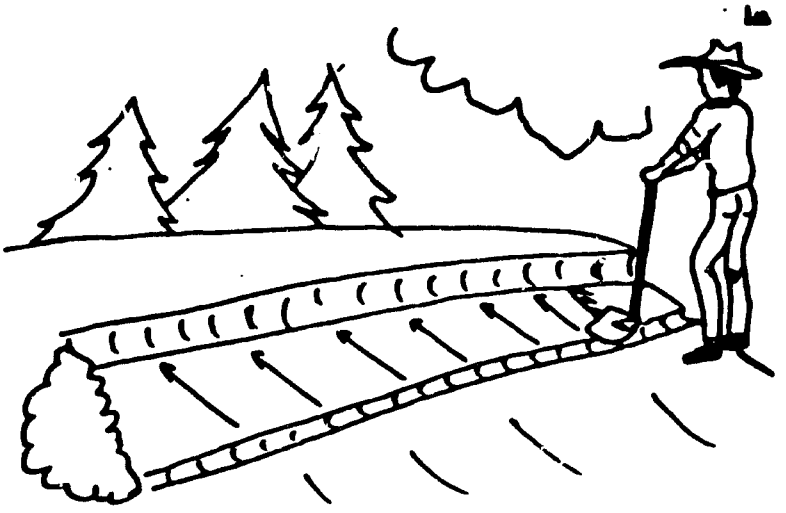
HALE EL SUBSUELO A LA ORILLA DE SU TERRAZA HASTA LA SEGUNDA CURVA MARCADA, DEJANDO UN DECLIVE HACIA ADENTRO SUFICIENTE PARA ALMACENAR TODA LA LLUVIA.

EL DECLIVE DEL TERRAPLEN DEPENDE DE SU CLASE DE TIERRA (¿ABSORBCION RAPIDA O LENTA?).

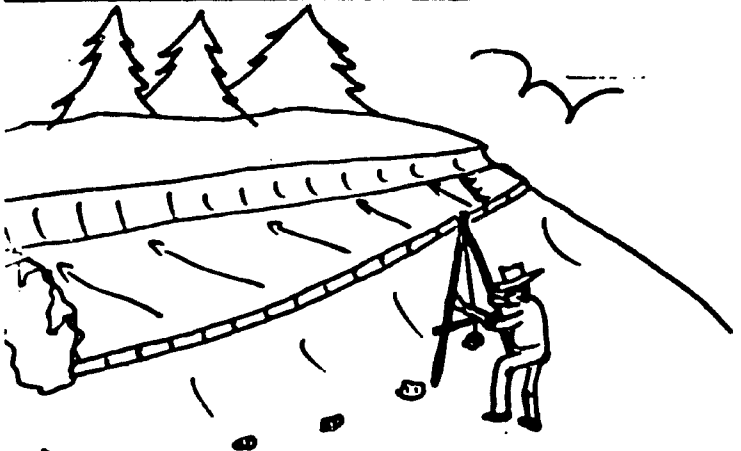


HALE LA CAPA BUENA DE LA SIGUIENTE SECCION Y PONGALA ENCIMA DE LA TERRAZA QUE CONSTRUYO CON EL SUBSUELO.

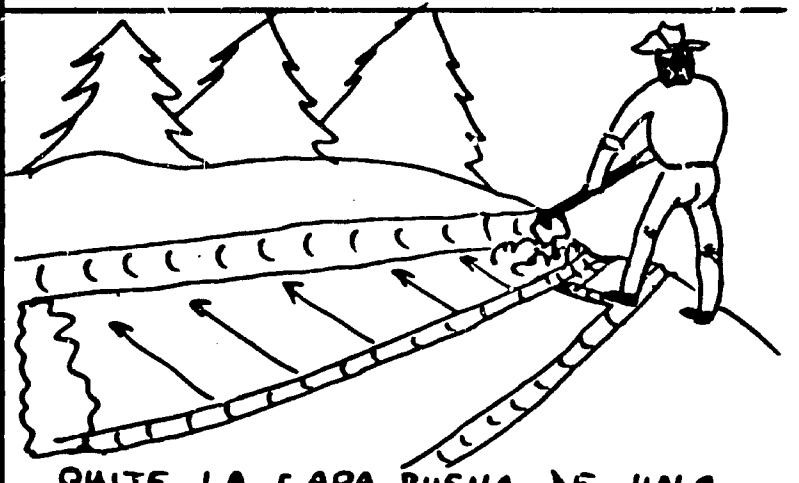
REPITA ESTE PROCESO HASTA LLEGAR AL FINAL DE SUS PRIMEROS DOS TRAZOS.



AL TERMINAR LA PRIMERA TERRAZA HACE FALTA UN POCO DE LA CAPA BUENA, NO SE PREOCUPE.



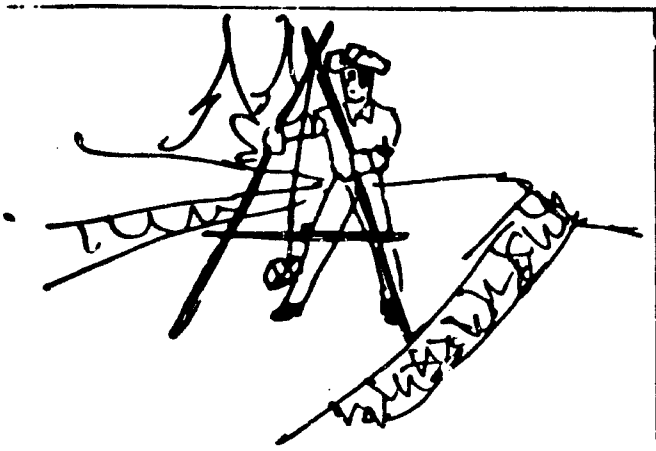
DECIDASE DE QUE ANCHO QUIERE SU SEGUNDA TERRAZA (DEPENDE DEL % DE LA PENDIENTE DEL TERRENO) LUEGO TRACE OTRA LINEA A NIVEL.



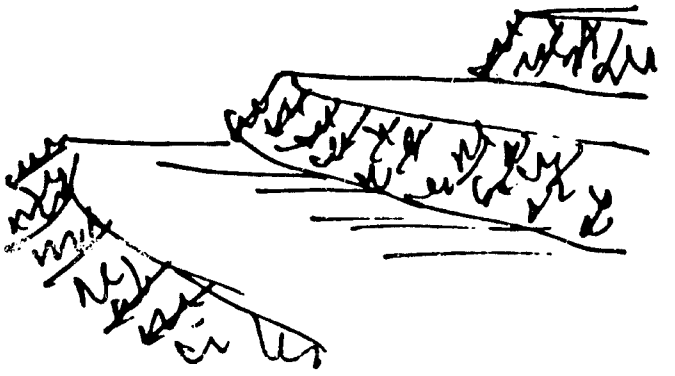
QUITE LA CAPA BUENA DE UNA PARTE DE LA SEGUNDA TERRAZA Y TIRELA ENCIMA DEL SUBSUELO QUE FALTA POR CUBRIR DE LA TERRAZA DE ARRIBA.

NIVELAR CADA TERRAZA ANTES DE EMPEZAR EN LA SIGUIENTE. 1° EL PIE DEL TALUD.

2° LA ORILLA DEL TERRAPLEN.

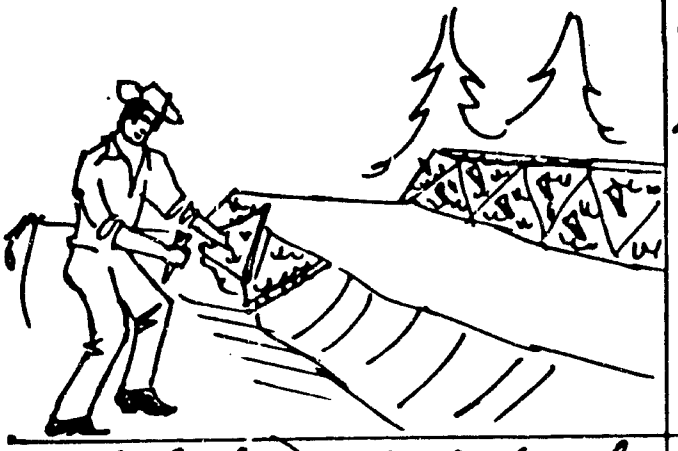


TERCERO, EL TERRAPLEN DEBE TENER SUFICIENTE DESNIVEL HACIA ADENTRO PARA ALMACENAR TODA LA LLUVIA QUE CAE EN LA TERRAZA.

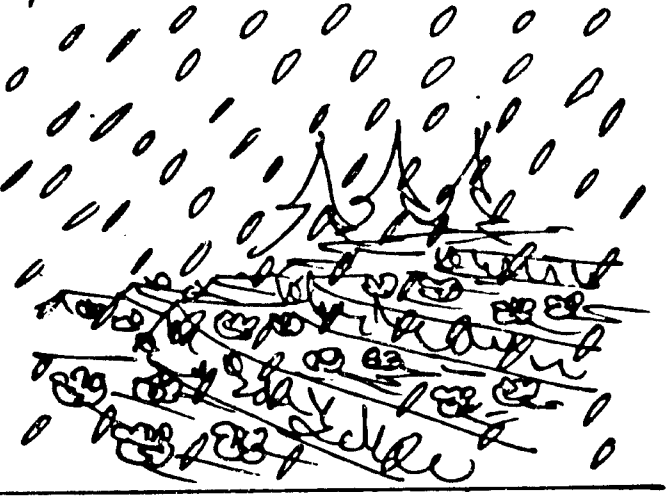


REPITA ESTE PROCESO, GUARDANDO LA CAPA BUENA HASTA QUE TERMINE TERRAZEANDO TODO SU TERRENO.

TRANSPLANTE LOS TALUDES CON SU NUEVO CULTIVO DE GRAMAS O PLANTAS PERENNES EN FORMA DE TRIANGULO.



LAS TERRAZAS SON MUY EFECTIVAS PARA ATRAPAR Y ALMACENAR LA LLUVIA.



LAS SIEMBRAS Y LIMPIAS (CALZADAS) ATRAVEZADAS FACILITAN LA ABSORCION DEL AGUA Y EL MANTENIMIENTO DE SUS TERRAZAS.

274 CAMPESINOS GUATEMALTECOS CON SUS TERRAZAS HAN AUMENTADO, COMO PROMEDIO SUS COSECHAS DE MAIZ: 141 % DE INCREMENTO; PAPAS: 98 %; FRIJOL: 95 %; TRIGO: 81 % EN EL PRIMER AÑO.

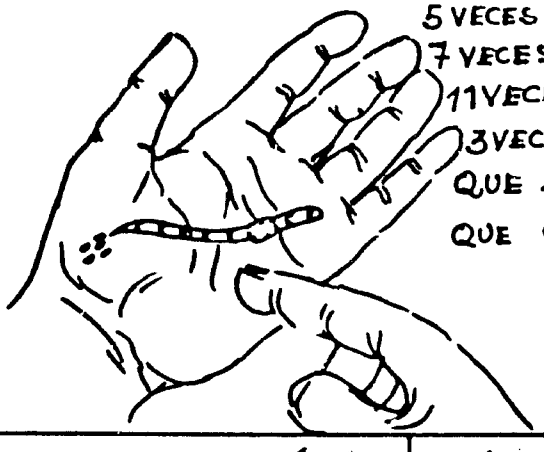
# Folleto de Conservacion de Suelos.

Por:

# "Lombrices"

Ing. Agr. Jerome E. Arledge.
Ilustró: Gustavo Pineda

LAS LOMBRICES TIENEN BOCA Y ANO.
LA LOMBRIZ AL COMER LA MATERIA ORGÁNICA PRODUCE ESTIÉRCOL, QUE ES:



5 VECES MÁS RICO EN NITRÓGENO
7 VECES MÁS RICO EN FÓSFORO
11 VECES MÁS RICO EN POTASIO Y
3 VECES MÁS RICO EN MAGNESIO
QUE LA MATERIA ORGANICA QUE COMIÓ.

SÍ, ASÍ ES JUAN, UN TERRENO CON LOMBRICES ES MÁS RICO EN ABONO ABSORBE LAS LLUVIAS PORQUE LA TIERRA ES MÁS FLOJA, ENTONCES AUMENTAN LAS COSECHAS.

PEDRO, ES POR ESO QUE EN NUESTRAS TIERRAS, QUE NO TIENEN LOMBRICES, NO PENETRA RAPIDAMENTE LA LLUVIA, LA MAYOR PARTE SE PIERDE HASTA LOS RÍOS, SE CAUSA EROSIÓN, NO SE DESARROLLAN BIEN LOS CULTIVOS Y LA PRODUCCIÓN ES MUY POCA.-

¿JUAN, CÓMO PODEMOS AYUDAR A LAS 1,600 CLASES DE LOMBRICES DE LA TIERRA, A MEJORAR NUESTRAS TIERRAS?

ES IMPORTANTE NO QUEMAR NI ENTERRAR LA MATERIA ORGÁNICA MUERTA. SI CUBRIÉRAMOS NUESTRAS TIERRAS Y ARREGLÁRAMOS NUESTRAS PLANTAS CON UNA CAPA DE ELLA, SUFICIENTEMENTE PROFUNDA DONDE NO PUEDA CRECER EL MONTE

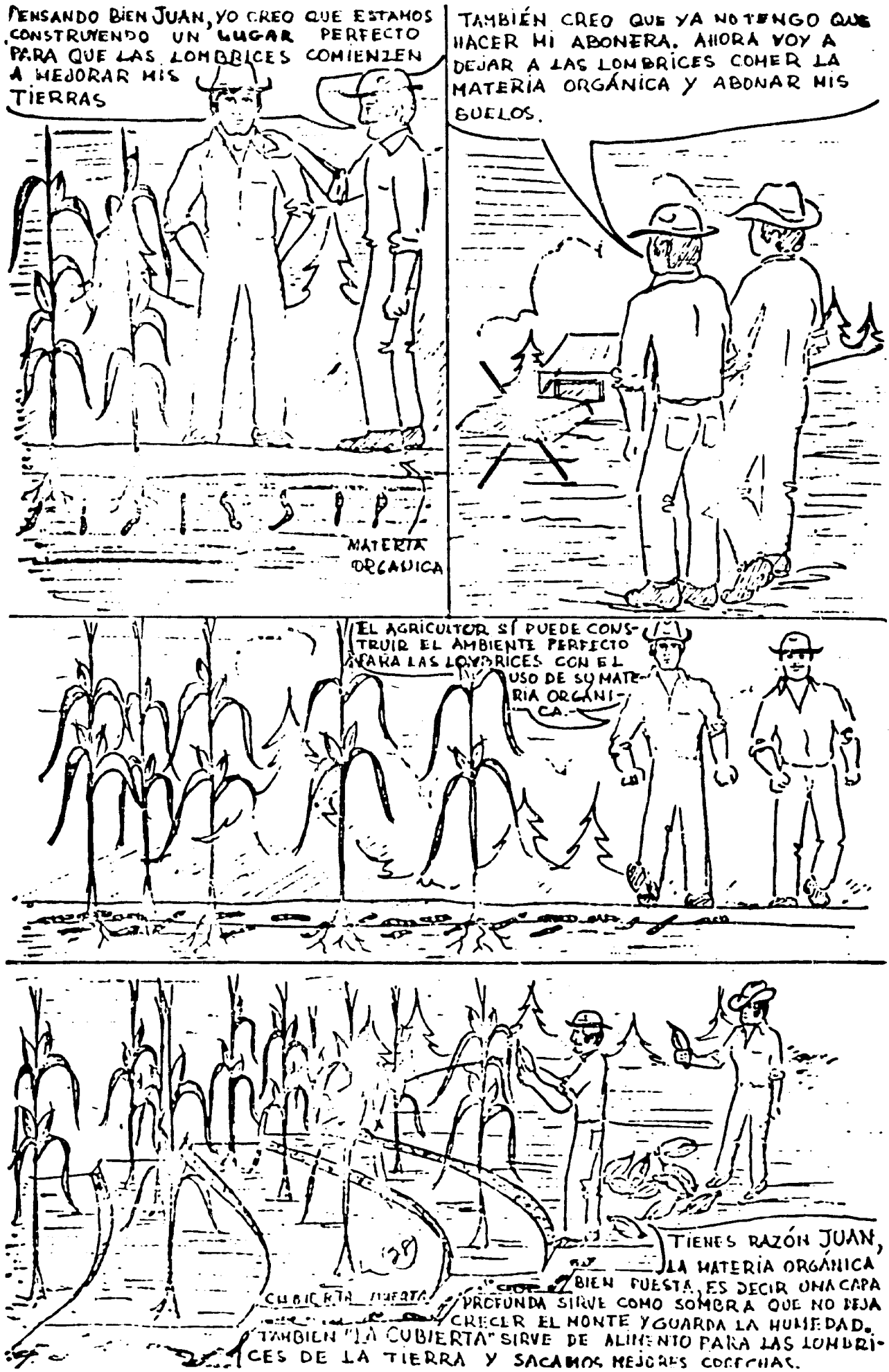
CARLOS. ¿TÚ QUÉ CREES QUE PASARÁ?

BUENO, NO PUEDE CRECER EL MONTE, NO SE PUEDE SECAR LA TIERRA PORQUE LA MATERIA ORGÁNICA ESTÁ DANDO SOMBRA A LOS SUELOS

MATERIA ORGÁNICA

SÍ CARLOS, SI HAY SOMBRA, LA TIERRA ESTÁ HÚMEDA Y SE PONE SUAVE LA MATERIA ORGÁNICA, ENTONCES AYUDAMOS A LAS LOMBRICES.

MATERIA ORGÁNICA


PENSANDO BIEN JUAN, YO CREO QUE ESTAMOS CONSTRUYENDO UN LUGAR PERFECTO PARA QUE LAS LOMBRICES COMIENZEN A MEJORAR MIS TIERRAS
MATERIA ORGANICA
TAMBIÉN CREO QUE YA NO TENGO QUE HACER MI ABONERA. AHORA VOY A DEJAR A LAS LOMBRICES COMER LA MATERIA ORGÁNICA Y ABONAR MIS SUELOS.
EL AGRICULTOR SÍ PUEDE CONSTRUIR EL AMBIENTE PERFECTO PARA LAS LOMBRICES CON EL USO DE SU MATERIA ORGANICA.
CUBIERTA VIVA
TIENES RAZÓN JUAN, LA MATERIA ORGÁNICA BIEN PUESTA, ES DECIR UNA CAPA PROFUNDA SIRVE COMO SOMBRA QUE NO DEJA CRECER EL MONTE Y GUARDA LA HUMEDAD. TAMBIEN "LA CUBIERTA" SIRVE DE ALIMENTO PARA LAS LOMBRICES DE LA TIERRA Y SACAMOS MEJORES COSECHAS.