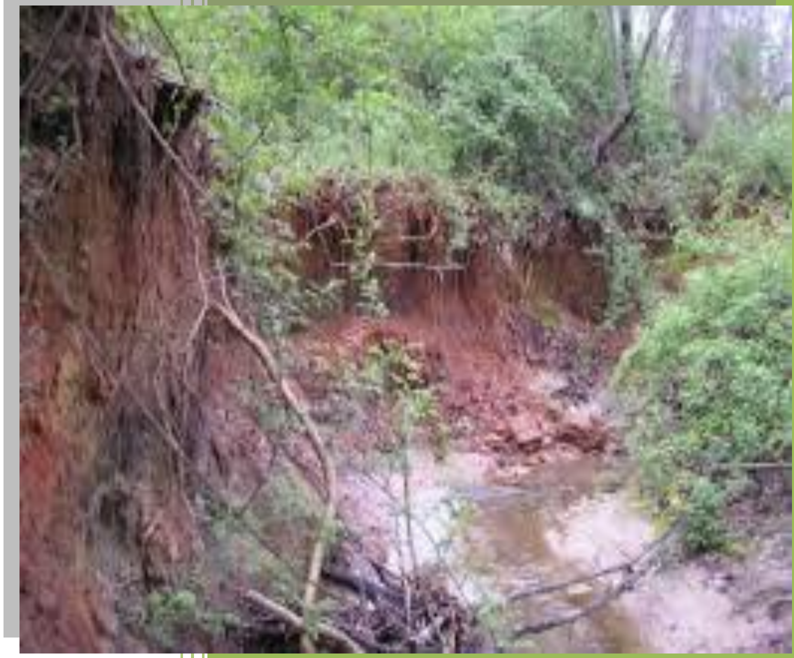
Guidelines for Soil & Moisture Conservation
Ama Jungle Yojana (AYY)



Guidelines for Soil & Moisture Conservation activities in Ama Jangla Yojana (AYY)

The Ama Jangala Yojana or the Community Forest Protection and Management Program is being implemented in the State of Odisha with the assistance from CAMPA, MGNREGA, NRLM and State Plan. The twin aim of this scheme is restoration of degraded forests and enhancing income of people living in the vicinity of such forests so as to reduce their dependence on the forests, simultaneously providing them with energy efficient options.

The major interventions under this scheme are not only to be decided by the community, but also to be implemented by the community. However, the Project Executing Body is to fascilitate implementation of various components envisaged under the scheme in the field.

Soil & moisture conservation is one of the important activity in the degraded forest area which are primarily aimed to be treated under the Ama Jangla Yojana in joint forest management mode to fulfill the broad objective of conserving fertile top soil, enhancing soil moisture regime and diverting and conserving surface run off for reducing erosion. Basic principle reckons that the lands (arable & non-arable) should be treated and put to sustainable use as per their capability.

While numbers of SMC works are to be undertaken in the project areas, the processes and procedures followed by the implementing teams in planning, designing, preparing cost estimates and execution of various measures are matters of concern. Planning, designing and implementation of SMC measures warrants that the implementing team possesses certain basic knowledge of hydrology and engineering aspects and are conversant of principles relating to agriculture. Inadequacy of such knowledge and minimum of investigations would certainly lead to non performance of the structures/ measures failing to accrue desired results raising serious doubts on the cost-effectiveness of whole investment. With a view to bring in improvement in field practices and ensure adequate basis for various land based SMC measures these guidelines in respect of soil and moisture conservation works under AJY are prescribed.

1. Approval of Norms of Technical Sanction

a) The estimates of soil and moisture conservation activities will be prepared by the VSS in assistance with partner NGO and these would be submitted to the FMU chief after due checking by the member secretary.
b) The technical sanction of the works will be accorded by the Range officer and administrative approval will be given by the DFO concerned.

2. Hydrologic Survey

a) Contour map of area allocated to the VSS, prepared during the micro plan preparation, will be used for executing SMC works in the field; 1: 5000 scale map with contour interval of 5-10 m will be ideal for this purpose.
b) The coordinates of the structures would be taken by the GPS/Mobile app during micro plan as well as prior to implementation. The coordinates thus taken should be sent to the GIS cell of Project Unit for record and reference.
c) From the contour map, slope group map and drainage map will be prepared. Data related to rainfall, temperature, number and discharge of different water courses will also be

collected from secondary sources such as district / block offices etc.

d) Reconnaissance survey will be done to locate different types of existing structural measures, water resource development measures such as irrigation tanks, percolation ponds, dugout ponds, check dams in drainage lines, dug wells etc.
e) Needs of farmers, extent of degradation of land and water resources, runoff and erosion pattern to be collected through field visit and available records/ reports.
f) Assessment of runoff and soil loss shall be made through discussion with the locals, survey of tank/ pond and stream beds, water marks on the banks of drainage lines, culverts, bridges, etc.
g) Detailed topographic survey will be required to be carried out for the sites where water harvesting structures/ percolation ponds/ check dams etc. will be proposed.
h) Estimation of peak rate of runoff and water yield for design of structures will also be made.

3. Engineering Survey & Design

a) Levels of ground shall be taken along the channel (longitudinal section) at different points on both upstream as well as downstream and across the channel/ stream at suitable intervals (cross section) where the structure/ bund / embankment is proposed to be constructed to take stock of channel geometry, bed slope, bank stability.
b) Contours will be marked on the proposed site with the help of hand level/ A-frame/ Hydro-marker.

4. Key Steps to be followed

a. SMC planning shall start from micro plan preparation to be initiated by the PNGO team during first year of the project. SMC planning procedures enumerated in the Micro Plan Preparation Hand Book will be the basis for selecting any intervention.
b. Broad treatment requirements of SMC shall be worked out by conducting land use survey of the whole area. Tentative cost involvement for each measure shall be determined.
c. Treatment priorities for area shall be determined in consultation with the local communities/ VSS without undermining grossly the ridge to valley approach.
d. Actual & detailed planning shall take place during the course of annual action planning process each year.
e. Detailed site survey need to be conducted following standard engineering procedures.
f. Proper design of different SMC measures is possible only after thorough survey and calculations based on empirical formulae.
g. Parameters such as rainfall intensity, runoff, soil, slope, land cover, proposed land use, etc. need to be thoroughly accounted for while working out hydrologic, hydraulic and structural designs for major engineering structures.
h. After the design is made and drawing/ sketch (section view, plan view, elevation etc.) is completed the cost estimation will be carried out. A sound design could lead to a technically feasible and cost-effective structure.
i. Estimates shall be prepared basing on the cost norm for soil and moisture conservation measures of Forest and Environmental Department, Govt. of Odisha, {Communicated vide Order No. 149/12 F (Affn.) 247/2012, Dated: 16th Februry,2015 of PCCF, Odisha }
j. When the activities planned are not covered under the cost norm provided by PCCF, Odisha, the CAMPA guidelines /Scheduled of rates of Govt. of Odisha 2013 of Works Department, Government of Odisha should be followed.
k. Pre-design survey, preparation of design and cost estimation for different SMC works need to be completed before successive year's annual action plan is prepared.

l. VSS and PNGO should be adequately trained to understand the simple/ basic arithmetic calculations, prevailing rates for some commonly adopted works items. On site training and lay out marking has to be provided to the VSS members.

5. Basic Records to be maintained at VSS/Member Secretary level

a) Stock register :
Details of construction materials received and utilized for construction need to be maintained properly by the VSS. Permanent stock register and is to be maintained at member secretary level & stock register for consumable items need to be maintained at VSS level.

b) Measurement Book:
Measurement book should be issued from project management office after proper entry and attestation. Measurement Book needs to be maintained by the VSS secretary properly with correct entries on volume and type of work done. It has to be check measured by the concerned member secretary. Disbursement certificate will be given by the president of VSS.

c) Payment Sheet:
Information on the names of the persons involved in labour/ mason work, person days engaged, volume of work done with payees' signatures etc. need to be available and counter signed by the secretary VSS.

d) Project Control Register:
Details of expenditure and work done for different projects executed under one VSS need to be properly entered into the PCR.

e) Design, Drawing & Bill of Quantity:
VSS should be in possession of an abstract of design of the proposed structure, engineering drawing and bill of quantity in support of break up of costs for smooth execution of works.

6. Check & Balance Procedures

a) At least 25 percent of the works (major earth works) should be cross verified through check measurements by the Forest Ranger/ACF on sampling basis. The DFO should conduct measurements in his presence for at least 5 percent of the works.

b) Proper layout of the SMC structures and measures shall be given by the concerned member secretary as per the design and for some complicated designs necessary on-site advices must be sought from the Forest Ranger /ACF/ DFO or experienced engineers available within the Block.

7. **Miscellaneous**

a) Soil moisture conservation works should commence soon after the rainy season.

b) Vegetative conservation measures be given due importance. Also sustainability of structural components to a great extent can be achieved through reinforcement of vegetative measures with mechanical measures.

c) Bio-engineering measures should be encouraged more and more from stability point of view. SHGs/VSS can raise seedlings of Vertiver, Sabai etc. which can be tagged in advance with the executants of structures for utilization.

d) Frequent training of the grassroots level functionaries is necessary. Person guiding the workers should have basic knowledge about level, slope and contour etc. Practical training in the field should be emphasized. The PNGO, volunteers and workers should be exposed to key contour line, longitudinal and cross-sectional level survey of drainage line at structure site.

e) Project Unit level officers should bear responsibility of guiding technical training activities, review work plans and field activities and should be involved in the identification and solving of the problems.

f) Defective works to be remedied by a joint visit of senior officers like RCCF/ DFO/ACF, suggesting precautions to avoid the defects. Renovation of old/damaged water bodies can be taken up if considered viable and cater to the requirements of villagers on resolution by the VSS committee with pre and post measurement of size and depth.

g) A brief note on soil and water conservation measures is appended for guidance.

APPENDIX

BRIEF NOTE ON SOIL AND WATER CONSERVATION MEASURES

Of the total amount of rainfall arriving at the surface, part infiltrates and the remainder becomes runoff, which concentrates in natural zones of depression. As runoff increases, so does its velocity, volume and its ability to cause erosion. Efficient control of erosion due to rainwater run off can be achieved by systematic planning and protection of the area from runoff, land preparation, cultivation of crops and soil cover. The measures required for soil and water conservation can be broadly divided into two categories, i.e., mechanical measures and biological measures.

Mechanical Measures

The structures, among others include bunds, terraces, trenches, grassed waterways, diversion drains and gully control

1. Bunds

- ✓ Bunds are more or less like narrow base terraces, and consist of earth embankments built across the slope of the land.
- ✓ They are also constructed along filed boundaries and are then referred to as peripheral bunds and field bunds.
- ✓ Based on the functional requirements, bunds can be divided into two types.
  - o Contour bunds – constructed for storage water
  - o Graded bunds – constructed for safe disposal of excess water.

Objectives

- ✓ Reducing the runoff velocity before attending erosive velocity.
- ✓ Checking the soil loss.
- ✓ Improving local soil moisture profile.

1.1 Contour Bunding

- ✓ Contour bunds are constructed following the contour as closely as possible.
- ✓ A series of such bunds divide the area into strips and acts as barriers to the flow of water, thus reducing the amount and velocity of the runoff.
- ✓ No cultivation is allowed on the earthen embankments.
- ✓ Under these bunds an area of about 5% is lost, i.e. not available for cultivation.
- ✓ Studies have shown that contour bunds result in a saving of soil ranging from 25 to 162 tons/ha/annum.
- ✓ In addition to controlling soil erosion and maintaining soil fertility, the construction of bunds helps in better infiltration of water into bunds ultimately replenishing the groundwater.

Suitability

- ✓ In un-bunded agricultural lands with 2.6% slope (maximum 10%)
- ✓ Area having low annual rainfall (less than 800mm)
- ✓ All permeable soils except black cotton soil.

Distance between two bunds

- ✓ Greater the rainfall and greater the slope, lesser shall be the distance
- ✓ More permeable the soil, greater the distance.

Thumb rule

- ✓ Vertical interval between two successive contour bunds is fixed at 1m.
- ✓ On higher slopes, bund should be closer, but not closer than 30m.
- ✓ On lower slopes, bund should be far, but not far than 60m.

Design of contour bund

- ✓ Design of contour bund involves the selection of vertical and horizontal intervals and determination of bund cross section.
- ✓ The criteria for fixing the vertical interval is same as discussed under graded terrace.
- ✓ The cross section of the bund is determined by fixing the side slopes, base width and top width.
- ✓ The height of the bund should provide sufficient storage behind the bund to handle the expected runoff. But in any case it should not be less than 45 cm.
- ✓ In practice, capacity is provided to take care of runoff from rains expected in 10 year's recurrence interval.
- ✓ The maximum runoff volume is estimated from the maximum amount of rainfall expected during the recurrence interval and infiltration characteristics of the area.
- ✓ The height of bund should be provided with a freeboard of 20% of the design depth.
- ✓ The top width varies from 30 to 90 cm, depending on the height of bund (greater the height, more should be top width).
- ✓ The side slopes depend on the nature of the soil. The following side slopes should be provided.

Recommended side slopes for different soil

Type of soil	Side slope (H.V)
Clay	1:1
Loam	1.5:1
Sandy	2:1

- The base width depends upon the depth of water and soil type.
- The base should be sufficiently wide so that the seepage line does not go in the middle.

Don'ts

Never excavate continuously as it may cause formation of channel.

Construction steps

- ✓ Layout for construction should be started from the top of the catchment.
- ✓ A horizontal line along the slop is marked at one end of the field.
- ✓ Using a pipe level, contour line is demarcated up to the end of the field.
- ✓ Next line for contour bund is demarcated on the line with elevation difference equal to vertical interval.
- ✓ Soil for construction of bunds should be taken from burrow pits of suitable chosen size.
- ✓ Size of burrow pits should be as per required volume of earth required for bund,
- ✓ Normal size of burrow pit is 3x3x0.3 m or 3x3.3.0.45 m.
- ✓ A space of 0.3 m is provided as the gap between the bund burrow pit which is called as berm.

- ✓ All bunds from the top are constructed to their full sections.
- ✓ All the burrow pits should be uniform in size and the berm gap should be uniform.
- ✓ Ramps are provided for the free passage of cattle, implements etc. One the bund .
- ✓ Suitable vegetation protection must be provided to ensure stability of the bund

Maintenance

✓ Due to lack of maintenance much of the expected benefits are lost and in certain cases, degradation may bring even more damage. The neglect in maintenance of even a single contour bund would endanger the whole system in lower reaches. So before rainfall, following repairs or maintenance works should be attended to:

- ✓ Firm plugging of all breaches.
- ✓ Filling up all sags in bunds
- ✓ Restoration of proper height and section.
- ✓ Plugging of all rat holes.
- ✓ Repairs of damaged outlets and bunds.
- ✓ Growing grasses and trees on bunds.

1.2 Graded Bund

- ✓ They are used for safe disposal of excess runoff in high rainfall areas and regions where the soil is relatively impervious.
- ✓ They may have uniform grade or variable grade.
- ✓ Uniform graded bunds are suitable where the length of bunds and discharge are more.
- ✓ Variable grades are provided in different sections of the bund so that the velocity of flow is within non-erosive limit.
- ✓ Normally bonds deconstructed along a suitable grade and water is allowed to flow behind the bond.
- ✓ The designed of the graded bond involves the selection(or)determination) of vertical interval, grade and cross section are discussed earlier (under contour bund and graded terrace).
- ✓ The required capacity of the channel is determined by using the Rational method.
- ✓ The dimensions of the channel can be obtained by applying the Manning’s formula.

Objectives

- ✓ Breaking the length of slope and removing excess water at a non erosive velocity.
- ✓ Checking soil loss.
- ✓ Improving local soil moisture profile.

Suitability

- ✓ Unbunded agricultural land with 2-6 % slope.
- ✓ Where a suitable water course or drainage line is available in nearby area.
- ✓ Area having high annual rainfall(more than 800mm).
- ✓ Soil having low infiltration rate.

Grade

- ✓ In general a grade of 0.2 to 0.4 % is provided depending on soil type and location of drainage line.
- ✓ For permeable soil, grade of 0% at upper end and 0.5% at out let end.
- ✓ For impermeable soil, grade of 0.2% at upper end and 0.4% at out let end.

Channel cross section

The channel cross section should be such that it is of adequate size to carry the excess runoff at safe velocity and simultaneously permits the farming operation without any obstruction.

Maximum depth of 0.45 m. with a minimum side slope of 5:1 or more flatter. The cross section should be 1.0 %

Construction steps

- ✓ The first bund shall be located at a spacing of 1.5 times the vertical interval from the ridge.
- ✓ Demarcation of contour line for graded bund is as per the demarcation of contour bund.
- ✓ Graded lines are demarcated by lime with suitable grade at different interval.
- ✓ This line is the upstream edge of the bund. Considering the bottom width, the downstream line of the bund is also to be demarcated by lime.
- ✓ The channel of suitable size should be constructed (the width of the channel should be demarcated) at the upstream end leaving a space of minimum 1.0 m. from the upstream side of the bund.
- ✓ The volume of earth work in channel should be approximately equal to the total volume of bund after the settlement.
- ✓ The waterways or channels must be protected with suitable vegetative barriers /stone check or drops at suitable intervals.
- ✓ Suitable vegetative protection must be provided to ensure stability of the bund.

Maintenance

The graded bund should be inspected after heavy rainfall. The undue settlement in the bund, the places of depression excessive grade in the channel causing scouring and rill formations and excessive inter bund erosion should be inspected. Levelling, cutting or filling would eliminate the defects. For maintenance, the dead furrow should be always in the centre of the channel and the back furrow at the top of the ridge. Proper farming practices protect the cross- section from being reduced and help in constant build-up and easing the side slopes. Perpendicular crossing of the bund should be avoided. The counter bund may be planted with suitable grassed or vegetation. Proper and timely maintenance of grassed waterways are essential.

Limitations

- ✓ The main limitation of a graded bonding system is the requirement of grassed waterways (for diverting extra water) whose construction and maintenance requires the cooperation of several farmers.
- ✓ The water once removed from field cannot be brought back easily unless stored in ponds near to the individual fields
- ✓ Sees and seedlings in the channel, particularly, in the lower reaches, may get washed away if have shower occur at that time.
- ✓ Weeds which get collected in the channel portion thrive well under the better moisture regime which if not removed periodically may become a source of propagation into the fields.

1.3 Compartmental Bunding

Objective

- ✓ Breaking the length of slope.
- ✓ Checking the soil loss.
- ✓ 'Improving local soil moisture profile.

Suitability

- ✓ In irregular sized and very small and holdings.
- ✓ Where field boundaries/ bunds exists or in unbunded land.
- ✓ Where laying of contour or graded bund is not practically possible, mainly due to resistance of farmers.

Dimensions

The general dimensions should broadly follow the dimensions of contour bund. Since, the bund length per hectare is much more than the calculated length of bund in general are less than the dimensions of contour bund. Generally, cross section is decided keeping the existing side bunds which run along the slope is not constructed/renovated. Only the existing field bunds across the slope is renovated after talking the pre measurement of the length and section .provision of series suitable outlet for each bunding is a must considering the total runoff t5o be handled/cumulative runoff from the catchment.

1.4 Semi-Circular Bunds

Semi-circular bunds are earth bunds in the shape of a semi-circle with the tip of the bunds on the contour.

Purpose

These bunds are constructed to increase soil moisture and reduce erosion.

Location

Semi-circular bunds are suitable on gentle slopes (normally below 2%) in areas with annual rainfall of 200-750 mm. The soils should not be too shallow or saline. These bunds are easily constructed on uneven terrains.

2. TRENCHING

Trenches are dug around the hill slope at a given contour especially used for treating non-arable area of hill slopes. Continuous contour trench is recommended in the upper reaches of watershed. Trenches that are dug on contour lines is called as counter trench, whereas the trenches constructed continuously are called as continuous contour trenches.

Purpose

Trenches are suitable for erosion control in hills. These trenches intercept the runoff which enters into soil and increases soil moisture status. They hold water in upper reaches leading to increased percolation and soil moisture and recharge of ground water and to reduce erosion.

Location

Cultivable barren hillocks and common fallow lands with steep slopes in the upper reaches, usually in degraded forest lands, revenue lands and common lands.

- Adopted for hill slopes >20%
- Normal size: 1000 cm^2 to 2500 cm^2
- Continuous or interrupted
- Stone terraces and walls can be constructed whether stones are available

2.1 Contour Trenching

Contour trenching is excavating trenches along a uniform level across the slope of the land in the top portion of catchment. Bunds are formed downstream along the trenches with material taken out of them. The main idea is to create more favourable moisture conditions and thus accelerate the growth of vegetation.

Design

Plants are put on the trench side of the bunds along the berms. If not continuous, trenches are not more than 15m long and are generally staggered. The side slopes of the trenches shall be 1:1 or 0.5:1, according to the nature of the soil.

- ✓ Vertical interval between two successive contour t5renches is fixed at 1m.
- ✓ Trench should be closer, but not closer than 10m on higher slopes.
- ✓ Trench should be far, but not farther than 30m on lower slopes.
- ✓ Depth: 30-50cm, width:30-50cm.
- ✓ Practically adoptable size 45cm x 45cm.

Dimensions

For continuous trenches/ staggered trenches with the in between gap equal to length of trench, the runoff from the contributing area is estimated for 2 year frequency and the following formula is used to work out the dimensions.

$$Q = \frac{W \text{x} D}{100 HI}$$

Where,

Q=depth of runoff rom area in cm

W=width of trench in cm

D=depth of trench in cm

HI=horizontal interval in metres

Staggered trenches with gap not equal to length of trench:

$$Q = \frac{W \text{x} D}{100 HI (1 + X/L)}$$

X=gap between trenches in m

L=length of the trench in metres

For convenience of layout and construction, shorter lengths of 3.5 or7 m are generally adopted.

Step wise practice

- ✓ Measure the slope in one section of the ridge area.
- ✓ Join the highest point and lowest point along the slope by a straight line with a rope and lime (wet).
- ✓ Calculate the interval between successive lines of trench.
- ✓ On the straight line, mark points at the calculated interval.
- ✓ Demarcate the contour line starting from each of the mark points (using A-frame, pipe level).
- ✓ Excavate trenches along the demarcated contour line starting from the mark so that when the trench is filled with rain water, water remains at the level of the marked. Contour line or below.
- ✓ Always start excavation from the highest contour line.
- ✓ Pile the excavated earth at least 20cm, away from the trench in the downstream side.

- ✓ Deposit stones, gravels found during excavation/or collect freely available material nearby area in a layer of 1.0 ft/ or promote soil binder grass in the upper edges of the trenches.
- ✓ Suitable plantation works must be undertaken in the lower edge of the trench.

Suitable time

- ✓ Trenching is preferably carried out during winter and spring so that sowing and planting can be done during first monsoon.

Do's and Don'ts

Do's

- ✓ Boulders and gravels from excavation should be stalked on the lower side of the bund / spoil bank to serve as the toe of the bund.
- ✓ Top soil should be kept towards the trench as it can be used for refilling if necessary.
- ✓ Protection of trench area from animal and human interference.

Don'ts

- ✓ Do not go for trenches when slope is more than 25% or less than 10% Vegetative measures to be adopted in slopes more than 25% and contour bunding to be adopted in slopes less than 10%.
- ✓ Do not excavate trench across drainage line.
- ✓ Do not excavate trench when roots are encourntered or in the area of thick vegetation.
- ✓ Do not go for plantation inside the trench.
- ✓ Do not go for trench in excessive hard/stony earth and where loose stones are plentily available, instead go for stone bunding/stone wall terrace.
- ✓ Do not go for CCT in high rainfall areas; instead go for staggered trench in combination of 2 or 3 nos.

Purpose

To hold water in upper reaches leading to increased percolation and soil moisture and recharge of ground water and to reduce erosion

- Reducing the run off velocity.
- Checking soil loss.
- Improving local soil moisture profile

Location

Continuous contour trench is recommended in the upper reaches of watershed. It is also recommended for cultivable barren hillocks and common fallow lands with steep slopes in the upper reaches, usually in degraded forest lands, revenue lands and common lands.

Slope = 10-25% (max-33%)

Soil depth = Minimum 7.5cm (3.0 inch)

- Vertical interval between two successive contour trenches is fixed at1.00m (3ft)
- On higher slopes, trench should be closer, but not closer than10m.(30ft)
- On lower slopes, trench should be far, but not farther than 30m.(100ft)

Construction steps

- Measure the slope in one section of the ridge area
- Join the highest point & lowest point along the slope by a straight line with a rope and lime (wet).

- Calculate the interval between successive line of trench
- On the straight line, mark points at the calculated interval
- Demarcate the contour line starting from each of the mark points (using A-frame, pipe level)
- Excavate trenches along the demarcated contour line starting from the mark so that when the trench is filled with rain water, water remains at the level of marked contour line or below.
- Always start excavation from the highest contour line
- Pile the excavated earth at least 20cm. away from the trench in the downstream side

Do's

- Deposit stones, gravels found during excavation/or collect freely available material in nearby area in a layer of 1.0ft / trench or promote soil binder grass in the upper edges of the
- Suitable plantation works must be undertaken in the lower edge of the trench

Don'ts

- Do not go for trenches when slope is more than 25% or less than 10%v Vegetative measures to be adopted inslopes more than 25% and contour bunding to be adopted in slopes less than 10% .
- Do not excavate trench across drainage line
- Do not excavate trench when roots are encountered or in the areas of thick vetegation
- Do not go for plantation inside the trench
- Do not go for trench in excessive hard/stony earth and where loose stones are plentily available, in stead go for stone bunding/ stone wall terrace.
- Do not go for CCT in high rainfall areas, in stead go for STAGGERED TRENCH in combination of 2 to 3 nos. of Water Absorption Trench.

Important to note

- Most suitable in steep & irregular sloping lands and high rainfall areas.
- In highly undulating land align trench in the direction of flow of water (as shown in fig-4)
- Boulders & gravels from excavation should be stalked on the lower side of the bund/spoil bank to serve as the toe of the bund.
- Top soil should be kept towards the trench as it can be used for refilling if necessary.
- Trenching is preferably carried out during winter and spring so that sowing and planting can be done during the first monsoon.

Protection of trench area from animal and human interference is a must till it is fully covered by vegetation until achievement of the desired results.

3. Loose Boulder Structure (LBS)

These are the structures made up of loose stones and boulders in upper reach gullies. It reduces velocity of runoff water and trap silt and soil which promotes vegetation in the upstream side.

Suitability

- ✓ Gully size of 1.2 to 1.5 m . depth with contributory runoff area less than 2.00 ha.
- ✓ Area where plenty of stone and boulders are available.

Location

Gully size of 1.2 to 1.5 m. depth with contributory runoff area less than 2.00 ha and areas where plenty of stone and boulders are available are suitable for construction of LBS. The specific requirements are:

- ✓ Constructed in series on a drainage line.
- ✓ Independent catchment of LBS should not be more than 1 ha.
- ✓ Should not be constructed where bed slope is more than 20%.
- ✓ Locate the structure where the upstream slope is flatter to store more water and more recharge
- ✓ Height of gully = max depth of flow in stream + design height of structure in central portion of gully.
- ✓ Smaller angular stones (not less than15cm preferably 20-25 cm or1kg) can be used to interior portion.
- ✓ Angular stone is preferred for greater stability.
- ✓ Shale, lime stone or any loose rock should not be used as these disintegrate when comes in contact with water.
- ✓ The largest boulder must be placed at the lowermost edge of the d/s side of the LBS and preferably be anchored to ground.

Planning

- ✓ Identify the drainage line and start from the top, fix the topmost location of LBS.
- ✓ Walk 5m downstream, this is the d/s bottom edge of the LBS.
- ✓ Measure the slope of nala/gully bed over 10m Stretch starting from the bottom edge of 1 st LBS.
- ✓ If S>10%, HI=10m.//S<10%, HI>10m. (but in no case it should be beyond 50m.)
- ✓ And go on marking up to the end of the drainage line.

Design

- ✓ Maximum height = 1.0m (at the deepest section of gully / nalla).
- ✓ Top width= 0.4m
- ✓ U/S slope = 1:1 to 1:2, D/ S slope=1:2to1:4
- ✓ Provide a dip in the middle to avoid erosion at sides by directing max flow at the middle.
- ✓ Height of LBS at both side = height of embankment or1.5m. whichever is lower.
- ✓ LBS should be embedded 0.5m in to both the embankment stop/ prevent erosion where the LBS joins the embankment.
- ✓ If nalla/gully is hard and rocky, no base stripping is required, otherwise excavate max.0.25m.

Distance between two LBS

- ✓ On higher slopes, LBS should be closer, but not close than10m.
- ✓ On lower slopes, LBS should be far, but not farther than50m.

Construction steps

- ✓ Start construction from ridge to valley
- ✓ After finalizing the location, the site must be cleared by removing boulders and debris.

- ✓ Mark the bottom width and length of structure by lime and excavate trench with uniform depth of 45 cm (maximum) across the gully. Normal depth is 30.0 cm,
- ✓ The centre of the proposed site for LBS till it reaches on over the bed on nalla, if embankment is less than1.5m embankment only.
- ✓ From this line, draw two parallel lines at 20 cm. at both the u/s and d/s end up to the embankment (these two lines are the boundaries of crest, if top width is 40 cm.)
- ✓ Suppose upstream slope is 1:1 and downstream slope is 1:3 (a) Mark at 1.0 m perpendicular to u/s crest line (b) mark at 3.0 m distance perpendicular to downstream crest line. (these points are upstream end and downstream end of the LBS respectively and draw lines at both the sides)
- ✓ The LBS should be raised in horizontal layers.
- ✓ Using larger size stones laying in layer with proper interlocking fill up trench. Care should be taken so that last layer of the stone in trench is half inside the trench and half above the ground level.
- ✓ Use smaller stones to fill up the gaps in layers and use hammer or boulder to fix small stones for better stability of the structure.
- ✓ The upper portion is completed in the similar manner keeping the side slope in view.
- ✓ Care should be taken so that one layer of stone is interlocked with another layer of stone.
- ✓ The structure must keyed (extended) minimum of 1.5 ft into both side of the gully bank.
- ✓ Larger boulder must be placed outer sides (especially in downstream side).
- ✓ Care for maintaining both the slopes during raising of layers.
- ✓ Provide dip at middle, allow safe exit of excess runoff.

Dimensions	**Maximum**	**Usual**
Total Height	1.5m.	1.0m. or 3/4thof gully depth
Top Width	0.6m.	0.45m
Upstream side slope (H:V)	1:1.25	1:1
Downstream side slope (H:V)	1:2	1:1.25(1:2)

Important to note

- ✓ If it is not practically possible to follow the above method due to non-availability of sufficient boulders and highly undulating hilly topography, just locate the site as per people's choice keeping the technical point in mind.

Do's

- ✓ Locate the LBS only where the height of the stream embankment is greater than or equal to the sum of the peak depth of flow in the nalla and design the height of the structure.
- ✓ The top of the LBS should be lowest in the middle of the stream and highest at both of the embankment.
- ✓ The height of the LBS in the middle of the stream should be 1.0m above the ground level.

- ✓ Upstream slope of the LBS should be 1:1 while the down stream slope can vary from 1:2 to 1:4.
- ✓ The bed of the stream at the base of the LBS should be cleared of mud/ sand upto 0.25 m depth.
- ✓ The top of the LBS should be extended into either embankment by cutting a trench and filling it with boulders.
- ✓ Large boulders should be placed on the outer portion of the LBS.
- ✓ The use of angular boulder is preferred.

Don'ts

- ✓ Do not use boulders dug up from neighborhood as it increases soil erosion from that area.
- ✓ Do not use boulders less than 0.15m diameter.

4. Diversion Drains

Most effective control of gullies is by complete elimination of runoff into the gully or the gullied area. This may often by accomplished by diverting runoff from above the gully and causing it to flow in a controlled manner to some suitably protected outlet. It also effectively protects bottom land from hillside runoff and diverts water from uncontrolled areas.

Design

A diversion channel is constructed around the slope and given a slight gradient to cause water to flow to the desired outlet. The capacity of the diversion drains should be based upon estimates of peak runoff for the 10 year return period if it is to empty into a vegetative waterways. The design procedure is same as vegetated waterways.

5. Gully Plugging

a. Temporary Structure

Gully plugs (also called check dams) protects the gully beds by reducing the velocity of the flow, redistributing it, increasing its infiltration, encouraging silting and improving the soil moisture regime for establishing grasses and other vegetative cover. As far as possible such structures should have low heights, proper provision for dissipating kinetic energy, and be spaced closely enough. Such structures may usefully be combined with vegetative measures to help stabilization. Various types of gully plugs or temporary structures are made of locally available materials, earth, sand bags, loose rock dams, and others. Most readily available material and it is, therefore, easier and economical to construct earthen gully plugs where possible, but they require stabilization and vegetative cover. Loose rock dams are effective and longer lasting, but are economic only if the material is available on the site. For smaller amount of runoff to be handled, hedges or sod strip checks can also be effective.

Design criteria

The check dams should be extended far enough into the bottom and side of the gully to prevent washouts underneath or around the ends. Sufficient spillway capacity must be provided in the structure. The overall height of a temporary gully plug should not ordinarily be more than 75 cm. An average effective height of about 30 cm is usually considered satisfactory.

Spacing

Check dams theoretically should be spaced so that the crest elevation of one will be the same as the bottom elevation of the adjacent check upstream. However in practice a small grade is usually allowed in the gully bed to reduce the number of checks. A grade of 1% is usually allowed in fine sand and silt loam soils, and about 0.5% in silt and clay soil.

b. Permanent structure

Permanent masonry structure are very costly structures and, therefore, justifiable only in case of extreme erosion. Drop spillways, chute spillways, and drop inlet spillways are the basic permanent structures. These should be constructed only after considering the essential design parameters to avoid failures. Critical design is highly technical, and the relevant references must be consulted.

6. Stone wall construction

- Mark the contour line using pipe level.
- Excavate the trench up to 30 cm. depth and width up to 90 cm as per the suitability along the contour and deposit the excavated material on the upstream side of the trench.
- Arrange stones in layers with bigger stones at the bottom and downstream side with proper locking of smaller stones in the gap of bigger stones.
- Ensure proper locking between stones of different layers.

7. Conservation Ditches

This is basically construction of trenches along the contour in agricultural field where black soil is predominant. As black soil is having the typical characteristics of low infiltration rate, swelling and shrinking properties, construction of contour bund is not suitable because of frequent breaching. Graded bund is also not advisable because it disposes maximum water from the field. Hillside ditches consist of a series of shallow ditches built along the contour lines at appropriate intervals. Hillside ditches not only break long slopes into shorter segments to intercept surface runoff and serve as path way to facilitate farm operations and transportation. These are found to be suitable for slopes with a gradient of less than 40%.

Purpose

Conservation ditch is basically an inverted form of a contour bund (sunken into the ground) or a trench with flatter side slopes. Flatter side slope is provided for safety against scouring by incoming runoff. Along with the runoff, most of the eroded soil is stored in the ditch.

Location

Agricultural field with black soil or hillside slopes.

8. Check Dams

Check dams are the structures, generally constructed on a small river or nalla in order to break the flow of water during the monsoons, and allow it to seep into the soil. Check dams range in size, shape and cost. It is possible to build them out of easily available materials and even at a very little cost. Decision of building such a dam depends on its location. Essentially a check dam has an earthen dam and masonry spillway.

Purpose

- It cuts the velocity and reduces erosive activity
- The stored water improves soil moisture of the adjoining area and allows percolation to recharge the aquifers
- Spacing between the check dams should be such that water spread of one should be beyond the water spread of the other
- Height depends on the bank height, varies from 1 metre to 3 metre and length varies from less than 3m to 10m

Location

- A low weir normally constructed across the gullies
- Constructed on small streams and long gullies formed by erosive activity of flood water

8.1 Brushwood Check dam

Brush check dams made of posts and brush are placed across the gully. The main objective of brushwood check dams is to hold fine material carried by flowing water in the gully.

Small gully heads, no deeper than one meter, can also be stabilized by brushwood check dams. Brushwood check dams are temporary structures and should not be used to treat ongoing problems such as concentrated runoff from roads or cultivated fields. They can be employed in connection with land use changes such as reforestation or improved range management until vegetative and slope treatment measures become effective.

If soil in the gully is deep enough, brushwood check dams can be used in all regions. The gradient of the gully channel may vary from 5 to 12 percent, but the length of the gully channel, beginning from the gully head, should not be more than 100 meters. The gully catchment area should be one ha or less.

There are many types of brushwood check dams. The type chosen for a particular site depends on the amount and kind of brush available. Whatever sort is used, the spillway crest of the dam must be kept lower than the ends, allowing water to flow over the dam rather than around it. The maximum height of the dam is one meter from the ground (effective height). Both the upstream and downstream face inclination is 30 percent backwards. The spillway form is either concave or rectangular.

Technical specifications for Brushwood Check dam

Posts are set in trenches (0.3 by 0.2 m in size) across the gully to a depth of about 1/3 to 1/2 of the post length, and about 0.3 to 0.4 m apart. -The length of the posts is 1.0 to 1.5 m and their top-end diameter is 3 to 12 cm.

- Any tree or shrub species, locally available can be used as posts.
- The ends of interlink materials should enter at least 30 cm into the sides of the gully.
- The space behind the brushwood check dams must be filled with soil to the spillway.
- If sprouting species are selected as posts and interlink materials, brushwood check dams should be constructed when the soil in the gully is saturated or during the early rainy season.
- If non-sprouting species are used, brushwood check dams can be constructed during any season.

The primary materials used are brushwood, posts, or pegs and the filling materials are soils and stones. This can be used on small gully heads for stabilization. Posts or pegs to be used could be sprout-producing tree species available in the area. First, a foundation extending into the banks is dug. The brushwood is then placed between two rows of pegs driven in 40 cm apart across the gully bed. The distance between the rows is from 80-100 cm for gullies with about 5 m in width. The brushwood is then packed firmly and the two rows of pegs are tied together with wire. A notch or spillway of about half of the span and the top of the dam is then spared. On the lower side of the dam; brushwood is placed lengthwise to provide an apron that will prevent scouring by overflow. It is very important that these temporary structures are supplemented by cuttings and seedlings, which will replace the brushwood when decayed.

8.2 Log check dams

Log check dams made of logs and posts are placed across the gully. They can also be built of planks, heavy boards, slabs, poles or old railroad ties. The main objectives of log check dams are to hold fine and coarse material carried by flowing water in the gully, and to stabilize gully heads. They are used to stabilize incipient, small and branch gullies generally not longer than 100 m. and with catchment areas of less than two hectares.

The maximum height of the dam is 1.5 m from the ground level. Both its downstream and upstream face inclination are 25 percent backwards. Its spillway form is rectangular. In general, the length and depth of its spillway are one to two meters and 0.5 to 0.6 m .

8.3 Boulder check dams

Boulder check dams placed across the gully are used mainly to control channel erosion and to stabilize gully heads. In a gully system or multiple-gully system all the main gully channels of continuous gullies can be stabilized by boulder check dams. The maximum total height of the dam is 2m. Foundation depth must be at least half of effective height. The thickness of the dam at spillway level is 0.7 to 1.0 m (average 0.85 m), and the inclination of its downstream face is 30 percent (1:0.3 ratio); the thickness of the base is calculated accordingly. The upstream face of the dam is usually vertical.

8.4 Masonry check dams

Masonry check dams constructed with cement mortar and non-disintegrating stones are generally used in torrent control. The main objective of the dam is to hold fine and coarse material carried by flowing water in the gully or torrent. From a technical and economical point of view, it is not necessary to build masonry check dams to control channel erosion in gullies. Every kind of gully that is about 1000 m long and covers an area of 20 ha or less can be stabilized easily by boulder check dams. In a series of boulder check dams, the first dam can be built with cement masonry as well as those above and below a road at the junction points where the gully crosses it

8.5 Gabion Structure

If abundant stones are available but their shape and size makes them unsuitable for loose stone construction or expected water velocity is very high gabions can be used for construction check dams. A gabion is a rectangular shaped cage made of galvanized wire which is filled with locally found rocks or stones. To facilitate transport gabions are conveyed flat and are folded to required shape at construction site. The gabion check dams are made by connecting several gabion in both horizontal and vertical direction. An important advantage of gabion structure is its flexibility; it will shape itself according to stream bed when changes occur due to erosion without loosing its stability. After construction gabions are permeable but they will slow down water velocity considerably causing sedimentation and finally complete filling up behind the gabion check dam is achieved.

Vegetation establishment in gully control work

All structural measures used in gully control must be accompanied with vegetative measures to obtain a sound result.

- All structural measures should be completed in the dry season and the accompanying vegetative measures undertaken during the following rainy season.
- Suitable tree seedlings and cuttings must be planted just behind the structural measures.
- Shrub and grass cuttings must be planted between the structural measures.
- Tree and grass seeds should be sown between the structural measures, and on gentle, bare slopes which have sufficient soil.
- Gentle slopes which do not need any structural measures should be planted with tree seedlings, and grass and shrub cuttings.

9. Water Harvesting Structures

Water harvesting structures are intended to store rainwater flowing from the catchment for ground water recharge and lifesaving irrigation to the crops at a later time when the crops need it. Small-scale water harvesting is most successful when operated as a system with three components:

1) The watershed or catchment area that generates the runoff,

2) The reservoir which holds or collects the runoff, and

3) The serviced area where the harvested water is used for production.

Purpose

- To intercept and reduce runoff thereby inducing larger and extensive absorption of available rain water.
- To trap eroded materials thus reduces sediment production rate either in to streams or to the reservoirs.
- To create irrigation potential in mini commands
- To provide remunerative single or double crop base agriculture and generates regular or casual job opportunity in remote areas
- To increase total production and stabilized environment

Location

Water harvesting by external catchments is suitable in areas where there is a lot of uncultivated, open land available. It is not suitable in densely populated areas where most of the land is cultivated. Sites that are communally owned should be properly managed to ensure sharing among the intended beneficiaries.

Advantages of Water Harvesting Structures

- Runoff harvesting structures are small in size and low cost
- The construction can be completed in a time frame of less than a year without escalation of cost and can start functioning from subsequent rainy season
- The structures are small in size with a low reservoir capacity which can be filled up with a single shower of rain and become operative immediately in comparison to big reservoir. It can also be recharged / refilled number of times as against big reservoir.
- Runoff harvesting structures provide irrigation facilities even to the isolated remote areas and drought prone pockets where benefits may not flow from major medium or minor irrigation projects. The inter district, even intra block imbalance in development of irrigation facility can overcome to a great extent rectified by W. H. S.
- The runoff harvesting structures can provide protective irrigation to the lands close to the donor catchments and even to donor catchments by way of recycling the storage water by lifting.
- WHS constructed in remote rural areas can generate substantial casual and regular employment opportunity to rural labours through sustained profitable cultivation.

10. Percolation Tank

Percolation tank is a farm pond type structure constructed in relatively permeable soils in the upper reaches of the watershed to facilitate groundwater recharge. The runoff from the catchment gets harvested in the percolation tank where it gets sufficient time to slowly recharge the groundwater. The percolation tanks are generally constructed in the first and second order streams. The average catchment area in these streams is 50 ha. So, one percolation tank can be constructed in a 50 ha catchment area.

Purpose

The purpose is to arrest runoff, to enable collection and percolation of surface water in order to recharge the ground water table.

Location

Usually suitable in upper and middle reach in common/ revenue/degraded/forest lands. These percolation tanks are required to be constructed in hilly terrain where rainfall is inadequate or badly distributed and there is not enough time for the rain water to infiltrate and soak into the ground. It is observed that streams or nalas in such tracts get floods of short duration and remains dry for the major period. The percolation tanks are essential in these area to impound the short flow, spreading to large area and allow it to stand for long period so that water percolate down in to soil and recharge the ground water. The catchment should be above 40 ha.

11. V- Ditch

Where construction of contour bund is not possible, there conversation trenches like V-ditches are preferred. This is mainly done in black soils in Agricultural fields.

Purpose

- To conserve *in situ* moisture and reduce soil loss
- Circular basin of one meter dia for level lands depending upon infiltration and rainfall
- ‘ V’ ditches of size 5m x 5m with trees planted centre and height according to the rainfall and slope of sloppy lands
- Saucer basins / semicircular bunds with 2m diameter to a height of 15-20cm across the slope

12. Biological Measures

12.1. Contour cultivation

Contour cultivation is nothing but carrying out agricultural operations like planting, tillage and inter-cultivation very neatly on the contour.

Purpose

Contour cultivation reduces the velocity of overland flow and retards soil erosion. Crops like maize, sorghum, pearl millet which are normally grown in rows are ideally suited for contour cultivation. When contour cropping is adopted, the downward movement of soil and erosion by rains is reduced considerably

Location

Contour cultivation on terraces is practiced on a large scale for soil and water conservation. It has the capacity to retard runoff, increase infiltration of rainfall and conserve soil and water. In the field, guidelines are to be marked across the slope using a dumpy level or even a hand level. All subsequent agricultural operations are carried out making use of the guideline.

12.2. Strip cropping

Strip cropping is the growing of a soil-exposing and erosion-permitting crop in strips of suitable widths across the slopes on contour, alternating with strip of soil-protecting and erosion-resisting crop. The dense foliage of the erosion resistant crop prevents the rain from beating the soil surface directly. The alternate strip consists of close growing erosion resisting crop (close growing crops such as moong, urad, moth bean, groundnut, grasses) to erosion permitting crops like (row crops such as maize, jowar, bajra, cotton, etc). To achieve the best result, strip cropping is to be done in combination with other farming practices, like good crop rotation, contour cultivation etc. There are four types of strip cropping systems. They are: (1) contour strip cropping, (2) field strip cropping, (3) buffer strip cropping and (4) wind strip cropping.

Purpose

Strip cropping reduces soil erosion by reducing the effective slope length and facilitating absorption of rain water by the soil in undulating terrain. This is achieved by growing in strips and in an alternating fashion a minimum of two different crops along a slope. The crops usually differ substantially in their planting and harvesting date, thereby ensuring that at any time at least half of the slope is covered by vegetation. Strip cropping permits crop rotation, maximises the use of rainfall and allows use of modern machinery.

Location

This method is useful on regular slopes and with the soil of high infiltration rates.

13. Retention Ditches

Retention ditches are large ditches, designed to catch and retain all incoming runoff and hold it until it infiltrates into the ground. They are sometimes also called infiltration ditches.

Purpose

In semi-arid areas retention ditches are commonly used for trapping rainwater and for growing crops that have high water requirements, such as bananas. These crops can be planted in the ditch and thereby get increased supply of moisture.

Location

Retention ditches are particularly beneficial in semi-arid areas where non-availability of soil moisture is a problem. They should be constructed on flat or gentle sloping land and soils should be permeable, deep and stable. Retention ditches are not suitable on shallow soils or in areas prone to landslides.

14. Contour Farming

Contour farming means that field activities such as ploughing, furrowing and planting are carried out along contours, and not up and down the slope.

Purpose

The purpose is to prevent surface runoff down slope and encourage infiltration of water into the soil. Structures and plants are established along the contour lines following the configuration on the ground. Contour farming may involve construction of soil traps, bench terraces or bunds, or the establishment of hedgerows.

Location

Contour ploughing is successful on slopes with a gradient of less than 10%. On steeper slopes contour ploughing should be combined with other measures, such as terracing or strip cropping. The fields should have an even slope, since on very irregular slopes it is too time-consuming to follow the contours when ploughing.

15. Contour Furrows

Contour furrows are, small earthen banks, with a furrow on the higher side which collects runoff from the catchment area between the ridges.

Purpose

The catchment area is left uncultivated and clear of vegetation to maximize runoff. Crops can be planted on the sides of the furrow and on the ridges. Plants with high water requirements, such as beans and peas are usually planted on the higher side of the furrow, and cereal crops such as maize and millet are usually planted on the ridges.

Location

Contour furrows are suitable for areas with annual average rainfall amounts of 350-700mm. The topography should be even to facilitate an even distribution of the water. Contour furrows are most suitable on gentle slopes of about 0.5-3%. Soils should be fairly light. On heavier clayey soils these are less effective because of the lower infiltration rate.

16. Broad Bed and Furrows

The Broad Bed and Furrow system has been mainly introduced by the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) in India. Broad beds of 100 cm width are prepared and 50 cm furrows are provided in between two beds.

Purpose

To encourage moisture storage in the soil profile to support plants through mid-season or late-season spells of drought and to provide a better drained and more easily cultivated soil in the beds. Double cropping by means of inter-cropping or sequential cropping is also possible.

Location

The BBF system is particularly suitable for the vertisols. The technique works best on deep black soils in areas with dependable rainfall averaging 750 mm or more. It has not been as productive in areas of less dependable rainfall, or on alfisols or shallower black soils - although in the later cases more productivity is achieved than with traditional farming methods. The broad bed and furrow system is laid within the field boundaries. The land levels taken and it is laid using either animal drawn or tractor drawn ridges.

17. Grass Strips

Grass strips are cheap alternatives to terracing. Grass is planted in dense strips, up to a meter wide, along the contour.

Purpose

Grass strips create barriers that minimize soil erosion and runoff. Silt builds up in front of the strip, and within time benches are formed.

Location

Grass strips are suitable in areas where there is a need of fodder or mulch. If farmers do not have livestock, they have little incentive to plant grasses. Grass strips are not applicable on steep slopes and in very dry areas since grasses might not withstand drought.

18. Planting Pits

Planting pits are the simplest form of water harvesting. They have proved successful especially for growing sorghum and millet in areas with minimal rainfall.

Purpose

The purpose is to trap runoff, increase soil moisture status and reduce erosion.

Location

Planting pits have been proven successful in areas with annual rainfall of 200-750 mm. They are particularly useful for rehabilitating barren, crusted soils and clay slopes, where infiltration is limited and tillage is difficult. The slope should be gentle (below 2%) and soils should be fairly deep. Where soils are already shallow, they become even shallower when planting pits are dug. In those cases farmers should not plant in the pit, but in top of the ridge of excavated soils in order to maximize rooting depth.

19. Mulching

Mulching is done by covering the soil between crop rows or around trees or vegetables with cut grass, crop residues, straw or other plant material. This practice help to retain soil moisture by limiting evaporation prevents weed growth and enhances soil structure.

Purpose

Mulching is used in areas subject to drought and weed infestation. The mulch layer is rougher than the surface of the soil and thus inhibits runoff. The layer of plant material protects the soil from splash erosion and limits the formation of crust.

Location

Areas with limited rainfall usually respond very well to mulching. Mulching is not applicable in wet conditions. The fields should have good drainage

20. Cover Crops

Cover crops are usually creeping legumes which cover the ground surface between widely spaced perennial crops such as fruit trees and coffee, or between rows of grain crops such as maize. Often cover crops are combined with mulching.

Purpose

Cover crops are grown to protect the soil from erosion and to improve soil fertility. They protect the soil from splashing raindrops and too much of heat from the sun.

Location

Cover crops are suitable in dry areas, with annual rainfall of more than 500 mm. Cover crops are good alternative source of mulch, especially useful in semi-arid lands where crop residue are important animal feed.

21. Conservation Tillage

Conservation Tillage refers to the practice in which soil manipulation is reduced to a minimum. This practice preserves soil structure and, increases soil moisture availability and reduces runoff and erosion.

Purpose

To reduce labour and farm power requirements, costs, energy requirement and increase crop yield due to less direct impact of raindrops on bare soil and increased soil moisture status.

Location

Conservation tillage takes various forms, depending on the prevailing soil and farming conditions. When introducing conservation tillage, it is important to focus on the needs of the specific farming conditions. Each farmer's plot has specific soil characteristics and management needs.

22. Vegetative Barrier

Vegetative barriers inhibit surface runoff, slowing and ponding water and capturing and preventing sediment from flowing downhill (figure 3.50). Vegetative barriers have potential to not only reduce erosion but can enhance vegetated filter strips in the uptake of nutrients.

Purpose

Vegetative barriers are narrow strips of vegetation which are created primarily to slow runoff, capture sediment and resist gully development. A vegetative barrier reduces water velocities and establishes a broad uniform vegetative surface for the uptake of nutrients.

Location

Vegetative barriers can be used to eroding sites on areas of cropland, pastureland, feedlots, mined land, gullies, and ditches. This practice should be used in conjunction with other conservation practices in a conservation management system.

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