

Training Module and Handbook On Soil and Water Conservation Measures, Soil Fertility Improvement & Important NRM Works for ERs



**State Institute of Rural Development & Panchayati Raj
Mizoram : Aizawl**



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**Training Courses on
Soil and Water Conservation Measures, Soil Fertility Improvement & Important
NRM works for ERs**

Venue :
Duration :

DAY (S)	SESSION	TOPIC	RESOURCE PERSON
Day One	09:00 - 10:00	Registration	
	10:00 - 10:30	Inauguration	
	10:30 - 10:45	Tea Break	
	10:45 - 11:30	Ice breaking session	
	11:30 - 12:30	Objectives and introduction to the course	
	12:30 - 13:00	Lunch Break	
	1300 - 14:30	Introduction to Sustainable Development Goals & Gram Panchayat Development Plan & Fundamnetal Duties	
	14:30 - 16:00	Concept of Soil & Water Conservation/ Agronomic measures	
	16:00 - 16:15	Tea break	
	16:15 - 17:00	Discussion	
Day Two	09:00 - 10:00	Recap.	
	10:00 - 11:00	Soil & Water Conservation –Mechanical measures	
	11:00 - 11:15	Tea break	
	11:15 - 12:30	Soil & Water Conservation – Other Engineering measures	
	12:30 - 13:00	Lunch Break	
	13:00 - 14:30	Soil & Water Conservation works relating to MGNREGS/PMKSY/ Site selection & estimation	
	14:30 - 16:00	Soil Productivity Enhancement - Composting/Green Manuring	
	16:00 - 16:15	Tea break	
	16:15 - 17:00	Discussion	
Day Three	09:00 - 10:00	Recap.	
	10:00 - 11:00	Soil Productivity Enhancement -NADEP & Vermicomposting	
	11:00 - 11:15	Tea break	
	11:15 - 12:30	Soil Productivity Enhancement-Biofertilizers	
	12:30 - 13:00	Lunch Break	
	13:00 - 14:30	Major Plants Nutrients and its Management for major Agricultural and Horticultural crops	
	14:30 - 16:00	Shifting Cultivation and Sustainable Agriculture	
	16:00 - 16:15	Tea break	
	16:15 - 17:00	Discussion	
Day Four	9:00 - 17:00	Field visit	
Day Five	9:30 - 12:30	Preparation of group reports	
	12:30 - 13:00	Lunch break	
	13:00 - 16:00	Presentation of group reports	
	16:00 - 17:00	Course Evaluation & Closing	

Course Director

Chapter – I

OBJECTIVES & INTRODUCTION

1. Objectives of this training/introduction to the course

He training atanga zir chhuak tura beisei te:

- 1) Kan leilung awmdan phung hriat chian a, leilung luang ral tur ven dan kan hriat theihna turin.
- 2) Hun rei zawk atana thlai thar chhuak reng thei tura hmalak dan tur kan hriat theihna turin.
- 3) Thlai chin tur dik leh hlawk tur kan thliar thiam ang.
- 4) Soil and water conservation measures hrang hrang zingah hian kan tana tangkai tur kan thliar thei ang.
- 5) Sorkar scheme lokalte hmasawnpui thei turin lo dawnsawn dan kan thiam ang.
- 6) Kan intodelh theihna tur leh planning kan thiam theihna turin.
- 7) Chhungkaw tin kan intodelh chuan khaw intodelh kan lo ni ang a, kan ram chhengchhe tak hi kawng hrang hranga hmasawn turin ke kan pen pui ang.
- 8) SDGs leh GPDP hmang chungin vantlang leh chhungkua mal tinte hmasawna tur thlen tir kan tum ang a, mahni huan leh ram chhunga hna thawh hun a lo thlen hunah hmalak dan kan thiam ang.

2. Soil & Water Conservation awmzia leh nihphung

Eng vangin nge tui leh leilung luangral tur hi ven a ngaih?

- Leilung chunglang 20 cms vel hi thlai chinna atan lei tha, thlailin a chaw a hmuhna a ni.
- Lei tih thatna hmang lova a hmun ngaia thlai kan chin reng chuan lei chunglang hanna hi a tlahniam thin a ni.
- Leilung luangral tur kan ven loh chuan ruahsurin nasa takin in a len bo thin a ni.



- A mah ngau ngaua lei chunglang 2.5 cm vela chhah in siam tur hian kum 100-1000 lai a ngai ni a chhut a ni.



- Mithiam te chhut dan chuan tlang pang awih ven him loh hmun hectare khat (tin 2.5 hmun) atang hian, kum tin lei kalral hi ton 120 atanga ton 300 lai pawh a tling thei a ni an ti.

- India ramah hian kum tin hetiang a leilung kal ral hi ton maktaduaih 5,334 lai niin an chhut bawh (The Hindu, 26 Nov, 2010)

- Industry lama hmasawnna a la muan lai leh mihring an la thawl lai chuan ram ngaw thiah a tlem a, thing hnah tlain lei chunglang hang tha hi a siam leh mai thin a, tunah chuan khawvel a lo changkang tawh a ram ngaw kan chendarh nasa a, thingtlang lo neihna hmunah pawh a cycle hi kum tlem teah a tlahniam a, amahin ram ngaw a insiam hman tawh lo a ni.



- Leilung kal ral tirtu agent lian tak pahnih chu tui leh thli a ni a, a thlen tir nasa bertu chu Tui a ni.

- Human activity a bikin chen phulh (ran tlatna), thlai chinna a tana hman nasat lutuk leh ramngaw chereu in a thlen nasa bawh.

- Ruah surin lei nasa taka a deng thin lakah lei hi ven him tur a ni.

- Ruah sur vanga tuihawk luang hi hmun pakhtah chak deuha a luan lohna tura hmalak tur a ni, kawrte a in siam thuai thin avangin.



- Awihpanga tuihawk

luang thla hi muang deuh zawka luanthir dan ngaihtuah tur a ni.

- Ruahtui lo tla hi lei chhunga tam zawk a luh theihna tura hmalak tur a ni.
- Thli tamna hmunah chuan thli dal thei tur thingphun uar tur a ni.
- Lei phuar khawm tur thing bul leh thing tiak te humhalh hram hram tur a ni.
- Fur laia ruahsur luang liam mai tur hi khaw thal laia hman turin dahkhawl dan ngaihtuah tur a ni.
- Kawrte leh lui tuite a kangchah mai lohna turin lui hnar leh luikamahte thingphuna humhalh tur a ni.

3. Soil Erosion chi hrang te:

Soil and Water conservation chungchang kan sawi dawn chuan leilung kalral dan (Soil Erosion) tlem kan sawi fiah ang a. Agriculture ang zawng chuan **soil erosion** chu lei chunglang kal ral hi a ni a. **Soil conservation** chu ruahmanna felfai tak hmanga lei chung lang luangral turte, hman nasat avanga lei thatna tlahniam leh leia chemical tam lutuk te, lei a thur/al insiam nasa lutuk tur te ven a ni.

Soil erosion chi hnih te:

A. Water Erosion (Tui vanga leilung kalral):

- i) Ruahin lei a den hian lei a deng darhin a ti nghet lo phawt a, hei hi erosion level hniam ber a ni.
- ii) Tuihawk nasa takin lei chung lang hawrhin kua a hreuh a, lei nawite len boin *erosion* nasa zawk a siam. Kawrte a lo insiam a, tlangpangah a thlur thla sung thin a ni. Chung *erosion* te chu a nasat dan a zirin a hmingah *sheet*, *rill* leh *gully erosion* te phuah a ni.
- iii) Tuilian nasain lui kama lei awmte a hrut chhe thin bawk.
- iv) *Erosion* class a nasa ber chu Kawrpui inseam (*Ravine*) hi a ni.

B. Wind Erosion:

- i) Thli vanga lei chung lang tihsawna a awm thinna hmun langsar ber chu thlaler ramah a ni.
- ii) Lei thin leh lei tha te chu awlsam taka tihchet theih an nih avangin thli nataka a tleh hian a chhem sawn thin a ni.

C. Heng pahnih bakah khian vur vang te, mihring leh ramsa vang leh thil dang vang te pawhin leilung hi a kalral ve bawk a ni.

4. Leilung kal ral(Erosion) avanga harsatna lian zual te:

- Buh leh bâl thar chhuah a titem.
 - Leia chakna awmte a tidal.
 - Lei chhunga tui lût tur a tlem phah.
 - Lei lehna senso a tisang.
 - Lui tui lian a zual phah.
 - Nungchate dam khawchhuahna tur a nghawng.
 - Ram a tibua.
 - Thlalêr a siam.
-
- Lei lung leh tui luang ral vanga thlai thar tla hniam leh leimin leh harsatna kan tawh hrang hrang te ti kiam tur hian lei lung enkawl dan tha kan hriat a ngai a. Hmun khata in bengbela lei hanna leh thlai thar chhuah kiam lo zawngin hma kan lak a ngai tak zet a ni.
 - Chu mi tur chuan lo leh huan neitu in a ram a hriat chian a ngai a, a zau zawng, a lei that dan, sik leh sa, thlai chin turte a hriat vek a ngai a. Tha thlah lova practice tha kan tih te a zawm a ngai a ni.
 - Class dawtah hian kan hriat tur pawimawh zual kan sawi dawn a ni.

5. Soil & Water Conservation measures chi hrang hrang te

- Kan state hian ruahtui a dawng hnem hle a, tlangram awihpanga cheng leh eizawng kan nih avangin leilung luang ral a tam bik a. Kum khatah hian a tlangpuia chhutin ruahtui tla hi 2540mm (100 inch) vel lai a ni a.
- Temperature hi a ram lum hnawng bawk si (tropical to sub-tropical) atanga tlema ziaawm deuh ang velin a chhut theih ang.
- Khawchhak lam aiin khawthlang lam a hniam zawk a, khawchhak lam a vawh nawm viau lain khawthlang lam chu nipuiah a lum thei hle a, 36 °C lai pawh a kai thei a ni.
- Tlang pang awih dan a zirin soil and water conservation measures kan hman tur hi a danglam tura ngaih a ni a, kan zir tur zawng zawng hi hmun khat practice vek a rem lovang. Kan tana tha tur leh tangkai tur kan thliar thiam a pawimawh hmasa a ni.
- Tui leh leilung luang ral ven dan kan zir turah hian hna thawh tur leh tih dan (method) chi hrang hrang a tam hle a. A hnuai a mi ang hian hlawm lian deuh chi li-ah kan then phawt ang a, mithiam a hrana rawn ngai lo chi kan sawi fiah phawt ang a, mithiam tel na tur chi leh sum senso ngai tam chi kan sawi fiah leh bawk dawn a ni:
 - a) Agronomic measures
 - b) Mechanical measures
 - c) Other Engineering measures
 - d) Soil productivity enhancement

- A pawimawh hmasa berah chuan lo huan nghet nei turin kan rilru kan buatsaih phawt ang.
- Approach road leh tui lak tur a awm hnai vai em tih kan chian leh phawt ang.
- A ram leilung awm dan leh lei that dan kan hria ang a, a ram awih dan (slope %) kan chhut leh ang. A ram zau zawng hi a theih chuan teh chhuah vek tur a ni. Hei hian chet lak dan tur a hrii thui hle a ni.
- A ram sik leh sa a zirin thlai chin tur kan thlang ang. Ram luma chin chi thlai leh ram vawt a thlai chin chi kan hre hrang hmasa phawt ang a, kan ram neih chhunga chin puitlin theih tur chi kan hre hmasa ngei tur a ni.
- Hei tia lo inruahman lawkna hi farm planning tiin kan sawi thei bawk ang. Long term a tana kan chin tur leh short term turte, chhungkaw eitur thar chhuah turte, long term kan chin laia suma chantir theih tur thlai chin tur ngaihtuah tel a ngai a ni.
- Thlaiin leitha leh tui a mamawh dan tur te, sum ngai zat tur te a theih chuan chhut lawk vek tur a ni. A hmun ngaia thlai kan chin reng chuan lei thatnain dak hun a lo nei a, organic hlanga kan kal duh a nih phei chuan leitha siamna tur khur leh leitha atana hman tur thlai kan chin tel a ngai bawk a ni.
- Long term kan ngaihtuah tel loh avangin kum a lo vei tam hnuah kan hlawhchham fo thin a ni. Kan thlai chin dam theih hun chung hi a tlangpuiin a hriat theih bawk a, hei hian gap filling (a thi then leh thlai kung tar tawh paih a a thar phun) tih hun tur chhut lawknaah a tanpui thei ang.
- Leilung khuhtu thlai leh hnim a awm loh na hmunah chuan ruahtui a lo tlakin leilung kalral a tam bik a, chuvangin method hrang hrang kaihkawp hi a hlawk zawk hle a ni.
- Soil and water conservation measures tam tak hi a lo hlawhchham tawh thin a, a hmun dik lova hman te, a siamna man sang lutuk te, mipuiin an tuihui loh zawng te, ram changkanga an hman ang lo hman ve ringawt te, zirchianna hmasa awm lova technology danglam deuh lo hman hi hlawhchhamna chhan chi khat a ni.

Class dawt leh atangin chipchiar zawkin kan zir ang a, tunah chuan a chung a kan sawi tak nih phung leh rilru inbuatsaih dan tur kan sawi ang.

a) **Agronomic measures**- Hei hi biological measures chhunga mi tiin kan sawi thei bawk ang, cultural method tiin an sawi bawk thin. Hei hi soil and water conservation measures chhunga tih dan tur chi hrang hrang khaihawmna hlawn khat a ni a. A inven dan lam a hawi deuh zawk a, sum seng vak lo leh

midang min puihna tel lem lova kan tih ve mai theih, a thatna pawh kum khata lang mai lo a ni a, ram awih dan a zir leh thli a nat dan a zirte, ruahtui tam dan a zira kan thlai chin dan kan thlak kual te a huam vek a. Kum enge maw zat a liam hnuah a thatna a hriat theih chauh a ni.

b) **Mechanical measures-** Hei hi tlemin sum sen a ngai deuh a, permanent structure siam te a huama, a hman zui dan tur leh enkawl dan dik kan hman chuan a hlawk thei hle a ni.

c) **Other Engineering measures-** A chungka kan sawi, chhungkuain kan hman ve theih mai kan sawi bakah khian soil and water conservation measures hi sawi tur tam tak a awm a, PMKSY leh MGNREGA scheme hnuaia Natural Resource Management works tam tak hi he mi huang chhungah hian a lut a. Mimalin kan hman tangkai bakah a zau (watershed) ang zawng te, inhmantawm tur te leh vantlang ram te, luikam luang ral tur vente leh a dang tam tak a huam a ni.

d) **Soil productivity enhancement-** Hei hi soil and water conservation measures chhungah hian direct taka telh a ni chiah lo a, mahse long term plan siam tur te, eizawna ngial nghet atana agriculture hmang tur tan chuan thil pawimawh em em a ni. A chungka kan sawi tak ang khian hlawk taka thlai thar chhuak zat zat thei tur chuan leithatna kan vawn nun reng a ngai a, lei chunglang dur tha hi a kal ral ve reng bawk avangin leichi (fertilizer) kan hmang anih pawhin leitha pangngai hman tel ve reng a ngaia, hei hi mahni in tam tak a siam chhuah theih a, sum senga lei ngai lo pawhin a intodelh theih a ni.

A chungka kan sawi tak te khi hmun pakhatah kan hmang vek ang tihna a ni lova, kan tana tangkai tur kan thliar thiam a pawimawh hle a ni.

Chapter – 2

SOIL & WATER CONSERVATION – AGRONOMIC MEASURES

Lo neih dan chi hrang hrang hmanga leilung humhalh leh hlawk zawka thlai thar theihna tura hmalakna hi *conservation farming* emaw *advanced agronomical methods* ti a vuah a ni a. Kan tana tangkai tur chauh kan thlur bing dawn a ni.

Agronomic practices hrang hrang a lar zual te chu:

1. Contour farming (Tlang tan zawnga a tlara thlai chin).
2. Leileh dan dik leh hun eng emaw chen chhunga thlai ching lova ram dah awl.
3. Crop rotation (Thlai chin thlak kual), be lam chi thlai chin leh mixed cropping (Chin pawlh).
4. Mulching (Thlai chinna bak leilung khuh).
5. Strip cropping (A lane zawnga thlai chi hrang chin)
6. Thlai hmanga bunding siam (Vegetative bunding)
7. Cover crop
8. Agroforestry
9. Thing phun leh terrace ko tlang hman tangkai
10. Changkham

1. Contour farming:

Tlangram awihtlanah te hman a ni a, heng hmunah te hian ruahtui leia lut a tlem em em a, tuihawkah a luangral mai thin. Tlang/awihpang vang tan zawnga leiletin, khuar leh chhun pawn inkarthlak contour line zulzuia siama thlai chin a ni. Ram awihtlan vang tan zawnga a kual thlai chin



hian lei luangral tur nasa takin a veng a ni. Ruahtui luangral a titem a, lei luangral tur a veng bawk. Tin, buh leh bal thar chhuah a tipung bawk a ni.

2. Leileh dan dik leh thlai ching lova ram dah awl: Lei hi thuk taka leh nge tha a pawnlawi taka leh tihah hian inhnialna a tam hle a. Mithiam tam tak chuan ruahtui tlemna hmunah chuan pawnlawi deuh a leileh hian thlai thar a hlawk zawkin, hnim a tlem phah a, leilin tui a hip hnem zawk an ti. Lei thuk

taka leh hian lei a luan ral tir hma zawk a. Amaherawhchu, ruahtui tlak tamna ramah chuan 15-30 cm-a thuka leileh hianin hnim to a titlem a, thlai thar a hlawk zawk a ni. Thlai ching lova hun eng emaw chen ram dah awl a, chulai hmuna ran an tlat hian hun eng emaw ti hnuah lei a lo tha leh thin. He thil hi ruahmanna tha tak a nih rualin mihring tamna India ram angah te hi chuan a hman theih meuh loh a, mihring tamna ram kan nih avang hian chaw mamawhna a sang em em a, thlai ching lova ram dah awl hi chu kan hmun thenkhatah chauh lo chuan kan tlin rih lo a ni.

3. Thlai chin thlak kual (Crop rotation) be lam chi thlai chin:

➤ Thlai chikhat chauh hmunkhata kumtin kan chin hian kha leilung khan mineral eng emaw ber tlakchham a lo nei thin. Fertilizer te nen enkawl mah ila a tittha zo tawh lova, a tawpah chuan lei chhia leh thlai thar theih lohna hmunah a lo chang thin a ni. Thlai chin thlak kual hian lei chhe tur a veng a, thlai thar chhuah a hlawk bawh. Kumhnh danah chuan lo a thlai chinte hi a chi thlak thin tur a ni. Tih dan chi hrang hrang a awm a, a bial bik nei pawhin a siam theih a, a ngai reng ching lovin thlak kual mai tur a ni.



➤ Thlai chi kan thlak kual dawna kan ngaihtuah hmasak turte chu – sik leh sa, sum leh pai dinhmun, leilung pianhmang, ram awih zawng leh leilung luanral dan te a ni. Leia zung kaih thuk chi thlaite dawtah zungkaih thuk lo chi thlai a thlak tur a ni.

➤ Be lam chi thlai ho hian leia nitrogen siamna kawngah tha an thawh hlawk hle a. An zunga bacteria hrik awmte hian boruak a *nitrogen* awm chu *nitrogenous compounds*-ah a siam a. Heng *nitrogenous compound* te hi thlai a lo thiha a tawih khan leiah luang lutin lei thaah a chang mai thin. Chuvang chuan be lam chi thlai kan chinte hian lei nasa takin an tittha thin a ni.

➤ **Thlai chin pawlh (Mixed Cropping):**

Thlai thar chhuah hlawk zawkna tur a chin dan pawimawh tak pakhat a ni. Hetiang hmanga lo neihnaah hian thlai chin bik pakhat a awm a, chu thlai karah chuan thlai dang pahnih khat an ching tel thin. Hetianga lo neih dan hian lei chhe tur leh luang ral tur a veng a, natna vang emaw thil dang vang emawa thlai chin pakhat kha a hlawhtlin loh palh pawhin thlai chi dang kan chinte atang khan hlawkna tel tur a la awm thei a ni. Tlangrama kan lo neih dan hi a ni sa ve bawh a.



4. Chhawlichhin (Mulching):

Buhpawl emaw hnim hnah emaw plastic emawa lei khuh hi *mulching* chu a ni. Mizo tawng chuan 'chhawlichhin' tih a ni. Lei kalral tur a veng a, lei a titha a, lei a hnawng awm rei tak a vawngghim bawh thin. Tin, leia tui lut a titam a, hnim to tur a dipdal bawh, hlo thlawh tur a ti tlem thei hle bawh a ni. *Mulching* tihna atan hian kan huan leh loa awm remchang apiang hman mai tur a ni.



5. Strip Cropping:

Lei leh tui kalral tur venna kawng a loneih dan tha tak mai a ni. Lei ti kal ral tam ang chi thlai heng Vaimim, buh leh thil dang te tlang tan zawnga a hlawm a chin a, a dawtah lei kalral tur



veng thei deuh thlai be lam chi nen kar thlaka chin hian lei kalral tur a dang hle a hriat a ni a. Erosion siamtu thlai leh erosion vengtu thlai te chu inkarthlakim ram awih lutuk lovah an ching thin. Huan chhunga lei chhe lai deuh, thlai chinna atana tlak chiah loh pawh leitha siam thei thing leh thlai chinna a tana zuah awl pawh a theih tho a. Thli natna hmunah chuan thli dal tur zawngin thlai kung sang chi pawh a hniam chi veng him turin a chin theih bawk.

6. Thlai hmanga bunding siam/contour hedgerow

He mi atan hian ranchaw chi hman hi a remchang hle a; a kung leh a hnah chu a lo len deuhin ran chaw atan an la thin a; a kung bul lam leh a zung te chu leilung vengtu atan an tangkai hle a ni. Kum rei vak lovah heng thlai bulah hian lei nawileh hnawl chhek khawm hmangin zawl *terrace* a lo insiam ve mai thin a ni.



Contour Hedgerow

7. Cover crop

- i) Thlai inkara thlai leh thil dang chin hi a ni.
- ii) Hei hian lei kal ral tur a veng
- iii) Hnim to chak lutuk tur a veng thei bawk
- iv) Be lam chi te hi a tha hle, behlawi, badam, etc te a tha
- v) Leitha thing chi te pawh plantation hmunah a theh theih a ni

8) Agroforestry

Hmun pakhat a thlai leh thing chinpawlh hi agroforestry an ti a, a bikin leitha siam thei thing phun hi a hlawk hle a hriat a ni a, lei kalral tur ven him a nih rualin thlai leh thing te hi an tangkai ve ve bawk a ni.



Agroforestry

Model Land Use

Hmun thumam ram thendarh tur a ni

3/1 -A chung ber - Thing kumhlun chi chin tur a ni

3/1 – A lai -

Horticulture lam leh thei kung thlai chin tur a ni.

Contour bund emaw siana Lakhuihthei leh thei dang te pawh a chin theih a, theikung te chu half moon terrace ah te a chin

theih a. Contour in karah hian thlai chi hrang hrang a chin theih bawh a ni.

3/1 – A hnuai ber - Buh leh thlai tenau, ran chaw te chin tur a ni.



Model Land Use

9. Thing phun leh terrace ko tlang hman tangkai

Thing phun hi a hmun remchang lai a piangah a mawi tur zawng leh tlar felfai neiin a phun theih zel a. Ramriah te, lui hnarah te, kawngkamah te a par chi leh khuaiin a tlan duh chi te pawh thlai leh thil dang tan a tangkai avangin uar zel tur a ni. Terrace ko tlang hi hman tangkai thiam chuan leimin tur te a veng a, hmun awl kan hmang tangkai thei bawh a ni.

10. Changkham

Changkham hi Mizo loneih dan pangngai huang chhung a mi a ni a, lo hal hnuah thingtlawn kang bang te chu thingbulah emaw peg khengin tlang tan zawngin an kham thin a. Hei hian lei luangral tur kha nasa takin a lo dal thin a. Tun hnaiah a tihdan ti changkang hretinleitha thing (nitrogen fixing trees) kan tihte contour lineah ching telin awmze nei zawkin hmalak a lo ni ta a ni.



Changkham

Chapter - 3

SOIL & WATER CONSERVATION – MECHANICAL MEASURES

Mechanical measures: hei hi Engineering measures chhunga ami tho a ni a, he mi class a kan sawi fiah tur hi chu chhungkaw malin kan tih ve theih leh scheme hnuai ni lo atang pawha kan ram awmdan a zira kan hman tur te kan thlur deuh bik ang.

1. Terrace

- *Terrace* chu mual tan zawnga ram laihzawl hi a ni.
- *Terrace* chuan leilung leh ruahtui luangral tur te a vengin, lei chhungril hnawna a ti pung bawk a.
- *Terrace* laih danah hian kan fimkhur a ngai a. *Contour line* mila kan laih loh chuan tui a luang thei thin a; chu chuan lei tha a len bo theiin *terrace* tlang te pawh a hawrh thei a ni.
- *Terrace* kan laih hmain lei chung hang tha chu chung lamah theh chhoh hmasak vek ni se, laih zawhah lei chunglang hangtha chu *terrace* zawlah dah leh thin tur a ni.
- Tin, *terrace* chu huan lu lam atanga laih tan thin tur a ni.
- Hmun awih lutukah chuan *terrace* laih kher tum loh pawh a tha zawk thei. Hmun awihah chuan *terrace* ko a sang hma em em a, chu chuan lei min a siam duh a; tin, tha sen pawh a tam bik thin a; *Terrace* pakhat atanga a dang kal pawh a harsa thin. Leilung pian hmang khawih danglam nasat a ngai thin a; hei hian leilung dinhmun a ti derthawng thin a ni. *Terrace* kan lai duh talh a nih pawhin zim te tein kan lai mai tur a ni.



2. Half Moon Terrace

- Mual awihtlana kan thlai phun bulah tui leh leitha khawlina tur atan bial chanve (semi-circle) anga laih zawl hi a ni a, a bial thlang lam chu lung emaw thing emaw hmang pawhin a dawl zawl theih a ni. Kan hmanraw neih rem chan apiang hman mai tur a ni.
- Tin, hmun awih lutukah chuan zau takin a siam theih loh a; thlai kung chhak lam zawk laih zawl pawhin a siam theih. Amaherawh chu a hmun hma a awih poh leh kan terrace siam chu a zim a ni mai. Hmun awih takah chuan zau taka laih kher tum loh a tha.



Half Moon Terrace

3. Full Moon Terrace

- Hei hi thlai kung hual papa laih zawl kual vek hi a ni a.
- Hei hian thlain tui leh leitha a hmuh ang zawng zawng te tangkai taka a chhawr theihna'n a pui thin a ni.



Sanling plantation is part of Regeneration

Full Moon Terrace

4. Contour bund

- Hei hi mual tan zawnga lei chhun pawn a ni a;
- Hei hian tui luang chak lutuk tur a lo timuanging leitha pawh a lo khawl thei a ni.
- *Contour* mila line siama, chumi anga lei chhun pawn tur chu a ni.

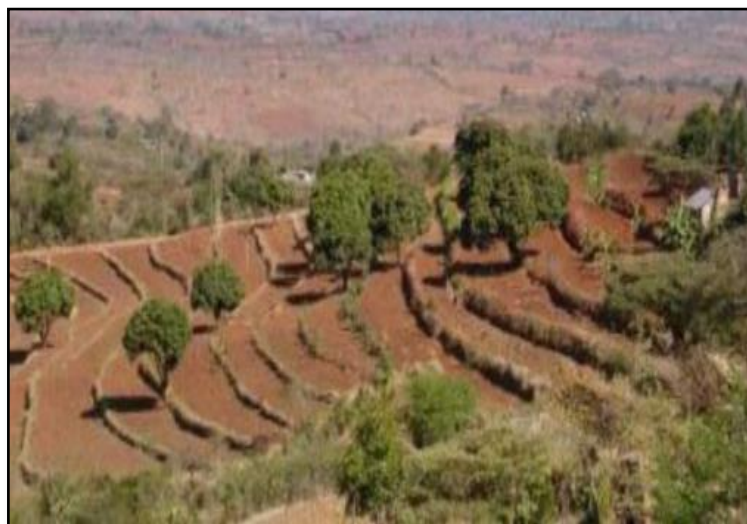
- Kan lei chhun pawn chu feet 1 vela sang leh a chhip zawl pawh feet 1 vela zau ni thei se; hei hian tui leh leilung luang ral tur nasa takin a veng thei a ni.

- Hmun awih lutuk lovah siam chi a ni a; hmun awih deuhah chuan siam zin deuh tur a ni.

- *Contour bund* hrul velah hian thlai kung *nitrogen* siam thei chi phun a tha a, ranchaw lam chi te pawh chin a tha.

- Hei hian ran chaw leh kan thing tuah tur mamawhte a phuhru thei a, a hnah leh zar nawi tla te chu lei ti thatu tangkai tak a ni bawk.

- *Contour bund* inkar ram te chu thlai hmun atan hman tur a ni a. *Contour bund* chuan lei luangral tur leh ruahtui luang ral mai turte a veng a; ruahtui tling khawmte chu zawi zawiin lei chungah put lutin tui hna siamtu tangkai tak a ni bawk.



Contour Bund



Contour Bund

5. Contour trench

- Contour Trench hi Ruahtui luang ral mai lova, lei chhungril lama puh luh tir turin tlang panga tlang dung kham zawnga lei laihkhwar a ni. Hmun awih lutukah chuan lei min a siam theih avangin hman chi a ni lo a ni.



- *Contour trench* chu mual vang lam zawngin a zawl phei dap 'contour' zela laih khuar tur a ni.
- Tui pawh tling se a chim san zawng inang deuh pat tura ngaih a ni.
- Hetianga lei laih khuar hi inzawm lo leh inkar thelh deuha laih a nih chuan 'staggered trench' tih a ni.



Staggered Trench

6. Gabion structures:

- *Gabion structure* chu thir hrui phiar hmanga lung phuar khawm a tih theih mai awm e.
- Italian tawng 'gabbione' atanga lak niin chu chu "big cage" (bawmrang lian) tihna a ni. Thir len hmangin lung chu fel fai takin an phuar khawm a. Block hrang hranga siam a ni thin.
- Tui lianin luikam a la hek zel tur venna leh tui luang chak lutuk tur a veng thei a; lei nawi leh hnawl te a dang khawmin, a thlang lama lui/tuikhuaha leinawi lut tur a ven bakah Leichhungah tui a lut a, tuihna tipungtu a ni thei bawk.
- Tui a put tlang zung zung theih avangin khaw fur lai pawhin a rih belhna a nasa lutuk lova;
- Tin, thirlen hmanga phuar khawm a nih avangin tlema a lo chet deuh hret pawhin concrete anga khi



Gabion Structure



Gabion Structure

leh rinawm loh phah ve lem lo bawk a.

- Chuvang chuan thil dang tam tak- Kawng siamna te, dil kam hungna atan te, insakna atan thlengin an hmang tangkai hle a ni.
- A hmanna a zirin, a inang lo nual a ni. Kawrtea leimin leh tui hawk na lutuk tur venna atan pawh a hman tangkai theih bawk.

- 7. Boulder checks:** Lui kawr leh ruamah te tui hawkin lei a hawrh nasa lutuk venna tur te, tui hawk luang chak lutuk tur leh lei lung kal ral nasa lutuk tur venna atan lung an rem khawm thin a, hei hian nasa takin kawr kam leite tuiin a kal ralpui tur a veng thei.



8. Brushwood checkdam:

Hei hi thing hmanga checkdam siam a ni. Lui leh kawrah te chuan thingtuai, thingzai leh maute an phun tlar a. Chutah chuan a zal (a phei zawngin) zing takin an kham leh thin. Hemi tinghehna atan hian a thlang lam atanga dona siam pawh a tangkai thei hle. Tui a lo kal chuan thing karah a put tlang mai thin a, hnawl leh lei nawi te chu lo tling khawmin a lo inkhuap ta thin a; hun a lo kal deuh chuan a lo inhnawh khat vek thin. Hei hian tui luang



chak lutuk tur leh leilung kalral chak lutuk tur vengin, a chheh vel leh a thlang lam ramah te hnawnna a pein, thal laiin tuihna a tipung thei a ni. He hmuna lei nawi chambang te hi lei tha tak a ni thin a, thlai chawmna atan te pawh a hman theih a ni.

Chapter – 4

SOIL & WATER CONSERVATION – OTHER ENGINEERING MEASURES

Engineering measures kan han tih hian leilung luang ral tur venna atana kan hman terrace lai, chhun pawn (contour bunding), lai khua lam (trenching), check dam siam leh a dang dangte hi a huam vek a. He mi chapter ah hian chhungkaw pakhat mai nilovin kan intawm theih tur tui lakna tura tana tangkai emaw, mipui vangtlang tana tha tur luipui kam tuiin a la hek tur dan te, mimalin kan tih mai theih loh kum tam tak daih tur hmalakna, engineering lam han kaihnawih kan sawi dawn a ni.

1. Anicut:

Tuikhua (Dam) chikhat, lui luanglai emaw kawte emaw, irrigation atan emaw tui khawlna atana khua ang hi a ni.

A lema tarlan ang hian Parmanent structure hmangin, RCC emaw lungrem hmang a siam thin a ni.

A tangkaina te:

- Lei luang ral tur vengtu a ni.
- Tui luang ral chak lutuk tur lo ti

muang a, hun rei zawk hman theih tura chhawp chhuah nan.

- Lei hnua tui ti tam tu a ni a, a chheh vel thlai leh thing tan hnawng

siam tu a ni.

- Lei hnawna vawng rei tura pui tu a ni.
- Thal laia huan thlai chawmtu a tan a tangkai.
- Intur atan tui khua emaw agriculture atan a tui khua chi khat a ni.
- Tui lakna tui hnar ti chak tu atan leh tui hna ti pung tura pui tu a ni.



Anicut construction

Siamna hmun tur uluk taka thlan tur a ni:

- Tui hnar tha, kang chat mai lo tur thlan hram tur a ni.
- Tui khuah na hmun chu a zawl thei ang ber thlan hram tur a ni.
- Tui khuahna structure dahna hmun chu tui khawlna hmun zau leh dawng hlawk tak, mahse tui luanna kuang zim lai ber ni thei se.
- A zau lai a khuah a nih chuan structure man a to hma mai bakah a flo theilo a ni.
- Tui khuahna structure thut phah (foundation) chu lei nghet tha tak emaw lung chhuat (Rock bed) ni thei se.
- A siamna hmanrua awlsam taka lak khawm theihna hmun ni thei se.

A nih phung/Specification:

- **Foundation:** A structure innghahna, a thut phah, structure pum innghahna leh ti nghettu a ni a, lei char tha tak emaw lungchhuat a thlen hma loh chuan lai mai tur a ni.
- **Main wall:** Hei hi tui luang lai khuap tu ber a vang zawnga tan tlang tu structure hi a ni a, Upstream/ lui hnar lam hi a ding ngil a, Down Stream/ luimawng lam hawi hi a side slope hi 1:1 slope a siam tur a ni.
- **Wing wall/Side wall:** Structure lui dung zuia siam hi a ni a, hei hian lui kam lei tuiin a ei ral loh nan a veng tu a ni.
- **Baffle wall:** Structure, Main wall atanga meter 1-2 a hla ah main wall parallel in 0.3m – 0.45m a sang in siam a ni a, hei hian lui mawng lam a tui luang chhuak chak lutuk kha a lo ti muang in lei luangral tur nasa takin a veng a ni.
- **Apron:** Hei hi Main wall leh baffle wall inkar hmun awl lai hi a ni.

Measurement and Estimation:

He hna atana measurement lak ngai te chu:

- Lei lai hna (earthwork) foundation a tan.
- Tui khuah tur san zawng/thuk zawng (Height of Main wall)
- Tui khuah sei zawng (Length of Main wall)
- Top width of Main wall/a chung zawl
- A mawng hlai zawng/bottom width.
- Side wall sei zawng/length of side wall.
- Side wall san zawng/ height of side wall
- Side wall chhah zawng/thickness of side wall.
- Baffle wall seizawng, san zawng, chhah zawng.
- Apron sei zawng, Zau zawng leh chhah zawng.

Estimation:

Estimates kan siam dawna kan hriat reng tur chu, a chung a kan han tarlan tak measurement lak ngai te hi uluk takin kan la tur a ni a, chumi hnuah estimate chu uluk taka siam tur a ni. Estimate kan siam dawn reng reng in kan Schedule of Rates hman turah kan Chiang Hle tur a ni a, tun hma chuan MGNREGS hna atan hian PWD SOR hman thin a ni a, amaherawh chu hemi hman a nih hian kan scheme nen hian a inmil tawh lohna lai hi a awm fo mai a, chuang chuan Rural SoR hi buatsaih mek zel a ni.

2. Drainage Line Treatment:

Tuihawk luan kawr, luitui luan kawng, thlai chinna ram leh thlai chin theih lohna ram a mi te hi drainage line chu a ni. Heng tui luan kawrah te hian tuihawk leh hnawl a luang thin a, chung ho luang chak lutuk tur lo dang tura ruahmanna siam hi *drainage line treatment* chu ani. *Drainage line treatment* hmang hian lei chung lang luang ral tur leh lei hnawng riral mai tur chu ven a niin, thlai chinna atâna ram tha a siam bawh. Tin, luikama drainage line treatment kan siam hian luikam hawrh chhe tur a veng bawh.

Measures:

Drainage line treatment tih hma hian uluk taka survey leh planning tih tur a ni. Tui luan chak dan te, lui kuang zau zawng te, lui thuk zawng te, a ram awih dan te zirchian phawt tur a ni.

☉ **Check Dams:** Tui luang chak lutuk tur lo dang tur leh hnawl lo dawh tura siam a ni.

☉ **Temporary check dam:** Awlsam taka hmanraw hmuh theih hmanga siam tur a ni. Eg. live vegetation, brushwood, logwood, loose stone, etc. A san zawng hi 0.75m aia sang lo tur a ni. A sir kilte aia a lai a hniam tur a ni a; hmanraw hman a zirin a that chung hian kum 3-5 a awh a ni. Kawrtah *temporary check dam* hi siam thin a ni.

☉ **Semi-permanent structures:** Hetiang structure hi kawr ruam, tlangram awih deuhah siam thin a ni. Gabion (lung fun) hi hman tlanglawn ber a ni a, kum 20-25 thlang tha tura ngaih a ni.

☉ **Permanent Gully control structures:** Heng structure te hi brick hmangte, gabion hmang te, RCC te, earthen plugs/dams concrete/steel pipe hmanga siam an ni tlangpui. Kawr ruam zau tak leh tuihawk tamna leh hnawl tamna hmunah siam thin a ni. Hetiang structure that hun chhung hi kum 25-50 inkarah chhut a ni.

◎ **Gabion Check Dams:**

Gabion check dam hi hnâwl leh lei lo dâl tura lui laiah leh lui mawng lamah siam thin a ni. Gabion structure hi thirlên (3.15mm- a chhah) hmanga bawm siama, a chhunga lung fûn a ni. Thir bawm size hi 3 m x 1 m x 1 m a ni tlangpui a; a chhin size hi lung len zawng a zirin 10-20 cm a ni thin.

Gabion structure thatnate:

- i) tliak lovin an ulhkual vak theih,
- ii) tui a lut tlang thei
- iii) a ngialnghet
- iv) a senso a tlem.

Chapter – 5

SOIL & WATER CONSERVATION WORKS RELATING TO PMKSY & MGNREGS

Engineering measure chung a mi tho an ni a, a hmalama kan sawi tawh bakah vantlang inhmantawm theih leh a group ang zawng hman theih chi kan sawi deuh bika ang a. Hna lian leh Engineer hna chu chapter dawt lehah kan sawi ang.

Lei leh tui kal ral tur humhalh na lam vantlang huap hna leh tui dahkhawlna hna te:

1. Tuilak kawng intawm

MGNREGA emaw PMKSY leh sorkar scheme dangah hian tui lakna kawng (irrigation canal) siam a phal thin a. Hei hian thlai thar nasa takin a tihlawkin, mi rethei leh dinhmun chhe zawk te chawikanna tura pawimawh tak a ni. Tui lak hi mau leh hmanraw dang hmang pawhin a tih theih a ni. Hmun thenkhatah chuan Cement concrete hmang te pawhin tui kawng hi an siam bawh thin.



2. Thing phun leh Ramngaw

siam (Afforestation):

Ramngaw hian leilung leh tui luangral tur a veng a, boruak thianghlim min pe bawh. Thal laia tuihna tha tak nei tur chuan ramngaw te hi kan mamawh em em a ni. Ramngaw chhungah thlai leh rannung chi hrang hrang kan mamawh tam tak a awm thin. Ramngaw siam



hi thil pawimawh tak a ni a; chuvangin sorkar scheme hrang hrang hnuaiah hian thing phun hian hmun pawimawh tak a chang a ni. MGNREGA hnuaiah thing phun hna thawh theihna tur ram/hmunte chu heng a hnuaia tarlarte hi an ni:

- i) Ram awl laiah (waste land)
- ii) Ram chhengchhe laiah (barren land)
- iii) Chi al tam lutuk na hmun, thlai dang thatlohna hmunah (salt affected land)
- iv) Ram/Huan thalo laiah (Problematic land)
- v) Tui dahkhawlna chhehvelah (tank foreshore)
- vi) Kawng kamah (roads/railways/canals)
- vii) Huan/Ram ri ah (field boundaries)
- viii) Zirna in leh anganwadi hmunah te.
- ix) Vantlang ramah te (common land)
- x) Ramhnuaiah te (forest land)

Thing phun hi hunbik nei thil a nih vangin kan thing phun turte kan kui tiah hun tur pawh ruahman fel a tul thin a, awmze neia nursery lamah pawh kui tiah sa a, chu chu a huna phun mai theih tura ruahman sa a tha a ni. Thing phunte vil reng tur hian Village Monitoring Committee (VMC), Gram Panchayat/ Village Council hriat puinaa siam tur a ni a, anni hian hnathawhte an lo endikin an veng zui dawn a ni.

MGNREGA Schedule-I-para-4(I)(v) chuan “Vantlang ram te, ramhnuaiah te, kawng kamte, tuilakna kam te, tuikhuah kamah te leh tuipui kam vel te a ramngaw siamthar a thing phun te hi paragraph 5-na a a huam chin chhungkuate dikna hriatsak chungin a phal a ni.

3. Roadside Plantation: Roadside Plantation hi PMGSY kawngpui leh

kawngpui dang kamah te siam theih a ni. Kawngpui hnaih berah chuan thing kung te deuh chi phunin, a dawtah chuan a laihawl chi leh a tlar thumnaah chuan thing lian leh daihlim chi phun tur a ni a. Thlai kung chu 4-6 meters kar danah phun tur a ni. Tlar tin inhlal



zawng chu 3 meters tal a ni tur a ni. Hei hian kawng himna thlenin, leilung leh tui luang ral tur te. Lei min tur te a veng thei dawn a ni. MGNREGA

hnuaiah hian thlai kung 200 phun leh enkawl hna chu mi harsa chhungkaw 1 kutah dah zel theih a ni a. An enkawl puitlin hunah chuan thing atanga hlawkna pawh a enkawltu chhungkua ten an chhawr tangkai thei ang. Kawngsir thingphunah hian a mawi leh hmuh nuam tur tlar nalh te ngaihtuah tel tur a ni.

PMGSY kawng thlanchhuah dan:

- Gram Panchayat/Zilla Panchayat leh MGNREGA officers te rawn chung in PMGSY officer in PMGSY kawng kama thingphunna tur te chu a thlang ang a (Kawng kam hmunawl tha awmna te thlan tur a ni)
- Pradhan /Sarpanch/ Members of Gram Panchayat leh Gram RozgarSevak te tel vekin Transect walk neih tur a ni (a phunna hmun tur thlang tur te, a zauh lam bituk tur te leh thing phunna chin leh phunlohna chin tilang tel sketch buatsaihna turin). Transect walk tih hian engkim fel tak a chhinchhiah tur a ni.
- Kawng dung zui zawng in avenue plantation a tih theih ang a (kawng ko piah lamah), kawng bul hnaia sorkar ram awmna apiangah kawng himna ti chhe silovin thing a phun theih bawh a ni.

National Highway thlanchhuah dan

National Highways chu NHAI (National Highway Authority of India) in a thlang tur a ni. National Highway kam a thingphun hna reng reng chu NHAI te nen a thawhho ngei ngei tur a ni a, estimate a material component te chu MGNREGA hnuaia a State Employment Guarantee Fund chhunluh zat bawh kha NHAI hian a chhung ve ang.

- 4. Nursery:** Thing phun tur kui tiaha hmunte hi “Nursery” tih an ni a. Kan hmanna tur a zirin Temporary leh Permanent te a awm hrang leh a ni. Kan thing phun hna thawh kal mek chu kum 5 aia tam kal pui tur a nih chuan Permanent Nursery hi siam thin a ni a, kum 5 aia tlem a ni dawn erawh chuan Temporary emaw Semi-Permanent Nursery te siam thin an ni. Nursery siam dawna kan hriattur pawimawhte :

1) Nursery siamna hmun tur thlan kawngah:

- a. A hmunhma: Hmun laili tha laiah, pan zung zung awlsamna laiah thlan tur a ni. Tin, kan thing phunna tur hmun hlat lutuk lo ni se.
- b. Tui awm thatna hmun a ni tur a ni.
- c. Nursery kan siamna tur hmun chu hmun zawl tha, tui hawk luanna kawr mumal tak nei leh hmun fai tha a ni tur a ni.
- d. Lei sak leh ban lutuk awmna hmun ni lo se la.

2) Nursery pian phung:

Nursery chu a theih chuan killi nei (rectangular) anga siam tur a ni a, a chhungah chuan kal velna tur kawng zuah awl tur a ni. Endikna atana vah velna tur leh a chhunga chet velna turin kawng zuah hi a pawimawh em em a ni. Tin, kan thing kui tiah duh zat azir zelin a len zawng pawh hi hisap mai tur a ni.



3) Nursery siam dawn chuan heng te hi hriat reng tur a ni:

- Nursery chu Sawrkar ram ah emaw SHG te in bul hnai, tui pektur awmna hmun leh Thing chinna hmun hnaihah a ni tur a ni.
- Nursery siamnana kan hmanraw hman te chu ram leilung in a huat loh zawng, Mau, Di leh Thilthek te a siam tur a ni.
- A hungna atan chuan thlai hring vek emaw a hmun a hmanraw awm ang ang hman mai tur a ni.
- A awm remchang a nih chuan hnah atanga ip siam leh a tlukpui te, Polybag nilo ho hmang tura hmalak.
- FYM remchang awm thei thei te chu leitha atan hman tur a ni
- Nurseryah hian a hnachhawp a zirin, a hlawk theih dan ber tur thlir chungin rualbanlote, taksa chaklohna nei te, upate leh Jobcard neite hnathawk tur a ngaih pawimawh hmasak tur a ni.
- Thlaite hrisel taka an awm reng theihna turin nitin a enkawl hna thawh dantur mumal tak a relfel thlap tur a ni.
- Mamawh zat ang mil zel in nursery ah chuan thlai tiak siam tur a ni.
- Nursery atan a thlai chi mamawh te chu Forest Department lam be rawn chung a ngaihtuah tur a ni.
- Nursery hna thenkhat heng: phun hma a thlai chi sawngbawl te, a hun tak a thlai chi tuh te leh adt. reng reng hi Forest Department kaihhrucina hnuai a tih zel tur a ni.
- Nursery siamna a tel SHGs emaw Committees te chu a khat tawkin Forest/ Horticulture Department in training an pe tur a ni.
- Gram panchayat 60:40 ratio hi vawn tlat tur a ni.

5. Percolation Tank: Hei hi mimal huanah pawh siam theih a ni a, thlai chawmna tan pawh an hmang thei ang. A chhuat hi zut phui a nih loh avangin, lei chhungah tui a put lut thin a, chu chuan a chheh vel ram tihnawngin, a thlang lam ramah tuihna te a siam thei thin a ni. Tin, Sangha leh tui lam sate khawina atan pawh a hman theih bawk. Percolation tank hi farm pond ang pawhin a hman theih bawk



6. Farm Pond/Dug Out Pond (DOP)

A hmun thlan dan :

- DOP chu huan khawihmunah pawh siam theih a ni. Dilin tui a khawl theih zat chu ruah tui tam zawng atanga chhut tur a ni a, huanthlai chawm zo thei tura ruahman tur a ni.



- DOP chu huan thlai hnai thei ang ber, flawm si leh awlsam taka hman theih tur hmunah siam hram tur a ni.
- DOP laihna hmun chu 2% diin a awih tur a ni lo.
- DOP laihna hmun chuan a tui dawn khawlna area chu 5ha diin a zau tur a ni lo.
- DOP laihna hmun chuan tui hip theilo lung chhuat chu metre thum hnuai chinah a nei ngei tawh tur a ni.
- Tui 10cm a sang a hectare khat chawm tur hian 1000cum tui mamawh a ni a.
- Tui Mamawh zat = Tui in a chawm tur zau zawng x tui in a chawm thuk zawng, e.g. 1 hectare x 10 cm or 10000sqm x 10/100 = 1000 cum. DOP dimension tur chu 25m x 20m x 2.5m niin hemi size hian 1000cum tui a khawl thei dawn a ni. He DOP hian 25m x 20m = 500 Sqm hmun hectare khat atangin a awih dawn a, hemi avang hian 5% model tih a ni.

DOP siam dan :

- A chung a tar lan tak ang hian a hmun thlan theih ni se.
- A hmun tur thlan fel hnuah chuan a laih dan tur ruangam fel taka duan ni se.
- Kan lei laih chhuah chu dil ko a atang meter 2 atang a meter 3 a hlaah dah ni se. Hemi hmun awl hi Berm tih a ni.
- Lei laih chhuah chu lei tha a nih chuan huan thlai hmunah theh darh emaw sem rual tur a ni.



Hriat tur tul te:

- Lei nawi tling khawm tur veng turin tui luankhawmna dil hnar te chu tha taka siam leh tih fai tur a ni.
- DOP chu tui luanglai emaw lui luang lai hmunah siam loh tur a ni.
- Loneitu tui lakna engmah dang neilo te chu ngaihpawimawh hmasak tur a ni.
- Tui dah khawl na atan chuan dil chu thuk apiang hi a tha a ni. Hei hian dil hmun luah a ti zim a, thlai chinna hmun awl a tam phah zawk a ni.
- A chhuat, a bang leh a tui luan chhuahna te chu lung hmanga ven tur a ni a, hei hian lei luangral tur a veng dawn a ni.

DOP Ruahman dan:

Zawhna: Lo neitu huan chu 2 hectare a zau a ni a, thlai chin na atan a tha tak a ni a, thlai chawm khawp tura tui mamawh zat chu engtia tam nge ni ang?

Chhanna: Huan zau zawng chu: 2 ha

Tichuan 1 ha = 10000 sqm tih kan hre bawk a.

Chumi a nih chuan, 2 ha = 20000 sqm.



Stop Dam

Tui thlai kham khawp 10cm a thuk chawm tur chuan tui 2000 cum kan mamawh dawn tihna a lo ni a, a chhan chu

$$20000\text{sqm} \times 0.1\text{m} = 2000\text{cum}$$

Tichuan DOP size chu 40m a sei 20m a zau leh 2.5m a thuk a tul dawn a ni.

7. Stop Dam: Tui luang ral mai mai tur danna tur atana tui khuah a ni a, chhungkaw hrang hrangin tui lakna atan a hman theih a ni.

8. Earthen Dam: Lei chhun pawn hmanga tui khuah hi earthen dam chu a ni.



Earthen Dam

9. Springshed Development:

Sikkim sorkar-in an State mamawh an thlen tih hlawhtlinna pakhat a ni a. Hemi hmang hian Himalayan region velah chuan MGNREGA hmanga hnathawh nasa takin a tipung dawn a ni. Spring (lei hnuai atanga tui lo chhuak) hi Sikkim mipuite inghahna ber a ni a, amaherawhchu tuihna a tlem zel avangin an Sorkar chuan Springshed Development Programme a duang a. An tum bulpui ber chu tui hnar in tui tam leh zual a pek chhuah theihna tur leh heng tui hnar ten hun rei leh zual tuihna an neih



Springshed Development

theihna tura hmalak a ni. Tun hnai ah tui hna hnar ber ruah tui te leihnuai a an put luh tlem tak em avangin nasa taka tui hna a tlem ta a. Hemi avang hian "Dhara Vikas (Spring-shed Development)" tiin MGNREGA hnuaiah hma lak a ni ta a. An hmalakna tlangpui te chu tui hna awmna bul vel (catchment area) humhalh leh cheibawl te, tui luang ral tur ven nana contour hrang hrang siam te leh tui mamawh tam lo chi thingphun uar leh a dangte an ni.

10. Strengthening of embankment:

Lui kam a lo ngheh zawk theih nan lei hmanga tih ngheh a ni a, he lei hi uluk taka tihmuka tui luang ina a tihchhiat mai mai loh nan siam tur a ni.



A hna thawh hmaa hriat tur te:

- Hna thawh tan hmain a lui len zawng te, a tui luan chak zawng te, a kam sir ngheh leh ngheh loh te uluk taka survey phawt tur a ni.
- Lui chu a len vak loh emaw a kamsir a ngheh that chuan lei hman tam vak a ngai dawn lova, nimahsela a lui a len a a kam sir a ngheh loh chuan uluk taka design a ngai thung dawn a, lei pawh mamawh hnemin uluk taka tih awih a tih muk tur a ni.

A siam dan:

- Lei chu a lakna hmun atangin lui kam sir ah chuan vur tur a ni.
- Lei vur hi 15-23cm a chhah danah zel tihmuk zel tur a ni.
- A lei vur pah hian a awih dan tur ang mila siam zel tur a ni.
- Lei hman a chak that loh chuan lung hmuh theih awlsam rem tel a tha zawk a ni

11. Construction of Drainage Channel/ Irrigation Canal

Channel chu Gravity hmanga hmun sang zawk atanga hmun hniam zawka tui kal theih nan a tui kuang siam hi a ni.



A pawimawhna te:

- Ram chung a tui tam lutuk luan chhuah nan a tangkai a ni.
- Tui pek nan a tangkai a ni
- Tui lo len thut palha tui hmun danga luanchhuahtir nan a tangkai hle a ni
- Tui tha neilo te tan tui lakna tha tak a ni

Hnathawh hmaa hriat tur te:

- A tui lakna hmun tur a that tawk leh tawk loh te, a ram awih that tawk leh tawk loh te, tui a luan that theih dawn leh dawn loh te uluk taka survey phawt tur a ni.
- Engineer in uluk takin a design tur a ni a, a tlangpuiin trapezoid anga siam thin a ni.
- A kam sir te chu a awih deuh in a nghet tha hle tur a ni a, hei hian tui luang ina a sir a eiralna lakah a veng dawn a ni.
- A thuk zawng hi tui lak tanna aia a chhuahna a hniam zawk theih turin design tur a ni.

A siam dan:

- Uluk takin a laihna hmun tur te chu chhinchhiah phawt tur a ni a, hei hian a hnua hnathawh a ti awlsam dawn a ni.
- Design ang mila laih tur a ni a, tui lo len thut thulha inven nan a thuk dan tur pangai aia athuk hreta laih tur a ni (free board 30cm vel dah tur).
- Lei laih chhuah chu channel kam sirah vur zel tur a ni a, he lei hi tihmukin, lehlam lehlamah bund atana hman zui tur a ni.
- Channel sir laih awih chu uluk taka tihmuk tur a ni a, hei hian tui luang ina a lei eichhiatna lakah a veng nasa hle dawn a ni.

Canal han tih chu tui kawng tihna a ni deuh mai a. Lui tui emaw tui dahkhawlna (reservoir) atanga tui lo kalte kan hman mamawhnaa hman tura tui lak penna atana tui kawng kan hai chawp hi a ni. Canal lian pui pui a awm a, chung chu major distributory an ti a; nimahsela huan leh lo vela tui pekna atana



kan hman mamawh ang chi erawh chu a canal te zawk an nih vangin minor distributory tih an ni.

Irrigation atana hman tur hian tui hna awmna laiah tuichhunchhuah laih thin a ni a, chu tuichhunchhuah chu mimal tana hman tur ni lovin MGNREGA hnuaia minor irrigation atana hman tura ruahman tur a ni. Tuichhunchhuah bul hnaia huan/lo neituten an inremsiamna in laih tur a ni a,

chu tuichhunchhuah chu an huan thlai chawmna tui lak nan an hmang theuh thei dawn a ni.

Tuichhunchhuah laih hna chu thawh a nih hmain a kaihhnawih sorkar department hnenah hriattir hmasak tur a ni a, anni lamin tuichhunchhuah laihna hmun tur chu zir Chiang Hmasa In, tui awmdan te an zir Chian Hnuah Chauh Ruahmanna leh laih mai theih tura inbuatsaih theih Chauh a ni. Tin, tuichhunchhuah chu inhman tawm tur thil a nih avangin a ram neitu leh hamthatna dawngtute chanchin Chiang Taka Ziak leh ram neitute inrem Siamna (MOU) te chu Ruahmanna Siam Hunah felfai taka thil tel tur a ni.

Huan leh lo te hi hmun zawl vekah a awm thin loh avangin tlangram leh hmun sang lai deuhah chuan irrigation atana hman tur tui dahkhawlna hi hmun sang laiah Siam a, chuta tanga tui luan thlak tir leh mai thin a ni a. Chumi atana tui thiar chhohna chu Lift Irrigation an ti a ni. Pump hmangin emaw thil dang pawhin tui hi lak chhoh theih thin a ni.

Tui kawng siam that hna thawh laia hriat reng tur te:

1. Kan tui kawng thawmthatte chu a kuang chu tha takin, chhe mai theilo turin kan siam tur a ni a.
2. Tui kuangte chu nghet takin kan sawh anga, a theih phei chuan tui tlem azawng theh huhin nghet takin kan sawh muk ang. Khi tem tuam leh bal hek mai thei lai te awm hauhlo tur a ni.
3. Culvert hnaih deuh laia tui kawng awmte phei chu uluk lehzuala siam thin tur a ni.
4. Tui kawng kan thawm that dawnin a lema entir tak ang hian trapezoid pian anga siam hi a tha ber a, a tlo ber bawk a ni.
5. A theih chuan kan tui kawng siam hi a sir tawn tawnte hi concrete emaw a siam theih ni sela, chu chuan tui luangin a chheh vel lei a ei hek nasa tur a veng anga, enkawl a nuam em em dawn a ni.
6. Tui kuang hi a slope atan lei sakhat deuhah chuan 1:1 hman thin a ni a, lei nemah erawh chuan 2:1 tepawh hman thin a ni.
7. Tui kawng laih faina lei vung hi a kam velah chhek tawp lovin, 1 m vel a kamah zuah awl phawt hnuah chhek khawm Chauh tur a ni. He hmun zuah awl lai tak hi "Berm" an ti bawk thin.

Tui kawng (Canal) thuam that hna thawh dan turte:

1. Tui kawng hmun thenkhat 50% dawn lai lo chim emaw, lo chhia a awm chuan a theih anga siam that a, a kuang pawh thuam that leh tur a ni.
2. A chimna laia lei vung te chu hai faiin, a tlang bel that nan pawh a la hman leh zel theih bawh a ni.
3. A kuang slope chu 2:1 vel a siam tur a ni a, tichuan a hlui lo awmsa a tla bal lai leh bel tharna lai tepawh chu nghet takin a in char zawm thei dawn a ni.
4. Tui kawng chu hai fai mai bakah a sir vela hlobet awmte chu rih fai vek tur a ni.
5. Thing zung emaw hnim lian deuhthe pawh a zung nen chawpa thlawh fai tur a ni; hengte hian tui kawnga bawhlhlawh emaw thildang lo luangte a lo dang bet a, a hnawh flat thin a ni.

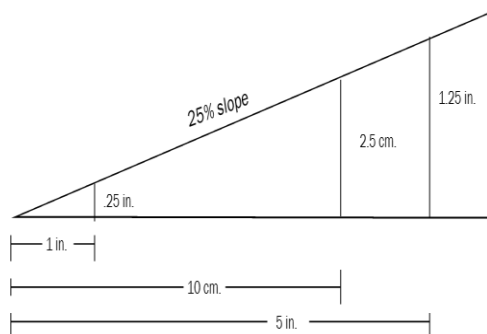
Chapter – 6

SOIL & WATER CONSERVATION – SITE SELECTION & ESTIMATION

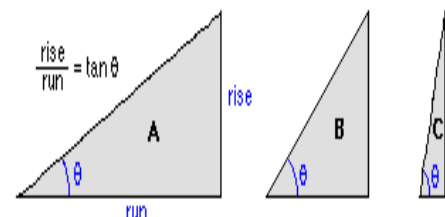
1. Slope Percentage lak dan – Ram awih lam sawi dan pakhat chu percentage a ni a. Ram awih dan Chiang taka kan hriat hian farm planning leh hmalak dan tur a hriat thui hle a ni. Hetiang hian chhut tur a ni:

Measuring tape emaw Mau remchang emaw pawh a hman theih a, ngil takin tlangpang hnualam hawiin kan pawt ngil phei ang a, chu chu 90 degree in a thlep thla ang. Kan teh tanna leh kan teh tawpna, lei a zu tawhna chiah kha chhinchhiah tur a ni. Hemi kan pawh zawl phei hi run/base kan tih chu a ni a sei zawng chhinchhiah tur ani. 90 degree kan pawh a lei a thlen thlak na chiah san zawng kha rise/perpendicular tiin an sawi a. A kham phei hi a san zawng in sema, 100 in puntir leh tur a ni.

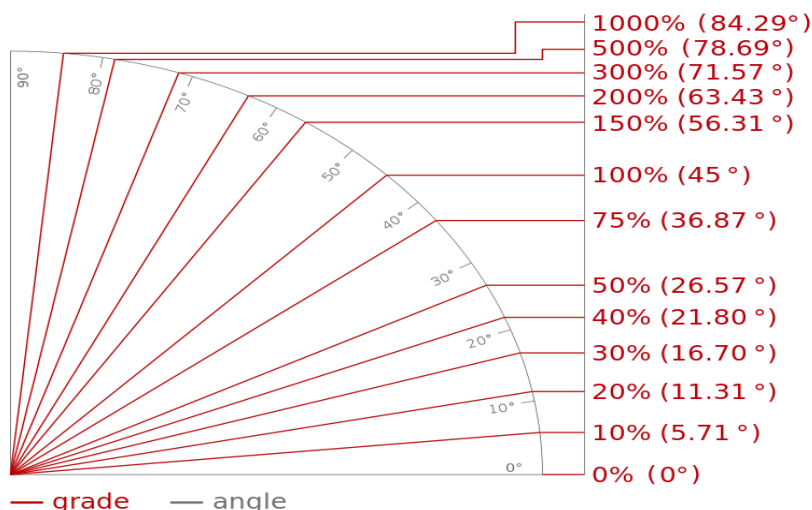
Formula= Rise/run x 100



Degree of slope = θ
Percent of slope = $\frac{\text{rise}}{\text{run}} \times 100$



Degree of slope =	30	45	76
Percent of slope =	58	100	373



2. Bench Terracing:

Hmun awiha thlai chin dawn chuan bench terracing hi hman thin a ni a; ram awih lutuk ti ziaawm tura step siam a ni deuh ber a. Ram awih dan hi 33% vela atân recommend a ni, amaherawh chu, hmun thenkhat tlangram chhengchhe tak tak Himalayan region ang ah chuan bench terracing hmanna ah chuan 50% chin hmun awih ah pawh laih thin tho a ni.

Bench terracing hi chi 4 ah then a ni:

- i) **Level terraces:** Leilet bial kan tih hi a ni. Lei dur thatna hmun (Soil depth – medium to deep), ruahtui kum khatah 2500-3000 mm (ruahtui tamna hmun). Buh chinna atân hman ber a ni. Ram awih dan (Slope) 33% hnuai lamah hman a ni tlang pui.
- ii) **Inward sloping terrace (a chhunglama awih):** Ruah tui luan chhuah zung zungna tura leilet chhûng lam tlêma tih awih luh deuh a ni. A hma a mi ang tho kha khian ruahtui tamna hmunah hman a ni. (Soil depth – medium to deep, rainfall – high). Alu, thlai rah chi, vaimim etc te chinna atân hman a ni.
- iii) **Outward sloping terrace (a pawn lama awih chhuak):** Terrace pâwn lama tlêma awih deuha laih hi a ni. Lei thûk lo leh ruah tui tlêm, kumkhatah 1200 mm hmunah te siam a ni. Buhtun lam, buh sanghar etc., te chin thin a ni. Ram awih dan 33% hnuai lamah hman a ni tlangpui. Hmun thenkhatah chuan bench terrace te hi hmun awih 33% pelah te an siam a. Zir chianna atanga a lan dan chuan terrace 50-70% slope ah pawn lama awih a siam hian lei chunglang lei hang tha a ei ral nasa hle a, heng te hi lung hmang emaw lei hmanga bial tlang siama dan tur a ni.
- iv) **Puerto rican type terrace:** Lei lai chhe si lova terrace zawi zawi a siam dan a ni. Lei kan laih phut te zawi zawiin hnuai lamah hnawl thlain contour a lo insiam ang a. Chu contour line zûl zuiin grass emaw a remchang danga dawl tur a ni. Grass leh grass inkarah hmun âwl zuahin, chutah chuan thlai chin a ni. Lei kan laih phawn kha a sira grass-a hungah khan zawi zawiin a lo tling khawm a, kum 3-4 hnuah chuan terrace-ah a lo chhuak mai thin. Ram awih lam hi 12% hnuai lam, lei thuk zawng (soil depth) hi a laihawl (medium to deep), ruahtui tlak tam dan hi kum khatah 1500 mm hnuai lamah a tha tlangpui.

Terrace Laih dan:

Terrace chhuat chu zawl khata (contour line) awm tur a laih tur a ni. A inkar hlat zawng pawh a chhuat zau zawng tawp a tanga teh a mumal taka vawn tur a ni. Terrace laih chu kawi vut emaw in elh lutuk a laih loh tur a ni. A ngil thei ang ber leh kual mumal taka laih tur a ni.

Terrace laih chu a tlangpui thuin a chung lam a tanga tan hi a tha a, mahse lei chung lang lei tha dah tur chuan a hnuai tanga tan ve thung tur a ni. Chumi a nih loh chuan lei chung hang tha chu lak khawm hmasak a, laih zawh hnuah dah let leh mai tur a ni.

Spacing of Terrace

$$VI = \frac{S \times Wb}{100 - (S \times U)}$$

VI : vertical interval, in m

S : slope in percentage (%)

Wb : Width of bench (flat strip), in m

U : Slope of riser (using value 1 for machine-built terraces, 0.75 for hand-made earth risers and 0.5 for rock risers).

Example: Calculate the VI of 4 m wide, hand-made benches on a 30% slope with earth risers.

$$\begin{aligned} VI &= \frac{30 \times 4}{100 - (30 \times 0.75)} \\ &= 1.55 \text{ m} \end{aligned}$$

3. Water Harvesting:

A tum ber chu tui dah khawl a, mamawhna hrang hrang atâna hman a ni. *Water harvesting structure* heitang hian then a ni -

- 1) Dug out or excavated farm ponds (khur laihkhuar),
- 2) Small earthen embankments (Lei chhunpawna khuah),
- 3) Embankment cum dugout type ponds (Chhunpawna bawka laih khuar baw).

Sangha khawina atan dil hi a hman theih baw.

Hemi bakah hian a hnua ami ang hian mahni hman tangkai turin tui hi dahkhawl theih a ni bawh:

- i) In chung tui lak
- ii) Kawrte tui lak
- iii) Mau reh kuak hmanga tui lak (Bamboo drip irrigation system)

4. Boulder Check:

Lung hmanga tui luang lai, kawrte emaw lui tenau deuh, tui luang chak lutuk lo ti muang a, lo khawl thei tura khuah hi a ni ber awm e.

Siamna hmun tur:

- Boulder check pakhat tui dawn khawl na area (catchment area) chu 1 to 2 ha aiin zau lo se.
- Boulder check reng reng tui luanna chhuat slope 20% ai sangah siam loh tur a ni. Hemi ai a awih ah chuan Tui luang chak tak kha boulder check hian a dawl zo dawn lo a ni.
- Boulder check hi a siamna hmanrua lung awmtamna hmun emaw, lak mai awlsamna hmunah siam hram tur a ni. Hmanrua lak khawm harsa tak leh material cost sang turah chuan siam loh hram a tha.
- Tui khawl tura beisei chu nilo mahse tui tlin khawl tam theihna hmunah emaw tui engemaw chen khawl thei tur a siam chu duhthusam a ni.
- Hmun awih deuh ah chuan Boulder check te chu inhnaih deuhah dah tur a ni a, mahse 10m aiin inhnaih lo se.
- Hmun awih dan nep deuhah chuan inhlath deuh a siam nise, mahse 50m aiin inhlath lo se.

Entirna:

Lui te pakhat 1500m a sei, a hmun awih dan slope chu 10% a ni a, 1 metre a sang boulder check hi engzat nge a siam theih ang?

Soln: hmun awih dan chu: Slope 10%

Boulder check height: 1m

$$HI = \frac{V \times L}{Slope} \times 100$$

Slope

$$HI = \frac{1}{10} \times 100 = 10$$

Hemi awm zia chu metre 10 dan zelah boulder check hi siam tur tihna ani a, amaherawh chu, boulder check pakhat hian meter 5 zel hmun a luah dawn a chuvangin $HI = 10 + 5 = 15m$

Boulder check siam theih zat chu : $1500/15 = 100$ Boulder checks

- Boulder check hi a tlangpuiin meter 1 a sang/thuk a siam hi a ni ber thin. A chung zawl (top width) hi 0.4m – 0.5m hman a ni tlangpui baw.
- Lung remkhawm danah pawh hian awmze nei thlap a rem a ni a, lui hnar lam hnaih leh a chhungril ah hian lung te deuh dah a ni a, a pawnlawi deuh leh lui mawng lam hawi ah hian lung lian tha tha dah thin a ni. Hei hi a chhan chu tui force khan lung a len bo mai loh nan leh structure a ngheh zawk nan a ni.

5. Contour Trenches

a) Continuous contour trench:

A thil tum te:

- Tlangpanga tui luang chak lutuk ti muang tu
- Lei luangral tur veng tu
- Lei hnawna ti rei tura pui tu

A awmna hmun:

- Hmun 25% ai a awih ah chuan siam loh a tha. Hetiang ai a awihah chuan thing phun, hnimhnah to tir emaw thing buk te phun hi lei luangral tur venna atan chuan a tha ber a ni.
- Hmun 10% ai a awih lo ah chuan contour trench siam hi a tul hran lo a, hetiang hmunah chuan contour bunding siam hian awmzia a nei thui zawk a ni.

Contour trench inkar hlat zawng (Spacing):

- Contour trench pahnih insan hleih na chu meter khat (1m) a ni. Hemi a nih avang hian 5% slope ah chuan contour trench inkar chu 20m a ni dawn tihna a ni. Chutiang zelin 10% slope ah huan 20m a lo ni dawn tihna a ni.
- Hmun awih zual lai ah huan contour trench te chu an in hlat tur a ni lo a, amaherawh chu 10m aiin an in hnaih tur a ni lo.
- Hmun awih vak lo ah chuan trench te chu inhlat deuhah an awm tur a ni a, amaherawh chu 30m aiin an inhlat tur a ni lo.

Contour trench design:

- Contour trench chu meter chanve a zau, meter chanve a thuk a lai h a ni tlangpui thin a ni.
- A thuk lam: 50cm

- A zau lam: 50cm
- **Berm:** Lei laih chhuah sa chu khur atang 20cm a hla-ah khur thlanglamah paih thin ani. He hmunawl (gap) khur leh leivung inkar hi Berm tia hriat a ni a, hei hian khur chhungah leivung kha a tlak luh leh mai lohna tura veng tu a ni.

Unmoved undeterred

Contour trench ruahman dan (layout):

- Hmun awih dan (slope) chu mual pawng lai atang hmun hran hran ah teh chhuah tur a ni.
- Hmun awih dan slope 10%-25% te chu chin chhiah la, contour trench ruahmanna siam tur a ni.
- Mual dung sei theihna lai ber hmun chu chhinchhiah a, chumi atang chuan contour trench chu tan tur a ni.

b) Staggered contour trench te chu contour line vawn dik a awl zawk avangin a him zawk a ngaih a ni. Khur hi meter 4 a sei metre chanve a zau meter chanve a thuk in line khatah laih a ni a, a hnuai a khur laih chu a chung karawl zawn chiah ah laih tur a ni. Hei hian tui a khawl kawngah tui kalral a tlem dawn a ni.

6. Earthen Contour Bunds:

A thil tum te (objective):

- Tui luang chak lutuk ti muang turin.
- Lei chung lang luangral tur veng turin.
- Lei hnawna vawngrei turin.

A awmna hmun tur(location):

- Slope 10% ai sang ah chuan siam loh tur a ni. A chhan chu tui luang a chak avangin bund chu awlsam takin a chhe mai dawn a ni.
- Slope 10% chin leh a hnuai lamah siam a tha ber a, contour bund ah chuan tui hi khur chhung chauhin dawng loin bunding pawh hian a lo dawn tho avangin hmun awih ah chuan a tih chi loh a ni.

Contour bund inhlat zawng:

- Meter khat hi a insan hleihna a ni tur a ni. Chumi awmzia chu 10% slope ah chuan contour bund inhlat zawng chu 10m tihna a ni.

- Hmun awih deuh ah chuan bund te chu an inhnaih tur a ni a, mahse 30m aiin an in hnaih tur a nilo.
- Hmun aiwh vak lo ah chuan bund te chu an inhat tur a ni a, mahse 60m aiin an inhlath tur a ni lo.

Design:

- A san lam: 60cm
- A tlakhniam theih chin: 20-25%
- Hemi a nih chuan bund san lam chu: $60 \times 1.25 = 75\text{cm}$ a ni dawn tihna a ni. Lei thil leh lung deuh hmun ah chuan a tlakhniam theih chin hi 10% vel tur a ni.
- Top width a chung zawl zua zawng: 20-30cm
- Bund chhunglam/chhaklam slope (Upstream Slope): 1:1
- Bund pawnlam/thlanglam slope (Downstream slope): 1:1.5, lei thil leh lung deuh ah chuan 0.75:1 a hman theih a ni.
- Tui chhuahna(exit): Tui luanchhuahna chu leichhuat ai sangah siam tur a ni a, tui te chu hun reilo te tling lai lawk tur a duan a nih hnuah a chuang liam chu exit ah an luang chhuak mai dawn a ni. Hemi vang hian exit chu uluk taka siam angai a, lung chhuat emaw tuiin a tih chhiat mai theih loh tur a siam tur a ni.
- Lei laih: Lei laih chu inzawm put a laih tur a ni lo a, a chhan chu kawr ang maiin tui kalna kha a awm theih vang a ni. Hei hian nasa takin lei a ti kal ral ve thei flat a ni. Khur kan laih te chu inzawm loin meter chanve dan velah laiin lei laih chhuah te chu bunding siam nan hman tur a ni. Khur (trench) chu meter khat a zau hi a tawh thei mai a ni. Khur leh khur inkar chu tooth tia vuah a ni a, a lema entir ang hian a sei zawng chu meter hnih vel leh a san zawng chu 30cm niin lung hmanga siam tur a ni.
- Berm: khur leh leivung inkar hi Berm tih a ni. Berm hian khurah leivung tia lut leh mai tur a veng a ni.
- Hnim hnah to tir hmanga bund venhim: Bund lei luangral mai tur ven nan hnimhnah to tir emaw phun hi a tha hle a ni.

7. Earthen Dam:

Tui khawh a tam zawh theih nan lui pakhat ai tam infinkhawmna hmun ni thei se.

- Tui pump chawp ngailo, gravity flow hmanga huan leh thlai tui pek theihna hmunah siam ni thei se.
- Tui khuahna hmun chu lui kuang zimna lai ni si, tui khawh tam thei tur a hmun tha tak ni se la, lei hmanga khuahna chu a tawh thei ang ber a ni dawn a ni.

- Foundation atan a lei char tha awmna hmun, lung chhuat awmna hmun ni thei se.

Catchment yield (Tui luangkhawm tur zat hriat dan):

- Kum khat chhunga ruahtui tla 10% (Rr) hi chhut nan hman tur a ni.
- Dam in tui a dawn khawlina hmun (Catchment area) (A) chu Km² in chhut tur a ni.
- Y hi catchment yield a ni a, cubic metre a chhut a ni.

$$Y = Rr \times A \times 1000$$

Storage Capacity (Tuikhuah in tui a khawl theih zat):

Kan tui khuah chuan tui engzat chiah nge a khawl theih tih chu he formula hian chhut a theih a ni.

$$Q = \frac{LTH'}{6}$$

Hetiengin,

Q = kan tui khuah in tui a khawl theih zat cubic meter in.

L = Tui khuah bang sei zawng Full supply level a tehin.

T = Tui khuah bang atang ngil taka tehin a tui chim chin tawp thleng.

H = Tui khuah thuk zawng full supply level atanga tehin.

6 = hei hi factor a ni a, 4 atanga 5 pawh tawn hriat a zirin hman theih a ni.

Heta tanga thil lo lang Chiang ta chu, kan tui khuah tur chu tui luangkhawm thei zat leh kan tui khuah in tui a khawl theih zat tur chu fimkhur taka chhut hmasak a him ber a, chumi mil chuan kan tui khuah tur thuk zawng te, tui paih tur chin te, a tlangpui chu a hriat theih dawn a ni.

8. The embankment (Lei hmanga tui khuah slope vawn dan):

Lei hmanga kan tui khuah chu a chim mai loh nan slope uluk taka siam in vawn flat tur a ni. Lui hnar lam side chu upstream tih a ni a, slope vawn tur chu 1:2.5 to 1:4 a ni. Lui mawng lam hawi side chu downstream tih a ni a, slope vawn tur chu 1:2 to 1:3 a ni.

Freeboard (Tui chim loh tur chin):

Hei hi tui khuaha tuiin a chim ngai reng reng loh tur chin sawina a ni a, a tlangpuiin 0.5m – 1m alin a tlem tur a ni lo.

Core depth and thickness (Tui khuah lai mu):

Hei hi tui khuah lai mu a ni a, tui put tlang loh na tur a tlak lei sawh muk 2m-4m a chhah a ni tlangpui a, a thuk zawng emaw san zawng hi tui khuah thuk lam 75% vel a ni tlang pui a ni.

Crest width/top width (Tuikhuah chung zawl):

A chung zawl hi meter 2 aiin a zim tur a nilo. A tlangpuiin Dam tenau pawh hi meter 5 thuk hi a ni deuh veka, a chung zawl hi meter 3 hman mai emaw he formula hi a hman theih bawh.

$$Cw \text{ (in m)} = 0.4H + 1$$

Cw~a chung zawl, H~ tui khuah thuk zawng.

Settlement allowance (a tlakhniam theihna) :

Dam hi siam zawh a nih hnuin 5%-10% in a tla hniam ve leh thei a ni.

Surplus Weir/waste weir (tui chuang liam paihna):

Hei hi tui khuah atanga a chim tur chin level bak tui chuang liam paih chhuahna atan a siam a ni,

Earth Dam hi a man tlangpui chu tui cubic meter khat zel a chhut in Rs. 20 – Rs 30 man ang vel a ni.

8. Gabion Structure:

A tangkaina te:

- Lei luangral tur veng tu a ni.
- Lei nawi a lo dang chat a, hei hian lui mawng lama tui khuah pawh-mawh tak te lein a chhilh khat mai tur a veng.
- Lei tang khawm te chu lei tha a ni a, thlai chinna a tan lakchhuahin a tang kai.
- Lei hnuai tui a ti pung.
- Tui luang ral mai tur chu lo ti muang in rei zawk tui a awm tir thei a, hei hian hun rei zawk hman theih turin a chhawp chhuak a ni.

Siamna hmun:

- Gabion structure pakhat tan hian tui lak khawlha area (catchment area) chu 5 ha. vel a ni a, hemi ai catchment area tlem ah chuan boulder check siam a tawh chauh a ni.
- Tui a khawl tam theih nan, a siamna hmun chu hmun zawl lai, tui khawl tam thei tur lai a siam ni se.
- Tui tlin khawmna hmun chu tui lei hnuai a zep relh theihna hmun a ni tur a ni. A chhan chu kha tui tling khawm kha tui hna ti pung tu tur atan a kan ruahman vang a ni.

Design:

- Lung thir phiar hmanga fun khawm (pack) a ni a, inhne rem takin uluk taka rem khawm tur a ni.
- Thir phiar (wire mesh) chu rectangular shape dik tak a kil pawh ngil tha tak a ni tur a ni a, hemi a kil ti khawng tur hian rod te pawh dah thin a ni.

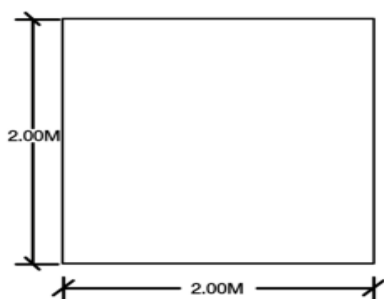
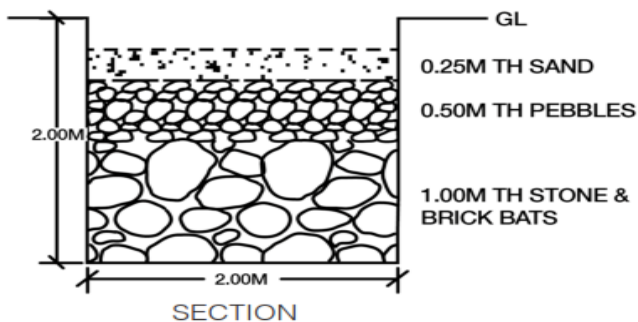
10. Mini percolation tank/water absorbtion trench:

Soak pit/recharge pit:

Soak pit chu lei chhuat hnuai lama khur, tui lei hnuai a lut thei tur a ruahman hi a ni. Hei hian lei hnuai tui inkhawl chu tipungin tangkai taka hman theiha siam tu a ni. Soak pit hian rannung mihring tana hlauhawm tak tak tui luang sawn lo,



SOAK PIT



lung leh brick hmanga thun khah tur a ni. Chumi chung metre chanve (0.5m) chu tiau lung hmanga thun khah hnuah 0.25m vel chu balu

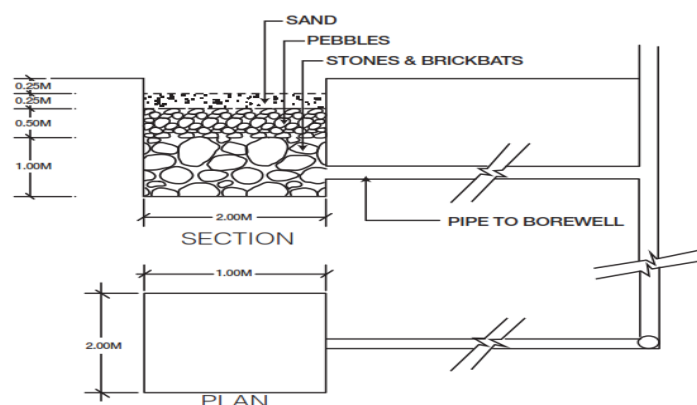
tling reng atanga lo piang thei tur a ti tlem bawh a ni.

A hmun tur thlan dan: soak pit chu tui chhunchhuah, tui pump emaw tui pipe hmanga lei hnuai a mi lak chhuahna hnai ah siam tur a ni.

Design Drawing leh pawisa ngaizat:

Pit size (2mx2mx2m) chu 2m a sei, 2m a zau, 2m a thuk a ni a, a mawng atanga teh in meter khat chin chu

RECHARGE PIT



hmanga thun khah tur a ni. A bak 0.25m la awm chu tui dawng khawl tu tur a tan dah awl tur a ni. Ti hian tui chu lei hnuaiah bawlhhlawh telloin a lut tawh mai dawn a ni. Khur khat atan pawisa ngaizat hi Rs. 2,200/- bawr vel a ni.

Balu - Lei tel lo balu fai tha ni se.

Rora - rora fai tha tak leh a thar hman tur a ni.

Lung leh brick nawi - Lung chang tha, fai tak leh brick nawi rawh chan that a ni tur a ni. Hmanrua kan hman tur hi fai tha tak a ni ngei tur a ni.

11. Stop Dam:

Stop dam hi tui luang lai hnar nei tha kumtluana luang ang chi ah hian siam thin a ni. Fur ruahtui luang ral mai tur lo ti muang a, hun rei zawk hman theih tura lo dang chat tu a ni. Fur ruah tui tam lai chuan tui luan chhuahna gate chu hawn thin a ni a, hemi hian lei nawi tuikhuah chhuata tling khawm tur a ti tlem a ni. Fur ruahtui a zawh hnu chuan gate chu khar leh niin, tui chu a in khawl tha leh in a lo khat leh mai thin a ni.



1 hectare ram a tan hian stop dam chu 20m a sei, 2.7m a thuk, a chung zawl 1.5m leh a bang slope 1:1 size hi a taww thawkhat viau zel a ni. Hei hian Rs. 5 lakh vel man a ni. Tui a khawl atanga teh a cubic metre rate chu Rs. 90-100 a ni. Stop dam hi lung rem emaw brick hmanga siam theih a ni a, heng hmanrua te hi awlsam taka hmuh leh hman theih an ni tur a ni. Gate atan hian Pre fabricated metal hman tur a ni.

12. Land Leveling:

Land leveling emaw grading chu ram/huan chhengchhe lai deuhte siam rema, hai fai a, lai h zawl deuhte hi a ni. Ruahtui luang in emaw lei a lak nasat lutuk loh nan te, ram chhunga tui luanna mumal taka sial nan te, ram leilung hnawnna tha leh zual zawka vawn him a nih theih nana ram leilung awmdan siam rema, siam that hi land leveling chu a ni.

Land Leveling hna thawh dan turte:

1. Ram chu kan siam rem dawn chuan a teh tanna tur felfai takin kan chhin chhiah anga, kan thawh chin tur ram chhung chu then hrang hranga

thenin, a then 5x5,15x15,20x20m te in kan siam ang, tichuan a chawp te te in rual rem takin kan siam rem thei dawn a ni.

2. Kan ram siamrem tur kan then darh thliah thliahte chu a ram pian awmdan kan siam fel hnuah contour line siam tur a ni a, chumi siam dan tur chu a ram awmdan a zir zelin contour line te inkar zau zawng siam rem mai tur a ni. Hetiangin:

Slope percentage required	Contour interval
0 – 1	5m – 15m
1 – 2	15m – 30m
2 – 5	30m – 60m
5 – 10	60m – 150m

3. Contour map nena enmil chungin ram leilung awmdan a zirin then hrang hranga siamin, a tha thei ang ber tura irrigation kalpui a nih theihnan ruahman thin a ni.

Chapter - 7

SOIL PRODUCTIVITY ENHANCEMENT - COMPOSTING/GREEN MANURING

Fertilizer leh lei tha (manure) te hi kan hmang nasa tawh hle a, kum 1960 hnu lam atang phei chuan ram thang mek India ah hi chuan fertilizer hi hman a awlsam avangin leitha tak tak diin a lar ta zawk a. Amaherawh chu hei hian that loh na tam tak a neia, kum hnih khat chhung chu thlai thar hlawk mahse hun alo reia leiin a tuar a, thlai a thar hlawk thei lo a ni. Hemi anih avang hian leitha (manure) te hi hman a tul hle a ni. Tunlai phei chuan chemical fertilizer tellova thlai chin, organic farming hian ngaihhlut a hlawhin an ching thar hle a, thlai leh thei thar chhuah te pawh a tui bik an ti a ni.

Fertilizer leh manure te hi a tam lam in angah chuan manure hian thlai tana chaw tha mineral te a pai tlem zawk a, mahse lei a ti tha thung a ni. Tin, awlsam taka siam theih a nih avangin tupawhin kan tih ve mai theih a ni. Leitha siam dan chi hrang hrang leh farm planning hi kan la sawi fiah chho zel ang a, kan sawi ang zawng zawng kan ti thei lo a nih pawhin a then hi uluk taka practice ni se, hlawkna kan hmu ngei ang.

Lei chunglang hang tha hi loneih/huan neih lama hlawhtlinna inngahna ani a, leiah hian hrik te tak te te mit lawnga hmuh tham loh an awm a, chung hrik te chuan hnim leh thlai leh rannung thi te chu leitha ah an lo chantir thin ani. Chung hrik te chu chemical (damdawi) lei tih thatna te hian a ti hlum thin a, tin, hnim leh thlaiin a khuh loh lei, ni in a em char vang te pawh in lei thatna hi a tla hniam thei bawk. Leichi te hmang uar viau mah ila leiin thatna a neih loh chuan thlai thar a hlawk rei thei lo ani.

Leitha siam chhuah leh lei thatna vawn nun

- Lei tha tam tawh siam chhuak turin in buat saih tur a ni. Heng leitha te hian lei tui pai theihna te a ti punga, thlai mamawh chaw tam tak a keng bawh a, lei me lutuk leh lei ban lutuk te pawh thlai chinna tlak lei tha ah a siam thei ani.
- Leitha tam tawh kan neih bakah hian thlai chi ngai ngawr ngawr ching lovin be kawm nei chi te nen in ban leh tir thin tur ani. Tin, a chinna



Sun hemp

hmun te sawna thlai chi hrang hrang bial hran hrana china a kum leh a thlak thleng kual te pawh hi a tha hle ani.

- Buh seng zawh hnu ah buhpawl te thlawh thluk veka lei khuh nana hman hian lei ni em char tur a veng a, hnim a to tha thei lova, leitha ah a chang zui thin bawk, buhpawl chauh lo pawh thil chi hrang hrang a hman theih a heng thlai sengna bang nawi, thingzai herna nawi te leh thing hnah te pawh.

1. Legumes (Thlai zung bawk nei chi) leh thlai chin tur

- Be kawm nei chi hian a zung bawk leh a hnah tla tawih hmangin leitha a siam theih a, a then khat chu a dam rei loh avangin thlai seng zawh veleh china lei nena leh pawlh pawh hi a tha hle. Leilet bial kotlangah te pawh a chin theih a, a hnah sah a hunah



Horse gram

- leilet zawlah chap darh leh mai tur ani. Lei dur tha hi hun bi nei takin pek tur siam chhuah reng tum tur ani a, a tawih zawh hma in pek loh tur ani.
- Thlai in chaw tha tam tawh a hmuh chuan a hrisel thin a, thlai hrisel chu rannung leh natna in an ngamlo bik ani. Tum khatah thlai chi khat chauh ching lovin, chi $\frac{3}{4}$ chin tur ani. Chu chuan rannung puang thut laka avaia kan thlai kan chan tur a lo veng him thin a, rannung hian beih bik an nei thin a. A then bei mahse a duh loh zawng chi a lo awm anih chuan a him hlah thei ani.
- Thlai te hi mumal taka rem tur a ni. Nisa duh tam bik te chu a chinna lai tur ngaihtuah a, thing hlim hnuaia chin chi te chu thlai dangin zar hlim tir tur ani. Thal laia tui pek ngai chi thlai te chu tui vawi enge maw zat pek ngei tur ani, huan chhungah rem chang laiah ruahtui dawn khawlna tur tuikhuah laih a chu chu thal laia thlai chawm nan hman tur ani.
- Leitha khur hi lai kher lo pawhin zem a kual theih bawk. Mahni rem chan dan ang zelin a tha tur chu en chhinna neih a tuipei tak tak a ngai a ni.
- Farm hual vela thing tangkai phun kual hi a tha hle bawk thli na lutuk te a lo dang a, a buk hlim hnuaiah daihlma chin chi thlai te a chin theih bawk.

2. Thlai hring hmanga leitha siam/Green manuring – Thlai then khat abikin

kawm nei chi te hi leitha siam nan a tha hle a. Chutiang thlai then khat chu a chinna hmunah thlawh thluka lei an leh hnan mai thin a, chutiang chu 'green manure' an ti a. Tin, hmun hnan ami thlai te, thing hnah te leh a zik no te pawh a lak khawm theih a chu chu green manure ang thova lei nena leh pawh tur ani hei hi chu 'green leaf manure' tiin an vuah ani.



Dhaincha

Thlai chi hrang hrang hnah ngah deuh chi chu green manuring atan hian an theih deuh vek a, chung zingah chuan heng leitha thing kan tih mai, Tephrosia, dhaincha(kelbe lam ang deuh chi), sunhemp, behlawi leh be lam chi hrim hrim te hi an tha leh zuala, lei chhe hmun ah leh tui awm mang loh na hmun ah pawh an nung thei a, a hnah leh zar no te chu kih thluk hnuah lein an vur a, hun engemaw ti hnuah chuan lei tha ah alo chang a. Hei hi ram tih tui leh nan leh thlai chinna tlaka siam nan pawimawh em em a ni. State hrang hrang heng Kerela, Orissa, W.Bengal, Andhra Pradesh, Mysore leh Punjab vel ah te chuan an uar hle a ni. Thlai dang chin lak lawh lai pawhin thlai tlar karah a chin tel theih thova, a remchang hle a ni.

- a) Mizoin kan tih dan pangngai angina be lam chi te hi buh hmun leh huanah tam zawkin ching tel ila.
- b) Green manure atana hman thlai te hi buh leh thlai dang te nen a tlar felfai tak siam in a chin pawlh(intercropping) theih ani.
- c) Leilet bial kotlangah leitha thing leh be kawm nei chi te hi a chin theih bawk.
- d) Crop rotation-hmun ngaiah thlai ching reng lovin be kawm nei te nen chin thlak thin ila.

3. Leitha siam dan (compost & FYM)

Leitha (manure) hi chi hrang tam tak a awm a, chung zingah chuan FYM(farm yard manure) te, Compost te, bone meal te leh oilcake te hi a lar zual an ni a. Heng zingah hian compost leh FYM siam dan kan zir dawn ani.

FYM (farm yard manure) siam dan:

Hei hi ran zun leh ek leh an mutna hnu zun leh ekin a chiah piah hnu ningnawi atanga siam ani.

Khur 6m a sei, 2m a zau, 1m a thuk laih tur ani. 1m khat danah daidan thliah thliah tur a ni. Ran zun leh ek te, an mutna hnu zun leh ekin a chiah hnu te chu khur chungah chuan vawm luh zel tur ani. A khur a lo khah a, lei zawl atanga meter chanve a lo nih hunah duh tawh tur ani. Tui bucket 4-5 in leih huh tur ani a, chumi hnuah bawng ek chawhkawi leh lei chawhpawhlin zut mam tur ani. Hei hian tuihu leh nitrogen boruaka a kal ral tur a veng a, tho insiam tur a dang bawh a ni. Nisa em nasat tir tur ani lova, ruah nan tir tur ani lo bawh a ni. A theih chuan a chung zar a tha hle a, a hnu thla 4-5 ah a hman theih a, hetiang hian bawng pakhatin kum khatah leitha 5-6 ton a thar chhuak thei ani.

Compost siam dan:

Hnim leh thlai sengna hnu ningnawi atanga siam leitha hi farm compost an ti a, khawpui thli atang pawhlin a siam theih bawh a, chu chu urban compost an ti bawh a ni.

Siam dan chi hnih a awm a:

- 1) Aerobic method :
Khur 1m a thuk, 2m a zau, a sei lam duh ang chen laih tur a ni. Hetah hian hnim te, thlai sengkawm tawhna hnu ning nawi



te kha vawm luh thin tur ani. Ift vela chhah anih hunah bawnggek tuiin rual taka theh huh tur ani a, ran zun te meivap te, bone meal te pawh kan hmuh theih ang apiang telh zel tur a ni. A ro lutuk chuan tui in theh huh thin tur ani. Khur a lo khaha meter chanve vela lei chung lama a pawn thlengin hetiang hian tih tur ani. Chumi hnuah thla khat danah vawithum chawh leh tur ani. Chawh leh a piang hian tui tin 3-4 velin

leih huh ziah tur a ni. Thla 4-5 ah a hman theih. Ruahtui leh tuihna tamna hmunah chuan lei lai khuar lovin lei chungah zem a kual theih ani.

- 2) Anaerobic method: Hei hi FYM siam dan nen khan a in ang hle a, hetah hi chuan ran ek ai ah hnim leh thlai ning nawi te hman ani. Aerobic method ang tho in bawngek tuiin theh huh thin tur ani. Khur hi mahni duhang tawh or 4.5m a sei, 1.5m a zau, 1m a thuk laih tur ani. Chawh leh angai ve lova, meter chanve a sang a lo nih hunah bawngek tui leh chirhin zut phui tur a ni. Thla 4-5 ah ahman theih.

Chapter - 8

SOIL PRODUCTIVITY ENHANCEMENT - NADEP COMPOSTING/VERMICOMPOSTING

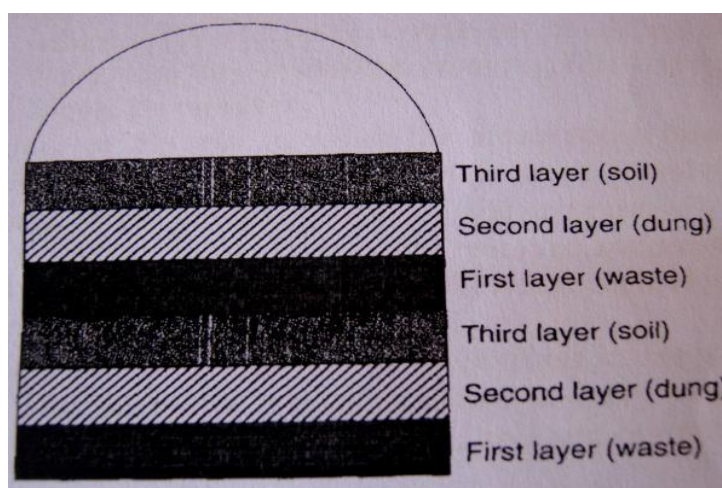
Nadep Composting Method

- NADEP dan hmanga leitha siam dan hmuchhuaktu hi Maharashtra state-a loneitu mi pakhat, N.D. Pandharipande a ni a. Amah hi “Nadepkaka” tia hriat lar a ni a, leitha siam dan a hmuhchhuah pawh hi ama hming chawiin “Nadep method” (Nadepa leitha siam dan) ti a vuah a ni.
- NADEP method danglam bikna thuruk chu mihring tha tlemte hmanga hun rei lo chhunga leitha thahnem tak siamchhuah theihna hi a ni. He dan hmang hian ran ek Kg 1 lek hi leitha Kg 40 ah siamchhuah theih niin, chu chu thlai chawm nan hman nghal theih a ni.

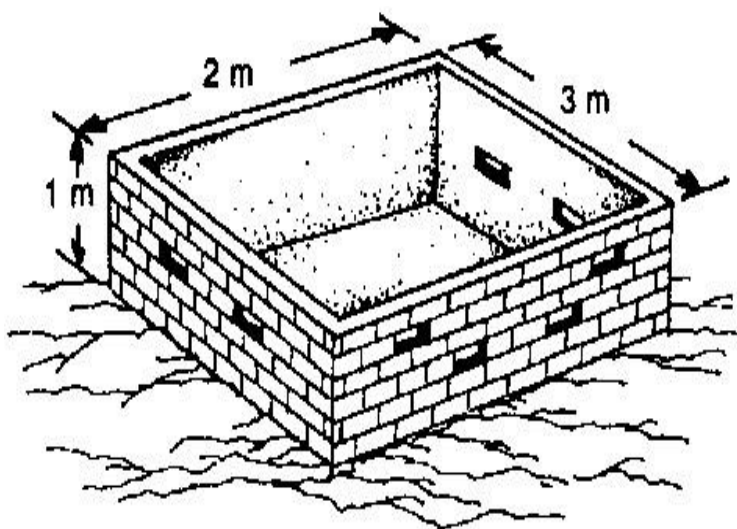
1. Khur (Tank) siam dan:

- Nadep method-a leitha siam nan chuan khur laih emaw, brick hmanga leitha khur, kil 4 nei, a dung zawng leh vang zawng inchen lo (rectangular) siam tur a ni.
- Khur len zawng hi a dung ft 10, a vang ft 6 leh a san zawng ft 3 vela siam tur a ni. Leitha kan mamawh tam dan a zirin a khur hi tih len theih a ni a. Mahse a dung zawnga tihlen tur niin, a vang zawng hi chu ft 6 aia zau lo a ni tur a ni.
- A khur hi leirawhchan (brick) leh hlum hmang siam theih a ni a, cement pawh hman theih a ni.
- Brick rem hi cement-a tih vek a nih loh pawhin, a tlar (lane) chung ber pahnih erawh hi chu cement-a plaster ngei tur a ni. Hei hi kan khur siam tinghettu tur niin, leitha dahluh leh lakchhuah laia khur chhe mai thei laka ven nan a ni.
- Tuna khur len zawng kan sawiah hian brick 1,500 vel a ngai a chhut a ni.
- Khur siamna hmun hi uluk tur a ni a, hmun sang (lei pawng lai) lam deuhah siam tur a ni. Tui tlin theihna hmunah siam loh tur a ni.
- A theih chuan thingbuk hnuaiah khur hi siam a tha a, tin tui awm hnaihna hmun ni thei sela. Tui hi kan leitha siam tur tihhnawn nan hman a ngai a.
- Leitha siamte hi huana hman tura siam a nih thin avangin huana thiar luhna hnai remchangah khur hi siam a tha bawk.
- Khur atanga tui put tur chi reng reng ven tur a ni a, khur mawng pawn lampangah lei emaw, chirh emawin zut phui tur a ni.

- Khur bang brick rem hi a pangah boruak chhuah leh luh nan tih awng zauh zauh tur a ni a. A awng lai tur hisap sain brick rem kan mai tur a ni.
- Hetianga brick hmanga khur siam hi a harsat viau chuan lei laih khuar hmang pawhin tih theih a ni a. Khur len zawng chu a hmaa sawi ang zat tho kha a ni tur a ni. Tin, khur thuk zawng hi ft 3 aia thuk a ni tur a ni lo. Hetianga khur laih erawh hi chu lei hnawn lutukna hmunah chuan tih loh tur a ni.
- He an bawm siam chhungah hian hnim hnah emaw thlai chhia te, lei leh bawng ek dah tur a ni a, 60-75% vela a hnawn reng theihna turin tui leih thin tur a ni. Lei 16-18qtls, thlai chhia 14-16qtls, Bawng ek 1-1.2qtls ang vel chawh pawlh tur a ni a, a chhungah lei leh bawng ek chawh pawlh hmanga zut phui tur a ni.
- Ni 75-90 vel a in up hnuah a inchawh pawlh-ah chuan heng microbial culture -Azotobacter, Rhizobium leh phosphate solubilizing bacteria te hi pawlh tur a ni. Tichuan ni 110-120 velah kan leitha siam chu a hman theih tawh a ni.
- Vawikhat siam hian leitha 2.5-2-7 ton vela siam chhuak thei a, chu chu hectare khat ram chawm thei tur anga ngaih a ni.



- Huan thlai rah leh hnah tawih (A ro emaw a hring emaw) Kg 1300-1500 vel lak khawm tur a ni a, Bawng ek emaw Biogas ekchhia emaw Kg 100, Lei dip tha Kg 150 – 180, leh Tui Litre 1200-1400 te chawhpawlh tur a ni.



- Khur Hnawhkhah dan (Pit Filling): A lem a lantir ang hian Agricultural waste,

Bawng ek leh Lei dip te hi a indawt dan zel hian a inchhawk in rem chhoh tur a ni. Ni 20 atanga Ni 30 ah chuan a lo tawih tan tawh a. Chutiang hunah chuan nem muk a, a chung a sawi tawh ang tho khian hnawh khah leh vat thin tur a ni. Hetiang hian thla thum chhung thleng chu a tih theih a. Ni 7 atanga Ni 10 inkar vel apiangin Tuiin tih huh thin tur a ni.

Hriat tur pawimawh te:

- A hu kalral nasa lutuk tur ven nan Di emaw, Buhpawl emaw in a chung siam tur a ni.
- Khur chu hnawh khah hmian a chung lam bang chu Bawnggek tuia zut chhuah vek tur a ni. Chu chuan a ei tawih tu tur hrik te inthlahpun na tur a pui dawn a ni.
- Engvang mahin khi (Cracks) a awm tur a ni lova, chutiang a lo awm a nih chuan Tui nena chawhkawi in char phui vat thin tur a ni.
- Khur chu vawi khat chhilh ah (Ni khatah) chhilh khah nghal tur a ni a, Chhilh khah chhung hi Ni hnih (Darkar 24) aia rei a ni tur a ni lo.

4. Vermicompost

Vermicompost chu changpat hmanga leitha siam a ni a. Mumal taka siam chhuak tur chuan a siam dan dik taka siam a ngaia, a hnuaiah hian sawi fiah a ni.

Vermicompost pit pakhat hian Leitha Kg 150 zel a chhuak thei a, chu chu 0.25 hectare a zau chawm thei tawh khawp a tam ani.

A hmun thlan thu (Site Selection): A siamna hmun tur thlan dan turah chuan NADEP in a lo duan sa tawh ang khi a ni.

A siam dan tur: A tlangpuiin Vermicompost pit hi Khur khat, hmun hniha thenhran/pindan a ni a, a Pindan pakhat len zawng tur chu 3.6m X 1.5m X 0.76m (A sei zawng 3.6m, A zau zawng 1.5m leh A thuk zawng 0.76m) a ni.

Pindan pahnih te daidan na hi tiphui vek lovin, pindan pahniha an kalkual vel theihna turin Changpat vah tlang theihna tur kua siam tur a ni.

Changpat chaw: Thlai thar seng tawhna chuangbang te, Thing hnah leh Ran Ek te hi hi Vermicompost pit atana kan mamawh bulpui ber an ni a. Fu her tawhna fe (Fu-fep) te, Thlai chi hut (chhia), hedge cutting (Pangpar chehrual leh Thing zar thlakna nawi te), Phuai te, Favai te, Ran ek te, Bio-gas plant thli te, Beram, Sakawr leh vawk zun leh ek te, Ar ek (flem te) leh Thlai rah tawih te te hi Changpat chaw tha tak an ni.

A sawngbawl dan tur (Preparation of Vermicompost bed):

Step 1: A hnuailam 10cm a chhah chu Favai, Fu-fe leh Buhpawl (Agricultural Waste) ang chi chawhpawlh a chap tur a ni a. Chumi chungah chuan Lei phul chhuak vekin Tui a tih huh thet thet tur a ni.

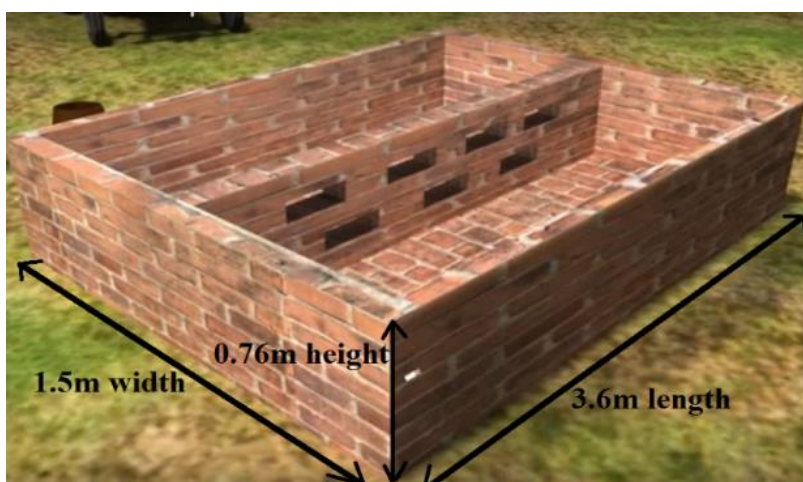
Step 2: Thlai hnah leh rah bangnawi (Organic Waste) te chu Bawng Ek leh Tui nena inchawhpawlh tawh chauh a siam tur a ni. Bio-gas plant atanga tui/thli lo chhuak hi Vermicompost siamna



atana pawlh tur tha berte zing a mi a nih avangin hmuh mai tur a awm chuan tih tel ngei ngei tur a ni. Ni 4 atanga Ni 5 dan zelah vawi 2-3 chawhle thin tur a ni.

Step 3: Khur ah chuan Changpat dahluh tur a ni a, Organic Waste chawhpawlh chuan vur tur a ni. Duhthusamah chuan, a chaw Kg 400 zelah Changpat 2000 dah tur a ni.

Step 4: Buara in khuh tur a ni a, a khat tawkin Tuia tih huh reng thin tur a ni. Tichuan ni Sawmruk (60) hnuah chuan thil chawhpawlh te kha Vermicompost ah an lo chang tawh ang.



Step 5: Vermicompost chu lakchhuaha, Sarang/Theiretpuan chung a chap darh a, Darkar 2-3 chhung pho ro tur a ni. Tichuan Changpat te chu a hnuai lamah an lut anga, changpat awm lohna a chunglang chu lakkhawm tur a ni. Changpat te chu uluk taka lakkhawm leh bawh tur a ni.

Fimkhurna tur te (Precautionary Measures):

- Khur chu a hnuai lam/mawng lamah Tui a lut thei a, a huh leh lutuk emaw, Tui a tam lutuk emaw a nih chuan Boruak tha a awm lo anga, chu chuan a chhunglam boruak nihphung pangai tur chu Acid emaw Base level (pH) ah a siam anga, Changpat rihna te ti tlahniamin an nih tur ang a ni thei lo thin a ni. Khur chhunga Tui lut tur ven nan hian Tuiluankawr tha tak siam tur a ni a, tin, a khur ko tihsan hret emaw pawh a pawh lo ani.
- Khur chu Fanghmir te, Tlumpi te, Tit/Ketaminu te, leh Utawh te, Sazu te, Zawhte te, Ui leh Ar te an luh lohna tur leh an tihchhiat loh na turin ven tur a ni.
- Bawng Ek tharlam chuan Lum leh Sa a siam theih avangin Mit lawnga hmuh theih loh Rannung (Micro-Organism) te tan harsatna a siam thei a, hman miah loh tur a ni.

Chapter – 9

SOIL PRODUCTIVITY ENHANCEMENT - BIOFERTILIZERS

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Organic farming programme kalpui mek ani a, NGOs, Departments leh Central Govt ten hma la in kan ram ah pawh Organic certification programme khaw hrang hrang ah kan nei ve ta nual mai. Chutih lai chuan kan ram a awm ve tho leitha siam theih, thlai chin nana pawimawh em em Biofertilizer kan hriat chian a kan hman uar a tul ve hle bawk. Vermicompost kan hmang uar tan ta hle a, bawng vulh lo tan chuan siam ve mai theih a nih loh bakah a lei ralah chuan thil to tham ve tak a lo ni si a, Biofertilizer uar zawk a kan hman hian kan chemical fertilizer mamawh kan ti tlem a, tun ai a uar zawk a kan hman hi a hun tawh hle a ni. Govt of India pawhin Ministry of Agriculture kaltlangin loneitute'n biofertilizer awlsam zawk a an hmuh theihnan hmun hrang hrang ah regional center te siam in state hrang hrang ah Biofertilizer production unit siamna tur a pek belh zel bawk a, thlai chin nan a thil pawimawh em em mai anih a vang leh thil hman awlsam tak leh tlawm tak anih avangin keini pawh hian tun aia kan hman uar leh kan zir chian deuh a ngai a ni.

Biofertilizers: Biofertilizers han tih hian lei a hrik (microbes) tangkai chi ho hrang hrang, thlai zungin chaw an lakkhawmnaa lo pui thin ho sawina a ni. Heng hrik tangkai tak tak te hi thlai chi sawngbawlnan (seed treatment)/(soil treatment) a hman thin a ni tlangpui a. Thlai chi (seed) sawngbawlnan emaw thlai chinna hmun lei a kan dah/pawlh khan thlai zungin chaw an zawnna bik thlai zung bawr vel (rhizosphere) ah hna an thawk a, thlai zungin awlsam taka chaw an duh ang an hmuh mai theihnan an lo pui thin a ni. Heng biofertilizers hrang hrang te hi leiah an mahni in awm ve thin tho mahse, an tam dan(population) te leh a chi hrang chi (isolates) thlai tan a chaw tha an siam dan (efficiency) a in an loh avangin heng hrik tha bik ho hi an ti pung a, chung ho chu Biofertilizers kan tih te chu an ni. Biofertilizers hman hi kan uar chhoh zel a ngai a, a chhan chu awlsam tak a hmuh mai theih an ni a, hman a awlsam bawk a, Chemical fertilizer te nen pawh hman pawlh theih vek an nih avangin uar leh zual a hman a tul tawh hle.

Biofertilizer hrang hrang te chu a hnua ami ang hian group hran hran ah then an ni leh a, chung te chu:

S. No.	Groups	Examples
N₂ fixing Biofertilizers(Nitrogen thlai tan a pe thei te)		
1.	Free-living	<i>Azotobacter, Beijerinckia, Clostridium, Klebsiella, Anabaena, Nostoc,</i>
2.	Symbiotic	<i>Rhizobium, Frankia, Anabaena azollae</i>
3.	Associative Symbiotic	<i>Azospirillum</i>
P Solubilizing Biofertilizers (Phosphorus thlai tan a pe thei te)		
1.	Bacteria	<i>Bacillus megaterium var. phosphaticum, Bacillus subtilis</i> <i>Bacillus circulans, Pseudomonas striata</i>
2.	Fungi	<i>Penicillium sp, Aspergillus awamori</i>
P Mobilizing Biofertilizers (Phosphorous thlai tan a siamsak thei te)		
1.	Arbuscular mycorrhiza	<i>Glomus sp., Gigaspora sp., Acaulospora sp., Scutellospora sp. & Sclerocystis sp.</i>
2.	Ectomycorrhiza	<i>Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.</i>
3.	Ericoid mycorrhizae	<i>Pezizella ericae</i>
4.	Orchid mycorrhiza	<i>Rhizoctonia solani</i>
Biofertilizers for Micro nutrients (Thlai chaw (micronutrient) siam thei te).		
1.	Silicate and Zinc solubilizers	<i>Bacillus sp.</i>
Plant Growth Promoting Rhizobacteria (Thlai than nana pui thei te).		
1.	Pseudomonas	<i>Pseudomonas fluorescens</i>

Biofertilizer chi hrang hrang hman lar zual bik te:

1. Rhizobium: Heng ho hi Bacteria an ni a, be lam chi ho bik (legumes) tan chaw tha (Nitrogen) an siam sak thin. Heng hrik te hian Bean/be kan tih ho nen hian chaw an in pe tawn a, thlai zungah an awm a, thlai in chaw a pe a, heng hrik ho hian thlai tan Nitrogen an siam sak ve thung thin. Bean zung a bawk chuk awm hi heng ho siam hi a ni a, heng hi **nodules** an ti a, Biofertilizer zing ah chuan a pawimawh ber leh thlai tan a chaw pe tha thei ber pawl an ni. Rhizobium ah pawh hian chi hran hran (species hrang hrang) an awm a, khawvelah he hrik tangkainna hi kum **1930** vel ah daih tawh khan hmuh chhuah a lo ni tawh a ni.

2. Azotobacter: Heng ho pawh hi Bacteria chi khat an ni a, thlai tan a chawtha (Nitrogen) pe thei tu tho an ni. Rhizobium angin thlai nen chaw an in pe tawn ve lem lo a, leiah a bikin thlai zung bawr (**rhizosphere**)ah te an awm deuh ber. Thlai hnah then khat atng pawhin an lak (isolate) theih bawk. Azotobacter chi hrang hrang 6 vel an awm a, India ramah hi chuan a tlangpuiin *Azotobacter chroococcum* leh *Azotobacter vinelandii* te hi a lar pawl leh hman tang kai pawl tak an ni.

3. Azospirillum: Heng Bacteria pawh hian thlai tan chaw tha (Nitrogen) an pe ve tho va, a maherawh chu buh ang chi fang nei ho (Graminae) tan a tangkai bik. Heng fang nei ho te leh tualto hnim kan tih ang (grass) zung atangte leh rhizosphere te hi an awmna a ni bik. Azospirillum hian thlai tan chaw tha chauh a pe mai lo va, thlai tha taka an lo than theihnana an mamawh (Indole acetic acid) te, thlai natna do theihna (resistance) te an pe a, heng *Azospirillum lipoferum* te, *Azospirillum brasilense* te hi a lar zual deuh te chu an ni. Heng hrikte hi boruak awm tam lohna (Anaerobic) hmunah pawh an dam thei tho bawkin an in thlah pung thei tho a ni.

4. Cyanobacteria (Blue green Algae): He hrik hi an mahniah chaw zawng thei tho an ni a, tin thlai te nen in chawm tawn in an awm thei tho bawk. Mizoram ah kan la hre lar em em lo va, amaherawh chu Mizorama buh hmun a heng hrik (Blue Green Algae) ecology a research ti chu an awm ve tawh awm e. A thlah pun leh buh chinna atana han siam mai hi a awlsam loh deuh avangin kan uar vak lem lo a, amaherawh chu buh hmun ah heng hrik ho hian Nitrogen tam tak an siam thei ani.

5. Azolla: Heng ho hi tui chung a lang chi an ni a, tui awmna hmun a khawh chi an ni thung. Floating fern te an ti bawk thin. Azolla hi hnim chi khat a ni mai a, amaherawh chu an hnah ah hian hrik chi khat *Anabaena Azolla* an awm a, Azolla leh heng an hrik pai ho hian thlai tan an chaw mamawh Nitrogen an siam thin a ni. Hnah te tak te, hring tha deuh mai an ni a, buh hmunah te an chhuah a, tui ah an lang a, buh hmuna hnim lo to tur pawh an control thei a, buh hmun a hman lar ber pawl ani. Tin, Azolla an tih rote hi ran chaw tha tak ani a, sangha chaw ah te , ar chaw ah te pawh an hmang tho bawk.

6. Phosphate solubilizing microorganism (PSM): Heng hrik te hian thlai in chaw an mamawh, a bik in Phosphorous thlaiin awlsam tak a a neih mai theihnana an pui thin. Heng, *Pseudomonas* te, *Baccillus* te, *Penicillium* te hian Organic acid an pe chhuak a, chu chuan thlai zung awmna bawr vel a ti thur ta thin a, thlaiin phosphate a mamawh a lak mai theih nan an pui thin

ani. Department ang pawh in PSM hi tih pun a sem ani thin a, biofertilizer pawmawh tak a ni.

7. Plant growth promoting Rhizobacteria (PGPR): Heng ho hi thlai zung bawr vel a bacteria chi hrang hrang thlai than thatna tur a pui thin te an ni. Heng zingah hian *Pseudomonas* te, *Bacillus* te hi hman lar zual te an ni bawk. Heng hrik tangkai ang chi ho hian thlai tan Indole Acetic acid te, Cytokinins te, gibberellins te leh ethylene lo insiam dang tu (ethylene inhibitor) te an siam thin a ni. Tin, heng bak ah hian thlai natna lak a an himnan natna veng thei antibiotics te, phytohormone te leh siderophore te an pai a, heng ho hian thlai natna tam tak lak atangin a veng thei bawk.

8. Acetobacter: Hei pawh hi bacteria chi khat tho a ni a, Fu (sugarcane) bik ah an hmang lar. Tin, Fu mai ni lo Kawlbahra ah te pawh Nitrogen tam tak siam sak thei tu an ni. Fu leh he hrik hian in kungkaihna thuk tak an nei a, Fu kung atangte, a hnah te leh a Fu zung a tangte in he hrik hi an la (isolate) deuh ber bawk. He hrik tangkai dan hi Brazil a Fu huan nei ho te hnen atanga lo in tan a ni a, an hmang lar chho tan ve tawh hle bawk.

Biofertilizer hrang hrang te leh an hman theihna thlai te:

Biofertiliser	An hman theihna thlai te
<i>Rhizobium</i>	Badam(Groundnut), Bekang (Soybean), Soybean, Red-gram, Green-gram, Black-gram, Lentil, Cowpea, Bengal-gram and Fodder legumes
<i>Azotobacter</i>	Cotton, Vegetables, Mulberry, Plantation Crop(thei chi hrang hrang ah), Rice (Buh) Wheat, Barley, Ragi, Jowar, Antam, Nihawi , Spices , pangpar ah te
<i>Azospirillum</i>	Wheat, Barley, Ragi, Jowar, Mustard, Safflower, Niger, Sugarcane (Fu), Vegetables, Maize (Vaimim), Pearl millet, Rice, Wheat (Fang nei hi Cereals ah an hmang tlangpui).
Blue Green Algae	Rice
<i>Azolla</i>	Rice
Phosphate Solubilizing Microorganisms	Eng thlai ah pawh a hman theih (non specific)

Biofertilizer te hi kan hman tam tawh em?

National Center for Organic Farming ho report atanga a lan dan chuan India ramah hian Biofertilizer production unit 122 vel lai a awm a, heng ho hian an awmna station theuhah Farmer ten uar zawk a Biofertilizer an hman mai theih nan Biofertilizer an siam chhuak thin a. Mizoram ah pawh hian Agriculture Department in heng biofertilizer hrang hrang te hi a siam chhuak a, amamawh leh a duh hnenah te a pe ve thin bawk. Heng hrik tangkai tak tak te hi kan ram leilungah pawh lei (soil) atangte, thlai zung atangte in mithiamten an la chhhuak (isolate) a, an that dan a zirin chung ho chu an thlahpun tir ta thin a ni. Hetia thlah pun an lo nih hnu hian (carrier) heng hrik ho pai nung thei tu tur nen an pawlh a, chung chu an pack ta thin a. Amaherawh chu heng carrier te hian a tlangpuin thla ruk hnu ah chuan an hrik pai te hi an lo thi then a, duh thu an sam em em tawh lo thin a, heng hrik te hi thi vek lem lo mahse, an flem tawh a avangin an hna thawh tur angin an thawk thei thin lo a ni.

Biofertilizers te leh a carrier chi hrang hrang te:

Kan sawi tawh angin India ram ah Farmer nuai tam tak an awm a, chung ho chuan an huan thlai enkawl nan Nitrogen, Phosphorus, Potassium etc an mamawh tam em em a, Chemical fertilizer ringawt hman lo a rual khai tak a chemical te leh heng hrik tangkai tak tak te nen a huan enkawl a lo nih theih nan te, heng hrik tangkai tak tak te hman tangkai alo nih theih nan India sawrkar pawhin hma a la nasa a, Biofertilizer siamna pawh hmun 122 lai mai siam ani tawh a ni. Chutih rualin University hrang hrang ah te, Private company hrang hrang ten research ti in biofertilizer tha zawk leh tangkai zawk a siam dan te an lo zir chho ve zel a, tunah chuan Liquid Biofertilizer te pawh a lo lar chho tan ta viau mai. A tang kaina flem han tar lang lawk i la.

1. Biofertilizer (hrik tangkai ho) te kha liquid carrier ah hian an dam hun chhung (shelf life) powder carrier alin a let in a rei a, kum 1-2 dawn lai te an dam thei.
2. Heng liquid carrier ah hi chuan contamination a awm flem zawk(hrik tangkailo ho ten an ti buai nep)
3. Temperature sang ah pawh e.g 40 °C thleng ah pawh heng hrik te hi an dam tha.
4. Liquid biofertilizer (biofertilizer tui chi) siam hi a powder nen a tehkhin chuan a man pawh a flawm in a in awlsam hleih zawk a ni.
5. Farmer te tan hman mai a awlsam a, a dose pawh a flem zawk bawk.

Research kan tih ve a hun tawh em?:

Sawi tawh ang khan heng hrik tangkai tak tak te hi kan leilung ah hian an awm ve vek a, state dang a isolate te hi an tha bik kher lo. Entirnan PSB

(phosphorous solubilizing Bacteria) ho phei hi chu kan leilung ang lei thur a awmte hi an tha ber a ni. State hrang hrangah biofertilizer te hi state department ang te, NGO te leh Company ang te pawhin an slam nasa em em a, Farmer te pawhin a tangkaina an hre Chiang a, an hmang nasa em em a ni. Tin, Department ang te pawhin Research an bei nasa a, Isolate (a chi tha bik) tha thei ang ber tur neih tumin survey te, experiment hrang hrang te an bei na sa hle mai. Kan Farmer te hian tun thleng hian a tangkaina hi kan la hre tawh lo nge kan demand te leh kan hman dan te han thlir hi chuan kan la belchiang tawh lo emaw ni tih mai tur hi a la ni a, a tangkaina leh a thatna te pawh kan zir chian leh a hun tawh hle mai. Heng hrik te hi thil tangkai em em mai, a maherawh chu hman dawn chuan han sawngbawl ve hlek ngai ang chi an ni a. Agriculture Department (Crop Husbandry) hian heng hrik tangkai tak tak te hi an thlahpun tira, a hmang duh tan chuan a awm reng a ni.

Chapter - 10

MAJOR PLANTS NUTRIENTS AND ITS MANAGEMENT FOR MAJOR AGRICULTURAL AND HORTICULTURAL CROPS

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Thlai chaw mamawhte:

- Boruak leh tui atangin : Carbon, Oxygen, Hydrogen
- Lei atangin: Nitrogen, Phosphorous, Potasium (K), Calcium, Magnesium, Sulphur, Iron, Manganese, Boron, Zinc, Copper, Molybdenum, Chlorine.
- Thlai mamawh hnem bik 3: Nitrogen(N), Phosphorous (P), Potasium (K)
- Nutrient dang zawng hi a bik taka mamawhna hmunah lo chuan pek ziah an ngai lo

India ram state thenkhat a fertilizer an hman zat leh Buh leh bal an thar hlawk dan:

Ram hming	NPK hman zat (kg/ha)	Tharchhuah zat (q/ha)		
		Buh	Alu	Wheat
China	236.5	53.04	115.76	30.17
India	53.6	24.87	159.68	19.95
State:				
Punjab	155.00	34.63	192.49	35.40
Mizoram	20.00	15.4	73.6	-

Fertilizer in thlai chaw an pai zat:

Fertilizer hming	Thlaichaw pai zat (%)		
	N	P	K
Nitrogen pai chite			
Urea	46	-	-
Calcium Ammonium Nitrate	25	-	-
Ammonium Sulphate	20.6	-	-
Phosphate pai chi te			
DAP	18	46	-
Single Super Phosphate*	-	16	-
Rock Phosphate	-	20	-
Potassium pai chi te			
MOP	-	-	60

NPK hnathawh tlangpuite:

Nitrogen (N):

-Thlai nunna bul, thanlentirtu, hrinna petu, chaw dang ei that theih nana puitu.

Phosphorus (P):

- Chakna petu, a zung chhuah hma tirtu, thlai rah leh a chite tithatu, Nitrogen ei tam lutuk vengtu.

Potassium (K):

-Natna leh sik leh sa danglam thut do chak tirtu, buh lam chite hmin hma tirtu, thlumna siamtu leh petu (alu, kawlbahra, balhla etc) N leh P an eithat theih nana puitu a ni bawk.

Fertilizer larzual leh a hman dan:-

- **Urea:** Mum hilhel, fim var sar, lei hnawng deuh ah theh darha, leh pawlh nghal tur.

- **DAP:** N&P a pai. A mum rawng uk, vawi 1 ah thlai chin hma emaw chin ruala a vai a hman tur.

- **MOP:** A sen leh a var, DAP ang tho a hman tur .

Thlai maltin chaw tha mamawh zat annei hranga, an mamawh dan zat hi chhutchhuah mai tur a ni. A hnuai ami hi thlai thenkhat in fertilizer an mamawh dan tlangpui lakkhawm a ni a, ruahtui tam dan a zir te, a ram awih dan a zir te, leilung awmdan a zir te, thlai variety leh thil dang vang pawhin a danglam thei tih erawh hriat a tha ang. Fertilizer bakah hian leitha pangngai telh tura chhut a ni bawk. Heng bakah hian nutrient tenau dang an la mamawh tel thin bawk a ni.

Thlai hming	N (kg/h)	P(kg/ha)	K(kg/h)
Buh	60	40	50
Vaimim	120	60	40
Bekang	30	70	50
Badam	20-40	50-60	30-40
Fu	120-150	80-100	60-80
Alu	20-60	80-150	150
Sawhthing	75	50	50
Aieng	60	50	120
Hmarcha	56	56	28
Purun	72-112	72-112	80
Tomato	60-110	35-60	35-60
Bean	60	60	40
Antam	40-60	25	25

LIMING/CHINAI THI HMANDAN

- Lei thur leh thur loh hriat hi a pawimawh hle a, kan leite hi eng ang chiah a thur nge a nih kan hriat a tul a ni.
- Leithur kan tih hi 'Acidic cations' chi hnih H^+ leh Al^{3+} ten an siam a ni a. Lei thur leh thur loh kan hriat dan ber chu a pH kan endik atangin a ni.
- (Soil pH chu lei zawng sawina a ni)
- pH 7 hi neutral a ni a, pH7 hnua lam zawng hi acidic (thur) kan ti a, a chung lam zawng hi alkaline (al) kan ti thung a ni.
- pH hi ph meter hmangin a en theih a. Agri. Deptt.-ah Soil testing laboratory-ah lei hi a endiktir theih bawk.
- Chinai thi tawngpawng hman hian lei a tichhe thei a ni tih kan hriat a pawimawh bawk.
- Thlai chi hrang hrang hian leithur an ngam dan chen a inang lo va, a tlangpui hi chu 6.5 – 7.5 pH ah an to thei a, thlai thenkhat chuan pH hniam tak e.g. 5.0 aia hniam te an mamawh a, thenkhat erawh chuan a sang deuh te pawh.
- Tawngpawng hman ngawt lovin, kan lein chinai thi hman a mamawh em tih leh, kan lei thur dan mila thlai chin dan tur kan thlan thiam a tul a ni.

LEI THUR CHHAN TLANGPUI TE :

Lei hi amaha rawn thur ringawt a ni bik lo va, thur chhan hrang hrang a nei a, chungte chu :-

- Lei lo insiamna bul (parent material): Lei hi lung kehdarh lo nawi ta-in a siam a ni a, chutiang lungpui a lo chhuahna azirin a thurin a thur lo thei a ni.
- Ruahsur: Ruahtui hian leia 'basic cations' thenkhat, e.g. Ca^{2+} , Mg^{2+} leh K^+ te a luanralpui thin a, chutiang basic cations luangral ta te hnawhkhat turin heng acidic cations, Al^{3+} leh H^+ te hi a lo insiam thin a ni.
- Leitha (fertilizer): Leitha, Chemical leh Organic pawh, a bik takin '*ammonia based*' ho hian leia H^+ ions belhin hman rei hnua chuan lei a lo tithur thei a ni. E.g. Urea.
- Thlai chaw ei: Thlai hian lei atangin chaw atan basic cations thenkhat heng K^+ , Ca^{++} leh Mg^{++} te a hip chho a, chutiang

hnawhkhat tur chuan H^+ ions te a lo insiam ta thin a ni, chu chuan lei thur a lo siam thei bawh a ni.

LEI THUR DAN HRANG HRANGTE :

- 1) Active Acidity: Lei leh tui chawhpawlh (soil-water suspension) atanga pH kan teha kan hmuhchhuah hi active acidity chu a ni. Thlai leh micro organism te hi hetiang thur satliah-ah hi chuan an to theiin an nung thei a ni.
- 2) Exchange acidity: H^+ ions leh Al^{3+} ions che vel hian exchange acidity a siam thin. Lei leh chi (salts) chawhpawlh (soil-salts suspensions) pH kan endik atangin exchange acidity hi a hriat theih a ni.

Active acidity chauh ni lovin exchange acidity pawh hi neutralize a ngai a, a chhan chu active acidity chauh kan neutralize chuan, H^+ leh Al^{3+} che vel khan lei a lo tithur leh thuai thin a ni.

- 3) Hydrolic acidity: H^+ leh Al^{3+} ions te che vel thei lo tura nghet taka awm thinte atanga lo insiam hi hydrolic acidity an ti. 'Residual acidity' ti pawhin an sawi thin tho; a chhan chu, active leh exchange acidity te kan neutralize hnuah pawh a la awm reng thin vang a ni. Hetiang thur hi chu tihreh chi a ni lo.

LEITHUR TIHREH (LIMING):

❖ *Leithur tihreh kan tum hian kan tih ber chu leithur siamtu H^+ ions leh Al^{3+} ions te neutralize turin Ca^{2+} leh Mg^{3+} te kha leiah kan zuk telh a ni ber mai. Leithur tihrehna hmanrua chi hrang hrang a awm a, chungte chu :-*

- 1) Calcium oxide (Ca_2O): Hetiang hi chinai kan tih ang hi a ni a, a dip var niin, mi a kang thei a, kutlawnga khawih chi a ni lo.
 - 2) Calcium Hydroxide ($Ca(OH)_2$): hetiang hi chinai thi an tih mai a ni a, kutlawnga khawih ngam a ni bik meuh lo.
- ❖ Calcitic limestone or Calcite ($CaCO_3$)
 - ❖ Dolomatic limestone or Dolomite ($CaCO_3.MgCO_3$): Hetiangah hian Calcium bakah Magnesium 20% vel a keng tel a, amaherawhchu a thawk muang thung a ni.
 - ❖ Marl
 - ❖ Slag

CHINAI THI PEK HUN LEH PEK DAN :

- Chinai thi hi engtik lai pawhin, kumtluanin pek theih a ni a, amaherawhchu favangah emaw, thalah emaw, thlai chinna atana lei kan sawngbawl laia pek hi a fuh ber a ni.
- Chinai thite hi tuiah an zawp ral ve lo va, chuvang chuan a chung lam chauhah kan phul a nih chuan, a chunglang chauh a lo al ang a, a hnuai lam chu a thur ngaiin a la thur tho thin.
- Thlai zung awmna awm vel, lei chunglang atanga 6-8 inch. vela thukah tal phul thei a tha hle. Tuiah zawp ral thei lo ni mahse, hna thawk (reaction) tur chuan hnawng a mamawh tho a ni.
- Kan lei awmdan azirin chinai thi hi tum khat emaw tum hnih (split application) telhah kan hmang thei
- Vaivut lei (sandy soils) ah chuan vawikhatah (one application) telh vek a pawl lo va, tlak leiah erawh chuan vawihnih telhah hman tur a ni ve thung
- Vut lei (sandy soils) hi a thur hma avangin a pH hi endik deuh reng a tha a, eng lei atan pawh kum tin endik hi a pawimawh hle. Chinai thi pek atanga ni 30 tal nghakin, leitha kan pe duh a nih pawhin chumi hnuah chauh kan pe tur a ni.

CHINAI THI KAN HMAN CHHAN TLANGPUITE:

- 1) Lei thur tihrehna turin.
- 2) Lei tihthat nan: Dose tlem deuh zawk, a tam berah 500 kg/Ha. a kan hman hian, lei thur a tireh zo lo va, mahse, thlaiin micro-nutrients a mamawh thenkhat heng, Calcium (Ca) leh Magnesium (Mg) te hi chinai thi hian a supply thei a ni.
- 3) Insecticides anga hman: Hei pawh hi dose tlem deuha hmanin rannung hlo atan a tangkai hle. A thahna phei chu a ni hauh lo va, mahse a ven nan a bik takin leia inkhuar chi, heng vual leh thil dangte ven nan a tha hle.

CHINAI HMAN DAWNA HRIATTUR PAWIMAWHTE:

- Lei thur tih-neutralize dawnin, chinai hmanna tur hmun zau zawng a zirin hman tur zat kan bithliah tur a ni.

- Lei dip leh nawi tha tak (fine-textured soil) hian lei hraw (coarse soil) aiin chinai thi a mamawh hnem zawk.
- Tin, lei, thlai tawih (organic matter) pai tam hian, a pai tlem aiin a mamawh tam zawk bawk. Chuvang chuan, hetiang lei hraw, lei thlai tawih pai tlem bawk si ang chi-ah hi chuan chinai hi tlem te te, kum tin pawlh thin a tha.
- Lei dur tha takah erawh chuan tum khata tam tham deuh taka pawlh hian kum 3-4 te a daih thin a ni. Chinai thi pawlh reng reng hian pawlh hnem lutuk palh a awm thei a, chuvang chuan a tawh hriat nan kan pawlh atanga ni 30 hnu velah emaw lei test-tir lehin kan lei dinhmun dik tak a hriat theih a ni.
- Chinai pawlh hnem lutuk (over liming) hi a chuangtlaiin a hek mai bakah, thlaiin an tuar thin a ni, leia micro-nutrients awmte thlaiin an ei theih loh phah thei bawk a ni.
- Chinai thi duhtawh hman tur awm lohna hmunah chuan, leithur tihrehna tur ni lovin, leia Ca^{+} a mamawh puhruk thei tur tawka tlem pawlh kha a pawl lo.
- Chinai thi hman reng hian lei thur chu tireh bawk mahse, Mg a tlakchham thin avangin, Mg pe thei tur thil, heng *MgO (Magnesia)* te, *Mg(NO₃) (Magnesium nitrate)* te, *MgSO₄ (Epsom salts)* te emaw *Dolomite* emaw telh thin a tha.
- Chinai dip tha tak hi a thawk rang a, mahse a daih rei lo thung a, chinai hraw deuh hi thawk muang deuh mahse a daih rei ve thung a ni. Chuvang chuan chinai dip tha kan hmang a nih chuan pawlh zin deuh a, a hraw a nih erawh chuan pawlh khat deuh mai tur a ni.
- Lei neutral-ah emaw a al-ah emaw chuan chinai pawlh in tangkaina pakhat mah a neih loh avangin a hek thlawn mai mai a ni.
- Lei chunglang bakah a chung deuh (sub-soil) hi a thur ve thei a, chuvang chuan chinai kha thuk deuh tak, e.g. feet 1 (khat) vel awma thukah emaw zuk dah tur a ni.
- Thlai thenkhat heng bean, be, bekang, nihawi leh la te hian chinai a mamawh sang bik a, wheat te, vaihlo leh kawlbahra te hian an mamawh tam lem lo a, alu te, buh te leh dawnfawh te hian an mamawh tlem leh a, thingpui leh coffee te, lakhuihthei te hian an mamawh tlem leh zual a ni.

- Chinai mamawh tam leh tlem kan tih hi leithur an ngam leh ngam loh dan a ni ber. A mamawh hnemho hian thur an ngam lo va, mamawh tlemho hian an ngam deuh a ni.
- Lei pH kan test-a 6.0 pH aia a san chuan chinai hman a ngai lo, a hniam erawh chuan hman a ngai ang a, mahse 6.8 pH aia tihsan erawh a ngai chuang lo.
- Buh bikah hi chuan pH hniam takah pawh a to theih avangin chinai thi hi a mamawh lem lo va, mahse kan hmang duh a nih chuan lei tih-al nan ni lovin micro-nutrients heng calcium (Ca) leh Magnesium (Mg) te pe tur tawh chauvin kan hmang tur a ni.

LEI TEST DAN

Kan leilung hi thil chi hrang hrang inpawlh awm khawmna a ni a, kan leilung dinhmun hrechang tur chuan khawh hmang a zir chian a ngai a, chumi tur chuan lei test tur lak khawm a tul thin. Chutianga khawh hmang a kan leilung a thlai chaw (nutrients) awm te zir chiang tur a lei lak khawm hi soil sampling an ti a. Soil sampling hi a pawimawh hle mai a, kan fimkhur loh chuan kan leilung zirchianna soil testing result kha a danglam vek thei a, chuvangin mithiam ten tih dan tur an sawi hi kan zawm a tul hle

Lei test tur lak hun

- Lei test tur hi a tlangpuiin huan thlai kan seng zawh awl lai deuh ni thei se, a chhan chu leilung sawngbawlna hun tam zawk kan nei thei anga, thlai chin loh lai a nih chuan chet vel a ti awlsam dawn a ni.

Hmanrua ngai te

- Lei test tur lak dawn hian hmanrua ngai te chu Soil Auger / Khurpi / Bawngtuthlawh leh polyethene bag te an ni. Mizoram ah chuan Bawngtuthlawh kan hmang ber a ni.

Lei test tur lakna hmun thlan

- Lei test tur kan lak dawn hian kan lei lakna hmun tur thlan thiam a pawimawh hle. Kan lei lakna hmun tur chu leilung inang tlang deuh, awihdan in ang deuh, thlai chin in ang deuhna hmun leh leitha hman dan in ang tlang deuh ni thei se.

Lei test tur lak loh na hmun tur :

- Lei test tur lak loh na hmun tur te chu hmun hnawng bik lai deuh te, tui kawng awmna lai te, ran ek thli luanna lai te, thingkung awm tam na lai te, huan sir kil lam deuh a mi te lak loh tur a ni. Chinai thi leh leitha (fertilizer) kan pek zawh hlimhlawlna hmun atangtein lak loh tur a ni bawk.

Lei test tur lak dan tur

- Lei test tur kan lakna hmun tur chunglang chu bawngtuthlawh in fai tak a rih tur a ni a, hmun hrang 10 -15 vel a mi lak nise, chu kan lei lakna hmun chu in zawn loin (zig zag in) lak tur a ni. Lei chung lang kan rih fai ah khan bawngtuthlawh hmangin ' V' shape in lei 15-20 cm vel a thukah lai ila, kan lei laihna vung kha paih fai vek ila, chumi hnua chuan bawngtuthlawh hmang in 1.5 – 2.5 cm vel a chhah lei tlang hlawm(slice) kha lak tur a ni. Kan lei lakna thuk zawng hi a pawimawh hle mai a, pawnlawi lutuk emaw thuk lutuk emaw a kan lak chuan kan leilung dinhmun dik tak thlai in a mamawh kha kan hre thei dawn lo a ni
- A tlangpuiin kan lei lakna thuk zawng hi 15-20cm vel a ni a, mahse kan thlai chin a zirin zung ei chi thlai sawhthing, carrot etc chinna hmun angah chuan thuk deuh hlek a mi lak a ngai a, lei lak na tur thuk zawng hi 30cm vel ni thei se a chhan chu thlai zung te an sei hlawn avangin an chaw lakna a thuk deuh vang a ni. Kan lei lakkhawm hmun hrang hrang a mi (huan khat chung a mi hmun hrang hrang 10 -15 vel a mi) kha hmun khat ah chhun khawm a, uluk tak a chawpawlh tur a ni. Chumi zawh chuan kan lei chawhpawlh chu hmun li ah then sawm in hmun hnih in opposite a mi kha chawhpawlh leh a, hmun hnih dang kha paih tur a ni. Tichuan kan lei chawhpawlh chu hmun li ah then leh in hmun hnih in opposite kha lak leh a hmun hnih dang kha paih leh tur a ni. Chutiang zelin kan lei lak khawm kha 500gm (1/2kg) thleng chawhpawlh a tih tur a ni. Kan lei lakkhawm chu polythene bag ah dah in lehkha them ah Hming, veng, khua, ram/huan awmna, thlai chin hming leh lei lakni te ziah a, polythene bag chhungah dah tur a ni.
- Soil testing (leilung zir chianna) hi kum 3-5 dan ah tih thin tur a ni a, lei test tur kan lak dawn chuan a hmasa a kan lakna thla ah chiah khan lak leh tum tur a ni. Entir nan kum 2013 February ah kan lak chuan kum thum hnu 2016 February ah chiah khan lak leh tur a ni. Khawvel hmasawn zelah soil testing hi loneitu te pawhin kan uar deuh deuh a pawimawh a, kan leilung dinhmun hrechiang hmasa a huan thlai kan chin hunah chuan kan thar chhuah pawhin hma a sawn ngei ang.

Chapter - 11

SHIFTING CULTIVATION VRS SUSTAINABLE AGRICULTURE

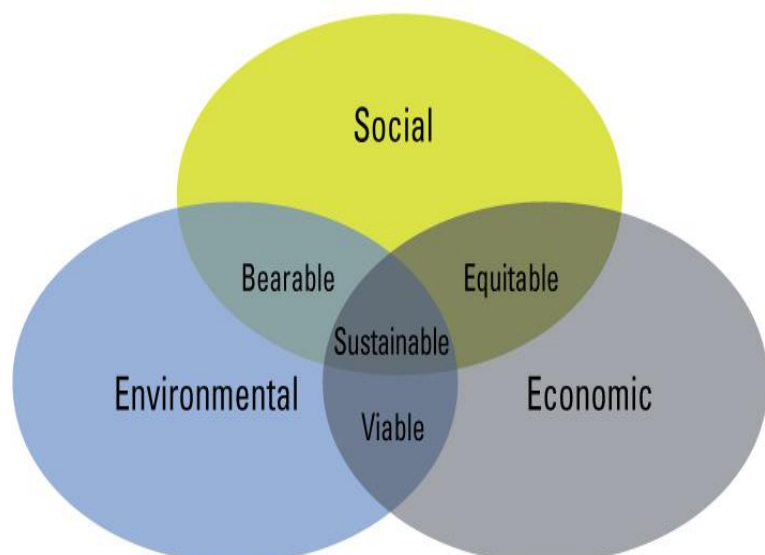
Shifting cultivation hi Mizotawng chuan Tlangram loneih dan, kum tina hmun hran hrana insawn dan hi a ni mai a. Lei a that dan a zirin kum 2 kum 3 lai pawh a neih nawn theih a. Tlangram awihpangah erawh chuan thlai thar a hlawk loh thin avangin nei nawn an awm meuh lo. He loneih dan hi ram rethei deuha chindan tlanglawn a ni a, ram changkang leh khawl tha leh tui awm thatna hmunah chuan a hlawk loh a vangin a lar tawh lem lova.



Hmasang atangin he loneih dan hi an lo ching tawh a, Europe leh ram dangah pawh kum zabi 20 lai hawl vel thlenga la ching zui an awm a. Mithiam te chuan, lalram thang duang tak lo ni tawh Mayan hote pawh kha indona avang leh ei leh bar hmuhna ber an ram te chu agriculture vanga a lo dak tak avangin an tluchhe leh ta niin an ring a ni.

Ngawpui tha leh thing leh maute an vat faia, nisain a em ro hnua an hal thin a. He lo halna atanga meivap hian leiah potash a tipunga chu chuan kum khatnaah chuan thlai thar a ti pung thin a ni. Mizo pi leh pu te hunah chuan an lo neih dan leh an nunphung, kut an hman dan te hi a in pawlh chiat a ni. Hmun dangah an insawn san hnua amahin zawi zawiin

The Three Pillars of Sustainable Agriculture



leithatna a lo insiam leh a, kum enge maw zat a vei hnuah an nei nawn leh thin a ni. Tun hnaiah hian mihring kan pun chak avang leh khawpui lo thang zel avangin he ram zuah tui cycle hi a kum a rei thei ta lova, leitha chambangte chu ruahsurin a tleuh faia, chu chuan leilung kal ral leh rah chhuah tha thei lo ram a hring chhuak ta teuh a ni.

Mizoramah hian flangram loneih dan hi kan chhonzawm zel dawn a nih chuan kan kalsan dawnah thei tiak leh leitha thing te phun a, thing par nei chite chin zui a tha em em a ni. Hei hian sava leh khuai te a hip khawm a, thing leh hnim inthlah chhawannaah nasa takin a tanpui a ni.

Hmun ngaia thlai hi kan chin rei poh leh lei thatna a tla hniam ve zel a, lein a nihphung a hlah tial tial a, tui a pai theihna a tlahniam a, hnim chi leia inphum te a kiam zel a. Hnim to chhuak tur a awm tawh loh chuan lei da leh ram chhiaah an chang ta thin a ni. Chuvang chuan hmun khata in bengbela sustainable agriculture nei thei tur chuan ruahmanna felfai tak kan neih a ngai a ni.

Sustainable Agriculture tih tawngkam bul bal taka rawn hmang hmasa bertu chu Australian Scientist Gordon McClymont niin sawi a ni a. He tawngkau chheh hi agriculture lamah chuan a pawimawhin a lar ta hle a ni. A tawi zawnga hrilhfhah tur chuan-'hmun pakhata inbengbela thlai chin leh ran vulh te nena kaikawpin, hun rei zawk daih tura ruahmanna siam chung a agriculture lama hmalakna' tiin kan dah thei ang.

Sustainable agriculture in a tum chu a lem ami ang hian kan chenna khawvel, min hual veltu thing leh mau boruak tha siam tu te an chereu loh na tur ngaihtuah tel te, chhungkaw tin leh mimal



tin an lo intodelh zawkna turin sum lakluhna tha zawk leh hlep tha zawk nei tura hmalak te a ni a. Hemi thleng tur erawh chuan ruahmanna tha a ngai thung a. Tlangram loneih kum tina insawn nen chuan a inkalh deuh flat thung a ni.

Awmze nei taka thlai thar chhuah tla hniam lo tura lei thatna vawn nun te, tui supply kham khawp nei tura hmalak te, thlai ei chhetu rannung control te a huam vek a ni. Ran vulh ek leh zunte, thlai ningnawi leithaa chantir te hi thil pawimawh tak a ni a, a kim changing kan sawi chhunzawm ang. Tui hman



daihzai dan thiam te, leilung luang ral lo tur zawnga hmalak te a tul hle a ni. Kan chenna khawvel hi a zau belh loh avangin kan neih chhun hi rambua leh hman tlak loha chantir lo tura hmalak hi mitinte mawhphurhna a ni.

UNO hnuaia Food and Agriculture Organisation chhut dan chuan tun atanga kum sawm tam ral hma hian thilsiam chhuahna lam (Industrial) leh khawpui zauhna atan kan thlai chinna hmun tha hi tam tak kan hlauh dawn a, thlai chinna hmun atan ramngaw tha tam tak kan ti chereu in chu chuan soil erosion nasa tak a siam dawn bawk niin an chhut a ni. Chuvang chuan kan neih chhun ang te an riral lohna turin mitinin hma kan lak a tul tak zet a ni.

Sustainable Agriculture Kan neih theihna tura ruahmanna

Thingtlang lo neih hi kan thinlungah a bet nghet hle a, thil dang tha zawk dap chhuah pawh a harsa hle a ni. Kumtinin buh leh bal ei tur thawh chhuah angai a. Lo leh huan neitu tam takin an harsatna an sawi chu, sum leh pai harsatna mai bakah duh ang tawka fertilizer leh pesticides hman tur awm lo hi a ni a. Thlai leh thei kung te rannung leh natna hrikin a beih nasat avangin a thar hlawk lo thin a, chuvang chuan an dinhmun pawh a hriat thiampuiawm viau. Amaherawhchu, heng thlai damdawite hi a hman dan tur dik taka hman phe chu an tlem viau ang.

Hmun khata in benbel ruahmanna hi vawi leh khata tih thut chi a ni lem lova, rilru lo siam lawka kum tin valh tih zau hret hret chi a ni a. A kum khatna ah zau vak lo kan enkawl zawh tawk vah a, buh chin na'na hman phawta, zawi zawi a thlai leh thei te phun tur a ni. A kum khatna a zau lutuk

enkawl zawh loh neih chuan phurna te a ti bo thei a, beidawnna mai a ni thin. Lei kal ral leh lei da tur ngaihtuah lawkin a tir atangin ruahmanna tha siam lawk tur ani.

Sloping Agriculture Land Technology (SALT)/ Contour Hedgerow/Alley Cropping

Phillipines-te, Indonesia-te leh ram dang tam tak keini ang bawka tlang ramahte chuan leilung luang ral leh thlai thar hlawk rei thei lo hi an lo buaipui nasa tawh hle a. Kan han sawi tur ber SALT, a lam pum chu 'Sloping Agricultural Land Technology' an tih pawh hi rei tak chhung an enchhin hnua an duan chhuah a ni a; 'tlangram loneih dan tha' tiin kan sawi mai anga, sustainable agriculture kalpui dan chi khat a ni. Nitrogen fixing shrubs/trees (leitha thing) awmze nei taka hmang tangkai chung a lo neih dan a ni a. Chi li lai (I,II, III,IV) in then darh ani a, ran pawh a vulh tel theih a ni. Hetiang ang deuh tlangram leilung luangral tur veng chung a lo neih dan hi hmun dangahte pawh hming hran hran neiin an lo ching ve tho va. SALT a danglamna bik erawh chu, hmanraw mawl te hmangin hlawhtling takin a kal pui theih a ni. Mizoramah pawh hlawhtling taka enchhin a ni tawh a ni.

Nitrogen fixing trees (leitha thing) te hi tlang tan zawnga phun tur a ni a. Tlar hnih zelin contour line zuiin an len hnua insi thap tur in a chi chu tuh tur a ni. A tlar inkar chu 1ft vel a ni tur ani a, an lo len deuh hnua a tlar inkarah chuan lung leh thing bung te awmze nei taka rem tur a ni. Hei hian lei chunglang hang tha luang ral mai tur kha a lo dang khawm a. Kum engemawzat a vei hnua pheih chuan amahin terrace a lo insiam thin a ni. Heng atan hian thing chi hrang hrang an enchhin a.



SALT Farm

Japan zawngtah (*Leucaena leucocephala*) te, *Taphrosia candida* te, *Flemingia macrofila* leh adang te pawh hlawhtling taka enchhin an ni a. Heng leitha thingte hian an zunga bawk(nodule) hmangin leitha an siam a, a hnah tla tawihin leitha a siam zui bawk a, khur felfai taka siamin leitha a siam theih bawk a. Chubakah ranchaw a tan te, thingtuah a tan te a hman theih a. Tin, a zung hi a thuk avangin lei kalral tur a veng bawk a ni. Contour line inkar ram awlah khan buhte leh thlaite a tha duh hle a ni. Kumkhat chhunga thlai thar nghal thei

chi leh kum tam tak daih
tur sumchang thlai hmunte
a buatsaih kawp nghal
theih avangin Mizo te rilru
mil zawng tak tur niin
alang. Ruahmanna fel tak
nena crop rotation kalpui
bawk chuan fertilizer leh
pesticides te hi hman a
ngai lo tluk a ni.

A thupaia kan hman
ang khian thlai dang



SALT Farm

emaw mau leh thing emaw

kara awmze neia thlai chin hrim hrim hian hlawkna tam tak a keng tel a, SALT
ah hi chuan leithatna belhchhah thei tur nitrogen fixing trees te hi chin atan
an hmang bik a ni.

Chapter hma lama kan sawi tak zawng zawng te kha sustainable
agriculture kan neih theihna tura thil pawimawh vek a ni a, kan ram awmdan
a zirin hmalak dan tur ruahmanna fel tak siamin hmasawn ai tum theuh ang
u.