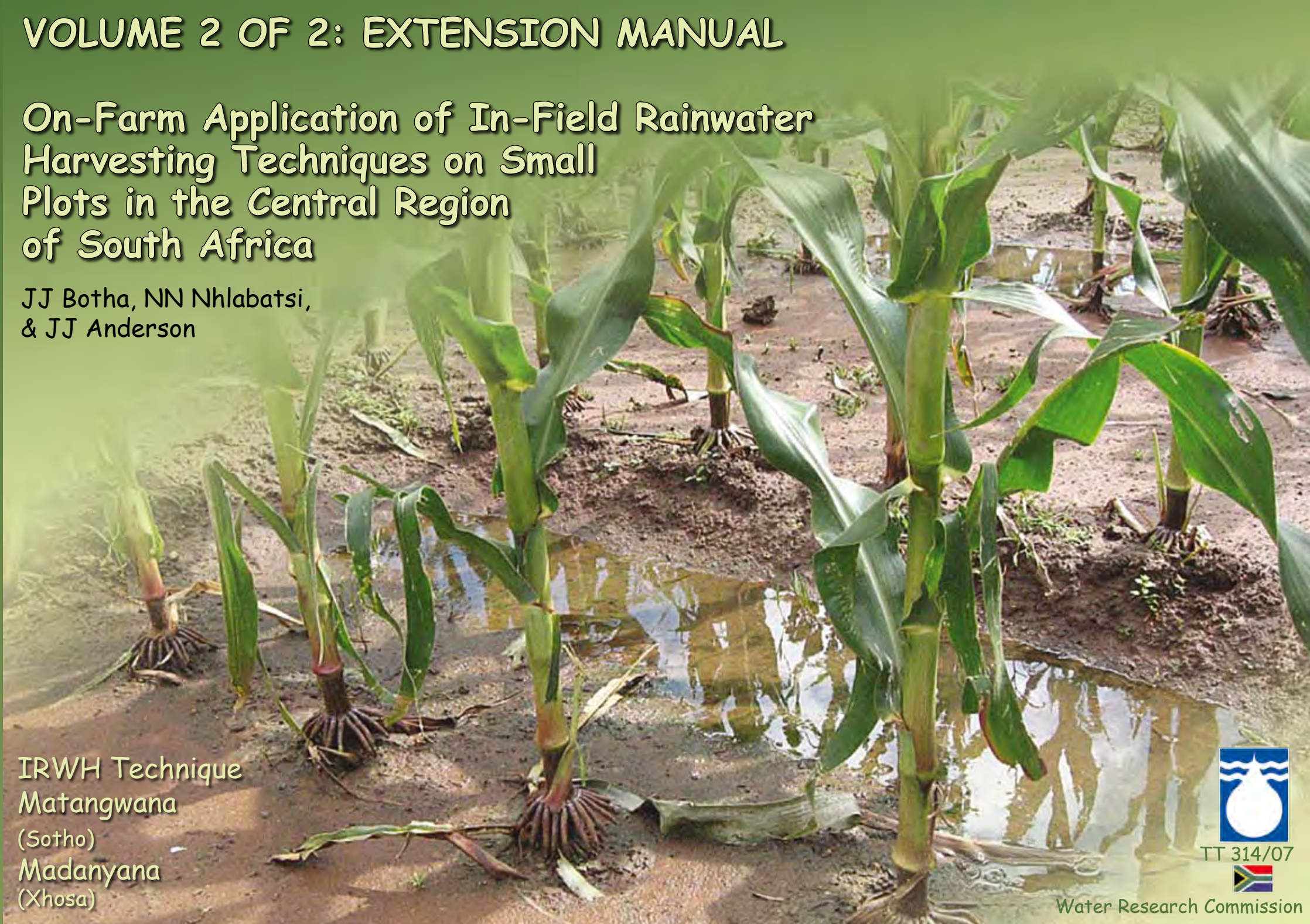
VOLUME 2 OF 2: EXTENSION MANUAL

# On-Farm Application of In-Field Rainwater Harvesting Techniques on Small Plots in the Central Region of South Africa

JJ Botha, NN Nhlabatsi,
& JJ Anderson



IRWH Technique
Matangwana
(Sotho)
Madanyana
(Xhosa)

TT 314/07
Water Research Commission

# ON-FARM APPLICATION OF IN-FIELD RAINWATER HARVESTING TECHNIQUES ON SMALL PLOTS IN THE CENTRAL REGION OF SOUTH AFRICA

VOLUME 2 OF 2: EXTENSION MANUAL

by

JJ Botha[1], JJ Anderson[1], DC Groenewald[2], NN Nhlabatsi[1], TB Zere[1], N Mdibe[1] & MN Baiphethi[1]

[1]ARC - Institute for Soil, Climate and Water, Private Bag X01, Glen 9360
[2]Department of Sociology, University of the Free State, Bloemfontein, 9360

TT 314/07

OCTOBER 2007

# OBTAINABLE FROM

Water Research Commission
Private Bag X03
Gezina
0031

The publication of this report emanates from a project entitled:
On-farm application of in-field water harvesting conservation techniques on small plots in the central region of South Africa (WRC Project No. K5/1355)

DISCLAIMER

This report has been reviewed by the Water Research Commission (WRC) and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the WRC, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

WRC Report No. TT 314/07
ISBN 978-1-77005-596-4
Set No. 978-1-77005-597-1

Printed in the Republic of South Africa

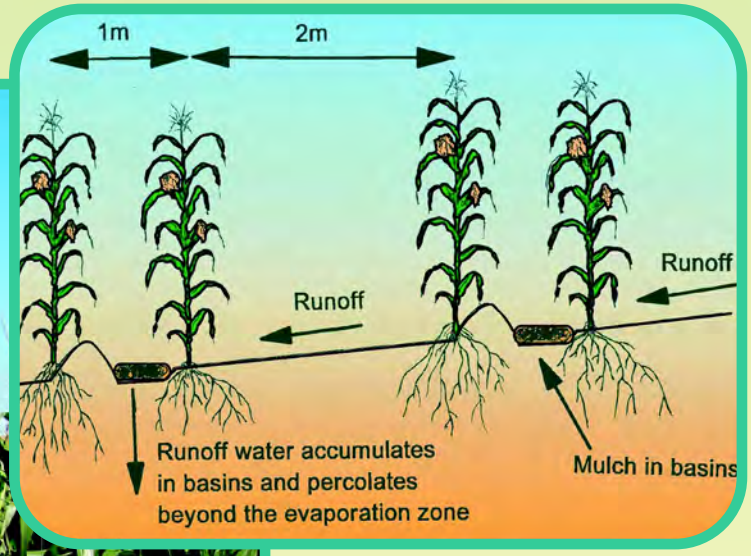
# TABLE OF CONTENTS


Functions of IRWH ..... 4
Example of a setup showing the IRWH technique ..... 5
Importance of IRWH technique ..... 6
Requirements and maintenance of the IRWH technique ..... 7
Is the soil suitable for IRWH? ..... 8
How to take a soil sample ..... 9
Land preparation ..... 10
How to prepare the slope on the runoff area ..... 11
Slope on the runoff and basin area ..... 12
Marking out the garden or field ..... 13
Crop production diary ..... 14
Preparation for planting ..... 15
Planting ..... 16
Direct planting ..... 17
Planting vegetables in seedbeds ..... 18
Taking care of seedlings ..... 19
Transplanting ..... 20
Planting calendar ..... 21
Planting methods ..... 22
Planting spinach ..... 23
Planting beans ..... 24
Planting onions ..... 25
Planting carrots ..... 26
Planting beetroot ..... 27
Planting maize ..... 28
Planting tomato ..... 29
Planting cabbage ..... 30
Planting melons, pumpkins and squashes ..... 31
Planting lettuce ..... 32
Weeding - manual control ..... 33
Weeding - chemical control ..... 34
Herbicides and pesticides ..... 35
When to spray ..... 36
Safety and storage of chemicals ..... 37
How to use a sprayer ..... 38
General maintenance of IRWH structures ..... 39
Reasons for maintaining IRWH plots ..... 40
General tips ..... 41
Marketing ..... 42
Marketing operations ..... 43
Record keeping ..... 44
Communication ..... 45
Types of communication ..... 46
Communication barriers ..... 48
How to improve communication ..... 49
Constructive and destructive conflicts ..... 50
Conflict resolution ..... 51
Basic guidelines for handling conflict situations ..... 52
Functions and roles of committees ..... 53
What steps to take to implement the IRWH technique ..... 54

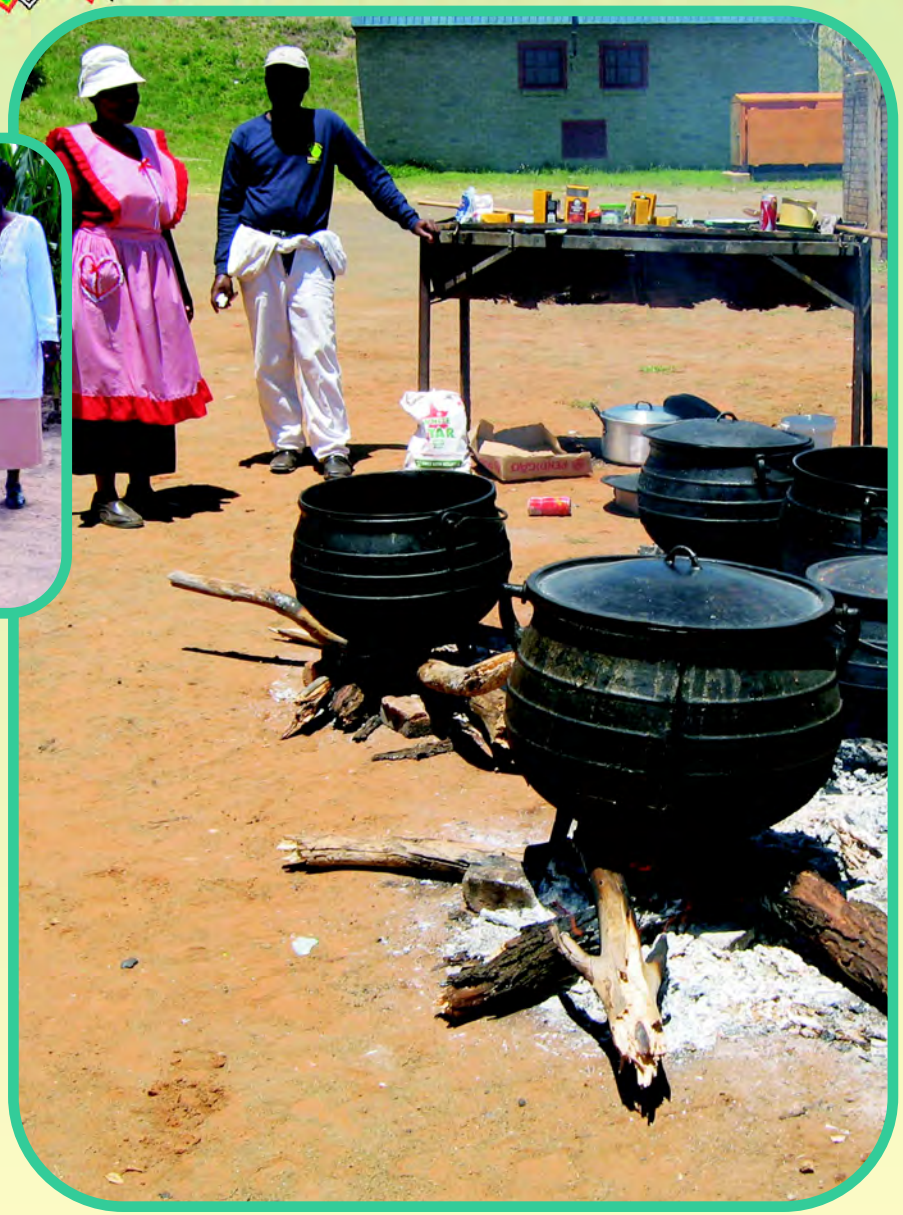
# FUNCTIONS OF IRWH
## (IN-FIELD RAINWATER HARVESTING)

- Harvest rainfall into the basins
- Basins help to reduce ex-field runoff to zero
- Prevents soil erosion
- Mulch in the basins helps minimize evaporation
- Promotes infiltration of water beyond evaporation zone and therefore minimizes evaporation

# EXAMPLE OF A SETUP SHOWING THE IRWH TECHNIQUE

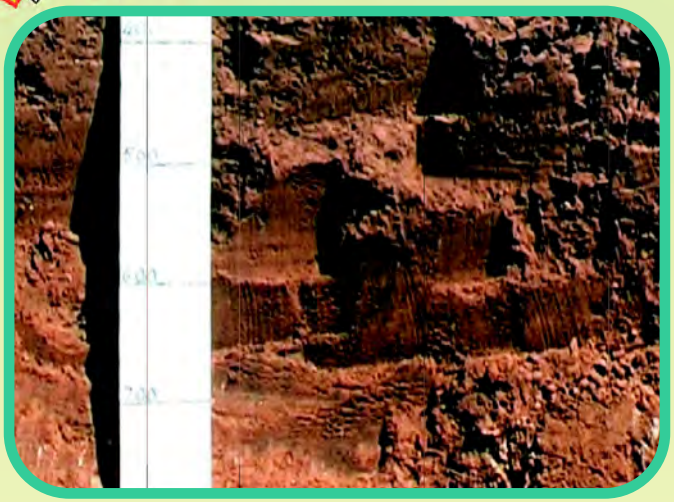



# IMPORTANCE OF IRWH TECHNIQUE



- Contributes to food security
- Contributes to poverty alleviation
- Contributes to improving the health status of community members
- Helps improve crop productivity
- Enables farmers to plant crops in areas that are marginal for crop production
- Helps improve the socio-economic status of resource-poor farmers

# REQUIREMENTS AND MAINTENANCE OF THE IRWH TECHNIQUE



- The slope must not exceed 7% on non-erodible soils
- The effective soil depth should be at least 700 mm - 1000 mm
- The annual rainfall must be between 400 mm - 700 mm
- Preferably clay or duplex soils

[Duplex soils are soils with relatively permeable topsoil (sandy) overlying a very slowly permeable horizon - duplex soils are erodible]

# IS THE SOIL SUITABLE FOR IRWH?

**1.** Determine clay content by the feel method: Take a sample of soil, wet it, roll into a worm and then form a C-shape with both hands. Feel how sticky it is to estimate the clay content


**2.** Take your soil samples to the laboratory for clay content analysis

**3.** Ask Dept. of Agriculture extension officer to auger and determine soil depth (minimum depth of 700 mm)

# HOW TO TAKE A SOIL SAMPLE

1. Go to the place you want to test

2. Dig a hole the depth and width of a spade

3. Using the spade, cut a thin slice of soil from one of the sides of the hole. Put this into a bucket

4. Take samples from different places in your garden or field, each time placing samples in the bucket

5. When you have several samples, mix the soil in the bucket well

6. Place a small amount of soil (± 1 kg) from the bucket into a paper bag

# LAND PREPARATION

1. Fence the area to prevent theft and animals from entering

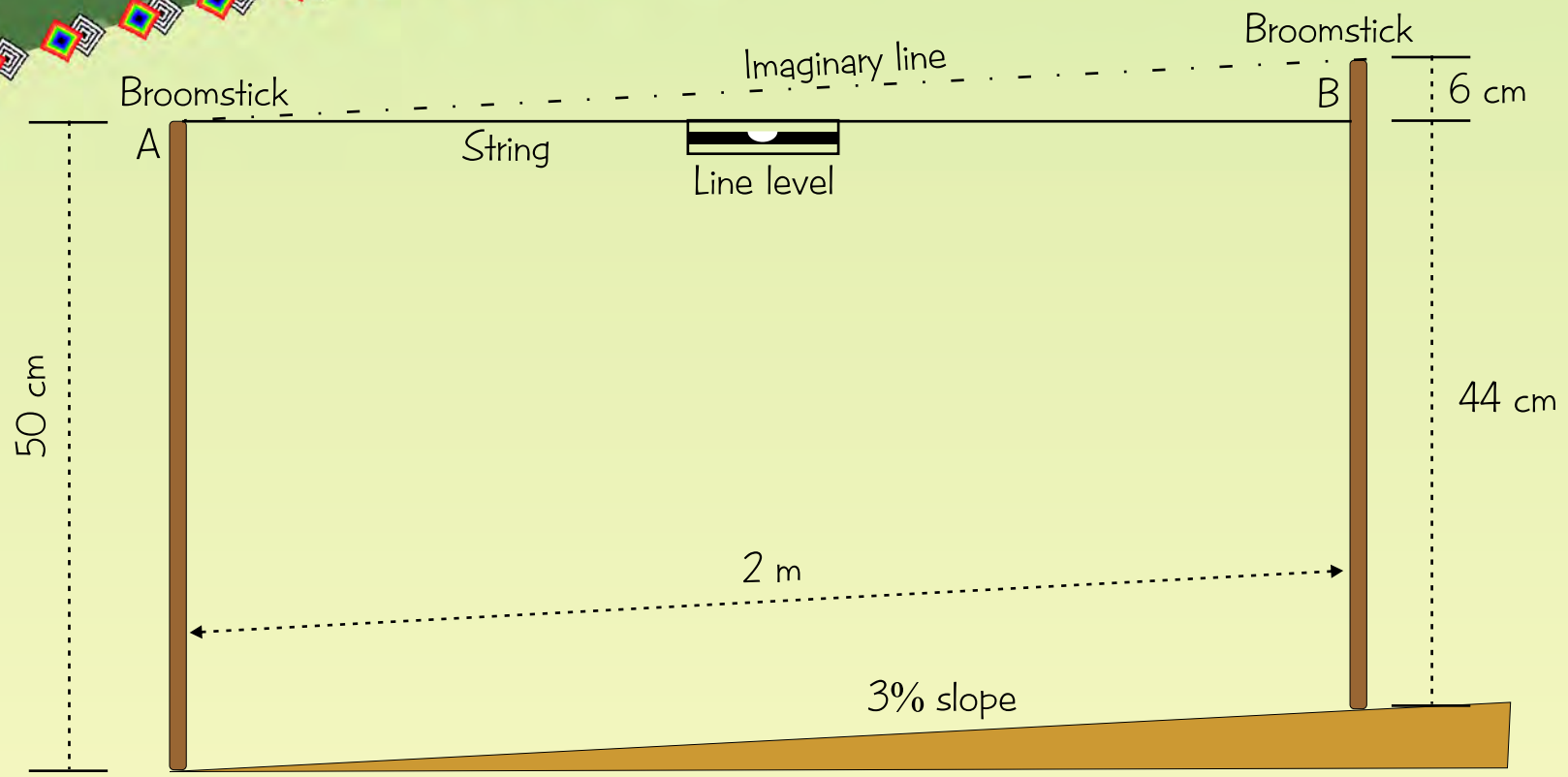
2. Clear weeds from the area

3. The field where the IRWH technique is to be implemented must not be on steep slopes

4. Prepare IRWH basins ACROSS the slope NOT ALONG the slope

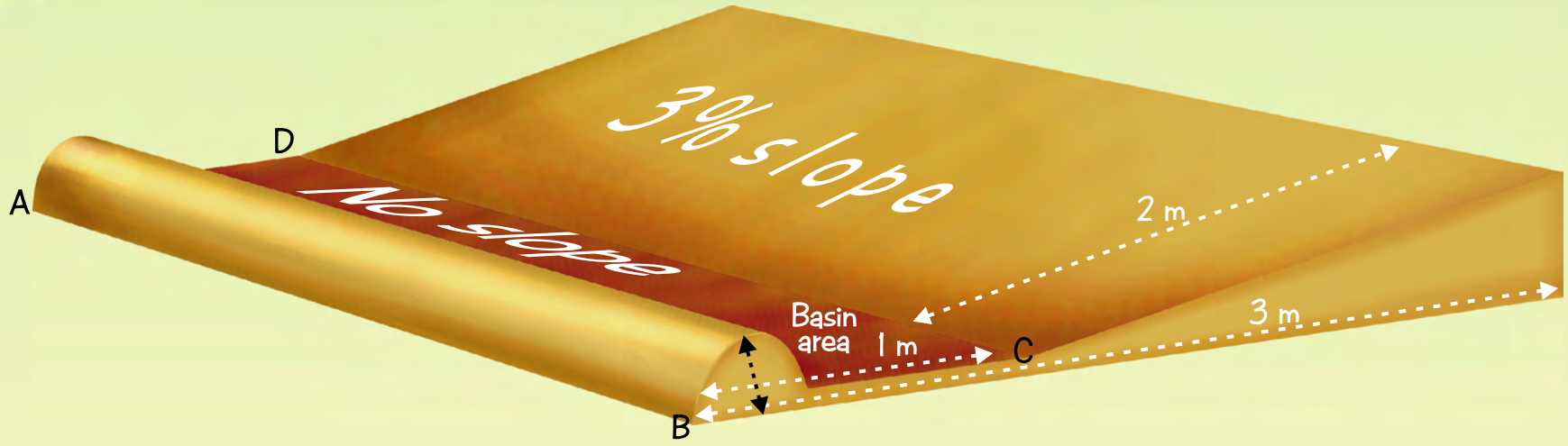
# HOW TO PREPARE THE SLOPE ON THE RUNOFF AREA

## Example For a 3% Slope




- Place broomstick A at the bottom of the line of slope. Another person takes broomstick B up the line of slope until the string is tight at 200 cm (2 m)
- The string should be tied at 50 cm on broomstick A and at 44 cm on broomstick B
- A third person must examine the line level. The bubble will not be in the centre when the slope is not 3°, but when the right slope has been prepared (by moving soil gently to the upper or lower levels) the bubble will be in the centre
- Follow the same procedure for the whole length of the field or garden to obtain a correct slope for the runoff area

# SLOPE ON THE RUNOFF AND BASIN AREA




Basin ridge must be at least ± 100 mm high

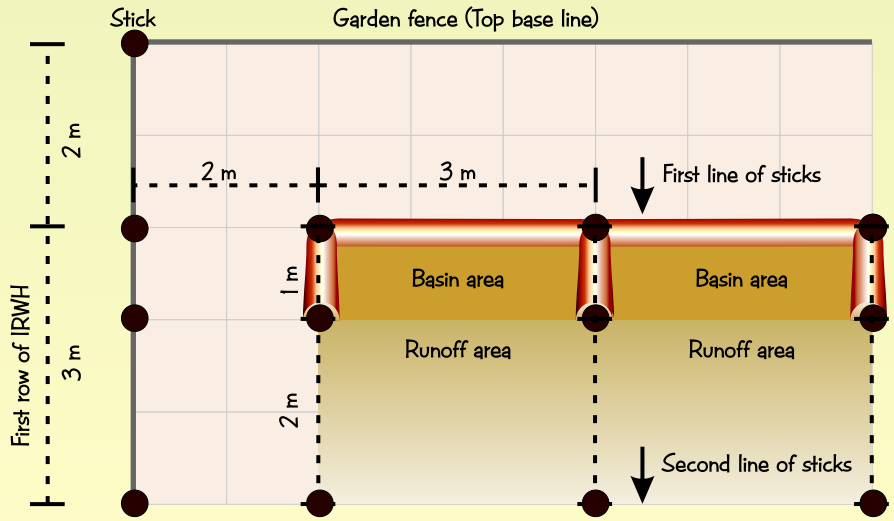
- The basin area should be level
- There should be no slope between points A, B, C, & D
- If that is not observed water will tend to concentrate on the lower side of the basin area
- Basins must be ± 100 mm deep in shallow soils and must not go beyond the A horizon

# MARKING OUT THE GARDEN OR FIELD

**NB: You need a tape measure, string, plenty of sticks and a hammer. Follow these steps carefully:**

- If you have a straight fence that runs across a slope in your garden, use it as a baseline that runs across the slope. Fix one tight string 2 m from the baseline and parallel to it

- Make measurements along the string at 1 m, 2 m and 3 m as shown in diagram. Mark the string and knock a stick into the ground at each mark

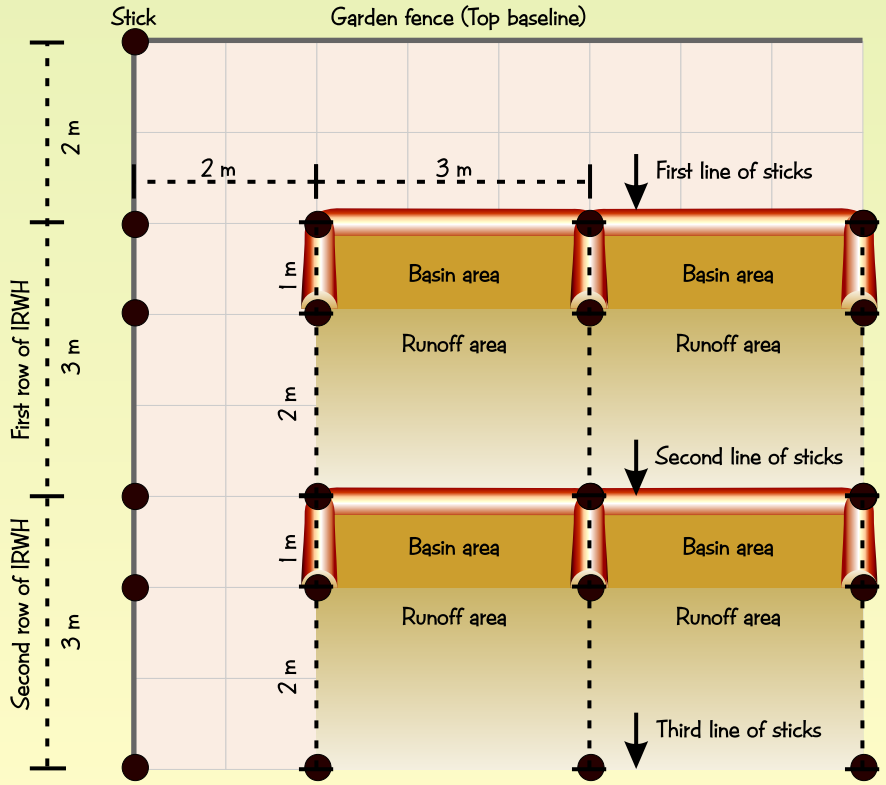



- Move the string 1 m down from your first line of sticks. Put sticks against the marks to mark out your basin area

- Move the string 3 m down from your first line of sticks. Put more sticks against the marks on the string

- Move the string down another 3 m and put the third line of sticks. This will give you your second row of plots

- Repeat the steps, moving the string until all the plots have been marked out



# CROP PRODUCTION DIARY

Set out your diary in a book like this:

| Date | Activity (What was done) | Remarks |
|---|---|---|
| 11/01/06 | Planted maize [variety PHB3394] | Soil very dry bur rain forecast |
| 02/02/06 | Planted beans [PAN 148] | Signs of rain next day |
| 25/02/06 | Noticed cutworms and used cutworm bait | Controlled by spraying |

# PREPARATION FOR PLANTING

- Before crops can be planted, the land has to be properly prepared. The aim is to provide the best conditions for seed germination and growth
- Prepare a suitable tilth. Use a fork or spade, a hoe and a rake. These tools will help you do the work properly
- For vegetables (e.g. cabbage and tomato) the tilth must be fine but for field crops (e.g. maize and beans) the seeds are large so the tilth does not have to be as fine as for vegetables
- Soil with a coarse tilth is less likely to be eroded than one with a fine tilth. This is important in the summer because heavy rain can damage a fine tilth easily
- A string, a tape measure and some sticks should always be used to get straight lines

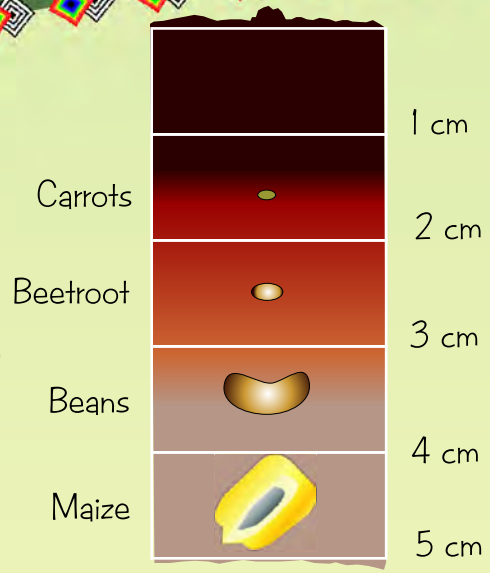
# PLANTING

- Plant when conditions are favourable. Planting can be done once the first rainfall event of 20 mm or more has occurred (one or two days). This will mean the soil has enough water for the seed to germinate

- Plant at correct depth and spacing. If you plant at the right depth you will get uniform germination, in other words, all the seedlings will appear about the same time. You need to see that the spaces between the plants are correct. Then the plants will have enough air, water, nutrients and light. Fertilizer recommendations are made for these plant spacings

- Crops can either be planted directly (seeds or cuttings) or transplanted (seedlings)

# DIRECT PLANTING (Seeds)



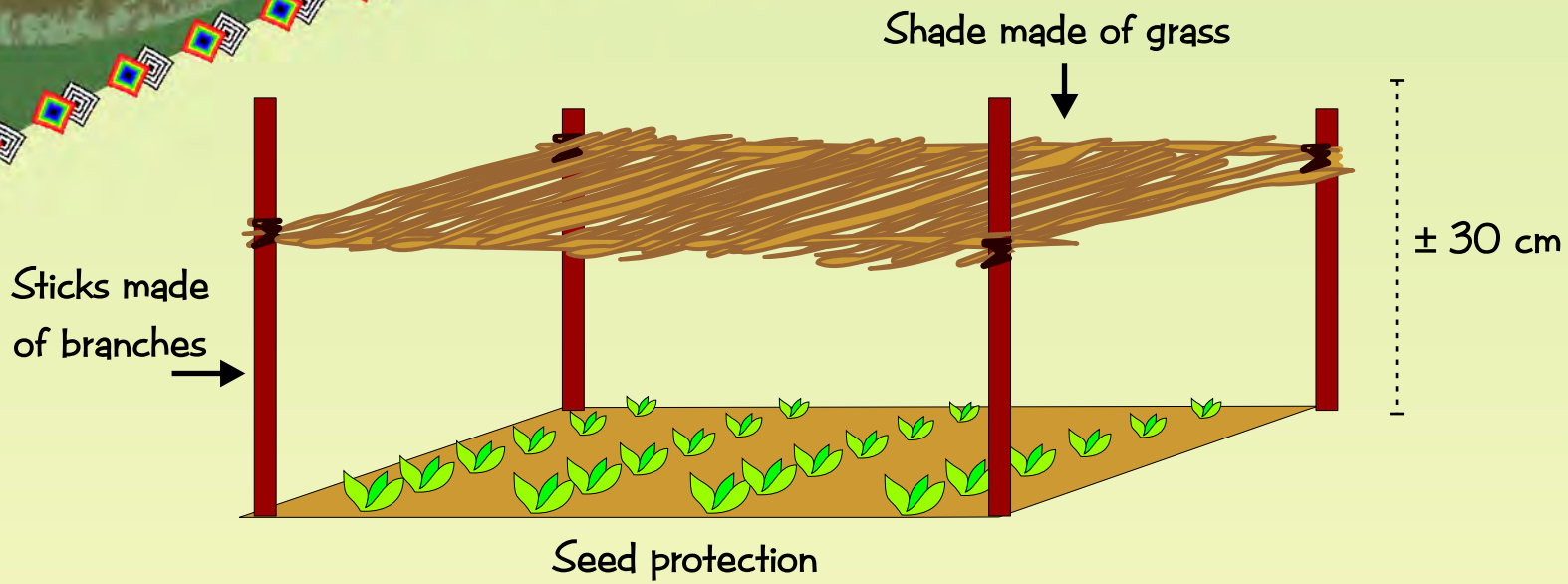

- Mark out the planting row (furrow) using a piece of string tied between two sticks. Make sure the string is pulled tight
- Check the amount of fertilizer needed for the crop. Apply the fertilizer as recommended, making sure it is mixed well with the soil
- Use a hoe, or edge of a rake, to make the planting row. A planting row for large seeds should be deeper than one for small seeds. [A good tip is to make the depth five times the diameter of the seed]. If the seeds are planted too deeply they may not be able to push their way through the soil after germination and may rot. If they are planted too close to the surface they may be eaten, washed away, or dried out by the sun
- When you plant the seeds, make sure they are planted evenly along the row. For good germination rather plant two or three seeds at each planting station in the row. Later these can be thinned out to leave one plant. Leave a stick in the ground to show where you planted
- Water the furrow (row), then rake the soil back over the seed and firm the soil using the back of the rake
- Water regularly after planting to ensure good emergence

# PLANTING VEGETABLES IN SEEDBEDS (Seedlings)

## Making a seedbed

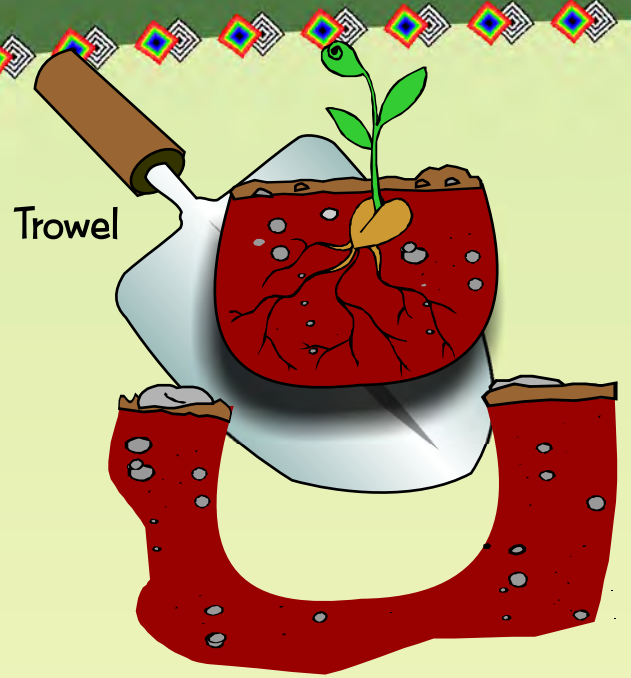
- Choose a sunny site with good soil, near your water source
- Mark out a square seedbed (1 m x 1 m) so that you can work from both sides without standing on it
- Add one bucket of manure or compost (5 kg) for each square metre and dig it in. Work the soil until you have a fine tilth
- Add 2 full matchboxes (MB) and one Coke bottle top (BT) of 3:5:1 fertilizer per 1 m x 1 m and rake it in
- Mark out shallow rows about 15 cm - 20 cm apart, using a stick or a trowel
- Plant the seeds thinly. Cover the seeds with soil and firm it down
- Water the seedbed well (using a watering can with spray funnel) and cover the bed with a thin grass mulch to keep the soil moist. Mark and label the rows

# TAKING CARE OF SEEDLINGS



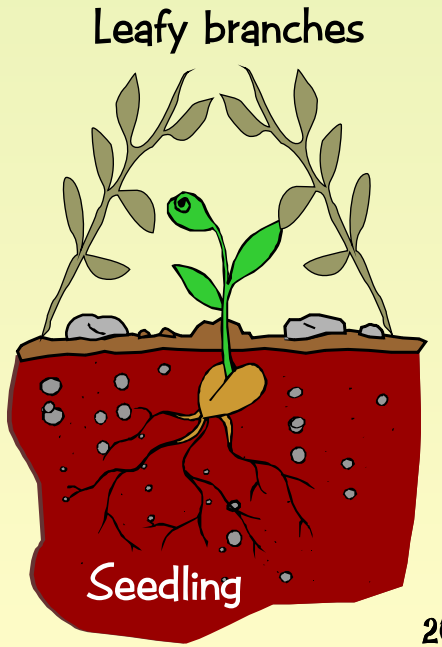

- Check the seedbed everyday. When the seeds start to germinate, remove the mulch. After germination, thin them to at least 1 cm apart within the rows. You may have to thin more than once
- Shade the garden with a raised cover on sticks to protect it from direct sunlight and heavy rains. After a week, remove the shade from mid-morning up to noon each day. Start with about two hours and build up to having no shade at all just before transplanting
- For the first two weeks, unless it rains, water the seedlings everyday. If it is very hot, water them twice a day. Avoid watering in the late afternoon, as this reduces the chances of damping off. After 2 weeks the seedlings should be watered less often. Watering less often and reducing the shade hardens off the seedlings before they can be transplanted
- Pest and diseases may attack seedlings. To prevent this, spray with a mixture of Malathion and Dithane

# TRANSPLANTING




**Transplanting means moving seedlings from the seedbed and planting them in the field or garden**
**[NB: The best time to transplant is in cool cloudy weather or late in the afternoon]**

- Water the seedbed, a few hours before transplanting
- Check how much fertilizer is needed and how it should be applied
- Mark out the rows and the planting stations. Apply the fertilizer as directed and mix it well with the soil
- Fill the planting holes or rows with water. The water will drain away leaving the holes wet
- Choose your strongest seedlings. Use a trowel or spade to lift them from the seedbed. Take care not to damage the roots. Only lift a few seedlings at a time to prevent them from drying out
- Put the seedlings into the planting holes. Hold the leaves and not the roots when you do this
- The hole should be big enough for the seedling to be planted
- Firm the soil around the seedling and water it
- If the weather is hot and dry, shade the seedlings with leafy branches
- For the first few days water at least twice a day



# PLANTING CALENDAR

## VEGETABLE SOWING CALENDAR (CENTRAL FREE STATE)

| JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Beans | Beans | | Beans | Beans | | | Beans | Beans | Beans | Beans | Beans |
| | Beetroot | Beetroot | | Beetroot | Beetroot | Beetroot | Beetroot | Beetroot | Beetroot | Beetroot | Beetroot |
| Broccoli | Broccoli | | | | | | | | | Broccoli | Broccoli |
| Cabbage | Cabbage | | | | | Cabbage | Cabbage | Cabbage | Cabbage | | Cabbage |
| Carrot | Carrot | Carrot | | | | | Carrot | Carrot | Carrot | Carrot | Carrot |
| | | | | | | | | | | Cauliflower | Cauliflower |
| | | | | | | | | Cucumber | Cucumber | Cucumber | Cucumber |
| Lettuce | Lettuce | Lettuce | | | Lettuce | Lettuce | Lettuce | Lettuce | Lettuce | Lettuce | Lettuce |
| | | Onion | Onion | Onion | Onion | Onion | | | | | |
| | | | Pea | Pea | | Pea | Pea | Pea | | | |
| | | | Pepper | | | | Pepper | Pepper | Pepper | | |
| | | | | | | | | Pumpkin | Pumpkin | Pumpkin | Pumpkin |
| Spinach | Spinach | Spinach | Spinach | | | | Spinach | Spinach | Spinach | Spinach | Spinach |
| | | | | | | | Squash | Squash | Squash | Squash | |
| Swiss Chard | Swiss Chard | Swiss Chard | Swiss Chard | | Swiss Chard | Swiss Chard | Swiss Chard | Swiss Chard | Swiss Chard | Swiss Chard | |
| | | | | | | | Tomato | Tomato | Tomato | Tomato | |
| | | | | | | | | Watermelon | Watermelon | Watermelon | |

- A seed needs the right temperature, air and moisture to germinate
- To provide the best conditions for germination and growth you must plant at the right time

# PLANTING METHODS

## FURROW METHOD

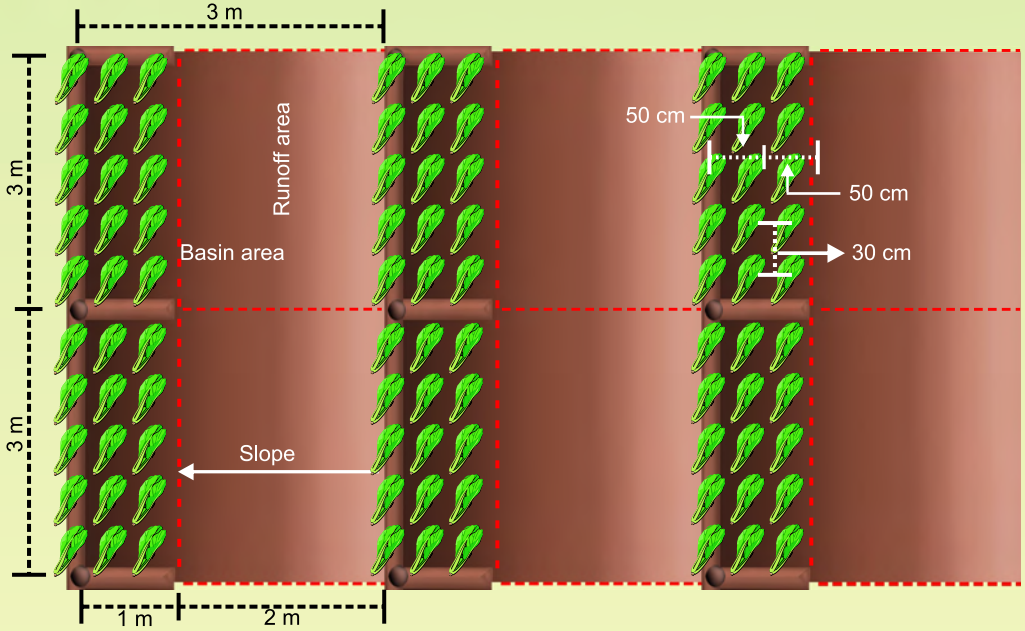
- Dryland crops and vegetables are mostly planted in furrows when using the IRWH technique and most are planted directly. [Furrows are also known as drills or rows]
- Bigger seeds like beans, maize, water melon, pumpkin and squash are planted at least 3 - 5 cm deep
- Smaller seeds like onions, beetroot, spinach, carrots, cabbage and tomatoes are planted at a depth of 2 - 3 cm. This should be done at the correct spacing
- Seeds can also be planted in a continuous stream and should be thinned later. Planting in rows or furrows makes weeding easier

## INTERVAL METHOD

- All crops can be planted this way. Interval planting is when seeds or seedlings are planted in holes per planting interval
- Instead of making a furrow, you make a hole at the correct spacing and drop one or two seeds in
- After germination you leave the strongest seedling and pull the others out
- This method uses a lot of seed; you should only use it if you expect germination to be low

# PLANTING SPINACH
## (Spinacea oleracea)

**Varieties:**
Springer, Splash, Fordhook Giant, Viroflay, Resistoflay, Lucellus




**Fertilizer:** The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole or planting station

**Plant spacing:** Intra rows: 30 cm
Inter rows: 50 cm

**Pests and diseases:**

| Name of pest or disease | Control method | When to use | Safety period to harvest |
|---|---|---|---|
| Leaf spot | Spray with Dithane 80% WP, 1 MB (10 g) in 5 litres of water or copper oxychloride, 2 MB (20 g) in 5 litres | Once a week after the disease is identified and after rainfall events | 2 days |

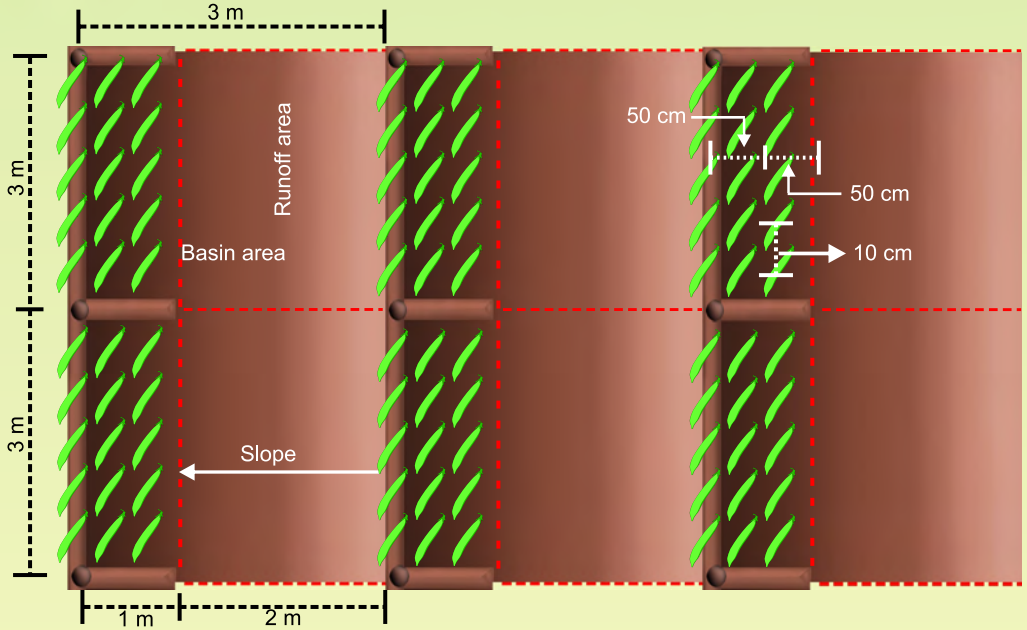
**Growing tips:** Spinach likes soils rich in organic matter

**Harvesting:** Leaves are ready 50 - 60 days after planting. Cut the outer leaves, leaving the inner ones to continue growing. It may only be possible to get one cutting in summer because of disease problems. Spinach does not keep long and should be eaten soon after harvesting

Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

# PLANTING BEANS
## [DWARF] (PHASEOLUS VULGARIS)

**Varieties:**
Seminole, Wintergreen, Provider, Nelson, Paulista, Alberta, Derby, Distinction, PAN 148




**Fertilizer:** The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole or planting station

**Plant spacing:** Intra rows: 10 cm
Inter rows: 50 cm

**Pests and diseases:**

| Name of pest or disease | Control method | When to use | Safety period to harvest |
|---|---|---|---|
| CMR beetle | Pick off by hand and kill; spray with Malathion 25% WP, 1 MB (10 g) in 5 litres of water | Only use pesticide if there are too many to collect | 2 days |
| Rust | Spray with Dithane 80% WP, 1MB (10 g) in 5 litres of water | Every week in hot weather | 3 days |
| Halo blight (more common in warm conditions) | Spray with copper oxychloride, 2 MB (20 g) in 5 litres of water | When seen and then every week | 14 days |

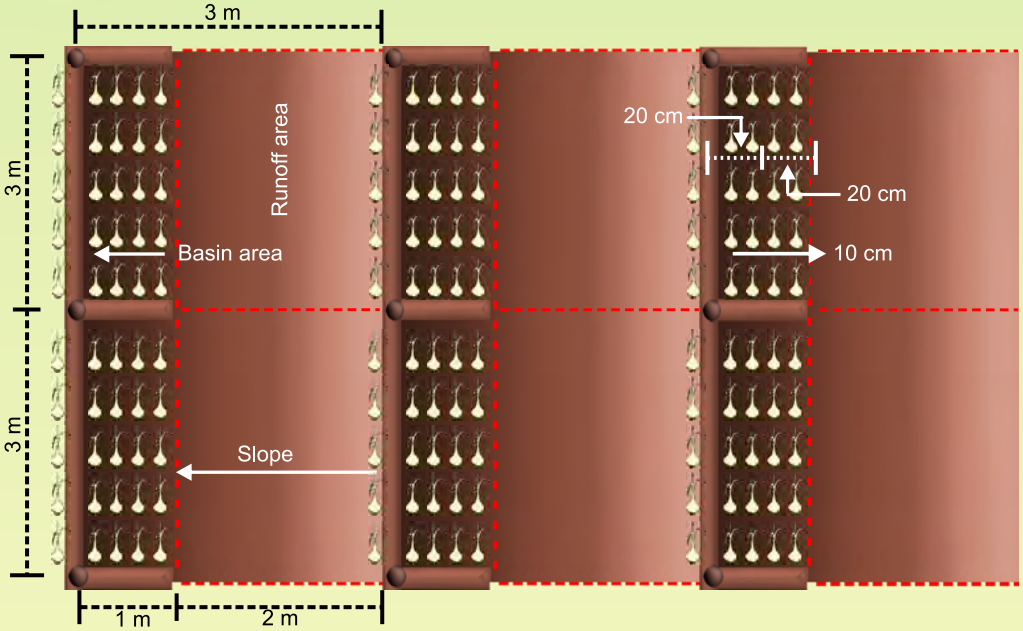
**Growing tips:** Beans like organic matter. Dig in compost or kraal manure before planting. Beans will not stand frost; therefore, avoid winter months. Avoid waterlogged conditions

**Harvesting:** Pick pods before the seeds start to swell (about 50 - 60 days after planting). If they are left too long, the pods become stringy and are not good to eat. Fresh bean pods should break easily. Pods that bend and do not break have been kept too long

Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

# PLANTING ONIONS
## (ALLIUM cepa)

**Varieties**:
Texas Grano 502 PRR, Pyramid, Australian Brown, Bon Accord, Red Creole




**Fertilizer:** The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole or planting station

**Plant spacing:** Intra rows: 10 cm
Inter rows: 20 cm

**Pests and diseases:**

| Name of pest or disease | Control method | When to use | Safety period to harvest |
|---|---|---|---|
| Blast (small manwhite spots on the leaves) | Spray with Dithane 80% WP, 1 MB (10 g) in 5 litres of water | When seen and every week | 3 days |
| Downy mildew | Spray with Dithane 80% WP, 1 MB (10 g) in 5 litres of water | When seen and every week | 3 days |
| Thrips | Spray with Malathion 25% WP, 1.25 MB (12.5 g) in 5 litres of water or Bulldock 20 ml per 20 litres of water | When seen | 14 days |

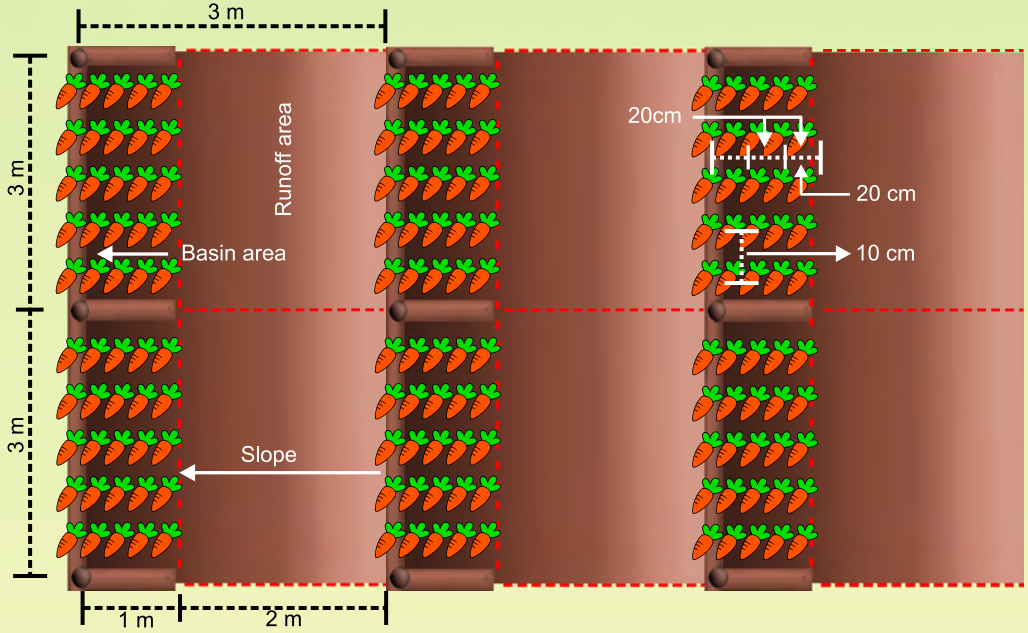
Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

**Growing tips:** Onions produce soft bulbs and do not keep well in soils with a lot of nitrogen. They should not be grown after beans or in soil that has manure added

**Harvesting:** Onions are normally ready 120 - 180 days after planting, depending on the variety. When bulbs reach the ripening stage, watering should be reduced to allow them to dry out. When the leaves turn brown and fall over, the onions should be lifted and stored in a dry place

# PLANTING CARROTS
## (Daucus carota)

**Varieties:**
Chantenay Red Cored, Cape Market, Kuroda, Duke, Prospector




**Fertilizer**: The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole or planting station

**Plant spacing:** Intra rows: 5 cm - 10 cm
Inter rows: 20 cm

**Pests and diseases:**

| Name of pest or disease | Control Method | When to use | Safety period to harvest |
|---|---|---|---|
| Blight | Use resistant varieties, e.g. Kuroda, or spray with Dithane 80% WP, 1 MB (10 g) in 5 litres of water | When seen | 2 days |
| Aphids | Spray with Malathion 25% WP, 1 MB (10 g) in 5 litres of water or metasystox 20 ml per 20 litres of water | When seen, then every week and after rain | 14 days |

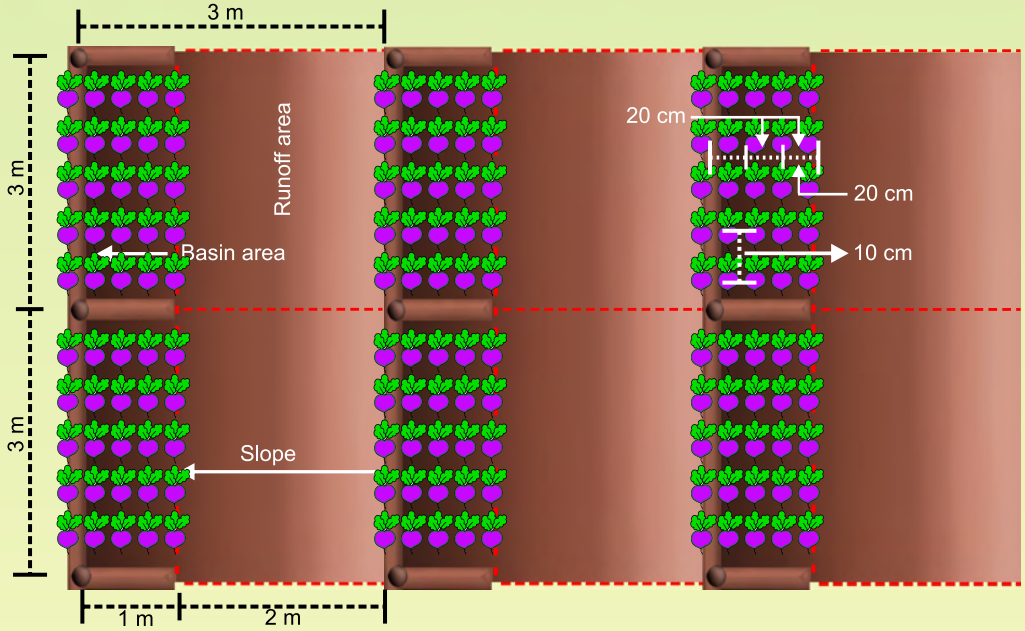
**Growing tips**: Do not add fresh organic matter to the soil before planting, as it makes the roots split. Carrots should be thinned when they have their first true leaves. Other thinning may be needed to get a final spacing of 4 - 5 cm between plants. Weed carefully, as the roots are easily damaged

**Harvesting**: Carrots are ready in 70 - 120 days. They should be well watered before harvesting so that they lift easily. They do not keep well and should be eaten soon after harvest

Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

# PLANTING BEETROOT
## (Beta vulgaris)

**Varieties:**
Detroit Dark Red, Crimson Globe, Early Wonder, Red Ace Warrior, Scarlet Supreme




**Fertilizer:** The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole or planting station

**Plant spacing:** Intra rows: 10 cm
Inter rows: 20 cm

**Pests and diseases:**

| Name of pest or disease | Control method | When to use | Safety period to harvest |
|---|---|---|---|
| Leaf spot | Spray Dithane M45, 1 MB (10 g) in 5 litres of water or use copper oxychloride, 2 MB (20 g) in 5 litres of water | Apply once a week after the disease is seen and after rain | 2 days |

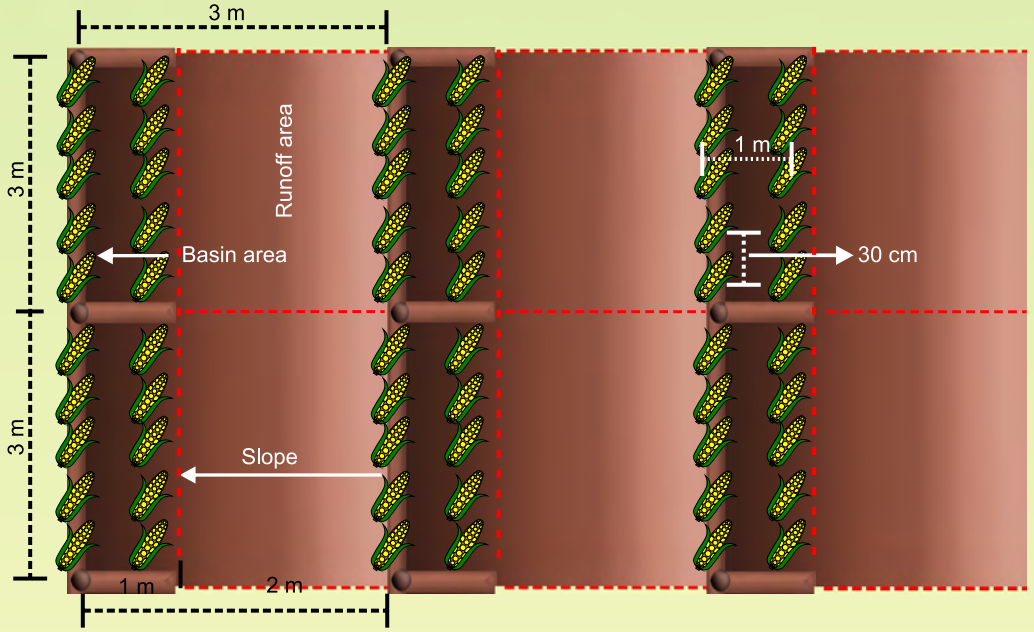
**Growing tips:** Beetroot does not like acid soils, but should not be planted soon after liming. The latter can cause dark patches on the bulbs and spoils quality

**Harvesting:** Depending on the variety, beetroot is ready for harvesting 55 - 70 days after planting. The roots should be harvested when they are 6 - 8 cm across. Older beetroot becomes woody and is not pleasant to eat

Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

# PLANTING MAIZE
## (Zea Mays)

**Varieties:**
PHB 33V08, PHB 3394,
PHB 33A14




**Fertilizer:** The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole per planting station

**Planting depth:** 5 cm

**Plant spacing:** Intra rows: 25 cm - 30 cm
Inter rows: 100 cm

**Pests and diseases:**

| Name of pest or disease | Control method | When to use |
|---|---|---|
| Cutworm | Use cutworm bait: 0.2 MB (2 g) of Dipterex 95% WP mixed with 1 litre of water and 750 g of mealie meal or Bulldock 20 ml per 20 litres of water | Apply to soil 2 days before or at planting. Always apply if cutworms have been present in the past or if maize has been grown for a long time in the same field |
| Stalkborer<br>A white caterpillar that eats out stems. It can be recognised by shot holes (row of holes) in new leaves as they open | Early planting or by dropping a pinch of Dipterex 2.5% granules down the funnel (top) of the plants | When more than 5 out of 100 plants have shot holes |
| Maize streak<br>The leaves have yellow streaks and plants are small | Early planting.<br>Use resistant varieties | |

Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

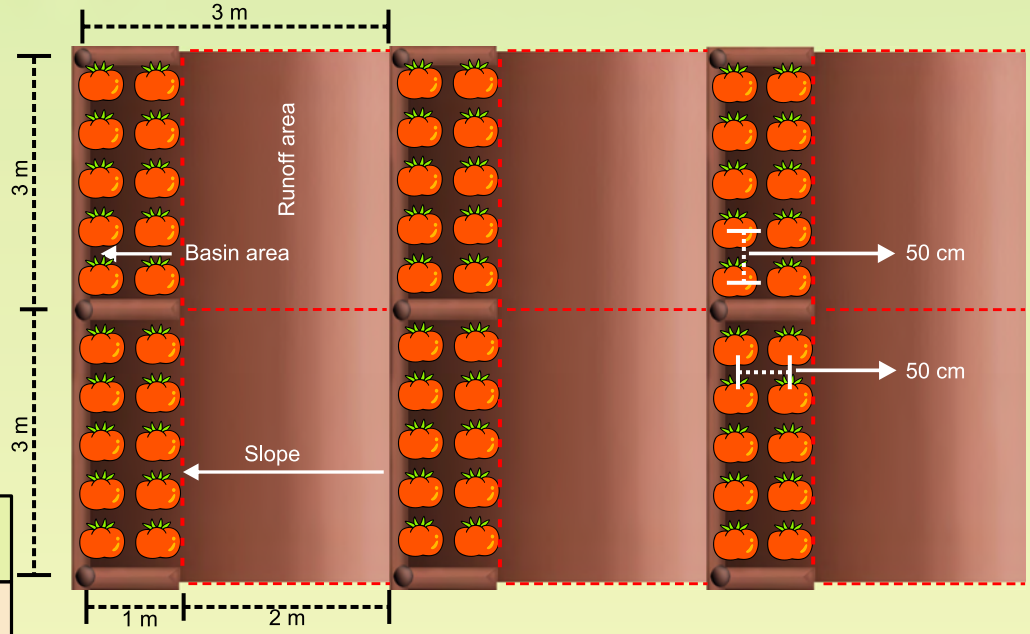
**Harvesting:** Maize can be harvested as green mealies or when the cobs have dried. Green mealies are ready 90 - 110 days after planting, and dried cobs 140 - 180 days after planting, depending on variety

# PLANTING TOMATO
## (Lycopersicon esculentum)

**Varieties:**
Shirley, Graziella, Fanny, Volcanic, Rock Star, Heinz 1370, Karino, Moneymaker, Floradale, Maximo

**Fertilizer:** The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole or planting station

**Plant spacing**: Intra rows: 50 cm
Inter rows: 50 cm




**Pests and diseases:**

| Name of pest or disease | Control method | When to use | Safety period to harvest |
|---|---|---|---|
| Bacterial wilt | None. If the area is infected, do not grow tomatoes on it for at least 5 years | | |
| Aphids | Spray with Malathion 25% WP, 1 ½ MB (15 g) in 5 litres of water or metasystox 20 ml per 20 litres of water | When seen, then every week and after the rain | 5 days |
| Nematodes (eelworms) | Rotation. 5 year rotation for any crop within the same tomato family | | |
| American bollworm | Spray with Gardona 50% WP, ½ MB (5 g) in 5 litres of water or Bulldock 20 ml per 20 litres of water | When seen, then every week | 14 days |
| Fusarium wilt | Use resistant varieties, e.g. Floradale | | |
| Verticillum wilt | Use resistant varieties, e.g. Floradale, Piersol | | |
| Late blight and Early blight | Spray with a mixture of 2 MB (20 g) copper oxychloride and 1 MB (10 g) Dithane 80% WP in 5 litres of water | When noticed and then once a week | 2 days |

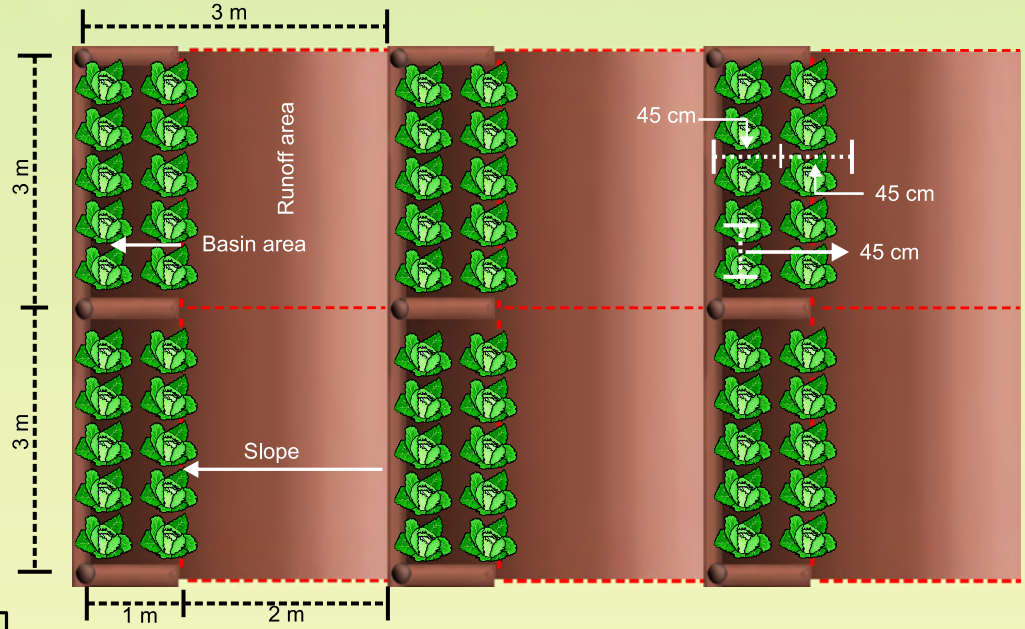
Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

**Growing tips:** Tomatoes should be supported on stakes to keep the plants upright. This helps to prevent diseases. They are deep rooted and can withstand dry conditions better than some vegetables. However, you should water every two days when the fruit starts to grow. Poor watering at this stage might make the fruit crack. Tomatoes should always be watered at the base of the plant, as wetting the leaves can invoke diseases

**Harvesting**: Tomatoes should be harvested when they start to turn pink. Careful handling of fruits is necessary

# PLANTING CABBAGE
## (Brassica oleracea var. Capitata)

**Varieties:**
Victor, Tropicana, Gloria, Riana, Green Crown, Beverly Hills, Rotan, Hercules, Marcanta, Millennium




**Fertilizer:** The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole or planting station

**Plant spacing**: Intra rows: 45 cm
Inter rows: 45 cm

**Pests and diseases:**

| Name of pest or disease | Control method | When to use | Safety period to harvest |
|---|---|---|---|
| Cutworm | Use cutworm bait. Mix ½ a BT (2.5 g) of Dipterex 95% WP with 750 g of mealie meal in 1 litre of water or Bulldock 20 ml per 20 litres of water | Apply to the soil 2 days before transplanting | |
| Aphids | Spray with Malathion 25% WP, 1 MB (10 g) in 5 litres of water or metasystox 20 ml per 20 litres of water | When you see more than a few aphids | 2 days |
| Diamond back moth | Spray with Dipterex 50% WP, 2 ½ MB (25 g) in 5 litres of water | When you see the caterpillars | 7 days |

Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

**Growing tips:** Cabbages like organic matter. If you have kraal manure or compost, dig it into the bed before transplanting. Cabbages do not like acid soils with a pH below 5.5. Water them regularly as drying out retards growth. Cabbages should only be grown on the same land once in three years. This rotation will prevent pests and diseases building up in the soil

**Harvesting:** Depending on the variety, cabbages are ready for harvesting 75 - 140 days after transplanting. A few weeks before harvesting, watering should be reduced. This helps the cabbage heads to firm up. Cabbage heads should be harvested when they are ready. If left too long they crack and split. Cabbage does not store well and should be eaten soon after harvest

# PLANTING MELONS, PUMPKINS AND SQUASHES (CUMULUS MELO & CITRULLUS VULGARIS)

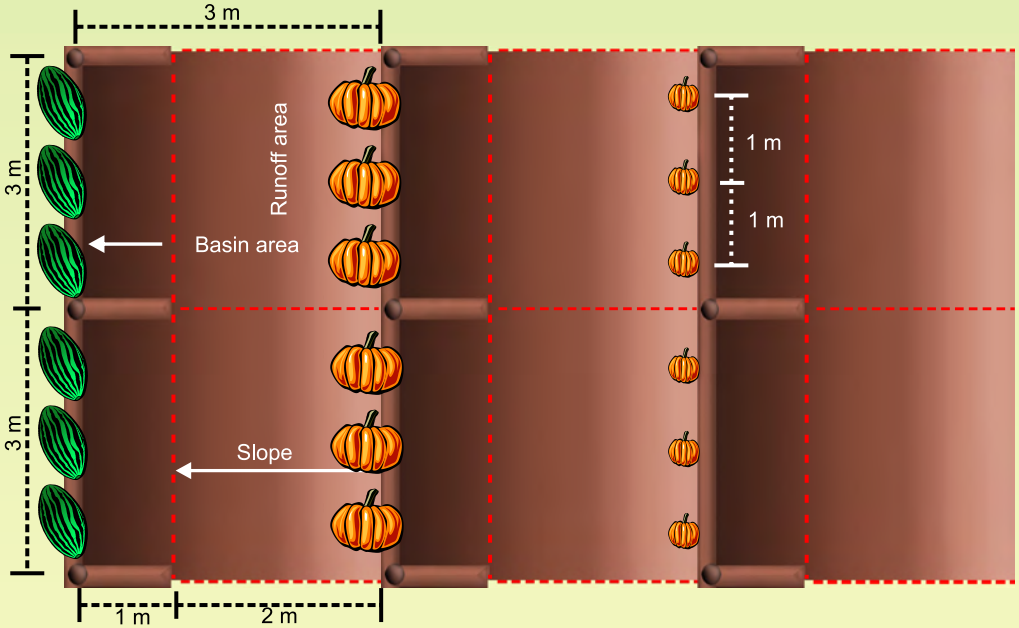
**Varieties:**

**PUMPKINS** [Royal Crown, Plat Wit Boer van Niekerk, Queensland Blue, Rovaal]

**SQUASHES** [Butternut Supreme, Early Butternut, Ambassador, President]

**Varieties:**

**WATER MELONS** [Royal Sweet, Tempo, Carmen, Crimson Glory, Vista, Sugar Baby, Congo, All Sweet, Sweet Princess, Crimson Sweet, Mickylee, Crimson King, Orange Sunshine, Orchid Sweet]




**Fertilizer**: The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole or planting station

**Plant spacing:** Intra rows: 100 cm (Only one line on the ridge)

**Pests and diseases:**

| Name of pest or disease | Control method | When to use |
|---|---|---|
| Pumpkin fly<br>A small black fly that lays its eggs in the fruit. The larvae, little white maggots, eat the fruit and make it rot | Spray with Malathion 25% WP, 1 MB (10 g) in 5 litres of water with 500 g of sugar | When flowering starts, then once a week |
| Powdery mildew<br>A white fungus seen on the leaves; it makes them turn brown and die | Spray with Bayleton 5% WP, 1 MB (10 g) in 5 litres of water | When seen |
| Downy mildew<br>Appears as brown spots on the leaves, causing them to curl and die | Spray with Dithane 80% WP, 1 MB (10 g) in 5 litres of water | When seen |

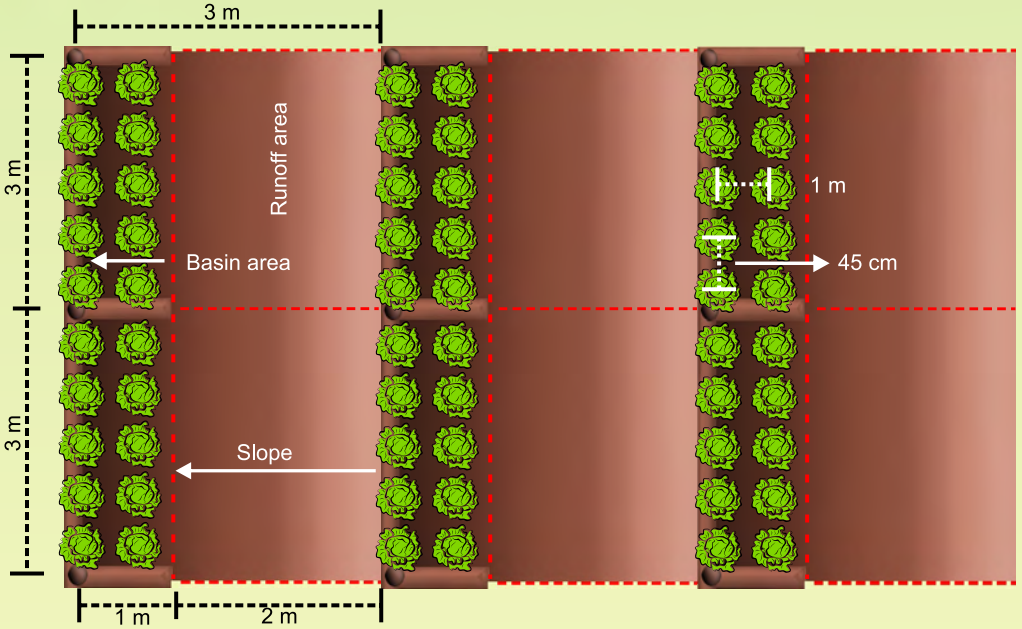
Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

**Growing tips:** The runners should be directed mostly towards the runoff area

**Harvesting:** Pumpkins and melons are ready 120 days after planting. They store well, but should be checked regularly. Bad ones should be thrown away

# PLANTING LETTUCE
## (Lactuca Sativa)

**Varieties:**
Great Lakes, Wintercrisp, Empire 2000, Tropical Empire, Summertime, Commander, Mohawk, Victory, Target, Del Oro, Del Rio, Robinvale, Iceberg




**Fertilizer:** The recommended compound fertilizer is 3:2:1 of NPK and is applied during planting at about 3.57 g (1 BT) per hole or planting station

**Plant spacing**: Intra rows: 35 cm - 45 cm
Inter rows: 35 cm - 45 cm

**Pests and diseases:**

| Name of pest or disease | Control method | When to use | Safety period to harvest |
|---|---|---|---|
| Aphids | Spray with Malathion 25% WP, 1 MB (10g) in 5 litres of water or metasystox 20 ml per 20 litres of water | When seen | 2 days |

**Growing tips:** Lettuce grows best in soils rich in organic matter and after following beans in a rotation. In hot weather lettuce may bolt (go to seed); then the leaves become bitter and unpleasant. Bolting can be avoided by using the right variety

**Harvesting:** Lettuces are ready after about 65 - 90 days. Crisp-headed lettuce should be harvested as soon as the heart (the firm centre) has formed. Lettuce loses freshness soon after harvest and should be eaten as soon as possible

Key: BT = Bottle top (e.g. Coke); MB = Matchbox; WP = Wettable powder

# WEEDING - MANUAL CONTROL

- The longer you leave weeds in the field, the more damage they do. Maize yields, for example, can fall by more than half if weeding is not done at the right time. Keeping crops weed-free in the early stages of growth is very important. It is at this stage that weeds do the most damage. But once a crop is growing well it keeps the weeds down itself

- Weeds should always be removed before they produce seeds, otherwise they will increase. Some weeds, for example couch grass, will grow again from pieces of stem. Hoeing and hand weeding this weed often spread it rather than control it
- You should start weeding as soon as your crop is above ground. You will have to weed more than once before the crop is established. You should weed between and within the rows, and take care not to disturb the roots of crop plants. Use a hoe or a spade for weeding
- Keep the field or basin weed-free, especially during the fallow period

# WEEDING - CHEMICAL CONTROL

- Use 2,4 D at 40 ml per 20 litres of water for broad leaf weeds
- Use Round Up at 40 ml per 20 litres of water for grasses and broad leaf weeds
- Use Terbo at 20 ml per 20 litres of water for broad leaf weeds
- Use Focus Ultra at 20 ml per 20 litres of water for grasses

# HERBICIDES AND PESTICIDES

## USING HERBICIDES AND PESTICIDES

Most of these chemicals are mixed with water and sprayed onto plants. Not all of them are used in this way. Some are applied as dusts, for example seed dressing; others are applied as granules and some as smokes; some are mixed with liquids other than water

## HOW HERBICIDES AND PESTICIDES WORK

The chemicals work in different ways. Some remain on the surface of the plant and kill the pest or disease when it touches or eats the plant. These are called contact pesticides. Others are absorbed (taken into) the plant and get carried round in the plant juices. These are called systemic pesticides, because they are in the plant's system. Systemic pesticides are often used to kill sucking insects, like aphids and thrips

# WHEN TO SPRAY

- It is important to know when to use a chemical. For some pests and diseases you only have to spray when you see them. This means you have to check your plot regularly for signs of damage. This is called protective spraying. Protective spraying can be expensive. It can also destroy natural enemies of pests and diseases and can damage the environment

- You should also know the conditions that make an attack more likely to happen. For example, late blight, a disease of tomatoes, spreads quickly in wet weather, but not in dry weather

- If you have tomatoes in the rainy season, you should spray once a week; if you grow them in the dry season you may not need to spray

- Watering wrongly can also spread late blight: wetting the leaves spreads the disease

# SAFETY AND STORAGE OF CHEMICALS

- All pesticides and herbicides are dangerous. They can kill! So you must take every care to store and use them correctly. Most of them can irritate the skin, eyes and respiratory system. Seed dressings are very dangerous and treated seed should never be eaten
- Many chemicals are poorly labeled and the labels give little information about their use or dangers. Chemicals should be stored in:
  - a) Labeled containers
  - b) Sealed containers
  - c) A locked dry box or cupboard away from seeds, fertilizer and feedstuff
  - d) A well ventilated storage facility
- Keep chemicals away from children or where children can reach them
- Never store chemicals in unlabeled food or drink containers
- Always use recommended amounts
- Do not harm yourself, your neighbour or the environment with chemicals
- ALWAYS WASH YOUR HANDS AFTER HANDLING CHEMICALS

# HOW TO USE A SPRAYER

1. Never mix pesticides and herbicides (use separate sprayers)
2. Always wear protective clothing, especially a nose mask, gloves and an overcoat or overall
3. Check that no liquid or chemical was left in the sprayer since the last time it was used. Wash the sprayer out, at a drain or in a safe place. Do not empty or wash the sprayer in rivers, streams or near a drinking source
4. Fill the sprayer to the correct level with water. Dry the sprayer unit on the outside. Pump it to the correct pressure. When at the correct pressure you can hear air escaping from the safety valve. Point the sprayer away from you and check that it sprays correctly. IF THE SPRAYER HAS ANY LEAKS DO NOT USE IT
5. If the sprayer is working correctly, pull the pressure valve to release the pressure. Refill it with about one litre of water
6. Measure out the correct amount of chemical and pour it in. Put the cap back onto the sprayer and shake it well to mix it
7. Remove the cap and fill the sprayer with water to the correct level. Replace the cap and shake again
8. Pump to the correct pressure. Check that the spray is coming from the nozzle. If there are no problems the sprayer is then ready for use
9. Start spraying only when you reach your field
10. Do not eat when spraying
11. Do not spray in wind: spray may be blown onto you. If you have different crops, avoid wind drift to other plants that you do not intend to spray. Do not spray if it is raining or is about to rain. Most of the chemicals will be washed off the plants and wasted
12. Spray the whole plant. There is no need to spray until the liquid is running off the plant, this only wastes the chemical
13. After spraying, wash the sprayer out
14. Use soap and water to wash your hands and any part of you that may have spray on it. Change your clothes

# GENERAL MAINTENANCE OF IRWH STRUCTURES

- Repair damaged ridges caused by heavy rainfall events using a rake and spade. Do not attempt to repair the basins while they are still very wet

- Use a rake to remove silt from the basins. Rake silt towards the runoff area (2 m runoff area). The runoff area must have a smooth surface with a slight slope towards the basin

- Avoid walking on the ridges; this might reduce the basin. It can also cause soil compaction that can result in slow germination of seeds and low infiltration rates

# REASONS FOR MAINTAINING IRWH PLOTS

- Planting will be done easily and quickly
- More water will be available for crop growth resulting in higher yields
- There will be no competition with weeds for available water and nutrients
- A healthy cropping environment is created

# GENERAL TIPS

- After the crop has been harvested, the remaining stalks can be cut down and put in the basins as organic mulch. The mulch will minimize water losses (evaporation) from the soil surface

- It is not necessary to remove the maize roots after harvesting; roots will decompose and act as manure

- Do not disturb the crust that developed on the runoff area; this will promote runoff towards the basin area

- Maintain plots throughout the year in order to ensure good crop growth and yields

# MARKETING

- In order to sell your produce you have to find a market for it. A market in this sense means a group of people (consumers) who want to buy what you have to sell

- You will have to prepare your produce for a particular market requirement. For example, if a farmer wants to sell maize, it must be dry with a moisture content below 13%, clean, free from disease and packed in clean bags or trucks. To meet this requirement a farmer must:
  - a) harvest at the right time,
  - b) shell,
  - c) clean,
  - d) grade,
  - e) pack and
  - f) transport maize to buyer(s)

This is all part of marketing. Therefore, marketing can be described as including all the processes that take place in getting or moving goods from the point of production (farmer's field) to the consumer

# MARKETING OPERATIONS

1. **Market research:** Market research gathers information about what consumers want, what they will buy, and the price they are prepared to pay

2. **Assembling:** Harvesting and collecting produce at the right time is critical to the quality of product and profitability of an enterprise

3. **Grading:** Grading separates produce according to its quality. Higher prices are paid for top grade produce

4. **Processing or value adding:** Processing involves changing the form of the product before it is sold, for example drying, freezing or canning. Often this is done so that the product will last longer. For example, dried pumpkin seeds last much longer than fresh ones. They can be sold later at a higher price

5. **Packaging:** Packaging makes the product easier to handle and more attractive. Use environmentally-friendly packaging material

6. **Storage:** Storage is necessary for many crops that are seasonally produced. Consumers in general want produce to be available throughout the year. Make sure your storage facilities for the various crops are ready at harvest

7. **Transport:** Transport is an essential part of marketing, as most goods need to be taken to a market from the point of production. Arrange or organize transport well in advance to avoid unnecessary losses

8. **Advertising:** Advertising helps you sell your goods, and lets the customer find out what is available. This can be done through the Water Harvesting Interest Groups. Visit your nearest market to see what you can supply to the consumer or vendor on the street

9. **Selling:** When you sell crops, convince consumers that they want the goods offered at the price you are asking, otherwise you will make less income/profit

10. **Record keeping**

# RECORD KEEPING

## EXAMPLE OF KEEPING RECORDS

| Date | Costs | Amount |
|---|---|---|
| XXXX/XX/XX | Fertilizer | R 200 |
| XXXX/XX/XX | Seeds/seedlings | R 100 |
| XXXX/XX/XX | Equipment /Tools | R 50 |
| XXXX/XX/XX | Transport | R 25 |
| XXXX/XX/XX | Total | R 375 |
| | | |

| Date | Returns | Amount |
|---|---|---|
| XXXX/XX/XX | Cabbage Sales | R 300 |
| XXXX/XX/XX | Spinach Sales | R 150 |
| XXXX/XX/XX | Maize Sales | R 200 |
| XXXX/XX/XX | Beans Sales | R 200 |
| | Total Returns | R 850 |
| | | |

| | |
|---|---|
| Total Returns | R 850 |
| Total Costs | R 375 |
| Profit /Loss | R 475 |

# COMMUNICATION

## Definition

Communication is the passing of the message from one person (sender) to the other (receiver). The giving, receiving or exchange of information, opinions or ideas by writing, speech or visual means (or a combination of all three) must ensure that the material communicated is completely understood by everyone concerned. There can be no doubt that communication is vital to all management functions. In fact, without communication there can be no management. Communication is what leaders do: it is the essence of leadership work! It creates order, gives clarity and keeps people focused

## Informing

The intention is simply to tell someone about something, as in a no-smoking notice, for example, or a letter giving news of recent events

## Influencing

The intention is to persuade someone to adopt a particular course of action or attitude toward something. The obvious example is advertising

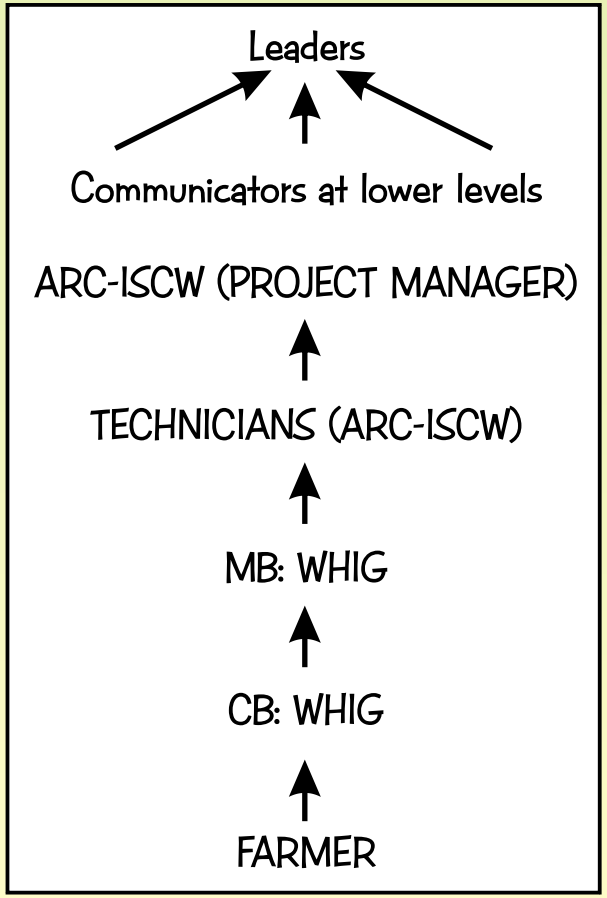
## Initiating action

The aim is to get the reader to do something; for example, it might be to urge an individual to attend a meeting

# TYPES OF COMMUNICATION

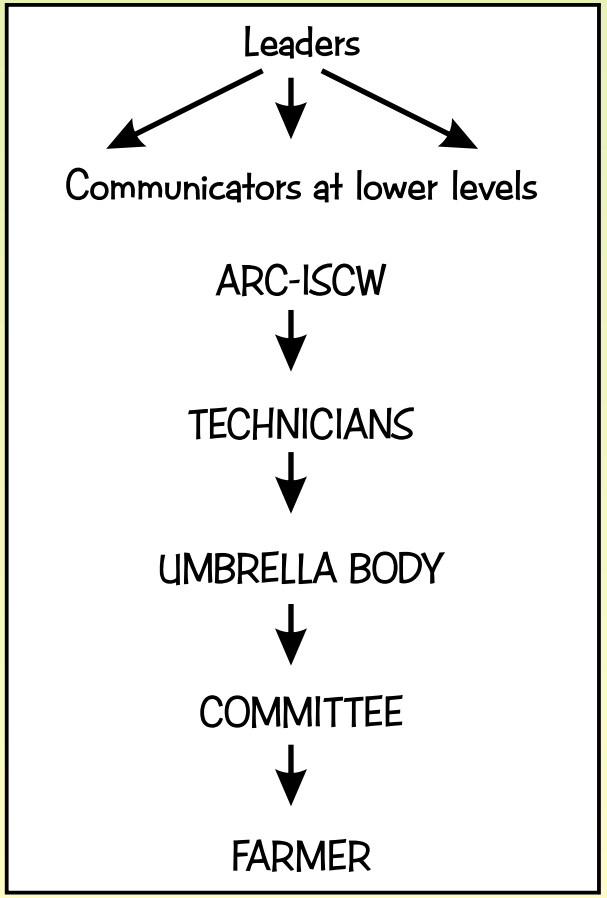
## Upward communication

Upward communication in general comes from the grassroots level to the leadership of any organisation, as shown in the diagram below:




## Downward communication

Downward communication in general comes from the leadership to the grassroots level of any organisation, as shown in the diagram below:



# TYPES OF COMMUNICATION (CONTINUED)

## Horizontal communication

Horizontal communication in general comes from one leader to another within an organisation. An example of horizontal communication is as follows:

| | | |
|---|---|---|
| Person 1 ⟷ | Person 2 at the same level | |
| Cobus ⟷ | Kobus ⟷ | Frans |
| Technician ⟷ | Technician ⟷ | Technician |
| MB: WHIG ⟷ | CB: WHIG ⟷ | ARC-ISCW |
| Chairperson ⟷ | Chairperson ⟷ | Chairperson |
| Farmer ⟷ | Farmer ⟷ | Farmer |

# COMMUNICATION BARRIERS

These are obstacles that distort or block effective communication

## Differences in perceptions

We all see and view things differently, and this could cause a major communication barrier

**Cultural differences:** belief in one's own culture often results in reluctance to try something new

## Stereotyping

When a previous mindset about the source of the message prevents us from accurately receiving it

**False promises or lip service:** when an individual or a group of people promise something, they should make sure they deliver

# HOW TO IMPROVE COMMUNICATION (EXTENSION/FARMERS)

- Spend more time and energy in getting the message across and have greater contact with farmers/extension
- Consider each other's needs and recommend technology which both parties can use in their own environment
- Plan the right mix of communication channels and technology to reach different target groups
- Work through local formal and informal leaders to relay messages
- Have high credibility with the farming communities you serve
- Aim to enhance independent decision-making and action by individual farmers, groups and local organisations

# CONSTRUCTIVE AND DESTRUCTIVE CONFLICTS

Conflict can destroy relationships or it can strengthen and enhance them. Since we tend to regard conflict as negative, the first step towards constructive conflict is to recognize both negative and positive aspects

## Destructive conflict

Occurs when it means no decision or no new behaviour or decision results and problem remains. Destructive conflict

- diverts energy from important tasks and issues,
- produces barriers to co-operation, understanding and action,
- decreases productivity,
- harms morale and self-esteem,
- produces irresponsible behaviour,
- prevents a healthy discussion and
- separates groups and sets up sides, "turning us-versus-them"

## Constructive conflict

Occurs when issues are open to co-operative discussions. Advantages of constructive conflicts include:

- problem solving,
- building group cohesion,
- helping individuals and groups to grow personally,
- paving the way for applying the knowledge to future conflicts,
- enhancing creativity,
- promoting a higher level of understanding and
- communication between individuals or groups

# CONFLICT RESOLUTION

Conflict appears in so many situations and in so many fields of life. Conflict is broadly defined as disagreements between and among individuals. Whenever individuals are brought together in a highly structured environment, and there is competition, the potential for conflicts exists. Conflict is in most cases a struggle over values, status, power and scarce resources. Conflict also refers to differences between individuals resulting in opposing attitudes requiring some form of intervention such as counselling or arbitration

## Sources and causes of conflict

There are a vast number of sources of conflict. **The most common are the following:**

- **Competition for limited resources**
  Such as personnel, positions of responsibility, space, tools and equipment
- **Conflict at work**
  - Timekeeping
  - Absenteeism
  - Refusing to obey instructions and challenging supervisor's authority
- **Goal differences**
  As a result of differentiation and specialisation, people in organisations sometimes strive to achieve opposing goals
- **Structural relations and interdependency**
  The formal organisation with its vertical and horizontal structures, policies, rules, regulations and procedures offers strong potential for conflict. Interdependence between departments also offers strong potential for conflict, especially in cases where one department is dependent on another for reaching its goals
- **Poor communication**
  Communication is the way people make contact. Lack of communication is one of the most common contributors to conflict

# BASIC GUIDELINES FOR HANDLING CONFLICT SITUATIONS

- Calm the person/situation down. Ask him/her to sit. Say: "I can see that you are upset. Tell me about it"
- Listen to the problem. Do not interrupt while the person is telling you about the problem
- Listen to both sides. Do not take a position unless you have heard all sides to a story
- Repeat the problem in your own words
- Select the correct approach
- Identify the type of conflict and the cause to establish the right approach
- Consider the type of person involved
- Demonstrate controlled behaviour
- Stay calm. Aggression can increase conflict
- Ask the person for possible solutions
- Doing this will require them to co-operate and will ensure that problems will surface earlier
- Make your own proposal to solve the problem. The person will feel that you are interested in them and their problems
- If necessary, make use of the formal structures of the organisation such as the Disciplinary Code and Grievance Procedure. These procedures are absolutely the last resort

# FUNCTIONS AND ROLES OF COMMITTEES

## A committee can be defined as:

a] A formal working group within a larger organisation, often formed by election, having authority or legitimacy of some specific kind. A committee is not a team, but there may be a limited number of distinct roles, such as chair, secretary, treasurer and so forth, which contribute towards ensuring that an effective group may be formed. A committee is small enough to ensure that informal discussion is possible without recourse to formal meeting procedure

b] A group of persons, usually appointed by a larger group or legislative body to define and/or carry out a purpose or respond to an issue; it can also be a group of one or more persons who are appointed or elected to carry out a charge. The charge can be to investigate, to recommend, or to take action or a select group of members with a defined scope of responsibility

## What is a group or a team?

**A group can be defined as**: Two or more people who share certain values and whose social roles are interrelated. A group in the broad sense is a collection of people belonging to an institution, ideology or race. A group in the narrower sense comprises people who interact directly

**A team can be identified as**: A group of people who have a specific purpose, have clearly defined and shared objectives, are organised, have a fixed number of members and share a common strategy, act inter-dependently, understand, analyse and improve their procedures

# WHAT STEPS TO TAKE TO IMPLEMENT THE IRWH TECHNIQUE

1. Contact the ARC-ISCW Research Group at Glen
Tel: 051-861 1149, Fax: 051-861 1027

Cobus Botha | Nhlonipho Nhlabatsi | Jacobus Anderson | Frans Joseph

Thomas Mandries | David Thamae | Thsepo Moshounyane | Elias Sebolai | Phillip Khumisi

2. Register with or seek information from Community-Based Water Harvesting Interest Group (CB:WHIG) or Municipal-Based Water Harvesting Interest Group (MB:WHIG). These are farmers already involved with the IRWH technique in and around Thaba Nchu [Free State Province] and Alice [Eastern Cape Province]