REPORT: FARMER COMMUNITY OF PRACTICE WORKSHOPS IN KITUI, MACHAKOS AND MAKUENI COUNTIES IN KENYA, DECEMBER 2017

Photo: Community of practice in Mutembuku village Kalawa, Makueni County.

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World Agroforestry Centre (ICRAF)

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Introduction to the Project

The IFAD/EU-funded project titled "Restoration of degraded land for food security and poverty reduction in East Africa and the Sahel: taking successes in land restoration to scale" is working with key development partners and programs, including the Drylands Development Programme to scale land restoration activities in Kenya. Visit the project webpage here: http://www.worldagroforestry.org/project/restoration-degraded-land-food-security-and-poverty-reduction-east-africa-and-sahel-taking

The five project outputs include:

Output 1: Ingredients of success and gaps in knowledge.

Output 2: Tools for targeting up-scaling. These are simple to use tools for use by grassroots organisations that help them to select appropriate land restoration options and match options to sites and farmer circumstances within four up-scaling domains in Ethiopia, Kenya, Mali and Niger.

Output 3: Enhanced understanding about what land restoration approaches work, by how much, where and for whom.

Output 4: Tools for targeting out-scaling.

Output 5: Nested communities of practice with refined tools, methods and guidelines for taking land restoration to scale.

This report highlights the objectives and co-learning with ~400 farmers that took place in December 2017 in the three action counties: Kitui, Makueni and Machakos.

Objectives of the Workshops

The community of practice workshops (CoP) were carried out across the six project sites with two workshops per county. The exercise was facilitated by Esther Kiura from ICRAF Nairobi; and the Community Facilitators (CFs) from various project sites namely: Angelina Kavutha- Waita, Stephen Maithya- Lower Yatta, Francisca- Yatta, Silas Muthuri- Mwala, Mercy Mwema- Kalawa, Sylvester Mwendo- Mtoto Andei; and Pius Lemba- IP Caritas Kalawa.

A detailed Farmer Feedback guide was developed and used to the facilitate the CoP with farmers. The guide is available online here: http://www.worldagroforestry.org/sites/default/files/outputs/Guide%20for%20Farmer%20Community%20of%20Practice%20Workshops_IFAD%20EC%20Land%20Restoration%20Dec%202017_final.pdf

The main objectives of the CoP workshops were to:

1. To provide a format for eliciting farmers' feedback (knowledge and perceptions) on the performance of the various land restoration options in terms of what worked and what didn't work (why and how);
2. To understand what farmers were hoping to achieve with the Planned Comparisons (PCs)
3. To document the lessons learnt

4 To understand the impacts of the land restoration options on their (farmer and their household) livelihoods

5 To gather suggestions on how to improve the performance of the land restoration options, including any modifications the farmers have already implemented.

The CoP was conducted in the villages by holding meetings under trees or in lead farmers' homestead. These are the usual meeting places during farmer training. Farmers expressed that they felt at ease holding the meetings in these areas unlike in hotels. This is because they are not used to the hotel environment and so they feel out of place.

The exercise involved asking farmers questions which were divide into sections as shown below.

1. Sec A. Farmers' understanding and interpretation of aim of the PCs. This was done by individual farmers by writing down answers to questions asked and sharing with the group.
2. Sec B. Farmers evaluation of the various land restoration options. This was done through group discussion each group with 5-7 members.
3. Sec C. Impacts of the land restoration options on farmers' livelihoods. Done through group discussion.
4. Sec D. Needs assessment. Done in plenary, open to all farmers to give out their views.

Attendance of the Workshops

Three-hundred and sixty-eight farmers participated in the Community of Practice (CoP) workshops in December 2017. The graph below shows that there was more female than male turn-up across all the counties. Males (21.7%), females (78.3%). This is because according to customs females (mostly women) are supposed to be home makers with responsibility of taking care of kinds, farming and general household responsibilities. They are directly involved in farming mostly providing labor together with children.

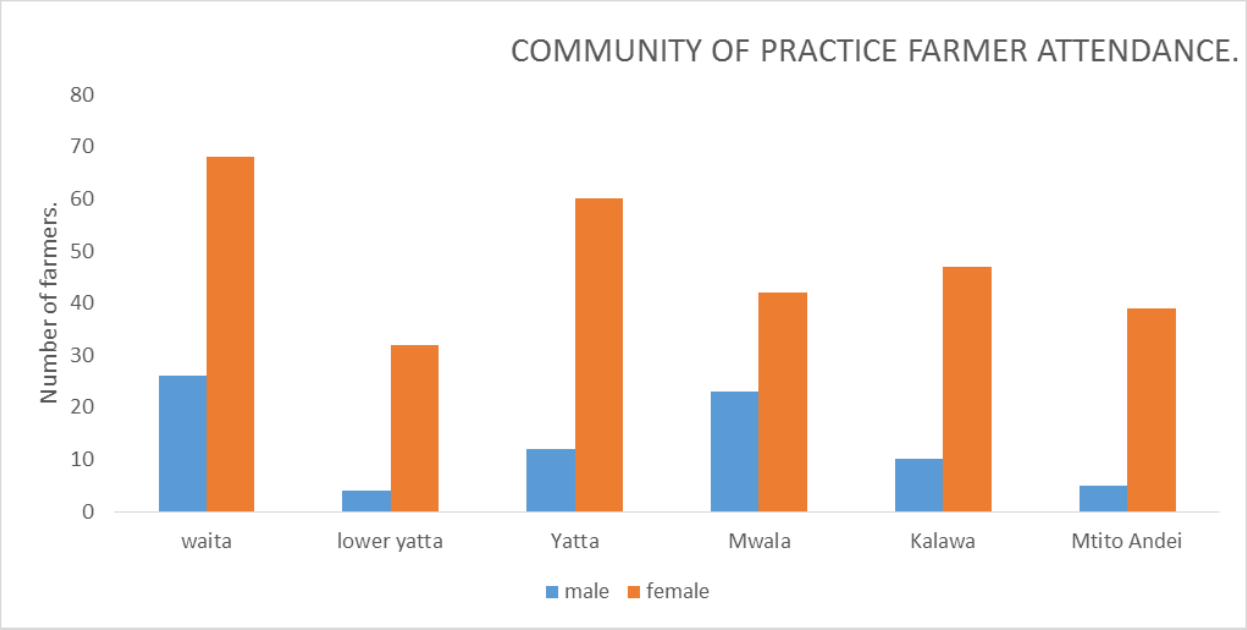

Figure 1: Attendance of the community of practice workshop by sub-county and gender.

On the other hand, men are the providers and majority are in town doing either in formal employment or as casual laborers. As a result, they are involved in decision making and not necessarily the actual farming.

Figure 2:CoP with all female farmers in Nguumo village Yatta, Machakos County.

Table 1: Village names and subcounty, county location.

Village	Sub county	County	Male	Female	Total
Syotuvali	Kalawa	Makueni	3	10	13
Mutembuku	Kalawa	Makueni	7	37	44
Changamwe	Mtito andei	Makueni	0	10	10
Nzambani	Mtito andei	Makueni	5	29	34
Kaunguni	Waita	Kitui	13	46	59
Kalulini	Waita	Kitui	13	22	35
Matiliku	Lower yatta	Kitui	3	15	18
Kithethesyo	Lower yatta	Kitui	1	17	18
Nguumo	Yatta	Machakos	0	28	28
Ulaani	Yatta	Machakos	12	32	44
Kitie	Mwala	Machakos	13	20	33
Malumani	Mwala	Machakos	10	22	32
TOTAL			80	288	368

Farmers' Understanding and Interpretation of the Planned Comparisons (PCs)

The PC activities farmers are involved in include tree planting and planting basins. Each farmer farmer agreed to be part of the PCs for various reasons. These reasons can be categorized into: 1) Knowledge acquisition; 2) Economic gain; 3) Environmental concerns. Specific responses from farmers under the knowledge acquisition category include (the number of stars indicate it was repeated across the sites):

- *To be trained on tree planting and management******
- *To get practical skills how to dig and plant maize in the planting basins****
- *To get knowledge of new farming methods and improve productivity*****
- *To be trained on the different methods of controlling soil erosion*****
- *To add more knowledge in agriculture*
- *To be trained on the best seed variety and crop species which are well adapted to the area*
- *To know trained on how to use the medicinal trees to make local pesticides for controlling pests and diseases*
- *To plant trees so as to get shade and make my homestead look beautiful****
- *To be trained on both on-farm and off-farm water harvesting technique*

Specific responses under the category Economic Gain include:

- *Some farmers hoped to get enough harvest, to sell surplus and get money.*
- *Sell plant products and byproducts such as fruits and timber to get income*
- *Get enough farm produce for household consumption.*

Specific responses under the category Environmental Concerns include:

- *Plant trees for shade in the homestead as trees make a place look good and will provide shade.*
- *To convert our denuded lands into productive ones.*
- *Plant more trees so as to prevent our land becoming more like a desert.*
- *Most of the areas looks like deserts and farmers wanted to know how to convert them into productive lands.*

Most farmers were involved in both planting basins and tree planting. Although a portion of them were involved in tree planting only. This is because it is not labour intensive and requires less time to dig the planting holes and actual planting.

Expectations of the Farmers

Table 2 summarizes the expectations of the farmers.

- Farmers are expecting get more yields from planting basin**
- To control soil erosion in my farm and this has been achieved as planting basins reduce speed and collect run off.
- To get some fruits in about 4 years to come this is because trees take some time to grow and mature. ***
- To get shade from trees in homestead and some farmers have achieved this as some neem trees are big enough to provide shade. ***
- To reduce hunger and poverty in our area and this has partly been achieved by some farmers who got had harvest in their planting basins.

Were the farmer expectation met

Yes,

- Last season some farmers harvested enough maize for their family consumption from the planting basins**
- Farmers were provided with tree seedlings last season some survived and they are still growing****
- Farmers are able to control soil erosion in their farm because planting basins collects run off*
- Farmers have been trained and equipped with knowledge on the right farming practices and this has helped them increase their farm productivity. **

No,

- Some farmers planted late and the rains were short and so maize dried and did not harvest anything
- The trees were attacked by termites and others dried because of lack of rains**
- There was severe attack of maize by army worms and only stovers were left***

Table 2: Expected benefits as perceived by the farmers.

EXPECTED BENEFITS FROM INVOLVEMENT IN THE PCS	**Kalawa**	**Mtito Andei**	**Yatta**	**Lower Yatta**	**Mwala**	**Waita**
To be trained on trees planting and management******	+	+	+	+	+	+
To get practical skills how to dig and plant maize in the planting basins***	+	+	+	+	+	+
To get knowledge of new farming methods and improve productivity******	+	_	+	+	+	+
To be trained on the different methods of controlling soil erosion******						
To add more knowledge in agriculture	+	+	+	+	+	+
To be trained on the best seed variety and crop species which are well adapted to the area.	+	+	+	+	+	+
To know trained on how to use the medicinal trees to make local pesticides for controlling pests and diseases	_	-	+	+	+	_
To plant trees so as to get shade and make their homestead look beautiful, get fruits and timber***	+	+	+	+	+	+
To be trained on both onfarm and offfarm water harvesting techniques.	+	+	+	+	+	+

Farmers' Adoption of the Land Restoration Options

Annex II describes the various land restoration options and the associated benefits.

Example of the Different Size Planting Basins:

- 1by1 planting basin- few farmers have adopted it. This is because it is small, labor intensive when making, has a low plant population hence low yields. Farmers are not willing to continue adopting it.
- 2by2 planting basin- this is the most adopted to farmers because it is easy to dig and apply manure, has a good plant population and gives maximum yields. Weeding is also easy.

- 3by3 planting basin- it is easy to dig and apply manure, has the best plant population and gives maximum yields. It was less adopted because training was done late hence no time for digging.

Advantages of Land Restoration Options

Example: Performance of the planting basins compared to farmer feedback

- ✓ The PCs performance were much better because of high yields even in shorter rains
- ✓ Crops planted in planting basins made maximum use of available nutrients and water
- ✓ There is maximum use of land and seeds using PCs
- ✓ It easy to weed and control pest and diseases through PCs
- ✓ Easy to water in case of short rains
- ✓ Helps in soil and water conservation
- ✓ Trees and crops grow and mature faster compared to those planted using farmers' method
- ✓ Planting Basins retain more soil moisture
- ✓ No wastage of seeds
- ✓ Maximum use of nutrients and available soil moisture
- ✓ It possible to determine plant population

Challenges Faced in Adoption of the Land Restoration Options

- ✓ It tiresome and time consuming to dig planting basins and tree planting holes.
- ✓ Lack of tools for digging the holes. This was a great challenge to farmers with 1by1 planting basin
- ✓ Pest and diseases especially armyworms and termites. This was the most reported cutting across all the sites
- ✓ Late delivery of seedlings
- ✓ Little rains were experienced and some crops dried up without producing.
- ✓ Rocky areas hence difficult to adopt pcs. This was common in lower Yatta and upper part of Mtito Andei
- ✓ Lack of good quality seeds for planting for November 2017 season. Seeds were only provided in Mwala, Machakos County
- ✓ Some pc activities were confusing to farmers and some did not understand well (especially number of seeds to plant per hole)

Modifications of the Land Restoration Options by the Farmers

- ✓ Some farmers mixed sand and manure when planting trees to reduce termites attack
- ✓ Planting melia trees using their normal methods to prevent rotting caused by excess water in the planting holes

- ✓ Applying cow dung on the trees to prevent goats from damaging the trees. This was common in Lower Yatta.
- ✓ Use of ash to control termites, mixing ash and water then spraying it to maize.
- ✓ Sprayed chemical pesticides to control worms. This was based on the financial status of the farmer and only a few farmers could afford.
- ✓ Mixed omo (washing detergent) with water to control worms. This was common in Mutembuku and Syotuvali villages.
- ✓ Using poultry manure in planting.
- ✓ Fencing the trees using locally available materials e.g. cement sacks.
- ✓ Mixed tobacco and water and sprayed the maize. This was in Kalawa.

These modifications were through their own observations and experience in farming over the years.

Figure 3: Group work during the Kitui community of practice.

Lessons Learned from the Planned Comparisons (PCs)

1. 1by1 planting basin is of no help to the farmers because it is tiresome and difficult to dig and apply manure and has a low plant population.
2. Holes without manure have very low production and plants seems to have a slow growth rate compared to those planted in the planting basins.
3. There is need to be holding training early so that farmers can have time to make planting basin and holes.
4. Seedlings and seeds should be delivered before rains as at times they came late.

5. Farmers should be provided with more fruit trees especially mango because it performance is good compared to other trees.
6. Farmers want to engage in other activities apart from planting basins and tree planting.
7. 3by3 planting basins is the best. It easy to dig, has more plants and gives high yields when compared to other pits.
8. Farmers should be often called for seminars and not only lead farmers.
9. Farmers should use their normal farmer method to plant melia tree.
10. Use of manure lead to high yields
11. Planting basins retains moistures more a long time hence more yields
12. They learnt different categories of trees that is fruits, timber and medicinal

Impacts of the Land Restoration Options on the Farmers' Livelihoods

1. Behaviors change- farmers' perception towards agriculture where farmers are getting more involved in the farming practices with increase in the number of planting basins each farmer has. Farmers also not depending to be provided with seeds and also purchasing more tree seedlings.
2. Farmers coming together as groups something which was not common before, train each other and share knowledge and experience.
3. Household participation in farming where men are being involved in decision making and children involved directly in making planting basins and digging tree planting holes. Women were the only participant in farming before.
4. Social economic- there was some harvest from planting basins enough for household consumption. This has reduced hunger and poverty levels among the famers.
5. Save in time and cost of farming. Labor for PC activities are most done by women and children. This saves money which could be used in hired labor. Time is not wasted Looking for ox plough (used as alternative source of labor as the basins and tree planting holes are prepared before rains.
6. Farmers who planted in planting basins harvested some maize for household consumption hence reducing poverty levels.
7. Farmers' perception on farming has changed. They used to believe that the bigger the portion of land the more the yields and this is necessarily not the case.

Figure 4: Farmers recording their continued needs (left) and the plenary feedback session (right) in, Machakos, Kenya.

Needs Assessment

- Farmers require additional skills
- Training on nursery establishment and management. This will help prevent damage caused during transportation of seedlings as in most cases they are not purchased within the project site
- Tree management especially grafting. Most mango seedlings provided were ungrafted.
- Manure decomposition. Some farmers don't have enough manure for use
- Value addition of agricultural produce especially mangoes
- Marketing and market linkages
- Production of horticulture goods especially tomatoes and water melons.
- Financial literacy especially table banking
- Poultry keeping and management
- Tree nursery establishment and management (seed preparation for melia)
- Rain water harvesting both on farm and off farm natural methods
- How to use medicinal plants to control pests
- Taking terraces gradient
- Bee keeping and management
- Agribusiness.
- Grafting of mangoes
- Marketing and warehouse management. This is mostly for cereal crops such as cowpeas and green grams
- Post harvest pest control

- Horticulture farming especially watermelons
- Type and crop varieties suitable to the area

Other support needed:

- Provide farmers with farming tools and equipment
- Storage/ hermetic bags
- Fencing materials
- Farm ponds and dam liners. Some farmers have dug the farm ponds but they cannot afford to purchase a liner
- Water tanks and water harvesting materials
- Pesticides and planting seeds
- Market and financial linkages
- Additional seedlings especially fruit trees, mango
- Sand dam construction, this is across all the sites because of water scarcity
- Cereals sorting machines

Things farmers will do differently going forward

- Farmers will dig more planting basins. This has key evidence in Kalawa where farmers have registered more basins in the November season compared to the previous season.
- Purchase their own seedlings and not waiting for the project to buy for them.
- Train other farmers and encourage new farmers to join the project, there were new farmers who joined the programme in the Nov season after they learned from other members.
- Planting early before the rains as farmers have enough time to prepare the planting basins.

Suggestions for the Project Going Forward

- Training should be done early probably before September so as to give farmers enough time to prepare the planting basins
- Farmers to be taken for exchange visit in other places for learning and to get new experience.
- Use of mulch is promoting termites. There is need to train farmers on proper application of mulch.
- Some farmers suggested for (tomoko) custard apple trees in Nzambani, Mtito Andei.
- The farmers were so happy for the engagement and giving them time to give their views and thoughts. Am also grateful for the support given to me by everyone.

Key Observations from Conducting the Community of Practice Workshop

1. Farmer meetings should be done within their locality and not in hotels. Farmers feel more accommodated and share their experience with ease. This is also cost effective.
2. Farmers' contribution and participation is best when farmers discuss together as a group and not individual. This is because of different literacy levels and also language barrier. Farmers are at ease when using their native languages.

Figure 5:Farmers during group discussion in Waita, Kitui county.

ANNEX I: KEY HIGHLIGHTS FROM THE COMMUNITY OF PRACRICE AT VILLAGE LEVEL

From the previous report on community of practice I gave a general report on the exercise from all the sites but there were a few things that were specific to particular villages which are presented below.

1. Syotuvali village, Kalawa in Makueni county.
   The village is located near the site for construction of Thwake dam. Some farmers who are part of the project have been forced to migrate and so they are not part of the PC activities as majority have not yet settled.
   This is also the reason for the low turn-up during the community of practice. Pius Lemba from Caritas and Ake Mamo were present.

   2. Mutembuku village, Kalawa in Makueni county.
   There is severe attack of maize by armyworms and farmers are trying so many methods to control it e.g. spraying the maize using omo (detergent), using powder from battery cells, using ash.
   A number of farmers have many planting basin compared to other places some with more sthan a thousand basins. This is because planting basin were introduced to them by World vision some years back. This gave them the concept that planting basin are good and they are embracing it. We were delighted to be joined by Pius lemba from Caritas and Ake mamo.

2. Ulaani village, yatta in Machakos county.
   The village has an earth dam where they get water for the trees when there are no rains. They requested for assistance to have the dam done again because of siltation and so the dam can only hold very little water.

   Nguumoni village, yatta in Machakos county. Only women turned up as they are the majority. They suggested for more fruit trees because medicinal and timber trees are not doing well.

   Kitie and Malumani villages, Mwala Machakos County. The farmers suggested they would like to be trained on how to grow horticulture crops preferably watermelon and tomatoes. This is because the soils are good and the market is available.

3. Matiliku village, lower yatta in Kitui County. Most parts are rocky and this why most farmers have few planting basins. Lack of tools for digging planting basins and tree planting holes is the greatest challenge. Termite attack is very common especially to melia trees. Rains were late but farmers are still trying to adopt the PC activities.

4. Nzambani village, Mtito andei Makueni County. The farmers have their own tree nurseries where some trees were purchased. They suggested for more training on nursery establishment and management especially for Melia trees. Farmers are much interested in bee keeping. They

have come up with a technique of joining two 3*3 planting basins to form a 6*6 kind of a basin which they feel is good.

5. Kaunguni, Kalulini village, Waita Kitui County. Rains were received very early, training and distribution of seeds was done timely. Farmers have adopted the PC activities and this resulted to the good turn-up. Farmers suggested that each should be given number of trees they are ready to take care of. Farmers suggested for assistance for setting up a earth dam and provided materials for fencing the trees.

Some general issues raised from all the villages were.

1. Farmers to be issued with ungrafted mangoes then they be trained on how to graft.
2. Farmers prefer more of fruit trees.
3. Army worms have attacked maize in all the sites.
4. Water is a problem in all the sites and farmers requested to be trained more on water harvesting technique.
5. Application of mulch seemed not to be clear to almost all farmers because majority mixed it with soil when planting and not for covering the soil.
6. Farmers suggested for the community of practice to be done periodically and to have exchange visits.

ANNEX II: DESCRIPTION OF THE PLANTING BASIN AND TREE PLANTING PLANNED COMPARISON OPTIONS AND ASSOCIATED PERFORMANCE AS DESCRIBED BY FARMERS

Table 3: Tree planting options and associated performance.

TREATMENTS	***Survival rate***	***Growth rate***	***Pest resistance***	***Soil water moisture content***	***Planting niches***
45cm diameter by 45cm depth- With manure	Lower survival rate compared to the 75cm for other species except Melia since it does not tolerate too much water	Lower growth rate of trees compared to the 75 cm basin; but higher growth rate with manure application	All trees except neem were attacked by termites irrespective of the treatment	Lower soil water moisture content retention due to smaller surface area compared to the 75cm basin. The farmers did not differentiate between manure use	The treatment had no influence on the planting niche. Most farmers prefer planting shade trees in the homestead; fruits planted in the cropland but near the homestead for easy and regular management. Slow growing trees planted in cropland, while trees that require regular attention are planted near homestead
45cm diameter by 45cm depth- Without manure	Lower survival rate compared to the 75cm for other species except Melia since it does not tolerate too much water	Lower growth rate of trees compared to the 75 cm basin. Lower compared to basins with manure	All trees except neem were attacked by termites irrespective of the treatment	Lower soil water moisture content retention due to smaller surface area. The farmers did not differentiate between manure use	The treatment had no influence on the planting niche. Most farmers prefer planting shade trees in the homestead; fruits planted in the cropland but near the homestead for easy and regular management. Slow growing trees planted in cropland, while trees that require

					regular attention are planted near homestead
75 cm diameter by 45cm depth- With manure	Higher survival rate due to bigger basins surface hence higher water retention	Higher growth rate compared to 45cm basins; higher growth rate with manure application	All trees except neem were attacked by termites irrespective of the treatment	Higher soil moisture content compared to the 45cm basin due to the larger surface area. Farmers did not differentiate between those with or without manure	The treatment had no influence on the planting niche. Most farmers prefer planting shade trees in the homestead; fruits planted in the cropland but near the homestead for easy and regular management. Slow growing trees planted in cropland, while trees that require regular attention are planted near homestead

75 cm diameter by 45cm depth- Without manure	Higher survival rate due to bigger basins surface hence higher water retention	Higher growth rate compared to 45cm basins; lower growth rate without manure application	All trees except neem were attacked by termites irrespective of the treatment	Higher soil moisture content compared to the 45cm basin due to the larger surface area. Farmers did not differentiate between those with or without manure	The treatment had no influence on the planting niche. Most farmers prefer planting shade trees in the homestead; fruits planted in the cropland but near the homestead for easy and regular management. Slow growing trees planted in cropland, while trees that require regular attention are planted near homestead

Table 4: Planting basin options and associated performance.

TREATMENTS (SIZE OR USE OF MANURE)	***Labour***	***Time spent***	***Yields***	***Plant population and seed number determination***	***Soil moisture content retention rate***	***Soil erosion control rate***	***Field preparation timing***	***Weed control***	***Tools and equipment***	***Land utilization***
1 by 1 (30 by 30 by 45cm)- With Manure	labour intensive during initial digging due to small surface area compared to the 2x2 and 3x3. It is the most costly of the 3	Takes most time than the other options during initial digging compared to subsequent	Low yields due to low amount of water harvested and small spacing between the maize.	Easy to determine the number of seeds planted depending on the number of planting basins	Lowest due to smaller surface area for harvested water. Relatively higher than without manure	Lowest surface run-off interception due to smaller basin surface area. Relatively higher than	Farmers dig the basins on time -during the dry period	Easy to weed crops from a localized location than when scattered	Require specialized tools which are not readily available and affordable	Optimal land utilization- planned spacing and farmers plant other crops in between the basins

	options. Relatively more labour mixing manure	planting seasons.	Relatively higher than without manure			without manure				
1 by 1 (30 by 30 by 45cm)- Without Manure	labour intensive during initial digging due to small surface area compared to the 2x2 and 3x3. It is the most costly of the 3 options.	Takes most time than the other options during initial digging compared to subsequent planting seasons. Takes Relatively more time mixing manure	Low yields due to low amount of water harvested and small spacing between the maize	Easy to determine the number of plants depending on the number of planting basins	Lowest due to smaller surfce area for harvested water.	Lowest surface run-off interception due to smaller basin surface area.	Farmers dig the basins on time -during the dry period	Easy to weed crops from a localized location than when scattered	Require specialized tools which are not readily available and affordable	Optimal land utilization- planned spacing and farmers plant other crops in between the basins
2 by 2 (60 by 60 by 45 cm) - With Manure	Less labour intensive during initial digging compared to 1 by 1 due to bigger surface area being dug. Relatively more labour mixing manure	Takes less time than the 1x1 option during initial digging compared to subsequent planting seasons. Takes Relatively more time mixing manure	Higher yield compared to 1x1 due to higher water retention, more seeds per hole and higher spacing. Higher than without manure	Easy to determine the number of plants depending on the number of planting basins	Higher moisture content compared to 1x1 due to a higher surface area of harvested water. Relatively higher than without manure	Higher surface run-off interception compared to 1x1 due to a bigger basin surface area. Relatively higher than without manure	Farmers dig the basins on time -during the dry period	Easy to weed crops from a localized location than when scattered	Require specialized tools which are not readily available and affordable	Optimal land utilization- planned spacing and farmers plant other crops in between the basins
2 by 2 (60 by 60 by 45 cm)- Without Manure	Less labour intensive during initial digging compared to 1 by 1 due to bigger	Takes less time than the 1x1 option during initial digging	Higher yield compared to 1x1 due to higher water	Easy to determine the number of plants depending on the number of planting basins	Higher moisture content compared to 1x1 due to a higher surface	Higher surface run-off interception compared to 1x1 due to a bigger	Farmers dig the basins on time -during the dry period	Easy to weed crops from a localized location than	Require specialized tools which are not readily available and affordable	Optimal land utilization- planned spacing and farmers plant other

	surface area being dug.	compared to subsequent planting seasons.	retention, more seeds per hole and higher spacing.		area of harvested water.	basin surface area.		when scattered		crops in between the basins
3 by 3 (90 by 90 by 45cm)- With Manure	Less labour intensive during initial digging compared to 1 by 1 and 2 by 2 due to bigger surface area being dug, easiest to dig. Relatively more labour mixing manure	Takes the least time compared to other options. Takes Relatively more time mixing manure	Higher yield compared to 2x2 due to higher water retention, more seeds per hole and higher spacing. Higher than without manure	Easy to determine the number of plants depending on the number of planting basins	Higher moisture content compared to 2x2 due to a higher surface area of harvested water. Relatively higher than without manure	Higher surface run-off interception compared to 2x2 due to a a bigger basin surface area. Relatively higher than without manure	Farmers dig the basins on time -during the dry period	Easy to weed crops from a localized location than when scattered	Require specialized tools which are not readily available and affordable	Optimal land utilization- planned spacing and farmers plant other crops in between the basins
3 by 3 (90 by 90 by 45cm)- Without Manure	Less labour intensive during initial digging compared to 1 by 1 and 2 by 2 due to bigger surface area being dug, easiest to dig	Takes the least time compared to other options.	Higher yield compared to 2x2 due to higher water retention, more seeds per hole and higher spacing.	Easy to determine the number of plants depending on the number of planting basins	Higher moisture content compared to 2x2 due to a higher surface area of harvested water.	Higher surface run-off interception compared to 2x2 due to a a bigger basin surface area.	Farmers dig the basins on time -during the dry period	Easy to weed crops from a localized location than when scattered	Require specialized tools which are not readily available and affordable	Optimal land utilization- planned spacing and farmers plant other crops in between the basins
Farmer practice	Labour intensive both during initial ploughing and maintenance	Time spent depends on labour source being used- either if using ox-plough or human labour.	Low yield due to low soil moisture retention, less optimal use of manure	Not easy to determine the plant population	Low moisture retention	Highest surface run-off due to lack of interception channels	Farmers depend on ox-plough and wait till last minute to finalize land preparation	Difficult to control weeds due to the expansive and scattered nature of crops planted	Use locally available tools including ox-plough	No optimal land use and no specific spacing