MANYAMULA DEEP BED FARMING PROJECT

PROMOTING SUSTAINABLE FARMING METHODS IN MALAWI

IMPACT EVALUATION SURVEY

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LIST OF ACRONYMS

ADD	Agricultural Development Division
AEDC	Agriculture Extension Development Coordinator
DBF	Deep Bed Farming
EPA	Extension Program Area
FGD	Focus Group Discussion
HA	Hectare
HH	Household
KII	Key Informant Interview
MoAIWRD	Ministry of Agriculture, Irrigation and Water Resource Development
MWK	Malawi Kwacha

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ACKNOWLEDGEMENTS

Kabash Consultants would like to express its gratitude to all stakeholders that participated in the Impact Evaluation Survey of the Deep Bed Farming implemented by the Tiyeni Organization in Manyamula Extension Planning Area (EPA). The consultations were held with staff from the Ministry of Agriculture in Manyamula EPA, community groups and households in selected communities within the EPA.

Kabash Consultants would also like to sincerely thank the Tiyeni Project management team, in particular, the Director, the Monitoring and Evaluation (M&E) Officer, the Field Manager and the Field Officer of DBF project for their guidance and coordination as well as their support in sourcing of information.

In a special way, Kabash Consultants would like to commend all those who participated in the household survey, key informant interviews and focus group discussions for their commitment and dedication throughout the entire period of data collection.

The views and opinions expressed in this report remain those of the author and do not represent the views of the Tiyeni Organization.

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EXECUTIVE SUMMARY

Tiyeni Organization engaged Kabash Consultants to undertake Project Impact Survey for Manyamula Deep Bed Farming (DBF) Project in Mzimba District. This Report presents the main findings of the Impact Survey in terms of the performance of the Project.

The purpose of the Impact Survey was to assess the impact made by the Project since November 2018 towards achieving the Project goal of contributing '*to transform small-scale farming through productivity and food security gains*'. The Impact Survey has outlined the change made by the project to socio-economic growth of the project beneficiaries from the time of its inception to the present; provided a comprehensive assessment on impact and sustainability of the project and provided recommendations on areas where the Project did well or did not do well.

In order to adequately address the scope of the assignment, the approaches of the Impact Survey collected both qualitative and quantitative data. Principally, the approach involved extensive review of the existing literature; key informant interviews with stakeholder at EPA level; focus group discussions with communities and a household survey. The household survey randomly sampled a total of 89 households in the Project impact areas. These approaches were also complemented by direct field observations.

The key findings of the survey have been aligned to the scope of work specifically the impact and sustainability of the project:

a) Achieved impacts

The project has improved the knowledge and skills of smallholder farmers (383) in sustainable climate smart Deep Bed method of farming; adoption of Tiyeni DBF System by smallholder farmers (2.2%), reduced food insecurity by >10% (43.5% - 58.5%), increased income (before DBF: MWK38,824; after DBF: MWK75,192). Further, the project has promoted agroforestry that some of the smallholders have grown *Tephrosia spp*. in crop fields that boost yield of crops as it has nitrogen fixation capacity. The project has improved socio-economic condition of the

project area by reducing poverty through realization of increased income from selling surplus yield. There has been an increase in the proportion of smallholder farmers practicing DBF System (>383) while there has been a decrease in smallholder farmers practicing destructive methods of farming.

b) Sustainability

The project has established well trained Lead Farmers (52.8%) in all sections who will take a role of providing guidance, train non-DBF farmers that ensures sustainability of DBF System. The project has also built the capacity of smallholder farmers with a positive adoption of DBF system in the project area that ensures continuity of DBF method. Further, the DBF sections have developed groups which also assisted the sections to come up with action plans to guide their future activities even after the project phases out. The DBF demonstration fields in the project area will also promote the adoption of the system in the project area. These initiatives will ensure sustainability of the project interventions.

c) Recommendations

The Deep Bed Farming system has successfully contributed towards improving yields to its impact area (Manyamula). The project has motivated a lot of stallholder farmers who are using the system as it produces higher yields and trained more Lead farmers for its sustainability. However, achievement is still compromised by the increased labour involved in breaking the hard pan manually using a pick-axe which affects the size of land prepared.

The study has revealed that the smallholder farmers who have been practicing DBF for between one year and three years are realizing bumper yield by using high percentage of organic manure as opposed to full use of inorganic fertilizer. Therefore this should be promoted as it has reduced the cost of production and promotes soil restoration in the field.

CHAPTER ONE: INTRODUCTION

1.1. Location of Manyamula EPA

The EPA forms part of the thirteen of Ministry of Agriculture extension planning areas in Mzimba south district under Mzuzu Agricultural Development Division (ADD). Manyamula EPA lies between 33º 20'E - 33º 35'S longitude and 11º 45'E - 12º 5' S, covering an area of 46,400 hectares of land and is about 25km from Mzimba boma. The EPA has 17,736 farming families with 25,780 hectares of arable land. Figure 1 shows the map of the project area.

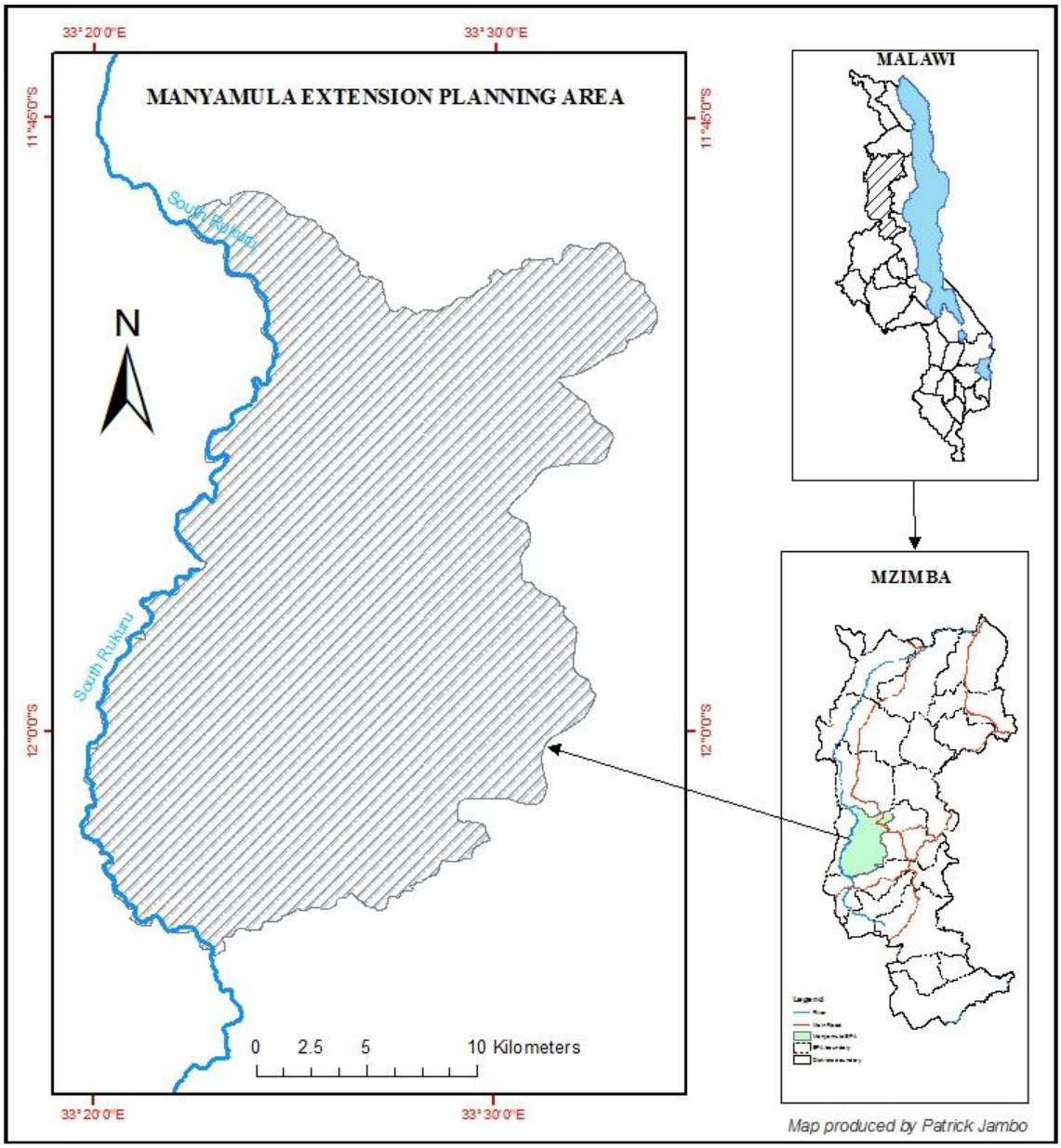

Figure 1: Location of Manyamula EPA and Districts in Malawi

The survey was administered to 89 smallholder famers from the following sections: Zuba Chulu, Tchemba, Njoka, Manyamula and Kalweya.

1.2. The Manyamula Deep Bed Farming Project

1.2.1. Background of the Project

Tiyeni Organisation is a charity and non-governmental Organisation dedicated to supporting the development of sustainable and resilient livelihoods among farmers in Malawi, through providing training and extension support in its unique deep-bed farming system. The overall goal of the Manyamula Deep Bed is '*to combating hunger and poverty of smallholder farmers by realizing surplus crop yield which are sold for income*'. The deep-bed farming system incorporates elements of 'conservation agriculture' techniques and offers an alternative to traditional agricultural practices in the region, which in recent years have been characterized by declining crop yields and food insecurity.

It was expected that by 2020, the implementation of Manyamula DBF would deliver the following major outcomes:

a) Improved farming practice by adopting Deep Bed Farming system.
b) Decreased household's food insecurity by 10%
c) Increased income of small holder famers by realizing surprise yield.

The key expected input of the project was:

a) Building the capacity for smallholder farmers for maximum productivity using sustainable climate-smart Deep Bed Farming methods and manage their surplus crop yields for maximum income and eradication of poverty.

The key expected outputs of the Project were:

a) Deep beds development by famers – arresting soil erosion and loss of water through the climate smart Deep Bed method of farming and improving infiltration and percolation.
b) Manure making by smallholder famers - rebuild soil fertility using good husbandry practices.

1.2.2. Objectives of the Survey

The aim of the survey was to assess the change made by the project towards achieving the goal of combating hunger and poverty of smallholder farmers by realizing surplus crop yield which are sold for income in Manyamula EPA through provision of capacity building in sustainable climate smart Deep Bed method of farming. Specifically, the impact survey focused on:

a) Outlining the contribution made by the Project to the socioeconomic development of the people from its inception to the present.
a) Assessing the results of the Project; and measuring the performance of the Project in light of its impact and sustainability.

1.2.3. Scope of work of the Survey

The impact survey assessed the change and sustainability of the project realized through provision of capacity building to smallholder farmers in climate-smart Deep Bed farming in Manyamula EPA. Among others, the survey has addressed the following specific tasks:

1.2.3.1. Achieved outcomes and impacts

This assessed the degree to which the outcomes and impacts were achieved and projection of the continued benefits to be realized from the interventions. In particular, the survey addressed the following key questions:

- To what extent did the project achieve its overall objectives?
- Were the needs of project beneficiaries met by the project? If not, why not?
- What, if any, social change at the community level did the Project contribute to?
- To what extent did the activities contribute to reducing food insecurity and increased income of smallholder farmers?

1.2.3.2. Sustainability

This part focused on the need to ensure that interventions of the project remain beneficial and relevant for a long time. In particular, the survey assessed the following:

- Were there sustainability plans and skills in place to ensure there is sustainability of project benefits?
- How did the community prepare to continue with the project outcomes?

- Were the community members knowledgeable and supportive to the project?
- Was there evidence of community contribution and ownership of the different project interventions?

CHAPTER TWO: METHODOLOGY

2.1. Summary of the methodology

The overall approach to the impact survey was that of mixed methods. Both qualitative and quantitative methods for data collection were employed as it was an ideal case with the current end of project impact evaluation, hence triangulates facts for credible impact evaluation results. Principally, the approach involved extensive review of the existing literature on Tiyeni Deep Bed Farming System; Key Informant Interview (KII) and Focus Group Discussions (FGDs) with smallholder farmers; a Household Survey and field observations.

The following tools were used for data collection in the study:

- A household questionnaire which was used to collect data at household level to ascertain household food security and income status (Appendix 1).
- Interview guide for FGDs with project beneficiary communities (Appendix 2).
- Checklists for KIIs with key stakeholder (Appendix3).

Operationally, the impact Survey was conducted in a participatory manner by involving a wide range of project management team, stakeholders and communities. The survey employed both quantitative and qualitative methods of data collection (Figure 2).

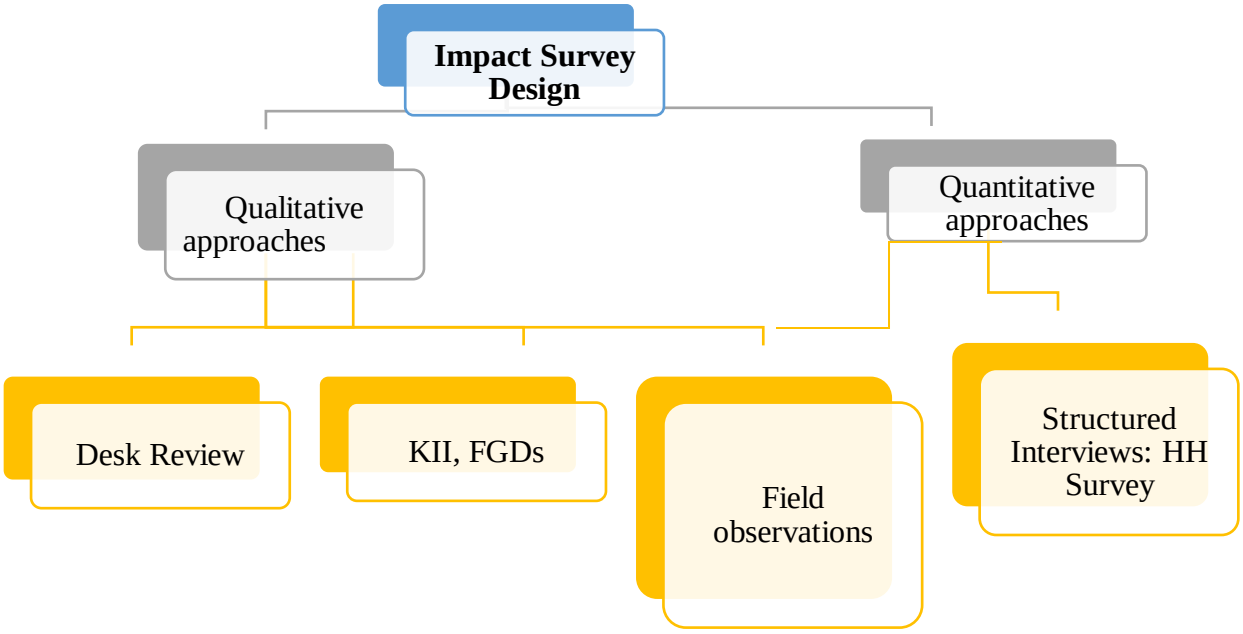

Figure 2: Summary of survey approaches

2.2. Details of the methods used

2.2.1. Literature Review

Existing reports and documents were assembled and reviewed (See Bibliography). Some of the key project reports that were reviewed were Tiyeni Annual Survey for Baseline/Impact Study Report; The Tiyeni Deep-bed System - Field Manual; Food insecurity, crop yields and Deep Bed Farming in Malawi Study report; How Many Farmers Are Retaining Deep Bed Farming? Trends and issues study report; Profitability of Deep Bed Farming (Focus Group Survey)and other relevant documents.

2.2.2. Household Survey

The impact survey included a survey of households to collect data on demographic and socio-economic characteristics; DBF knowledge, attitudes and practices; among others. The questionnaire was pre-tested before being administered to the respondents.

The total population of 383 was used in sampling and the sample size of 89 households was sampled representing 23.3% of the total population. A total of 16.9 percent of the households was sampled from residents in Zuba Chulu section; 10 percent from residents in Tchemba section; 22.5 percent from residents in Njoka section; 32.6 percent from residents in Manyamula section and 18 percent from residents in Kalweya section (Table 1).

Table 1: Sample Size for Manyamula DBF Project Impact Survey, 2021

Section	Percent	Total households sampled
Zuba Chulu Section	16.9	15
Tchemba Section	10.1	9
Njoka Section	22.5	20
Manyamula Section	32.6	29
Kalweya Section	18	16
Total survey	**100**	**89**

2.2.3. Key Informant Interviews

Key stakeholders in the project were consulted and these included officials from the Manyamula EPA and Project lead farmers to explore the various roles they played in implementation of the project, impacts and sustainability (Appendix VIII).

2.2.4. Focus Group Discussion

Focus Group Discussions (FGDs) were conducted with smallholder in Zuba Chulu, Tchemba, Njoka, Manyamula and Kalweya sections. The participants were selected carefully to ensure that they were representative of the project beneficiaries. During FGDs, issues of food security, income and DBF practice impact were highlighted.

2.2.5. Field Observations

Field observations were conducted within project area of deep bed fields, manure making points, agroforest fields, vetiver fields and other project associated features. Some of the pictures taken during the field observations are included in the report.

2.3. Data Analysis

Household data was analyzed using IBM SPSS Statistics 19. Before analysis, data was checked for outliers, missing data and subgroup sizes. Data was also checked for proportionality to ensure that the results produced are statistically representative at Section level. Qualitative data was transcribed and decoded manually, according to themes and the results were integrated in the report alongside other findings.

2.4. Limitations of the Survey

The Impact Survey identified the following limitation:

i. The survey targeted only farmers who adopted the system due to limited financial resources which led to in-depthless.

CHAPTER THREE: FINDINGS OF THE IMPACT SURVEY

3.1. Introduction

The findings of the Impact Survey that have been presented in this Chapter show the level of change made by the Tiyeni Organization in the implementation of the DBF System in Manyamula EPA. The results are organized around a set of questions on socio-demographic characteristics of the subjects, impact and sustainability.

3.2. Demographic and Socio-economic characteristics

The demographic and social-economic features of the households serve the purpose of describing the key characteristics of smallholder farmers that may have direct or indirect implications on the impact of the project interventions (Table 2). The results show the degree of gender sensitivity of the smallholder farmers with a higher involvement of female respondents in Zuba Chulu (73.3%), Tchemba (77.8%), Njoka (70%) and Manyamula (69%) sections. The study showed that 26.7%, 22.2% 30%, 31% and 56.2% were male respondents from Zuba Chulu, Tchemba, Njoka, Manyamula and Kalweya sections respectively. The study involved respondents of different age groups, mainly, 34.8%, 51.7% and 12.8% of the respondents were of less than 40 years, between 41 – 60 years and more than 60 years respectively.

The results show a higher proportion of the households engaged in farming (86.2%) as their main occupation indicating that the project area is dominated by smallholder farmers defines significant impact in smallholder farmers' lives. However, the lower proportion of households engaged in business and casual labourers (7% and 1% respectively) indicating very low opportunities for the respective occupations with insignificant impact in their lives.

In terms of monthly income earnings, the Impact Survey results in Table 2 show that about 88.8 percent of the sampled households earned less than MWK50,000 per month (an average of MWK1,667 per day) and about 10.1 percent of them earned between MWK50,000 - MWK100,000. Thus, only1.1 percent of the sampled households earned between MWK101,000 – MWK150,000 per month.

The analysis revealed that the majority of households have a greater change in their wellbeing with 60.7 percent of household with no prevalence to any disease history indicating improved health status of the households since the inception of the project. However, other households in the project area mention that they have insignificant health issues of Scabies (1.1%), Dry cough (13.5%), Malaria (20.21%) and Conjunctivitis (4.5%).

Table 2: Socio-demographic characteristics of smallholder farmers as of May 2021

Variable		**Section**				
		Zuba Chulu (%)	**Tchemba (%)**	**Njoka (%)**	**Manyamula (%)**	**Kalweya (%)**
Gender	Male	26.7	22.2	30	31	56.2
	Female	73.3	77.8	70	69	43.8
Age	Less than 40	40	22.2	35	37.9	31.2
	41 – 60	60	55.6	55	48.3	43.8
	More than 60	0	22.2	10	13.8	25
Occupation	Farming	93.3	100	75	96.6	93.8
	Business	6.7	0	25	0	6.2
	Casual labour	0	0	0	3.4	0
Monthly income	Less than MWK50,000	86.7	88.9	85	93.1	87.5
	MWK50,000-100,000	13.3	11.1	10	6.9	12.5
	MWK101,000-150,000	0	0	5	0	0
Level of education	None	40	44.4	20	41.4	12.5
	Primary	60	55.6	65	51.7	87.5
	Secondary	0	0	15	6.9	0
Marital status	Single	6.7	0	5	0	0
	Married	86.7	66.7	65	79	87
	Divorced	0	11.1	5	3.4	0
	Separated	0	11.1	5	3.4	0

	Widowed	6.7	11.1	20	13.8	12.5
Common diseases	None	66.7	55.6	50	72.4	50
	Scabies	0	11.1	0	0	0
	Dry cough	13.3	11.1	20	6.9	18.8
	Malaria	13.3	22.2	30	10	31
	Conjunctivitis	6.7	0	0	10.3	0

3.3. Impact

The Manyamula Deep Bed Farming Project had three targeted impact areas, which were

(i) reduction in household's food insecurity (10% minimum**)**
(ii) high levels of change in farming practice and
(iii) increased income of smallholder farmers from sale of crops.

3.3.1. Reduction in Household Food Insecurity (10% Minimum)

The study results indicated that

(i) the majority (77.5%) of households had more than 500 kilograms of food (harvested);
(ii) 13.5% had food within the range of 401 – 500 kilograms;
(iii) 5.6% had 301 – 400 kilograms of food and
(iv) only 3.4% of the households had less than 100 kilograms (in these cases where they have only just started using DBF system).

The analysis indicated that 71.9% of the households had food throughout the year with only 28.1% ran out of food between January and March.

The level of food security measured using Coping Strategies Index (CSI) as an indicator of household food security (Maxwell & Caldwell, 2008), indicated 68.5% of the households do not need copping strategies because they have enough food for the whole year following adoption of DBF System at the inception of the project (*the more people have to cope, the less food secure they are*). Therefore, the level of food insecurity has significantly reduced comparing to the threshold value (10% minimum) with 58.5% household food insecurity reduction. However, famers who have just started practicing the system were still using the copping strategies. Table 3 shows coping strategies which households use when they run out of food in Manyamula EPA.

Table 3: Adaptive coping behaviors in Manyamula EPA and the level of severity

Adaptive coping behavior	Count	%	Frequency of strategy			Severity category		
			Rarely (%)	Sometime (%)	Frequently (%)	Secure (%)	Mildly (%)	Moderate (%)
Borrowing food or money to buy food	9	13.5	33.3	58.3	8.3	50	50	0
Skipping meals	9	10.1	66.7	33.3	0	22.2	33.3	44.4
Skipping eating for whole days	3	3.4	33.3	66.7	0	66.7	33.3	0
Harvest immature crops	4	4.5	75	25	0	75	0	25
None	58	68.5						

In figure 3 it is clear that the severity of food insecurity following adoption of DBF in Manyamula EPA completely changed with severe food insecurity falling from 56% to 3% and full food security rising from 0% to 42%

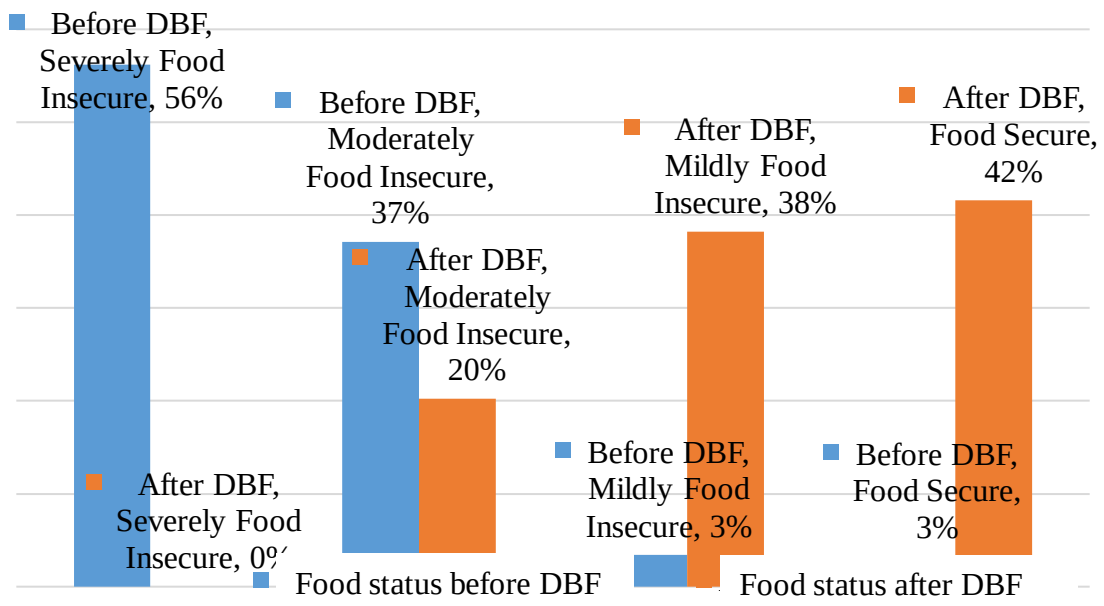

Figure 3: Household food status before and after the adoption of DBF

Further, the perceived severity of all adaptive coping behaviors captured in all FGDs conducted in Zuba Chulu, Tchemba, Njoka, Manyamula and Kalweya sections, indicated that there is a great reduction in food insecurity households. FGD participants mentioned that since the inception of DBF, there is a great impact that led to moderate food insecurity, mildly food insecurity and food secure in most of households.

'*Before the inception of DBF, most of the households were in food insecurity with harvested crop being exhausted before the end of the year. After adopting DBF, most of small holder farmers are now able to harvest a higher yield that last the whole year until the following harvest and eventually leads from moderate food insecurity, through mildly food insecurity into food secure (Tchemba section FGD)*'.

Figure 4 shows FGD conducted in Tchemba section.

Figure 4: FGD with smallholder farmers in Tchemba section

3.3.2. High Levels of Change in Farming Practice

3.3.2.1. Empowering smallholder farmers to rebuild soil fertility using good land husbandry practices.

Rebuilding soil fertility using good land husbandry practices was measured before and after introduction of DBF. Before DBF was adopted, the majority (86.5%) of smallholder farmers were applying artificial fertilizer in their fields to boost their harvest resulting in low average yield on an average of 127 kilograms on 0.104 hectare (Table 4). After adopting DBF system, the majority of smallholder farmers were applying manure mixed with only small quantity of artificial fertilizer and this has resulted in a higher yield on the same size of land (0.104 hectare) with average yield of 281 kilograms (just over double the yield realized before DBF). The use of manure mixed with a little fertilizer indicated a significant impact in building soil fertility that resulted in increased crop production.

'I have successfully harvested a bumper yield in two consecutive years once I started using DBF system and a number of people have already started approaching me to help them on how to use the system(KII: Kalweya Section Lead Farmer)'.

Table 4: Husbandry practice before and after DBF

Area (ha)	Husbandry practices	Before DBF		After DBF	
		%	Yield (kg)	%	Yield (kg)
0.104	Applying fertilizer only	86.5	127	0	281
	Applying manure only	11.2		22.5	
	Applying the mixture of fertilizer and manure	2.2		77.5	

During FGDs conducted in four sections, participants mentioned that before DBF they were achieving low yields compared to the current time as they are harvesting more yield on the same size of land used before DBF. More yields have been realized directly as a result of rebuilding soil fertility by applying manure mixed with handful fertilizer.

'*Applying manure made based on a mixture of simple materials such as grass, ash, water, virgin soil, little fertilizer to mention a few, has rebuilt soil fertility- hence realized more yield (FGD: Zuba Chulu section*)'.

3.3.2.2. Arresting soil erosion and loss of water through the climate smart Deep Bed method of farming.

The study analysis showed that there was a significant impact on empowering smallholder farmers to rebuild soil fertility using good land husbandry practices (figure 5). Before the inception of Deep Bed Farming, 65% of smallholder farmers mentioned that they were using bad farming practices which encouraged soil erosion occurrences and loss of water which resulted in loss of soil fertility that affected crop production hence realizing low yield. However, a proportion (73%) of farmers mentioned that they have observed medium reduction of soil erosion and loss of water after adopting DBF system while 27% of the farmers appreciated a higher reduction in soil erosion and loss of water that resulted in high yield.

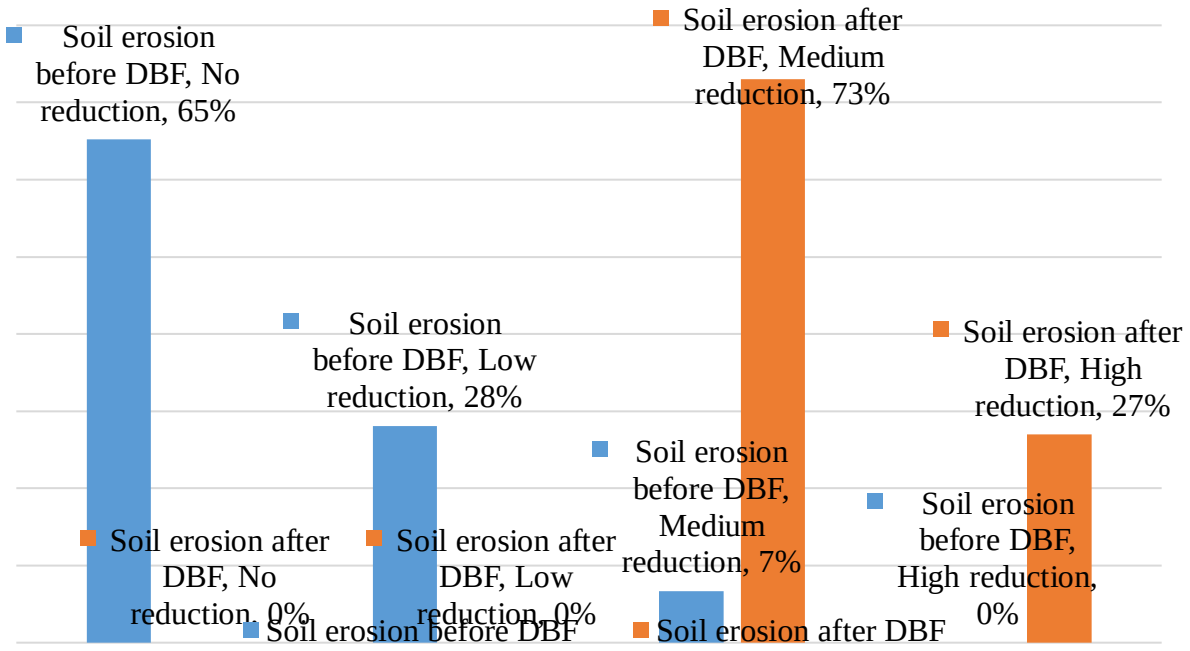

Figure 5: Level of soil erosion and loss of water before and after Tiyeni DBF

Figure 6 shows deep bed farming field already harvested with standing agroforestry trees of Tephrosia spp. in Manyamula Extension Planning Area.

Figure 6: Deep bed field with Tephrosia spp.

Smallholder farmers in Manyamula EPA mentioned their involvement in reducing the level of soil erosion and loss of water that affects crop production. The study indicated that 93.3%, 88.9%, 65%, 69% and 68.8% of smallholder farmers from Zuba Chulu, Tchemba, Njoka,

Manyamula and Kalweya sections respectively were on the stage of both contour terracing with close ridge and furrows and, deep and wide bed of the system that ensures deeper rooting depth and minimizes soil erosion as well as loss of water in crop fields and improvement of ground water retention.

3.3.2.3. Improving water infiltration and percolation.

The majority of smallholder farmers from Zuba Chulu (80%), Tchemba (78%), Njoka (50%), Manyamula (76%) and Kalweya (69%) sections were making the joint tasks of both mulching and breaking hard-pan of the DBF system that improve water infiltration and percolation. This widespread action by smallholders indicates a radical change to their farming activities. These good land husbandly practices improve water infiltration and percolation in order to enhance crop production. The results indicated that 30% and 20% of smallholder farmers were on the DBF system of breaking hard-pan and mulching respectively to improve water infiltration and percolation.

3.3.3. Increased Income for Smallholder Farmers from Sale of Crops

3.3.3.1. Building the capacity for smallholder farmers for maximum productivity using sustainable climate-smart Deep Bed farming methods.

The study showed that all participants (89) were trained by Tiyeni Organization in sustainable climate-smart Deep Bed farming methods. Farmers mentioned that they were trained in contour terracing, breaking hard-pan, deep and wide beds, mulching other farming methods. Using sustainable climate-smart Deep Bed farming methods has helped farmers to maximize productivity.

3.3.3.2. Building the capacity of smallholder farmers to manage their surplus crop yields for maximum income and eradication of poverty.

The adoption of DBF has led to surplus crop yields. The study indicated that on the average land size of 0.104 hectare, smallholder farmers have realized high crop production with surplus yield (avg: 281 kilograms) after adopting DBF which is more than double compared to the former yield on the same piece of land. Smallholder farmers tend to sell surplus yield which helps them to maximize income and reduce poverty in their homes so that their income increases from an average of MWK38,824 before adopting DBF to MWK75,192 after adopting DBF.

Figure 7 shows the average income of farmers before and after DBF System in Manyamula EPA.

Figure 7: Income trend after selling surplus yield before and after DBF System in Manyamula EPA

DBF system has surpassed other farming technologies which are practiced within the EPA, during first year of practice; Deep Bed farmers have seen a positive change in using DBF system. Because of this positive change other farmers who were reluctant to adopt this technology have shown interest to take up the technology in spite of the initial hard work of ground tilling (KII: Manyamula AEDC).

3.4. Sustainability

The impact survey revealed that there were a number of measures put in place to ensure sustainability of the DBF System in Manyamula EPA. These included the following:

- The project has established well trained Lead Farmers (52.8%) in all sections who will take a role in providing guidance, train non-DBF follow farmers that ensuring sustainability of DBF System.

- The project has also built the capacity of smallholder farmers with active participation in practicing DBF system in the project area hence ensuring continuity of DBF method. The FGD conducted with the smallholder farmers from Manyamula section confirmed as follows:

  "We are very confident that we will continue to enjoy the benefits that come with the Project because we have been trained in how we can use DBF system which gives us the ownership of knowledge and skills in implementing the farming system hence defines sustainability of the project interventions(Manyamula section FGD)".

- The DBF sections have developed groups which also assisted the sections to come up with action plans to guide their future activities even after the project phases out.
- The demonstration fields in the project area will also promote the adoption of the system by non-deep bed farmers upon looking on the fruits of using DBF System.

CHAPTER FOUR: CONCLUSIONS AND RECOMMENDATIONS

4.1. Introduction

This Chapter provides a synthesis of the key findings in order to draw conclusions on how Manyamula DBF Project changed the socio-economic status of smallholder farmers. The recommendations provide outstanding challenges that will affect the impact and sustainability of the project interventions.

4.2. Conclusions

The conclusions have been aligned to the scope of work of the impact survey to ensure that all the key areas have been adequately addressed.

4.2.1. Achieved outcomes and impacts

To a large extent, the Project has achieved its overall objective which was "combating hunger and poverty of smallholder farmers by realizing surplus crop yield which are sold for income in Manyamula EPA through provision of capacity building in sustainable climate smart Deep Bed method of farming". The Project has managed to meet the needs of smallholder farmers in terms of trained in sustainable climate smart Deep Bed method of farming (383), decreased household's food insecurity by 10% (43.5% - 58.5%), improved farming practice by adopting Deep Bed Farming system (2.2%) and increased income (before DBF: MWK38,824; after DBF: MWK75,192.) of small holder famers by realizing surprisingly high yields. The project has managed to build the capacity of smallholder farmers in sustainable climate smart Deep Bed method that farmers are able to practice in a non-destructive way environmentally, economically and socially. These sustainable land management practices include: contour terracing with closed ridge and furrows; mulching; manure making; breaking the hard-pan; zero tillage; intercropping; deep and wide beds and off-farm piggeries. This has resulted in reduced food insecurity, poverty and increased income of smallholder farmers through the realization of surplus yields.

4.3. Recommendations

The study has established the following recommendations:

i. The Deep-Bed Farming system approach has significantly contributed towards improving yields which has helped to eradicate food shortages and provide increased

household income to smallholder famers who have adopted the system. This achievement is due to Tiyeni Deep-Bed Farming project approach of working collaboratively and supporting existing agriculture extension workers within the impact area. Therefore, it is highly recommended that a good working relationship between the Tiyeni organization and existing extension agents in the impact area should continue for the benefit of the smallholder farmers.

ii. The use of organic manure as opposed to full use of artificial fertilizer should be promoted as it has proven to be the catalyst of bumper yields in smallholder fields.

iii. The survey was based on 383 population size of smallholder farmers registered in 2019. But the time the interviews were conducted there were close to 100 new farmers registered making a total of 483 farmers old and new. However, more were registering for DBF. Currently, close to 500 new farmers have registered. This has dramatically increased to 910 farmers practicing DBF. In this case, only 5.1% of farmers have been registered in DBF system in the project area. Therefore, there is a need of project continuation so that more farmers could benefit from the project as they are showing more interest.

APPENDICES

Appendix 1: Household Questionnaire

Data should be collected by interviewing knowledgeable members of households. Respondents should be informed that they were chosen through random selection and that their participation is voluntary. They are free to withdraw at any time without giving reasons and that the information obtained will be confidential.

Name of Enumerator _____ **Date**: _____

Address of respondent: District: _____

EPA : _____

TA : _____

GVH : _____

Village : _____

GPS Coordinate **X**: _____ **Y**: _____

A. HOUSEHOLD DEMOGRAPHIC DATA

Variable	**Response (Use codes)**					
Name of respondent/famer						
Sex	1=Male 2=Female					
Age of respondent	Years:					
Please give the number of people in each age category in your household.						
Age Group	Under 6 years old	7 - 18 Years old	19 - 40 Years old	41 - 60 years old	> 60 Years old	**Total**
Male						
Female						
Total						
Name of HH head						

Lead farmer	Yes ◯ No ◯
Relationship with head	1=Mother 2=Farther 3=Grandmother 4=Grandfather 5=Daughter 6=Son 7=Uncle 8=Aunt 9=Respondent
Marital status	1=Single 2=married 3=separated 4=divorced 5=widowed
Education of respondent	1=None 2=Primary 3=Secondary 4=Higher
Occupation of respondent	1=Business 2=Working 3=Farming, 4=Casual 5=Fishing, 6=Student 7=Other
Monthly income	Continuous in MK:
Tribe of respondent	1=Khonde 2=Tumbuka 3=Chewa 4=Tonga 5=Labia 6=Swahili
Health status- common disease	1=Diarrhea 2=Scabies 3=Dry cough 3=Malaria 4=Dysentery 5=Cholera 6=Conjunctivitis 7=Chronic 8=Disability 9=None

B. REDUCTION IN HOUSEHOLD'S FOOD INSECURITY (10% MINIMUM)

B1. How much food does your household have right now? First find out the quantity of each food in storage/reserve in local units e.g. bags, buckets, and bunches **(Food security)**

Type of food in store	**Local units of measurement**	**No. of units**	**Estimated weight (kg) per local unit**	**Total kilograms**
1. Maize (Whole grain)				
2. Cassava				
3. Millet				
4. Sweet potatoes				
5. Vegetables				
6. Beans				
7. Groundnuts				
8. Other foods (specify)				

B2. Does your household run out of food since the inception of Tiyeni DBF project?

Yes ◯ No ◯

B3. If yes, which months of the year your household normally run out of food (establish a range of months)

Month (s)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tick												

B4. If yes to B2, what coping mechanisms do you use when your household runs out of food (food shortages)? 4 = Never (zero times per week); 3 = rarely (once or fewer times per week); 2 = sometimes (2-5 times per week);
1 = frequently (almost every day).

Question	**Coping strategies**	**Frequency scoring**
During the period of food shortage, how did your family obtain food?	Eating foods that are less preferred	
	Limiting portion size	
	Borrowing food or money to buy food	
	Maternal buffering	
	Skipping meals	
	Skipping eating for whole days	
	Given by friends/family	
	Work in exchange for food	
	Hunt/eat wild plants	
	Harvest immature crops	
	Send HH member to eat elsewhere	
	Temporary work for money	
	Other (specify):	

B5. Does your household have any experience of increase in food security?

Yes ◯ No ◯

B6. If yes or no, what is your assessment on food status at your house during the years of Not Practicing and Practicing DBF? Use the following levels to define food insecure and food secure. **1**. Food Secure **2**. Mildly Food Insecure **3**. Moderately Food Insecure **4**. Severely Food Insecure

Not Practicing DBF			**Practicing DBF**		
2015	2016	2017	2018	2019	2020

B7. Does the adoption of the deep-bed farming system led to more household income being available?

Yes ◯ No ◯

B8. If yes, indicate household annual income (MK) before and after adopting DBF.

Not Practicing DBF			**Practicing DBF**		
2015	2016	2017	2018	2019	2020

B9. What is the current household income?

1. Very low income
2. Low income
3. Lower-middle income
4. Upper-middle/high income
5. All groups

C. HIGH LEVELS OF CHANGE IN FARMING PRACTICE

C1. Empowering smallholder farmers to rebuild soil fertility using good husbandry practices.

C1.1. Indicate whether your household used fertilizer or manure in the following growing seasons for the crops indicated in the table? **F** means Fertilizer, **M** means Manure

Crop	2017/18		2018/19		2019/20		2020/21	
Maize	F/M	Yield	F/M	Yield	F/M	Yield	F/M	Yield
Common Beans								
Ground nuts								
Other								

C1.2. Have you noticed any change in soil erosion for the following growing season? Rate change using the scale of **1**. High Reduction, **2**. Medium Reduction, **3**. Low Reduction, **4**. No Reduction

	2017/18	2018/19	2019/20	2020/21
Soil erosion				

C2. Arresting soil erosion and loss of water through the climate smart Deep Bed method of farming.

C2.1. Which Tiyeni DBF practice/s did your household use in the following growing season that arrest soil erosion and loss of water? Using the code to land management practices (LMP): 1. Contour terracing, 2. Deep and wide beds.

Crop	Area (Ha)	2017/18		2018/19		2019/20		2020/21	
Maize		LMP	Yield	LMP	Yield	LMP	Yield	LMP	Yield
Common Beans									
Ground nuts									
Other									

C3. Improving infiltration and percolation.

C3.1. Which Tiyeni DBF practice/s stages your household use in the following growing season that improved infiltration and percolation? Using the following code of Land Management Practices (LMP): 1. Breaking the 'Hard-pan', 2. Mulching (covering of organic material e.g. maize stalk) on top of the cultivated raised deep-beds).

Crop	Area (Ha)	2017/18		2018/19		2019/20		2020/21	
Maize		LMP	Yield	LMP	Yield	LMP	Yield	LMP	Yield
Common Beans									
Ground nuts									
Other									

D. INCREASED INCOME FOR SMALLHOLDER FARMERS FROM SALE OF CROPS

D1. Building the capacity for smallholder farmers for maximum productivity using sustainable climate-smart Deep Bed farming methods.

D1.1. Have you been trained in any sustainable climate-smart Deep Bed farming methods that help you to maximize production?

Yes ◯ No ◯

D1.2. If yes, who trained you?

D1.3. If yes, when was the training conducted? Use year.

D1.3. If yes which of the following areas of sustainable climate-smart Deep Bed farming methods were you trained?

No.	Area trained (DBF Package)	1=Yes 2=No
1	Contour terracing	

2	Breaking the hard pan	
3	Deep and wide beds	
4	Zero tillage and restricted access	
5	Mulching	
6	Composting	
7	Intercropping	
8	Off-farm piggeries	

D1.4. How much yield your household realized in the following years?

Crop		**Not Using DBF**			**Using DBF**		
		2015	2016	2017	2018	2019	2020
Maize	Area (Ha)						
	Yield (Kg)						
Cassava	Area (Ha)						
	Yield (Kg)						
Millet	Area (Ha)						
	Yield (Kg)						
Sweet potatoes	Area (Ha)						
	Yield (Kg)						
Vegetables	Area (Ha)						
	Yield (Kg)						
Beans	Area (Ha)						
	Yield (Kg)						
Groundnuts	Area (Ha)						
	Yield (Kg)						
Soya beans	Area (Ha)						
	Yield (Kg)						
Other							

E2. Building the capacity of smallholder farmers to manage their surplus crop yields for maximum income and eradication of poverty.

E2.1. What were total cost of production and total revenue realized from selling crops cultivated during the years of Not Practicing and Practicing DBF? Note: TPC means Total Production Cost (sum of Land Rent (MK), Seed, Fertilizer, Pesticide, Ganyu (MK), Transportation) and TR means Total Revenue (MK).

Crop		**Not Practicing DBF**			**Practicing DBF**		
		2015	2016	2017	2018	2019	2020
Maize	TPC						
	TR						
Cassava	TPC						
	TR						
Millet	TPC						
	TR						
Sweet potatoes	TPC						
	TR						
Vegetables	TPC						
	TR						
Beans	TPC						
	TR						
Groundnuts	TPC						
	TR						
Soya beans	TPC						
	TR						
Other							

End of questionnaire

Appendix 2: Focus Group Discussion Checklist

1. **Reduce food insecurity**

   What level of reduction in food insecurity have you realized from the farmers who are both practicing and not practicing DBF? (in %) **1**.Food Secure **2**.Mildly Food Insecure **3** Moderately Food Insecure **4** Severely Food Insecure.

2. **To empower smallholder farmers**

   2.1.Explain any change/impact in farming practice that has rebuild soil fertility using good husbandry practices in your field which arrest soil erosion through the climate smart Deep Bed method of farming?

   2.2. Tell us any change/impact in this farming practice that has rebuild soil fertility and arrest loss of water.

3. **Increased income for farmers from sale of crops**

   3.1. Since you started practicing this type of farming, have you noticed any change/impact in income from sale of crops?

   3.2. Does the project helped you in producing surplus crop yields that maximum income and eradication of poverty?

Appendix 3: Key Informant Interview Checklist

4. **Reduce food insecurity**

   4.1.What level of reduction in food insecurity has been realized from the farmers who are both practicing and not practicing DBF? (in % **OR** 1. Food Secure 2. Mildly Food Insecure 3. Moderately Food Insecure 4. Severely Food Insecure).

5. **To empower smallholder farmers**

   5.1.Explain any change/impact in farming practice to smallholder farmers who are using good husbandry practices which arrest the loss of water? (Practicing and not practicing DBF).

6. **Increased income for farmers from sale of crops**

6.1. Do you see any change/impact in income for farmers from sale of crops as the result of capacity building for smallholder farmers that maximum productivity using sustainable climate-smart Deep Bed farming methods?

6.2. Explain any change/impact realized from building the capacity of smallholder farmers to manage their surplus crop yields for maximum income and eradication of poverty. (Mention the crop/s).