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Buulding Resilience and Adaptation to Climate Extremes and Disasters

CONSTANT GARDENERS
AN IMPACT ASSESSMENT OF PERMAGARDENS IN KARAMOJA UGANDA - A CLIMATE SMART AGRICULTURE APPROACH

BUILDING RESILIENCE TO CLIMATE EXTREMES AND DISASTERS

Final Report, October 2017

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MERCY CORPS

Acknowledgments

Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) is a three year initiative funded by the United Kingdom (UK) Department for International Development (DFID). Globally, BRACED is being delivered through 15 programmes throughout Africa and Asia designed to build the resilience capacities of vulnerable people to prepare for, cope with and recover from climate related shocks. The programme is being implemented by Mercy Corps and partners in Wajir County in Kenya and Karamoja Uganda. The content of this report is derived from an internal impact assessment of the permagarden activities being implemented under the BRACED programme in Uganda. Eunice Awor and Angela Jovani of Mercy Corps monitoring and evaluation team in Moroto carried out the field data collection. We are grateful to the BRACED Uganda team for supporting the study and a special thanks to Eric Carlberg from Mercy Corps Technical Support Unit for providing programme guidance on climate smart agriculture as well as training and technical support on the permagarden component of the programme. The study report was prepared and edited by John Burns and Elizabeth Valone both working for Mercy Corps on the BRACED programme with contributions from Eric Carlberg. Thanks also to Amy Johnson, Annalies Veldmeijer and Phelix Ouma for reviewing, editing and formatting the final report. The contents of the report do not necessarily reflect the views of DFID, the UK Government or Mercy Corps and BRACED partners.

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Acronyms and Abbreviations

BRACED	Building Resilience and Adaptation to Climate Extremes and Disasters
CI	Confidence Interval
DFID	The Department for International Development (United Kingdom)
FAO	United Nations Food and Agriculture Organisation
GBP	British Pound
GOU	Government of Uganda
IGA	Income Generating Activities
KGS	Kilograms
NRM	Natural Resource Management
PROGRESS	Programme for Resilience Systems
SPSS	Statistical Package for the Social Sciences
TOPS	Technical and Operational Performance Support (TOPS) Program
UGX	Uganda Shillings
UK	United Kingdom
UNDP	United Nations Development Programme

SUMMARY

Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) is a three year DFID funded initiative designed to build the resilience capacities of vulnerable people to prepare for, cope with and recover from climate related shocks and stresses. The Programme for Resilient Systems (PROGRESS) is a sub component of BRACED being implemented by Mercy Corps and partners in Wajir County in Kenya and in the Karamoja sub region of Uganda. PROGRESS focuses on natural resource management (NRM), financial inclusion, market linkages, governance and gender. Under the PROGRESS NRM component in Karamoja, the programme has been supporting the promotion of climate smart agriculture including Resilience Design in Smallholder Farming Systems, permagardens and sack mound gardens. These agricultural techniques are particularly well suited to semi-arid regions, like Karamoja, and incorporate the principles of agro ecology, conservation agriculture and elements of permaculture. These approaches focus on improving soil health and water and land utilisation by building the capacity of farmers to design and maintain more resilient farms (TOPS, 2017).

This report presents the results of an impact assessment of the programmes permagarden activities. The objective of the study was to assess the impact of the permagardens in terms of production, utilisation and knowledge transfers. The assessment was carried out in May 2017, roughly 3 months after the programme began establishing permagardens, and during the hunger period which runs from January to June (FAO, 2010).

The study results are encouraging as they show high uptake and application of the permagarden techniques being promoted by the programme. Study participants also found the programme's permagarden training to be useful giving it a median score of 9 out of a maximum possible score of 10. The results also show that the permagardens have provided participating households with food security, income and savings benefits that have enabled them to better cope with climate shocks and stresses. For example, the permagardens have for the first time enabled people to successfully cultivate and harvest crops throughout the year, including during the dry season.

This has allowed people to smooth consumption during the annual "hunger season", and all study participants reported that their food situation had improved as a result of the permagardens. Consistent with this, the results indicate that the permagardens were a major factor in helping individuals cope with the hunger period. The results also show that there has been an increase in the number of food types being consumed on a regular basis as a result of the gardens, with over 87% of study participants regularly consuming at least one new/additional type of food. Further to this, a proporion of the participants (25%) specifically mentioned improvements in nutrition or diet as a result of the permagardens.

The permagardens have provided households with a new source of income, giving participants the potential to earn throughout the year. The results show that this income is derived from the sale of crops from the permagardens and is being invested in farming inputs, livestock and education with potential long term resilience benefits.

At the time of the assessment, 3,685 farmers had been trained and almost 11,000 permagarden beds had been established, these being the first of their kind in the programme area. Based on observations, a number of these were being established by households who had not been involved in the training activities, but had been taught the farming techniques by programme participants[1]. A simple cost benefit analysis was undertaken using the assessment results which suggests, alongside the afforementioned observations that permagardens can have a meaningful impact on household resilience for a relatively small investment.

[1] This replication was not anticipated or directly encouraged by BRACED but may represent an untapped opportunity for future permagarden training activities

1. Introduction

1.1 Background

The Karamoja region of Uganda is characterised by high levels of poverty and food insecurity with some of the lowest human development indicators and the highest poverty indicators in the country (UNDP, 2007). Food insecurity has been attributed to low, unreliable or unpredictable rainfall distribution, and low soil fertility (GOU, 2010). Drought represents by far the biggest threat to crop production often resulting in complete harvest failure. Poor harvests are common with these events typically being attributed to poor rainfall distribution (Mubiru, 2010). The Karamoja Action Plan for Food Security refers to 'extreme and intense climate change patterns that will continue to increase' (GOU, 2010; 4-5). Although it is difficult to quantify the impact of climate change, research findings suggest that crop yields in Karamoja have been declining over the past 20 years (Ayoki, 2007). Furthermore, the region has no permanent water sources, non-existent agricultural extension services and limited access to farming inputs. Karamoja also has an alarming number of vulnerable female-headed households who simply do not have the time or capacity to cultivate decent sized farm plots.

Alongside these constraints to crop production, the region is experiencing a longer-term trend of people exiting pastoralism due to a redistribution or decline in livestock assets (Catley & Aklilu, 2013). In Karamoja this has resulted in an increasing number of people becoming more dependent on rain-fed crop production which has major implications on food security, given the frequency of droughts and risks of crop failure (Burns et al, 2013). In order to avoid the risk of crop failure, increasing numbers of individuals are engaging in activities such as charcoal production and brick making (Stites et al, 2014). Over time these are likely to have a significant impact on the natural resource base and undermine livestock, crop, wild food and honey production.

Based on this contextual analysis, under the NRM component in Uganda, the programme began promoting permagardens as a way to build people's resilience. The permagarden method combines the concepts of permaculture and bio-intensive agriculture, and utilises locally available resources into the garden design (TOPS, 2017). Permagardens are particularly well suited to dryland areas and are capable of: producing high yields with small amounts of land, water and labour; providing year round access to nutritious foods; generating household income through the sale of excess harvests; and promoting water and soil conservation, and better utilisation of waste materials (ibid). Table 1 provides an overview of some of the merits permagardens have to offer in addressing some of the challenges to building resilience in the context of Karamoja.

BRACED Supported Permagardens in Karamoja:
Photographs by Charles Paul Obol

Table 1: Rationale for permagardens in Karamoja

Contextual Challenges	Permagarden Solutions
• **High levels of poverty, food insecurity and malnutrition**	Provides both food and income benefits for poor households
• **Increasing numbers of people exiting pastoralism** • **Limited space/opportunities for alternative livelihoods or income generating activities** • **Increasing natural resource exploitation**	Provides an alternative livelihood for pastoralist dropouts and an alternative to activities such as firewood collection, charcoal production and brickmaking
• **Water scarcity (no permanent rivers/lakes) for irrigation** • **Increasing dependency on rain-fed agriculture** • **Frequent droughts and dry spells**	Requires small amounts of water and utilises this in a more efficient way so that crops can be produced throughout the year regardless of season
• **Household labour constraints (high numbers of female headed households)**	Produces high yields from very small plots of land with a relatively low investment in labour (about two and a half days/month)
• **Non-existent agricultural extension services**	Focuses on building farmer capacity to adapt to environmental changes and builds on local knowledge
• **limited availability of farming inputs**	Utilises natural materials that are locally available

The permagarden activities started in the first week of October 2016 with training for extension workers hired by the programme. This was followed up with a second training during the last week of November with a total of 22 people being trained. Starting in 2017 the extension agents rolled out the training to PROGRESS communities and supported farmers in establishing permagardens. The majority of the study participants were trained in February 2017. By the time the assessment was carried out in the beginning of May, 3,685 farmers had been trained, and by the end of that month, 10,964 permagarden beds had been established[2].

[2] We estimated that each farmer established between 2-3 permagarden beds

2. Methodology

2.1 Research Questions

The aim of the study was to assess whether the BRACED permagarden interventions and activities have translated into improvements in income and consumption with associated improvements in household resilience. The study also aimed to investigate whether the training components have been successful in terms of uptake and application. The assessment was structured around the following research questions:

1. To what extent have participants applied the permagarden training techniques and how useful have these been?
2. What impact have BRACED permagardens had on household food security and income?
3. To what extent have the permagardens helped people smooth consumption and cope with climate related shocks and stresses?

2.2 Sampling

The sampling frame for the study included the 3,685 programme participants who had received the permagarden training. However, study participants were purposively selected based on having already established a permagarden at the time of the assessment, and on their availability and willingness to take part. A total of 65 farmers (Male=31, Female=34) from 14 villages across 5 sub counties in Moroto and Napak districts participated in the study. Data collection was carried out by BRACED Monitoring and Evaluation staff using a simple standardised questionnaire which was field-tested with 13 participants prior to the assessment in May 2017. Quantitative data was collected on production, consumption, crop sales, income and income utilisation. A standardised participatory scoring exercise was used to assess perceptions on how well the permagardens have helped people cope with the hunger period as a proxy for drought resilience. A similar exercise was used to assess the usefulness of the permagarden training.

2.3 Data Analysis

The data scores on the value/usefulness of the permagarden training were calculated at the median and the range using SPSS with the data on the application of new farming techniques being represented in a frequency table. The mean value for crop production, sales and income was calculated at 95% confidence interval using the T Test function in SPPS with average quantities by crop type being summarised using Microsoft excel. The utilisation of income from crop sales was calculated at 95% confidence interval and the food security (hunger gap) score was calculated at the median and the range using SPSS. The number of new food sources/types being consumed as a result of the BRACED permagarden activities was summarised in a frequency table.

3. RESULTS

3.1.1 Skills transfers

Table 2: Value/Usefulness of the permagarden training (n=66)

Training score (out of 10)	Frequency	Percent (%)	Valid %	Cumulative %
Ten	17	26.2	26.2	26.2
Nine	18	27.7	27.7	53.8
Eight	17	26.2	26.2	80
Seven	10	15.4	15.4	95.4
Six	3	4.6	4.6	100
Total	65	100	100	
Median score			9 (6, 10)	

Notes

Table 2 shows the results of the perceived value of the permagarden training. Study participants were asked to assign a score to the training on a scale of one to ten, with ten being very useful and one being not at all useful. The training received a median score of 9 (6,10) out of a maximum score of 10. Table 2 presents the actual scores given and the corresponding number (and percentage) of respondents for each score.

Table 3: Application of new permagarden practices

Technique (n=63)	Frequency	Percentage
Double digging	34	53.1
Wood ash/charcoal application	56	87.5
Composting	25	39.1
Mulching	56	87.5
Swales	56	87.5
Berms	50	78.1
Half-moons (Semi circle- banana cycle)	11	17.2
Rainwater catchment holes	33	51.6
Waste run off water irrigation	21	32.8
Plastic water bottle irrigation	6	9.4
Sack mound gardening	33	51.6
Clay pot irrigation	2	3.1
Triangular plant spacing	18	28.1
Crop rotation or intercropping	43	67.2
Succession planting	26	40.6
Manure application	32	50
Liquid fertilizer (tea) application	8	12.5
Liquid herbicide (tea) application	18	28.1
Live fence planting	4	6.3
Other (various)	11	17.2
Other (various)	2	3.1
Other (various)	23	35.9
Average number of new techniques applied (median & range)	8 (3, 17)	

Notes

Sixty-four out of the sixty-five study participants applied at least 3 new techniques from the training with a median score of 8 (3,17) new techniques being applied across the study sample. Table 3 shows the frequency with which the different types of farming techniques were used. Although not every technique was universally applied, the results generally show high uptake of the methods being promoted. However, it is important to note the Permagarden method does not require a farmer to conduct every agriculture technique listed in the table. Instead, the approach focuses on building farmer capacity to decide which techniques are best given the farmer's specific environmental conditions and the exact location of the garden. The farmer then makes the decision which techniques are best to maximise water capture, improve soil fertility and protect from pests and diseases.

3.1.2 Production sales and income

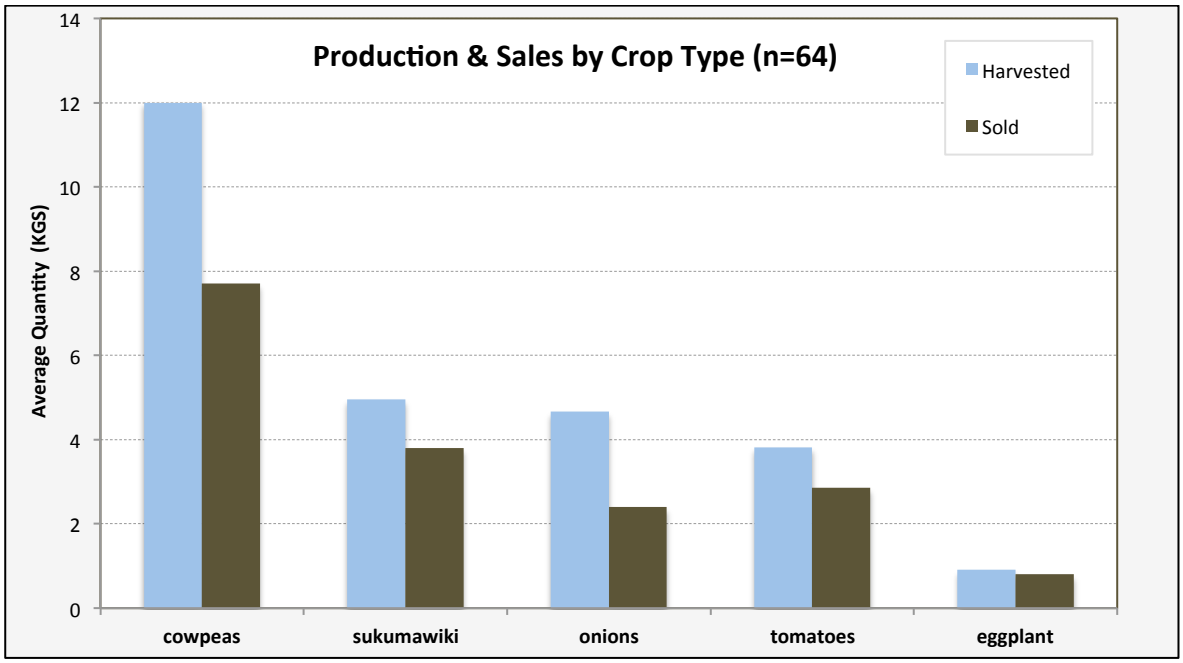
Table 4: Crop production and sales (n=64)

Production and Sales (all crops)	Mean Quantity/Value (95% CI)
Total harvest (KGS)	29.2 (17.2, 40.3)
Total sold (KGS)	18.8 (7.5, 30.2)
Total income from crop sales (UGX)	31,922 (5,474, 58,369)

KGS = Kilograms, UGX = Uganda Shillings, CI = Confidence Interval

Notes on table 4
Table 4 shows the mean quantity of all crops harvested from the permagardens as well as the mean quantity and income derived from the sale of these crops from the most recent harvest. These results are estimates provided by participants from a single harvest and so would roughly represent a 3-4 week production cycle according to study participants.

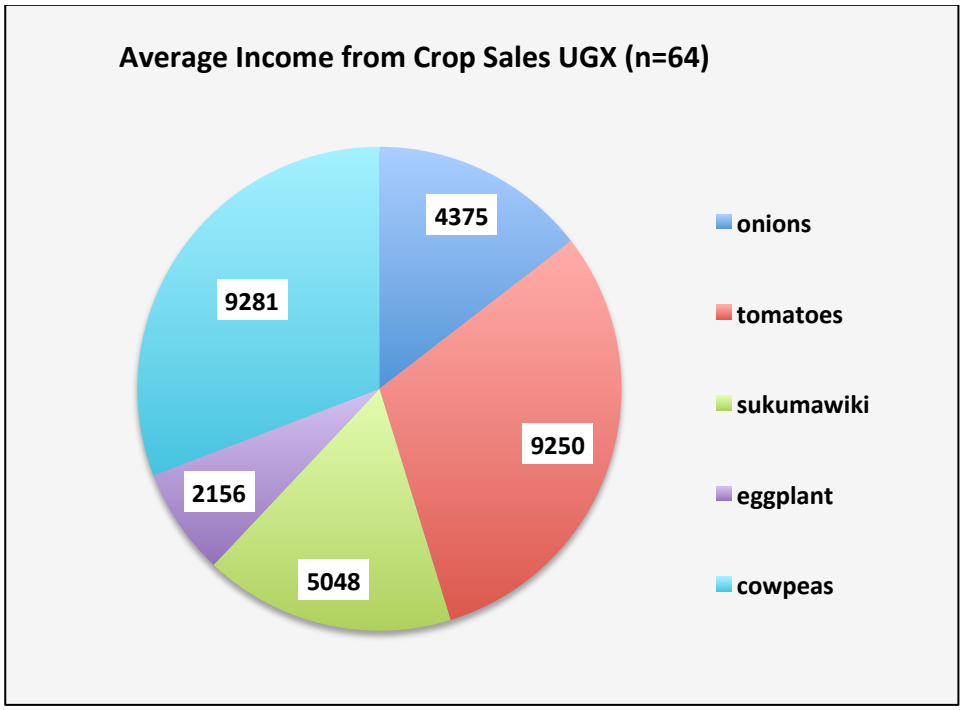
Figure 1: Crops harvested and sold by type



Sukumawiki = Collard greens

Notes on figure 1
Figure 1 shows the proportion of permagarden crops harvested and sold by type from the most recent harvest. In terms of both production and sales cowpeas represent the most important crop with over 86% of participants having cultivated and harvested these followed by collard greens (38%) and onions (59%). Other crops harvested included cabbage, okra and beans but these represented fewer than four participant/farmers per crop.

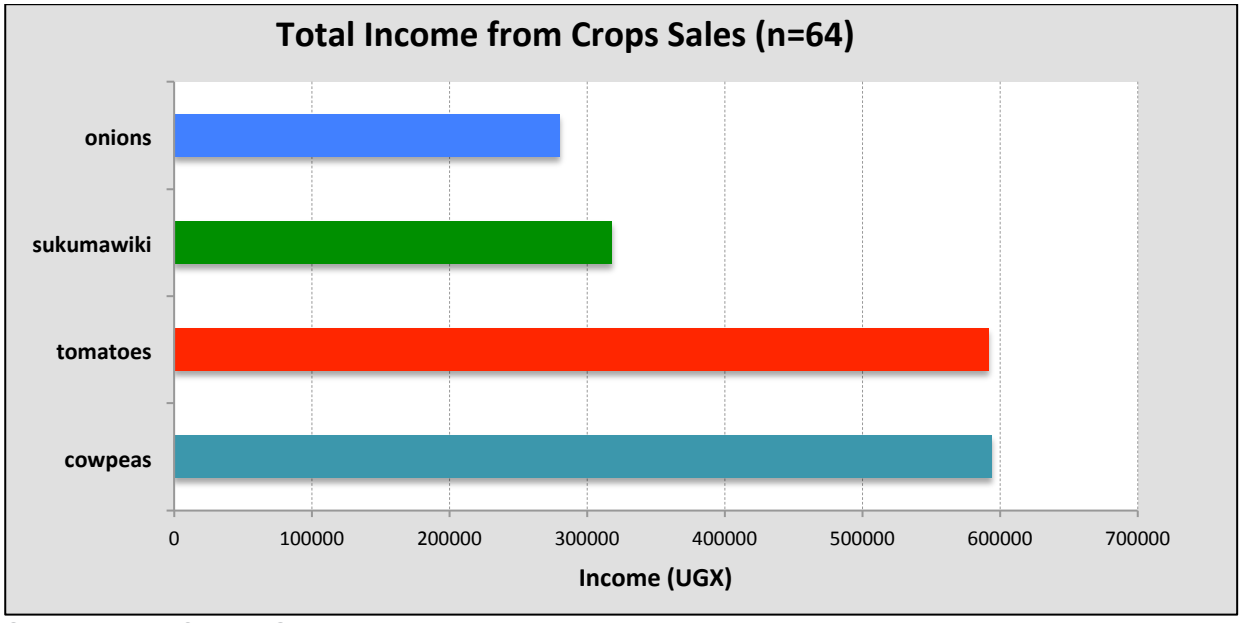
Figure 2: Income from crop sales by type



Sukumawiki = Collard Greens, UGX =Uganda Shillings

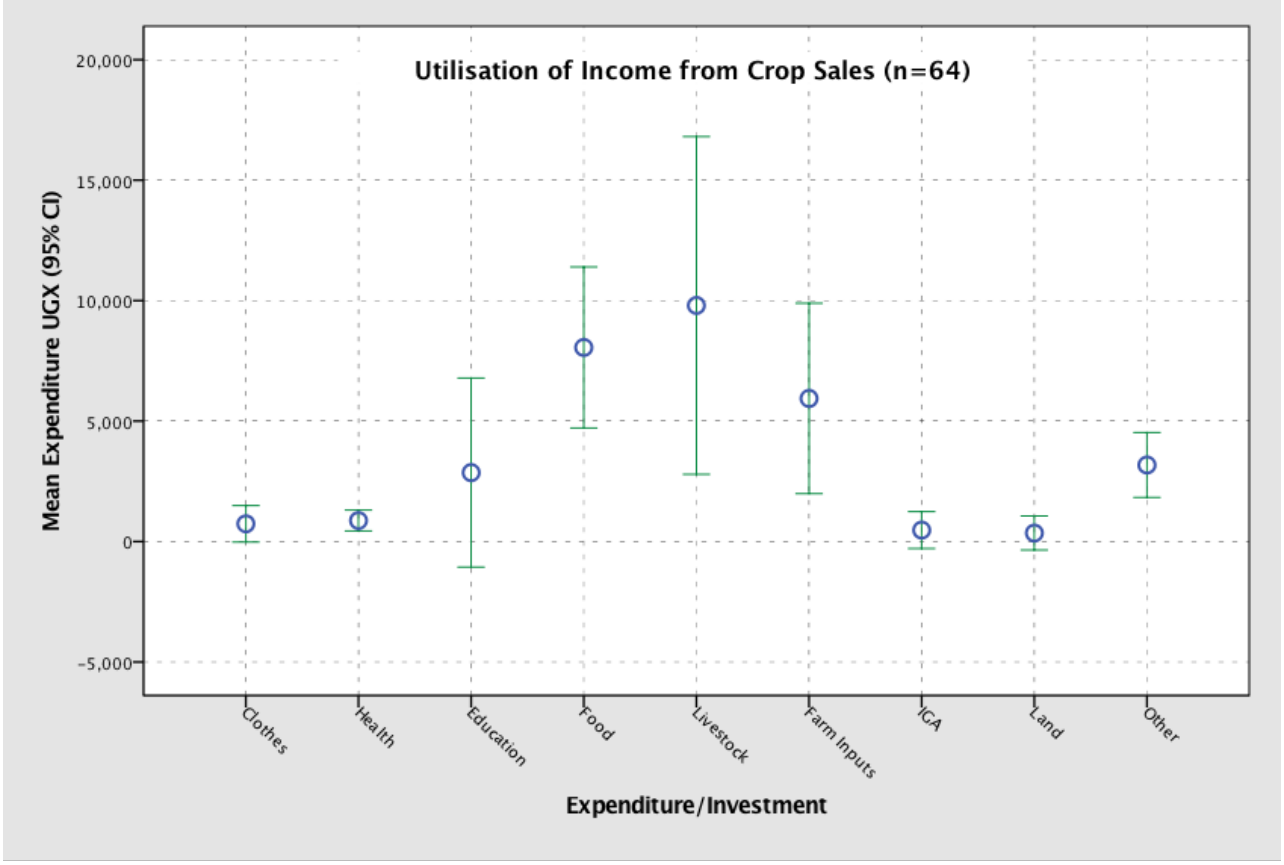
Notes on figure 2
Figure 2 shows the average income derived from the sale of permagarden crops by type. The results indicate that the two most profitable crops are cowpeas and tomatoes. However, even though fewer people produced and sold tomatoes than cowpeas, collard greens or onions (only 14% of the sample) they appear to achieve greater profits from the sale of these crops. This is also supported by the total (as opposed to average) income derived from these four crops shown in figure 3 below:

Figure 3: Total income derived from crop sales by type



Sukumawiki = Collard Greens

Figure 4: Utilisation of income from the sale of "BRACED" permagarden vegetables



IGA = Income Generating Activities

Notes on figure 4

Figure 4 shows the utilisation of income derived from the sale of crops produced from the BRACED permagardens. The results show that some of this income was invested in livestock (including poultry) farming inputs and education. The results also show that a considerable amount was spent on food thus enhancing the direct food security benefits derived from the gardens. It is likely that these expenditures would change according to season – for example food purchases may become less important following the main harvest (October –December).

3.1.3 Food security benefits

Table 5: Hunger gap food security score

Food Security score on a scale of 1-10	Frequency	Percent	Valid Percent	Cumulative Percent
Ten	22	34.4	34.9	34.9
Nine	15	23.4	23.8	58.7
Eight	11	17.2	17.5	76.2
Seven	5	7.8	7.9	84.1
Six	7	10.9	11.1	95.2
Five	2	3.1	3.2	98.4
Four	1	1.6	1.6	100
Total	63	100	100	
Median score			9 (4, 10)	

Notes
Participants were asked if they had experienced any improvement in their food situation as a result of the permagerdens. All respondents (100%) confirmed that they had. Given that the assessment was carried out during the hunger period (January to June) participants were asked to what extent the gardens had helped them cope with the hunger period on a scale of one to ten (10=helped a lot, 1=didn't help at all). The results show a median score of 9 out of a maximum of 10 suggesting that the gardens have helped people smooth consumption and better cope with the hunger period.

Table 6: Number of foods now being regularly consumed (n=64)

Number of new foods being consumed	Frequency	Percent	Valid Percent	Cumulative Percent
Four	3	4.6	4.7	4.7
Three	12	18.5	18.8	23.4
Two	17	26.2	26.6	50
One	24	36.9	37.5	87.5
Zero	8	12.3	12.5	100
Total	64	98.5	100	
Median score				1.5 (0,4)

Notes
Table 6 shows the number of foods being regularly consumed by participants as a result of the permagardens. On average participants are consuming between one and two new food types (median score) more frequently than they were in the past. It can be assumed that some of these new foods are being purchased (see figure 3) whereas others are being produced directly in the gardens. New types of foods that participants mentioned include eggplant, green pepper, watermelon, cabbage and okra.

Different examples of BRACED supported permagardens in Karamoja;

Photo by: John Burns

Table 7: Other permagarden benefits

Percieved benefits of BRACED permagardens (N=63)	
1	Not expensive to maintain, requires less water, you can do lots of things in a small piece of land
2	Easy to maintain, less attention is required
3	Improves household diet, households earn income, easy to manage, requires little land
4	Easy to maintain, less labour, easy to access
5	Improved household nutrition, helps in fight against hunger, one earns income, requires less land
6	Easy to manage, improves household nutrition; requires little land, easy to weed and harvest.
7	Easy to manage, less expensive, good yields are realise.
8	Gained knowledge on sack gardening, easy to grow even during dry season, it has improved household nutrition, requires less labour and less water to maintain
9	It has helped me and my family during the dry spell and hunger period, I have gained more knowledge on survival skills and practices
10	It has helped my household in times of hunger
11	Improves household nutrition, easy to access cash, It is easy to manage the garden
12	It has kept us busy during the dry season, easy practice to access cash, supports us during dry season
13	Helps in improving household diet, easy to maintain the garden, rescues us during the dry season in terms of food
14	Easy to maintain, good yields are realise, saves us from hunger during the dry spell period
15	Gained knowledge on horticulture, learnt survival ways/practices during dry spell
16	I have gained knowledge on permagardening, it has helped us survive during the dry spell
17	I now have access to cash through vegetable sales; it has helped my household cope up with drought
18	It has helped us improve our household nutrition, gained knowledge on resilience design agriculture, we are able to realise good yields
19	We are able to get money from selling vegetables to cater for our basic needs, we are able to realise good yields, improved household nutrition
20	It has helped us in improving our diet; it has also improved household nutrition, cheap to start
21	I now have an immediate supply of vegetables; it has helped me survive hunger continuously, I don't sleep hungry now
22	Continuous supply of vegetables, increased income generation, ideas and skills on water conservation within the garden
23	We are having regular vegetables, easy to manage and access at any time, increased household income
24	I have got the knowledge on permagardening and I believe if I harvest I will be able to get some cash
25	We are able to trap water for irrigation, constant vegetable growing
26	Income generating and food availability
27	I'm able to have vegetables regularly, we now know how to protect the garden from floods
28	You can easily access vegetables, get income through the sale of vegetables and improved my diet compared to before.
29	It is my source of food, income and generates extra income for savings
30	Reduced budget and source of income through sale of vegetables
31	Reduced market costs, income source and knowledge acquisition for different crop varieties.
32	Income generation for the family, income source and knowledge on spacing crops
33	Reduced expenditure since vegetables are free from the garden, knowledge, and income source
34	Reduced poverty due to vegetable sales, balanced diet for the family and knowledge gained from the training
35	Growing vegetables in the dry season, Income source and balanced diet
36	Source of food for the family, skills and knowledge on permagarden, and an income source
37	Source of money for savings, easy access to vegetables and balanced diet
38	Vegetables are easily got from the garden, source of money for savings, improved nutrition
39	Access to cash through selling vegetables, it has helped my household cope up with drought shocks
40	Access to cash, knowledge on permagardening, we have constant access to vegetables

Percieved benefits of BRACED permagardens (n=63)	
41	Easy access to vegetables, cash from the sale of vegetables
42	Source of income, knowledge on resilience design, how to harvest and capture water
43	It has supported us in times of need as we now have access to cash, there is constant supply of greens and it has kept the family members involved and active
44	Knowledge on permagardening, it is a great source of food, source of income
45	It has enhanced my weekly savings, I am able to meet my emergency needs
46	We are now always able to get what we need to eat, it has helped my household in settling school fees and other issues, it has kept me busy during the dry season
47	Have access to cash, it has promoted hard working and it has helped us become resilient to drought shocks
48	I'm able to diversify my livelihoods, I have access to cash year in and year out, it has given me an opportunity of expanding my businesses
49	It keeps us busy and we have gained lots of skills, we have constant access to vegetables, I'm able to save weekly, I'm able to start other income generating activities
50	It's easy to access cash now, we are able to pay school fees, we have vegetables whenever we want
51	Serves as a source of money, we have attained survival skills, we can utilize the small piece of land to its maximum potential
52	The saving amount has increased, it has boosted my income generating activities like poultry, and I have access to cash
53	Acquisition of knowledge and skills on how to survive during the dry spell, I now know how to manage pests and diseases.
54	We have a constant supply of vegetables, improved nutrition, we are able to get some cash
55	Vegetables are available to the household, we have income from the sale of vegetables, acquired knowledge on permagardening
56	Generation of income from vegetable sales
57	Constant supply of vegetables for both home and income generation, knowledge of permagardening, and balanced diet
58	There is constant source of vegetables for the family, reduction of expenses in terms of buying vegetables, source of income from sales
59	Source of income from the sale of vegetables, knowledge on permagarden, vegetables for the family
60	Source of income from the sales of vegetables, constant source of vegetables to the household
61	Access to vegetables, improved nutrition in the household
62	Constant production of vegetables, knowledge on how to do production during the dry season
63	Source of income, knowledge on permagardening, improved household nutrition
63	Reduced poverty level due to vegetable sales, balanced diet to the family and knowledge gained from the training

3.2 Cost Benefits of BRACED permagardens in Karamoja

Table 8 Cost-benefit analysis

Costs/Benefits		Amount
Inputs/farmer	UGX	GBP
Permagarden training	1895.5	0.5
Field assistants	386.4	0.11
Lunch stipends	109.3	0.03
Labour	15750	3.4
Seeds	5000	1.1
TOTAL		5.1
Outputs/farmer		
Consumed /estimated savings (36% of harvest)	17956	3.8
Sold (64 percent of harvest)	31922	6.8
TOTAL		10.6
Benefit-cost ratio (1 harvest)		2:0.7

Assumptions
Labour = 1 hour/day x 21 days at a minimum wage rate of UGX 6000/day/8-hour day

BRACED climate smart agriculture training demonstration site and training of BRACED extension agents in Moroto. Photo by: John Burns

4. DISCUSSION

4.1 Data limitations

As with all field based research in a development context, various non-sampling errors and biases can be expected. The assessment was carried out on a limited budget using BRACED monitoring and evaluation staff, with the primary audience being programme personnel. As a result it was a fairly light impact assessment and if evaluated on a hierarchy of evidence it would be considered somewhere from low to mid-range in terms of rigour (see Catley et al, 2014, 8). For example, purposive sampling was used (as opposed to random), and possible biases may exist due to the lack of independence of the data collectors and authors of the report. The assessment did not attempt to assess attribution, however this was deemed unnecessary given that the activities assessed were new to the area, having been recently introduced by the programme. Although the study did try to quantify production and income benefits from one production cycle, these figures were based on estimates provided by study participants. These results should therefore be interpreted as approximate as they do not necessarily represent absolute amounts.

4.2 Impact and Benefits

Overall the results are relatively encouraging, although arguably the full impact from the permagardens has yet to be realised. In terms of skills transfers, the findings suggest that the permagarden training was successful in terms of value and utilisation by programme participants. The training received a median score of 9 (6,10) out of a maximum score of 10. Consistent with this result, sixty-three out of the sixty-four study participants applied at least 3 new techniques with a median score of 8 (3,17) new techniques being applied across the study sample.

Assuming that the harvested crops that were not sold were consumed within the household, in terms of food security this would translate into an additional 10 kilos of legumes and vegetables (mean value) to the household food basket over the period being assessed. However this does not include the food purchased with income from crop sales, which represents the second most important expenditure (figure 3). What is important to note is that this increase in food availability and access occurred right during the critical hunger period when food is typically scarce. This finding is supported by the fact that every single study participant maintained that their food situation had improved due to the permagardens. When triangulated with the results from the food security "hunger gap" scoring exercise (table 5), the results show a strong association between the permagardens and people's ability to cope with climate shocks and stresses. The results show a median score of 9 (4,10) out of a maximum score of 10. Again the increase in the number of "new" foods being regularly consumed (table 6) provides further evidence that the permagardens have contributed to household food security with associated improvements in household resilience.

The results show an increase in the number of food types being consumed as a result of the gardens with over 87% of study participants now consuming at least 1 new type of food on a regular basis. A number of participants (25%) also specifically mentioned improvements in nutrition or diet as a result of the permagardens (table 7). A compelling argument has been made that "well nourished people are more resilient and a more resilient person is likely to be better nourished" (Hailey, 2015; 6). Although there is limited empirical evidence to suggest that home gardens (or permagardens) have a significant impact on nutritional status, a similar argument could be made that better off people are more resilient and more resilient people are better off. The results indicate that programme participants are better off now as a result of the permagardens which have provided people with a new source of income, and the potential to produce and sell crops throughout the year.

Consistent with this, almost 70% of participants specifically mentioned the income and savings benefits from the gardens and the results show a mean income of UGX 31,922 (5,474, 58,369) per participant[3]. This does not capture the savings benefits and it only represents a snapshot in time. It would be reasonable to assume that production and sales from the gardens will improve over time, as farmers become more adept at permaculture and adopt additional techniques. Similarly production would be expected to increase during seasons where there is greater water availability. Over a 12-month period, participants could potentially earn at least six times this amount, given that the results only represent one production cycle.

[3] This is based on estimates provided by participants for one harvest/production cycle which represents a timeframe of roughly 3-4 weeks.

The results show that this income was spent on food (figure 3) which helped people smooth consumption during the hunger period (table 7) thus improving people's absorptive capacity. The most important expenditure was on livestock purchases including poultry followed by farming inputs. These investments could potentially have long term impacts on food security, nutrition and income and contribute towards building people's adaptive capacity. The results also show that investments in education fell within the same range of the other key expenditures mentioned, all of which could potentially contribute to long-term resilience capacities.

5. CONCLUSIONS

Under the BRACED programme, resilience is defined in terms of anticipatory, adaptive and absorptive capacities and Bahadur et al, (2015) provide a detailed discussion of these different capacities. However for the purpose of this assessment a simpler interpretation was used defining resilience as people's ability to prepare for, cope with and recover from climate related shocks and stresses. Assuming that the dry "hunger" period (when the assessment was carried out) represents a proxy for drought, then the food security and income benefits from the permagardens have helped people to better prepare for and cope with climate related shocks and stresses. It is also possible that the income derived from permagarden crop sales might help people recover from these shocks although this could not be determined within the scope of this assessment.

The results are encouraging given that they only provide a snapshot in time, so the evidence of impact is fairly strong as one would expect significantly greater impact to be realised over a 12-month period. These results are also relatively conservative as they do not capture the maximum potential of the gardens which would be expected to be reached as farmer's skills improve. Further to this they do not factor in an increase in the number of gardens through duplication (which is already being observed), or the fact that greater yields are likely to be achieved during seasons when there is greater water availability.

The cost benefit analysis also shows good returns from a relatively small investment, particularly when one considers that this intervention was combined with other climate smart agriculture interventions which are likely to have yielded similar benefits. Participants indicated that they were able to obtain a harvest from their permagardens every 3 weeks, so if these results were to be modelled over the period of a year or beyond, we would see the benefit cost ratio improve over time as the initial investment cost is spread over each successive harvest.

Overall the results provide a reasonable level of confidence that the BRACED permagardens contribute towards building people's resilience capacities and provide enough justification for the duplication and scale up of this activity in Karamoja or similar contexts.

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