

Working Papers

11. Farmer Participatory Research in Northern Tanzania

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FARM-AFRICA WORKING PAPERS



No. 11

Farmer Participatory Research in Northern Tanzania

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FEEDBACK

We would like to know what you think about this Working Paper. Please complete the feedback sheet at the end of this publication and send it to us by post to the above address or by email to info@farmafrica.org.uk

Acknowledgements

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Tsamas Farmer Research Group

Front cover: VEO Prosper Shirime and FARM-Africa Project Leader Aloyce Kasindei discuss bean multiplication at Bashnet FRG's seed plot.

¹ Photos by Richard Ewbank, FARM-Africa, unless otherwise stated.

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Abbreviations

CBA	Cost-Benefit Analysis
FFS	Farmer Field Schools
FRG	Farmer Research Group
FPR	Farmer Participatory Research
SACCOS	Savings & Credit Cooperative Society
SARI	Selian Agricultural Research Centre
TSh	Tanzania Shillings
TOSCI	Tanzania Official Seed Certification Institute
VEO	Village Extension Officers

I. The approach to Farmer Participatory Research in Tanzania

FARM-Africa Tanzania began Farmer Participatory Research-type activities in Babati in 1990 with the implementation of the crop improvement component of the Babati Agricultural Development Project (BADP). The first phase of this project (1990–3) operated in five villages in Dareda ward, expanding to cover both Dareda and Madunga wards for the period 1993–96 and all five wards of Bashnet Division from 1996–000. The component was primarily focused on improving three crops – potatoes, maize and beans. Both crop diseases and low yields were identified by farmers as the priority constraints, to be addressed by on-farm trials of improved potato (Kenya), composite maize (UCA, Kilima varieties) and bean (Lyamungu 90) varieties.

In 2000, based on the success of the earlier work and demand from farmer groups across the district, Farmer Participatory Research (FPR) was formally incorporated as a component in the Babati Rural Development Project (2000–2005) operating district-wide. The two key methodological differences in the FPR approach as compared to the earlier crop improvement work were:

- farmers themselves identified the problems to be addressed, rather than the project; and,
- Farmer Research Groups (FRGs) were formed through a process of village selection rather than by the project with the local extension officer.

Group formation was based on the identification of typically 12 members (six men and six women, although in practice often more of each), using criteria such as ensuring representation of sub-villages (usually three to four per village), gender balance and the identification of research minded farmers able to share results with others. FRG members were formally approved at a village assembly, following which a FARM-Africa-facilitated planning meeting was convened to identify alternative solutions to priority agricultural problems that could be tested under on-farm conditions. The FRG members elected group leaders (a chair person and secretary) and began the work of developing their plan for the season, which included:

- training on improved agricultural practices;
- testing of improved seeds;

- soil and water conservation; and,
- preparing demonstration plots on their respective farms.

With implementation expanded to cover the whole of Babati District, FRG formation was guided by a number of geographical criteria, so as:

- to ensure accessibility by the maximum number of farmers;
- to be spread over the five agro-ecological zones found in the District; and,
- to focus on areas with relatively lower densities of Village Extension Officers (VEOs).

Although the target was to establish nine FRGs, by the end of 2002, 11 had been established and supported. A further 13 groups were added in 2004/5, three of these being jointly supported by the Nou Participatory Forest Management Project as they were established in forest-adjacent communities. From 2005–2007, FPR work continued as a stand-alone project with these 24 farmer research groups (see Table I overleaf for a groups and activities summary). The project’s approach to FPR essentially involved a six-step process including:

- group formation (two to three farmers per sub-village for a 12 member FRG) by village selection;
- leadership election;
- planning (including selecting technologies for testing and capacity building);
- design of on-farm trials/plots;
- implementation of on-farm trials (including exchange between groups and training for agricultural innovation); and,
- dissemination and information sharing to other farmers (each FRG member trains three to five other farmers, two field days/season, exchange visits).

Innovations tested included both hybrid and composite maize (hybrid maize performing better in the long growing seasons found in cooler agro-ecological zones at the top of the rift valley wall), beans, soya, sunflower and vegetables. In addition, agricultural techniques such as the use of botanicals (e.g. fermented cow’s urine to control maize pests), liquid fertiliser (from African marigold leaves) and terracing and contour bunds to control soil erosion.



False sunflower (or African marigold), commonly used for marking field boundaries and a good broadleaf to process into liquid fertiliser before it flowers

In addition to fermented cow's urine, botanicals tested have included:

- To control bugs on beans: 1 kg of crushed leaves of wild sunflower mixed with 2 litres of water, fermented and then diluted with 2 litres of water mixed with 10 g of powder soap.
- To control maize stalk borers: wood ash mixed with tobacco leaf (sometimes with pepper) and applied to the stalk.
- To control storage pests: burn dried cow dung and mix with ash of paddy husk, mixed with bagged maize or beans.

See Table 2 on page 6 for a list of innovations tested through on-farm trials by the FRGs.

Table I. Groups and activities summary

Group	FPR	Date started	No. of members		Seed retailing (est. 10/04)	Seed multiplication (est. 11/03)	Vegetable production (est. 11/04)	SACCOS	Date started	No. of members	
			♂	♀						♂	♀
1. Kimara	✓	06/05	11	9	p		✓	✓	07/05	16	8
2. Halla	✓	12/01	10	8			✓				
3. Qash (m)	✓	06/05	11	9		✓	✓				
4. Matufa	✓	06/05	10	8			✓				
5. Dohom (j)	✓	11/04	7	13			✓				
6. Erri (j)	✓	06/05	13	7		✓	✓	✓r	08/05	14	8
7. Qameyu (j)	✓	11/00	6	6	✓	f	✓	✓	07/05	19	6
8. Tsamas (m)	✓	12/01	8	5	✓	✓	✓	✓l	08/04	40	30
9. Kwaraa	✓	06/05	10	8	p	✓	✓				
10. Ayamango	✓	12/00	11	9	p	✓		✓l	09/05	29	14
11. Bashnet	✓	06/05	13	7		✓f					
12. Gijedabosh ka	✓	12/01	11	9	✓	✓		✓	07/05	18	7
13. Arri	✓	12/00	14	6				✓l	07/05	18	6
14. Nangara	✓	12/01	6	6				✓l	11/05	19	10
15. Kiongozi	✓	12/02	11	9				✓	06/05	20	11
16. Haraa	✓	12/01	10	10				✓l	11/04	19	3
17. Mandi (m)	✓	12/00	6	6	p			✓	11/04	29	18
18. Mwada	✓	03/01	6	6				✓	12/05	24	12

19.	Riroda	✓	06/05	10	10							
20.	Gabadaw	✓	06/05	12	8		f					
21.	Mamire	✓	06/05	9	9			✓				
22.	Kirusix	✓	06/05	10	8			✓				
23.	Utwari	✓	06/05	9	8			✓				
24.	Gichameda	✓	06/05	10	6			✓				
	Total	24		234	191	3(7)	9	13	12		265	133

Key:

- ✓ - implemented
- p – planned
- l – lending
- f – failed potato multiplication
- r – to be registered
- j – joint venture with Nou Joint Forest Management Project but now in BFPRP
- m – joint venture three group-managed enterprises involving a further 37 farmers



Ayamango group discussion

Bashnet	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
Gijedaboshka	✓	✓			✓	✓	✓			✓	✓	✓	✓	✓	✓
Arri	✓	✓			✓	✓	✓			✓	✓	✓	✓	✓	✓
Nangara	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kiongozi	✓	✓			✓	✓	✓			✓	✓	✓	✓	✓	✓
Haraa	✓	✓			✓	✓			✓	✓	✓	✓	✓	✓	✓
Mandi	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Mwada	✓	✓			✓	✓	✓			✓	✓	✓	✓	✓	✓
Riroda	✓	✓			✓	✓			✓	✓	✓	✓	✓	✓	✓
Gabadaw	✓	✓			✓	✓				✓	✓	✓	✓	✓	✓
Mamire	✓	✓			✓	✓				✓	✓	✓	✓	✓	✓
Kirusix	✓	✓			✓	✓				✓	✓	✓	✓	✓	✓
Utwari	✓	✓			✓	✓				✓	✓	✓	✓	✓	✓
Gichamedda	✓	✓			✓	✓			✓	✓	✓		✓	✓	✓

2. Building the management capacity of farmer groups

Both FRGs and the Savings & Credit Cooperative Societies (SACCOSs) that have emerged from FRG activities in half of the groups supported show many characteristics of good management, including regular meetings, elected officials with a clear understanding of the duration of their duties (elections every three years to renew a third of the committee), records on group activities from which they could readily report group progress and statistics to the group discussions. The most obvious feature of the group assessments was that the capacity building that the FRGs have benefited from is largely agricultural technology-based, with some focus on farm budgeting and group management.

However in groups where SACCOS were introduced, training on group management issues, such as group leadership, election of officials, constitutions and financial management was greatly enhanced. Some group management training was applied during the FRG formation phase but project staff acknowledged that with the SACCOS-related work, a more rigorous approach was implemented. The groups summarised their capacity building in the two phases as shown in Table 3 overleaf.

Groups highlighted various strengths including their increased marketing capacity more than doubling the price obtained at market² and the achievement of year-round food security. The key group management strengths identified (see the SWOT analysis in Table 4) were good leadership, input shop management skills and effective integration of the village extension officer into their activities. This was confirmed by VEOs - one explained that before FPR was introduced, farmers' yields were stagnating but after FPR, she now felt that she had an extension technique that worked³.

Group management weaknesses were also identified which included the group's capacity to organise collective storage and transport for marketing, the sustainability of their research work and the lack of an effective network with other groups and experts.

Groups indicated that they were linked to seed suppliers in Babati and were accessing seed from these sources. Those groups with input shops had appointed shop managers who had

² This may be linked to the increased penetration of Kenyan purchasers into the district resulting from recent droughts in that country

³ Ms Adella Macha, VEO Tsamas

records on sales, for example, Tsamas FRG shop manager indicated a total of TSh 600,000⁴ in the FRG account, with 80 per cent of seed sales so far within the village. Planning was evident in some FRGs – Qameyu indicated annual planning every January.

Table 3. FRG & SACCOS training highlighted by farmers	
FRG training	SACCOS Training
Timely preparation of land	Types of loans
Crop spacing and planting	Shares and interest rates
Use of improved seeds (maize & beans)	Record keeping
Use of botanicals and plant “tea” (fertiliser from plants)	Loan screening
Use of farmyard manure	Establishment of association bye laws
Crop storage and use of ashes	Managing a bank account
Farm budgeting	Establishing an association office
Composting (esp. for those without farmyard manure)	Establishing an association shop for members
Field inspection	Group management
Terracing and contour bunds	Leadership skills
Crop rotation	Empowerment & business skills
Intercropping	Exchange visits with other associations
Seed production and certification	Financial management
Identification of pests and diseases	
Soya processing	
Conservation tillage (magoye ripper)	
Environmental conservation and improved stoves	
Vegetable production	
Making soya milk	

⁴ TSh = Tanzania shilling (about 2,000 per UK£)

Table 4. FRG SWOT Analysis	
Strengths	Opportunities
<ol style="list-style-type: none"> 1. Produce quality seed 2. Integrate use of farmyard manure 3. Good leadership 4. Experience to date has given tangible results for members (send children to school, improve houses, buy SACCOS' shares, buy clothes, livestock, ox plough, radio, bicycles, mobile phones) 5. Able to hire extra land for seed multiplication 6. Improve the running of the input shop 7. Good integration with extension staff 8. Exchange visits has strengthened the group 9. 70-75% of other farmers in the village now using improved maize seed 10. Improved yields of composite vs local maize (15-20 bags/acre vs 5-8 bags/acre) 11. Improved access to markets has improved price of maize sold from TSh 3-6,000/bag to 12-25,000/bag 12. Have food all year round 	<ol style="list-style-type: none"> 1. Access credit from SACCOS 2. Increase seed production to increase coverage with improved varieties and increase group income 3. Diversify group income generating activities to include small agribusinesses 4. Train other community members on improved agriculture 5. Improve the sustainability of research work 6. Use water sources to irrigate seed multiplication plots 7. Exchange experience with other groups 8. Continue to increase soil fertility to increase production 9. Improve ability for group to market collectively
Weaknesses	Threats
<ol style="list-style-type: none"> 1. Knowledge of seed production & packing 2. Access to sprayers 3. Low purchasing power for crop inputs 4. Sustainability of research work 5. Access to transport for marketing 6. Not using available water resources to increase vegetable production 7. FPR results not disseminated to farmers as widely as they could be 8. Lack of storage facilities for buying & selling inputs, selling surplus crop production 	<ol style="list-style-type: none"> 1. Drought 2. Overgrazing of crop residues that could improve soil fertility 3. Pests (esp. armyworm) and weeds 4. Wild animals (with little compensation from Tanzania National Parks Authority for crop damage/loss) 5. Poor market conditions and access (incl. damage to infrastructure) 6. Poor farmers not able to afford inputs for innovation, reducing the spread of FPR improvements

Table 5. SACCOS SWOT Analysis	
Strengths	Opportunities
<ol style="list-style-type: none"> 1. Entry fee to cover operating costs 2. Ability to raise additional contributions to cover running costs 3. Larger part of the association credit fund from members buying shares and paying entry fee 4. Legally registered with Cooperatives Dept 5. Disburse loans and collect repayments 6. Improved fund management capacity 7. Well-trained treasurer 8. Meetings are well attended 9. There is trust within the group 	<ol style="list-style-type: none"> 1. Increase no. of shares per member 2. Exchange visits to SACCOS with longer experience 3. Mobilise more members to increase the size of the revolving fund 4. Build an association office 5. Enforcing constitution will minimise default 6. Use association profits to send committee staff for training 7. SACCOS can replace individuals who are not always available and charge higher interest rates 8. Diversify enterprises e.g. to maize retailing 9. Use credit to improve agricultural production e.g. purchase livestock, improved seeds
Weaknesses	Threats
<ol style="list-style-type: none"> 1. Credit skills require strengthening 2. Leadership capacity in aspects of loan-making 3. Lack of association offices 4. Access to modern facilities (safe, mobile phone, computer) 5. Lack of storage facilities for buying & selling inputs, selling surplus crop production 6. Security of funds to and from the bank 7. Fund not yet large enough to satisfy demand 8. Low income of the community limits ability to buy shares 	<ol style="list-style-type: none"> 1. Drought (most enterprises are agri-based) 2. Pests (esp. armyworm) 3. Wild animals (with little compensation from Tanzania National Parks Authority for crop damage/loss) 4. Mismanagement as the association grows 5. No bus to the bank which reduces security of funds held in cash 6. Markets are unreliable for surplus cash crops 7. Default 8. Corruption by association officials 9. Bank charges

On the other hand, SACCOS identified a larger number of management strengths (see Table 5 above) including legal registration, the ability to disburse and collect loans, fund management capacity, good attendance at meetings and trust within the group. Major weaknesses included leadership in certain aspects of credit not fully covered by the training,

the need for secure association offices and access to modern facilities (safe, mobile phones). There was also a suggestion that the training they received was carried out in two rounds and they needed regular refresher training and mentoring in the first few years of credit operation⁵. Qameyu indicated that they had received training for committee members only, who were then expected to train all SACCOS members, which was not adequate. All SACCOSs visited had plans for enlargement, often to over 100 members, which raises the issue of how relatively young structures and management committees will be able to manage this expansion without breaking into more manageable sub-groups.

One noticeable feature of FRGs in contrast to SACCOSs was the involvement of women, which dropped from 45 per cent in FRGs to 33 per cent in SACCOSs. Given that women have consistently out-performed men in credit schemes across Africa, this would seem an unusual direction for the project to have taken. By 2007, as group membership increased, the proportion of women members had risen to 38 per cent. Involvement at committee level seemed to reflect the broader involvement e.g. Qameya had three women in a committee of nine members.

⁵ This was implemented in the final year of the project.

3. The development of group-based input supply initiatives

As the FPR approach matured and provided solutions to the initially diagnosed production-related problems, so the groups themselves identified problems related to the multiplication of impact and the need for improved access to markets. Issues such as access and affordability of seed, and the ability of farmers to afford the hired labour needed to establish terracing for soil erosion control also emerged.

3.1 Certified seed production

The first attempt to overcome one of these problems – access to seed – occurred under the earlier project when, from 1998–2000, FRGs in Bashnet established seed multiplication plots for improved maize. These did not succeed due to high rainfall and associated diseases. However in 2004, groups again raised the issue of access to seed. Having identified the composite maize varieties most suitable for their areas, both group and non-group member farmers were unable to either access or afford sufficient improved seed for their needs. With support from the Tanzania Official Seed Certification Institute (TOSCI), six groups established seed multiplication plots for composite maize and bean varieties and two focused on potato seed production.



Lyamungu 90 bean seed, just harvested from a FRG multiplication plot

A further problem identified by groups was the need to market their increased field crop production at harvest time to meet pressing domestic obligations, such as school fees and other costs. After harvest, commodity prices for staples are at their lowest and so group members identified agricultural diversification as a strategy that would enable them to store field crops such as maize and beans and wait for better market prices, with immediate expenditure needs met through the production and marketing of a wider selection of horticultural crops. In June 2003, the project established a link with Multiflower Seeds, who supported FPR on-farm trials with vegetable seeds, training, field days for farmers and competition prizes (seeds and tools).

Seed multiplication has been initiated in nine groups, although only seven have been successful so far. Three groups established potato multiplication plots in late 2005 but these failed due to early season drought. This has not prevented the groups concerned repeating the exercise in 2006/7. A major constraint for maize seed production is the isolation requirement of 200 metres from other maize fields, although Ayamango persuaded a farmer operating next to their seed multiplication plot to plant the same variety to avoid contamination.

The project has linked both seed multipliers and input shops to a variety of institutions, including Multiflower, Selian Agricultural Research Centre (SARI) (who have trained seed farmers in production of maize, bean and potato seed), TOSCI (for seed certification), Arusha Foundation Seed Farm (for foundation seed supplies) and have ensured that these are linked to VEOs and the District Council. Tsamas FRG planted 23 kg of foundation bean seed in the 2004/5 season and harvested 150 kg of seed, 100 of which was graded "A". Of this 60 kg was sold at TSh 1,500/kg and 40 kg distributed to members (2 kg each). They planted a further 30 kg for the 2005/6 season.

In terms of linkage to Babati wholesalers, groups confirmed that they were accessing seed. Qameyu reported one of the impacts of the project was four members now owning mobile phones, which they use to order seed from Babati. If they could not travel to collect the seed, it was packed and transported by bus to the nearby town. Although maize seed is more expensive from their input shop (TSh 2,000/kg versus 1,900 in Babati), farmers preferred locally available seed due to time and distance costs. The group advertised their shop and items in stock at the VEO's office, at village assemblies and through kiosks in sub-villages. Groups also negotiated 60-day accounts with wholesalers once they had established a reputation as reliable customers.



1



2



3



4

1. TOSCI, SARI and Arusha Seed Foundation Farm staff inspect bean seed
2. Inspection again (near harvest) for certification
3. Bean seed ready for sale
4. A future entrepreneur⁶

⁶ Photos: Aloyce Kasindei & Faithrest Kimaro

3.2 Bashnet FRG's experience with potato seed multiplication

Bashnet group operates in the higher cooler areas of the district at the top of the Rift Valley wall. Having developed some experience with FPR with a neighbouring FARM-Africa-supported group and through direct contact with Selian Agricultural Research Station, they joined the project in mid-2005 with the priority of multiplying seed. The main reasons for this was related to their earlier involvement in accessing improved bean varieties, which they received from FARM-Africa in 2000. However, as group members replanted using their own seed, yields declined with each season. For the 2003/4 season, they decided to revitalise their seed and 90 farmers collected TSh 1,242,500 to purchase seed from Arusha Foundation Seed Farm. Availability was limited and the prospect of growing their own seed was raised. In 2004/5, they could not access any foundation seed from Arusha and farmers were forced to replant their own seed. This experience further emphasised the risk of relying on outside sources for new seed so, for the 2005/6 season, Bashnet FRG approached FARM-Africa to access 100 kg of foundation seed for three acres of seed production. This yielded 2,140 kg of seed sold locally for TSh 1,712,000. Price was set at TSh 800/kg, which compares with commercially available seed at TSh 1,000 so that farmers not only saved on purchase price but also on transport costs to and from Arusha. The group was not sure how many farmers had benefited as some purchasers bought 100 kg for resale to other farmers in their neighbourhood, but they estimated demand at about 30 kg per farmers, giving a total of over 70 benefiting farmers. The group wanted to increase the area of certified bean seed in 2006/7 but have repeated with three acres as weather conditions have been difficult.

The group also planted potato seed in 2005/6 but a mid-season drought caked the seed crop and nothing viable was harvested. Undeterred, the group has repeated the exercise and expanded to six one-acre plots, spread across their area to minimise the chances of complete failure. The crop was planted at a rate of 560 kg/acre with an anticipated seed harvest of 2,800 – 4,200 kg/acre. The group plans to sell potato seed at TSh 40,000 per bag (or TSh 285/kg) compared to the TSh 60,000 that farmers have to pay for commercially produced potato seed.



A Bashnet FRG member shows off a flourishing potato seed crop

The group has worked out the gross margin of potato seed production as follows:

Table 6. Gross margin of potato seed production	
Item	TSh/acre
Land cleaning	6,000
1 st cultivation with ox-plough	10,000
2 nd cultivation with ox-plough	10,000
Opening planting furrow	6,000
Sowing	6,000
Checking planting	2,500
Manure (purchase and unloading – 2 lorries/acre every 3 years)	80,000
Manure application (once every 3 years)	3,300
Weeding x 3	48,000
Spraying for pests	30,000
Fungicide application	20,000
Harvesting	20,000
Total variable costs	241,800
Yield	30 bags
Price/bag	40,000
Total revenues	1,200,000
Gross margin	958,200

This compares favourably with the gross margin for improved maize of TSh 60,416, even if using a lower estimate of 20 bags of seed/acre, which gives a gross margin of TSh 558,200. The group plans to set up a formal selling point after the 2007 harvest with a weighing machine. Ultimately they plan to establish an input shop for seed and other inputs with the profits made from potato seed sales.

3.3 Establishing input shops

In October 2004, three input retail shops were established to ensure sustainable seed supplies (both home-grown certified maize and bean seed and Multiflower vegetable seed) for farmers. Criteria for the establishment of input retail shops included:

- the existence of other input retailers in the area;
- the demand for improved seed;
- the experience of the group with seed multiplication; and,
- assessment of the village extension officer.

FRGs and FRG-run input shops were linked with commercial input suppliers in Babati Town, such as Pamoja Agrovet and Kai Agrovet. The former focused on the provision of vegetable seeds from Multiflower while the latter stocked both hybrid and composite maize varieties from seed producers such as the Panar and Kenya Seed Companies. Both Kai Agrovet and Pamoja Agrovet welcomed the introduction of village input shops, seeing these as opportunities for expansion rather than unwelcome competition. Kai had increased their annual sales of composite and hybrid maize from 10 to 50MT from 2004 to 2006, attributing this in significant part to the work of FRGs and demand from group members, either directly or through input shops. Pamoja Agrovet were even more direct in their attribution of increased business to the project. Through FARM-Africa Tanzania, they had been selected by Multiflower as a stockist for vegetable seeds. Pamoja has trebled its vegetable seed business, which now accounts for 65 per cent of sales compared to 25 per cent in 2004. Most popular seeds sold were (in order): (1) Chinese cabbage; (2) Leafy cabbage; (3) Sweet pepper; (4) Carrot; (5) Cucumber; (6) Tomato.

Although input stores have been established primarily to supply seed (maize, beans, vegetable) to farmers, in Qameyu, the input shop represented an opportunity to improve the provision of other inputs. In addition to seeds, the shop stocked farm tools (hoes, spray pumps, pangas) and pesticides. Although all three FRGs operating input shops have established seed multiplication, not all FRGs multiplying seed have established input shops.

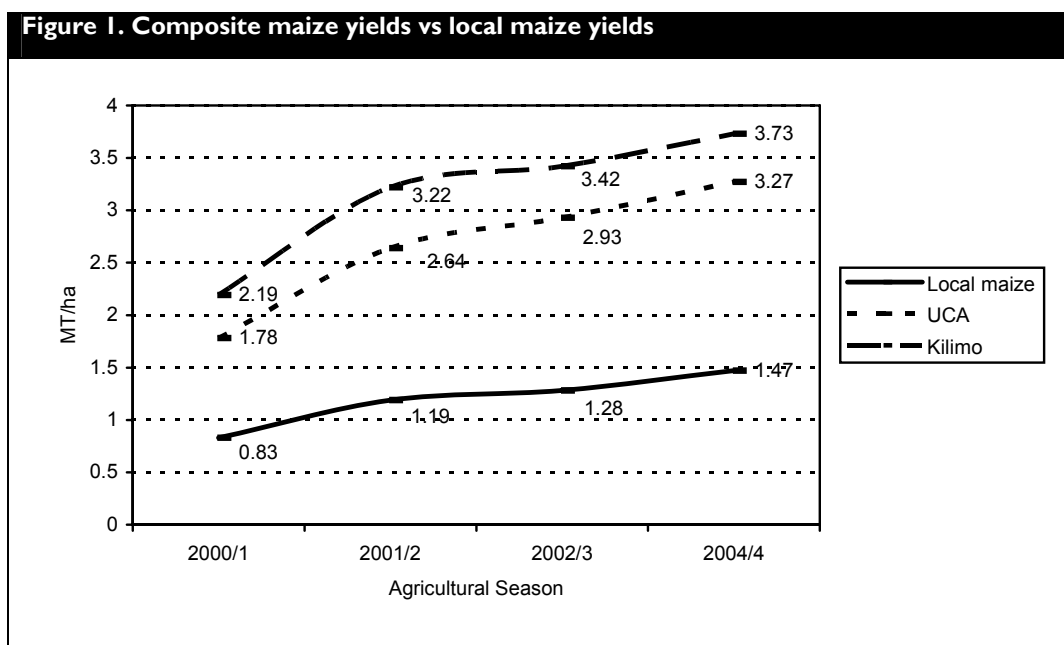
Currently six seed multiplier groups have no input shops, although two are planning them. Two of the groups planning to establish input shops do not currently operate local seed multiplication.

Multiflower Seeds Ltd. highlighted their marketing approach as “seeing is believing”, stating that no amount of radio or poster advertising can substitute for smallholder farmers actually seeing the results for themselves. This led them to link up with FARM-Africa Tanzania based on its reputation for impact with FPR. In 2002, Multiflower was selling about TSh 100,000 worth of seeds per month but by 2006, this had increased to TSh 2-3 million/ month worth depending on the time of year. FRGs particularly liked the reliability of the Multiflower product (imported from The Netherlands) as they had mixed results with other brands (poor germination and contaminated seed).

4. The results of on-farm innovation

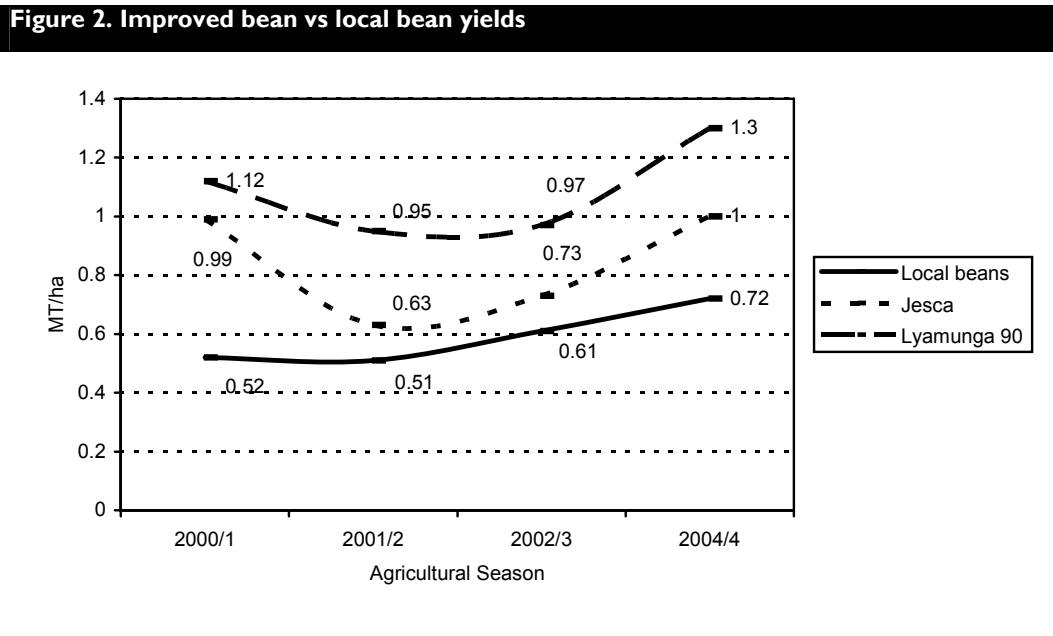
4.1 Increasing yields of staple crops

Ultimately, the best evidence of successfully-managed groups is in the performance of the activities they implement. Maize yield data shows that increases achieved over four agricultural seasons by the introduction of composite maize varieties averaged 162 per cent for Kilimo and 124 per cent for UCA as compared to local maize varieties with the same treatment (farmyard manure, correct spacing, timely planting) (see Figure 1 below). These results correspond to the levels of increase identified by farmers in their SWOT analysis. This means that for a farmer operating one acre of land, purchasing 6 kg of improved seed costing TSh 10,800 (£5.26) results in nine extra 100 kg bags of maize (14 bags vs 5 bags). This takes an average farm household from having staple food sufficient for five months of the year to a surplus of two bags.



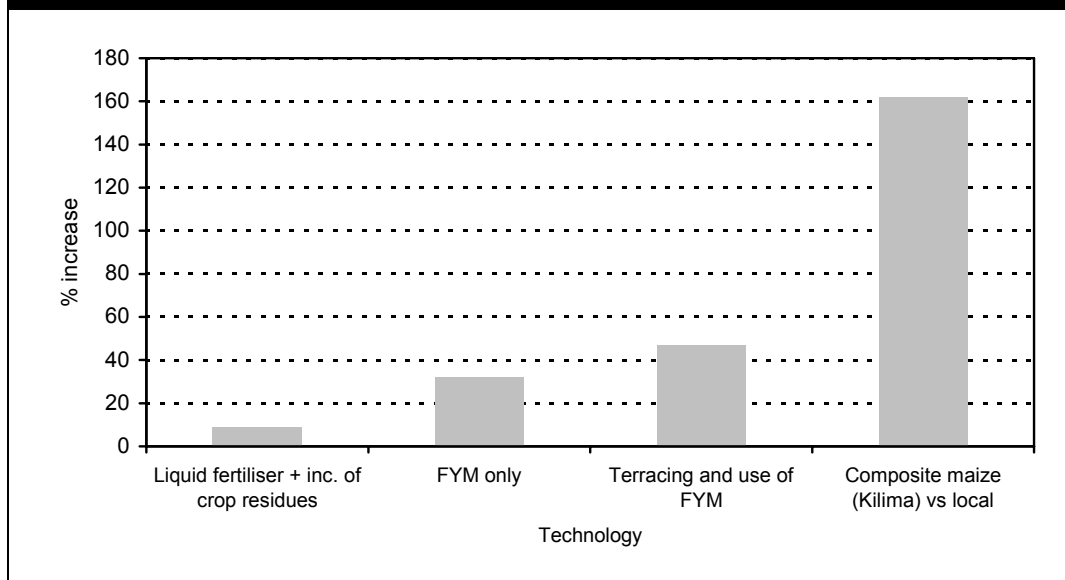
Similarly for beans, average yield increases over four agricultural seasons of 79 per cent for Lyamungu 90 and 35 per cent for Jesca over local bean varieties have been recorded and the project is working with the National Bean Programme to test a climbing bean variety with potentially two to three times the yield of Lyamungu 90 (see Figure 2 below). Interestingly Jesca was significantly more affected during a relatively bad year for beans (2001/2, although

the same year was a relatively good year for maize) than either local bean or Lyamunga 90 varieties. These results point to farmers adopting Kilimo composite maize (unless growing in the higher cooler longer-season areas) and Lyamunga 90 beans into their farming systems.



Comparison of different cultivation regimes for maize (see Figure 3 overleaf) demonstrates the relative effectiveness of switching to composite maize seeds, using farmyard manure, liquid fertilisers and crop residues, and terracing. The first three innovations (showing 9, 32 and 47 per cent increases in yield respectively) were tested using composite maize varieties on both with and without treatment plots. The fourth innovation compares local with composite maize (Kilima) but uses the same treatments on both plots (improved planting, spacing and application of farmyard manure).

Figure 3. Increase in maize yields using different technologies



As well as yield increases, income increases were highlighted by members in all groups visited, including:

- increased ability to meet primary school costs (school uniforms, books);
- increased ability to meet secondary school fees;
- improvements to housing;
- purchase of livestock (dairy goats and dairy cows);
- purchase of radios and small radios for use when out of the house;
- purchase of mobile phones; and,
- purchase of bicycles.

In terms of economic performance, project data for maize yields and costs for the 2002/3 and 2003/4 growing seasons across a sample of 46 farmers (composite and hybrid growers) indicate a slightly higher average of 19.6 bags per acre or 4.86 MT/ha average yield (see Table 7 overleaf). This data mixes farmers from both lowland and upland groups, the latter tending to use hybrids due to their longer growing seasons, which may explain the higher average figure. Cost items measured were seed, manure, storage and labour required, giving an average gross margin for an acre of improved maize of TSh 60,416 or £25.17. Local maize gives a negative gross margin of -TSh 29,489 per acre per year, or -£12.29 and composite maize gives a gross margin of -TSh 8,990 per acre per year, or -£3.75.

Although commercial labour hire rates have been used in the gross margin calculations, most labour tends to be provided by the farm family. The opportunity cost of family labour may well be valued at a lower rate depending on the demand for hired labour locally and consequently the gross margin to the farmer of both local and composite maize would not be negative. An alternative way of viewing the economic result to take this into account is to use returns to labour⁷. Compared with local maize, use of improved maize varieties using FPR demonstrates a considerable improvement. Cultivating improved maize gives an average of TSh 2,935, or £1.22 per eight hour labour day⁸, more than two and a half times the returns of local maize. Local maize returns to labour are only TSh 1,101 or £0.46 per day, whereas those for composite maize are TSh 1,778 or £0.74 per day. Adoption of improved maize therefore makes labour use on smallholder farms 1.6 to 2.7 times more economically productive than that applied to local maize. Put another way, adopting improved maize lifts a farmer from earning less than US\$1 per day⁹ (about 91 cents) from local maize cultivation to from US\$ 1.47 to 2.42 per day.

⁷ Use of commercial rates would be valid if all labour was hired in, but where family labour is used, there may be reasons for using lower rates based on the opportunity cost of the family's time.

⁸ 60 labour days compares with research in Nigeria showing a requirement of 44 days per acre and in Sri Lanka showing 43 days per acre, an increase which may be due to the lower level of ox-plough use in Babati requiring more hoe cultivation and therefore extra labour days. Project staff estimate that local maize uses only 60% (or 36 days per acre) of the labour required for improved maize.

⁹ See Millennium Development Goal 1

Table 7. Comparative gross margins and returns to labour per acre of different maize cultivation regimes

Item	All improved maize		Composite maize only		Local maize	
	Unit (cost or no.)	Notes	Unit (cost or no.)	Notes	Unit (cost or no.)	Notes
Seed	14,644	7.28 kg @ TSh 2,012/kg	7,280	7.28 kg @ TSh 1,000/kg	882	7.28 kg @ TSh 121/kg
Manure/fertiliser	24,725	Average cost of farmyard manure or fertiliser	24,725	Average cost of farmyard manure or fertiliser	17,600	Approx 4.4 ox carts of farmyard manure @ TSh 4,000/ox cart
Labour	115,660	481 hours (or 60 labour days) @ TSh 240/hr	115,660	481 hours (or 60 labour days) @ TSh 240/hr	69,120	288 hours (or 36 labour days) @ TSh 240/hr
Storage	22,500	Cost of bags + actellic for 20 bags	14,625	Cost of bags + actellic for 13 bags	0	Not required
Total variable costs (TSh)	177,528		162,290		87,612	
Yield (no. of bags)	19.7	100 kg/bag	12.7	100 kg/bag	4.8	100 kg/bag

Price/bag	12,109	Average price achieved by farmers	12,109	Average price achieved by farmers	12,109	Average price achieved by farmers
Total revenue (TSh)	237,944		153,300		58,123	
Gross margin (TSh)	60,416		-8,990		-29,489	
Gross margin (UK£)	25.17	TSh 2,400 = UK£1	-3.75	TSh 2,400 = UK£1	-12.29	TSh 2,400 = UK£1
Returns to labour (TSh)	2,935	Total revenue – (seed + manure + storage)/60 days, so this is the return to a day's family labour.	1,778	Total revenue – (seed + manure + storage)/60 days, so this is the return to a day's family labour.	1,101	Total revenue – (seed + manure)/60 days, so this is the return to a day's family labour.
Returns to labour (UK£)	1.22	Per acre per day	0.74	Per acre per day	0.46	Per acre per day

4.2 Diversification into horticulture

Having made improvements in field crop production, groups requested support to diversify into horticultural production. Links with Multiflower increased availability of seed to farmers, who began cultivating a variety of crops such as cabbage, tomatoes, onions and carrots. Multiflower have also provided training and technical support as well as prizes for vegetable cultivation. Results in terms of the economic impact of the introduction of horticultural enterprises has been recorded across a number of farmers and crops. See Table 8 below:

Table 8. Gross margins and returns to labour of a variety of horticultural enterprises¹⁰					
GM/acre	TSh	GM/acre	TSh	GM/acre	TSh
Cabbage:		Chinese cabbage:		Carrots:	
Seed	63,000	Seed	8,667	Seed	18,000
Manure	38,050	Manure	45,556	Manure	39,625
Labour	627,990	Labour	232,986	Labour	199,400
Total variable costs	729,040	Total variable costs	287,208	Total variable costs	239,025
Average yield	24,311	Average yield	11,098	Average yield	30,238
Value/unit	91	Value/unit	46	Value/unit	42
Total revenue	2,222,720	Total revenue	512,205	Total revenue	1,259,896
GM	1,493,680	GM	224,997	GM	1,020,871
UK£	622.37	UK£	93.75	UK£	425.36
Return to labour/day	5,943	Return to labour/day	3,523	Return to labour/day	11,450
UK£	2.48	UK£	1.47	UK£	4.77

¹⁰ A qualification on these figures is required as pesticide costs were not collected and these should be expected for horticultural crops.

Table 8 cont.			
GM/acre	TSh	GM/acre	TSh
Tomato:		Kang-kong:	
Seed	19,500	Seed	10,889
Manure	38,775	Manure	38,333
Labour	206,510	Labour	171,578
Total variable costs	264,785	Total variable costs	220,800
Average yield	355	Average yield	13,578
Value/unit	3,838	Value/unit	50
Total revenue	1,362,654	Total revenue	678,889
GM	1,097,869	GM	458,089
UK£	457.45	UK£	190.87
Return to labour/day	11,967	Return to labour/day	6,699
UK£	4.99	UK£	2.79

Tabu, a farmer in Matufa FRG, provides a case study of her experiences.

Box 1. Case Study of a FRG Vegetable Grower



Tabu weeding her vegetable plot (Photo: Aloyce Kasindei)

Tabu is a 30 year old single mother living in Matufa Village, Babati. She takes care of two children, currently in primary school, and her aged mother. In 2005 she started growing vegetables as a member of the recently-established Matufa Farmers Research Group.

The group received training on Farmer Participatory Research (FPR) from project staff, who also linked the group up with Multiflower Seeds Ltd. Multiflower provided further training and some free seeds for farmers to try. Previously relying on a small maize and paddy rice plot, Tabu planted 0.25 acre with vegetables during the August – October 2005 vegetable growing season. These included cabbage (both leafy and Chinese), tomatoes, sweet pepper, onions and okra. She harvested some for home consumption but also generated a surplus for sale. Her total income earned was TSh 220,000, which she spent on:

- payment of school costs (TSh 100,000);
- medical costs, domestic needs and purchase of vegetable seed for the next season (TSh 70,000); and,
- purchase of a mobile phone to link to markets and get better information on prices (TSh 50,000).

Compared to maize and paddy production, Tabu sees vegetable production as profitable. From a two-acre plot for maize and paddy rice, she generates about TSh 350,000 in surplus crop sales, which take six months to produce.

Interestingly, all vegetable farmers used manure rather than chemical fertiliser for their crops whereas 59 per cent of maize farmers used some form of purchased fertiliser¹¹. Units of produce were measured in bundles or crates. All vegetable crops required significantly higher amounts of labour input than maize, varying from 50 per cent more for kang-kong (a cucumber-type vegetable) to six times as much per unit area for cabbage. This clearly exerts an influence on the size of vegetable enterprise that a smallholder farmer can manage, so that despite the higher gross margins and returns to labour when compared to maize, typically farmers are cultivating only 0.05 to 0.1 acre of vegetables to supplement productivity and income from their main field crops.

Although cabbage gives the highest gross margin, because of the much higher labour requirement, returns to labour for both carrots and tomatoes are more favourable. The two Chinese vegetables, Chinese cabbage and kang-kong, give the lowest gross margins and lower returns to labour.

¹¹ This includes rock phosphate from the nearby Minjingu processing plant

5. The effectiveness of microfinance

Savings & Credit Cooperative Societies (SACCOS) were introduced largely during the final two years of the project, although three of the twelve had initiated these at an earlier stage. The project indicated the availability of matching funds up to a maximum of TSh 500,000 per group. The structure of the SACCOSs based on members joining through the payment of an entry fee and purchasing shares (of varying value) has promoted association ownership of the credit fund, with the project's matching funds seen as a subsidy to boost the fund. SACCOS members emphasised the care taken in approval of new members and in the screening of loan applications. So far, most loans have been for seed purchase, although some have expanded the criteria to cover procurement of farm tools (see Table 9 overleaf for the characteristics of the SACCOS in the four villages). Nangara listed a number of off-farm IGAs that it will consider once it started issuing cash loans in July 2006 - its position near to Babati and the profitability of related petty trading activities make this inclusion into the loan portfolio logical. Other groups emphasised on-farm diversification as the higher priority.

Average loan sizes were small (seed loans equivalent to the value of improved maize seed for about two acres) although the older group (Tsamas) had increased its loan size from £11-12 to over £17 per client and included loans for tools. Share costs varied with most groups basing the expansion of their revolving fund on both sales of additional shares to existing members. Nangara wanted all members to own at least five shares each, as well as attracting new shareholding members. Tsamas hope to reach 200 members. The amount of credit each member is entitled to is based on their share holding – Nangara aims to offer loans of twice the value of members' shares. Loan screening is based on a number of criteria, including the character of the applicant, the economic capacity of the applicant and the quality of the business plan presented to the committee. One group – Qameyu – had selected its nine committee members from each sub-village to ensure that it had members able to assess according to the first criteria.

Interest rates varied from group to group but are fixed irrespective of the rate of repayment within the loan period rather than on a declining balance basis. Groups indicated that the incentive for early repayment would be to access another loan rather than reduced interest costs. Each client is backed by a number of guarantors who are responsible for ensuring that

the loan is repaid. If it is not, the guarantors lose their access to loans and are required to repossess the asset identified as collateral by the client (such as a goat or cow).

Table 9. SACCOS characteristics in four villages (April 2006)

	Nangara	Ayamango	Tsamam	Qameyu
Reason for starting credit activities	To access credit for seeds and other inputs	To access credit for seeds, livestock and SSE	To access credit for livelihoods	To promote development and training
Start date	Nov 2005	Sept 2005	August 2004	July 2005
No. of members	31 indivs (22♂, 9♀)	48 indivs (32♂, 16♀)	70 indivs (40♂, 30♀), 37 in 3 groups	34 indivs (24♂, 10♀)
Proportion of ♀	29%	33%	43%	29%
Size of credit fund (TSh)	750,000	1,142,000	2,627,837	1,247,931
Amount out in loans	387,600 (52%)	1,094,440 (96%)	1,871,800 (71%)	0
Number of loans	15	48	53	0
Average loan size	25,840 (£12.90)	22,800 (£11.40)	35,317 (£17.70)	na
Type of loan	Seed	Seed	Seeds & tools	na
Interest rate	10%/annum	20%/8 months	25%/annum	Not yet set
Entry fee (TSh)	2,000	2,000	2,000/annum	2,000
Share cost	10,000	50,000	10,000	5,000
Type of loan	Individual	Individual	Individual & Group	Individual
Running costs	Covered by entry fee and interest rate	Covered by entry fee and contributions for extra funds at group meetings	Covered by entry fee and 10% of an interest rate of 25%	Covered by entry fee and contributions for extra funds at group meetings
Management committee of 9	FRG and SACCOS run by same committee	Separate committees for FRG & SACCOS	Separate committees for FRG & SACCOS	Separate committees for FRG & SACCOS
No. of guarantors per client	4	3	2 + spouse	2

Over the past year, SACCOSs have grown considerably from an average of 33 to 49 members (see Table 10 below). During the same period the gender balance of both group membership and representation on SACCOSs' management committees has improved from 33 to 38 per cent, reflecting the increased involvement of women as SACCOSs have expanded. The size of credit funds have increased faster than the growth in membership, more than doubling from TSh 10 to nearly 25 million (about £10,300 or an average of £859 per group). The project has provided matching grants up to TSh 500,000 for each group, so for every TSh 1 provided, a further TSh 3 has been generated in community contribution, membership fees and interest rate charges. Over the final year of the project, all groups benefited from further training and exchange visits with more experienced credit groups in the region which has helped focus the efforts of the management committees in developing mechanisms to (a) increase the size of the revolving fund and (b) cover their running costs.

Table 10. Change in SACCOSs from 2006 to 2007

No.	Name of SACCOS	Name of FRG	Size of SACCOS 2006			Size of SACCOS 2007			% increase	Total credit fund 2006 (TSh)	Total credit fund 2007 (TSh)	% increase
			Male	Female	Total	Male	Female	Total				
1	Endarbo	Ayamango	29	14	43	36	23	59	37.2%	1,140,000	2,252,000	97.5%
2	Magimo	Gijedaboshka	18	7	25	25	7	32	28.0%	1,000,000	2,375,000	137.5%
3	Tumaini	Kimara	16	8	24	23	20	43	79.2%	470,000	1,895,000	303.2%
4	Mwangaza	Mwada	24	12	36	50	35	85	136.1%	1,084,800	1,230,000	13.4%
5	Kuamisaki	Kiongozi	20	11	31	25	12	37	19.4%	500,000	1,234,082	146.8%
6	Bahati	Haraa	19	3	22	19	6	25	13.6%	1,035,700	2,225,400	114.9%
7	Juhudi	Qameyu	19	6	25	50	20	70	180.0%	1,247,931	3,215,000	157.6%
8	Uvumilivu	Nangara	19	10	29	25	15	40	37.9%	750,000	1,355,000	80.7%
9	Kumekucha	Tsamam	40	30	70	52	33	85	21.4%	1,453,900	3,969,445	173.0%
10	Erri	Erri	18	6	24	37	20	57	137.5%	0	1,035,000	-
11	Endaghetta	Arri	18	6	24	20	25	45	87.5%	390,000	1,200,000	207.7%
12	Bigema	Mandi	29	18	47	21	19	40	-14.9%	1,142,000	4,739,000	315.0%
	12 groups	Total	269	131	400	383	235	618	54.5%	10,214,331	26,724,927	161.6%

Groups have developed a variety of ways to achieve these objectives. Gijedaboshka had developed the more sophisticated approach of the groups visited, offering four types of loan to their members:

- a) Agricultural loans – used to cover maize and vegetable seed and ploughing costs, these are subject to a 25 per cent interest charge per season (nine months), repayable in 3 x 3 monthly instalments. Loans range from TSh 100 – 200,000.
- b) Business loans – primarily for trading; these are subject to 20 per cent over nine months with loan sizes the same as agricultural loans.
- c) Education loans – smaller loans (TSh 20 – 30,000) to enable parents to meet education costs even at times when their household cash flows are limited. These are repayable in four months but only attract a 4 per cent interest rate.
- d) Emergency loans – these are provided for unexpected expenditure e.g. health costs at the same loan size as education loans. No interest is paid for the first month, but charged at 3 per cent per month thereafter.

Qameyu and Ayamango have so far provided loans for seed purchase only, although both are open to supporting other enterprise costs (including non-agricultural loans) when their revolving funds are sufficiently large to cater for these. Ayamango's loan size varies from TSh 27,360 – 108,000¹², whereas Qameyu have provided two types of loan – maize seed loans from TSh 60,000 – 300,000¹³ and potato seed loans from TSh 100,000 – 800,000¹⁴. Maize seed loans tend to be to groups of farmers whereas potato seed loans are issued to individuals. Ayamango have organised bulk buying of maize seed but with loans issued to individual members.

Interest rates and other membership charges are likewise not uniform across the 12 SACCOSs supported but set through discussion with the membership based on a number of factors, such as:

- a) A realistic and affordable level for a loanee to pay
- b) The running costs of the SACCOS
- c) The potential profitability and risk associated with the enterprise supported
- d) The aims of the membership in growing their revolving fund.

¹² UK£11 - £45

¹³ UK£35 - £125

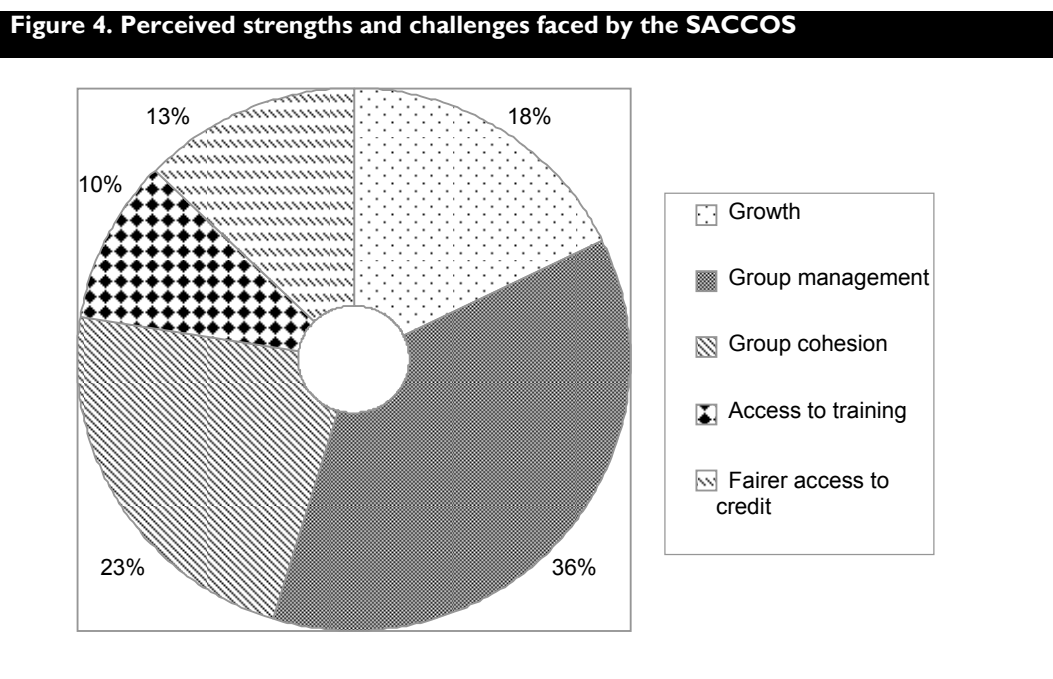
¹⁴ UK£42 - £333

The ability of a committee to persuade the membership will also play a role in this process – of the groups interviewed, Gijedaboshka had developed a wider variety of loan types and had also obtained agreement on higher rates of interest and charges. So despite having the smallest number of members and size of revolving fund, they had the largest surplus. Conversely Qameyu charged the lowest interest rate and therefore generated the smallest surplus. Despite having the largest revolving fund, Ayamango generated the smallest proportional return (only 4 per cent). Despite setting a reasonable interest rate, the group had not agreed on other charges and instead relied on adhoc contributions to cover running costs adequately (see Table 11, overleaf, for more information on the ability of the SACCOs to cover their running costs). They also had the lowest proportion of their fund out on loan.

None of the groups have started to charge their membership for the management committee's time and meeting costs or for any internal auditing services – as group sizes grow, inevitably these functions will become more time consuming and the less easily covered by voluntary support. Groups acknowledged that this was a concern but felt that their revolving funds had to grow significantly before they could start to pay these allowances. Clearly there is a tension between reinvesting any surplus back into the revolving fund and paying allowances for management costs. SACCOs will have to manage this situation carefully to ensure that their long-term sustainability is optimised.

Table 11. Ability of SACCOSs to cover their running costs (in TSh)						
	Gidegaboshka		Qameyu		Ayamango	
Item	Unit cost	Total revenue	Unit cost	Total revenue	Unit cost	Total revenue
Revolving fund size		1,677,000		3,370,000		5,600,000
Amount currently out on loan		1,250,000		2,650,000		3,000,000
% fund out on loan		75%		79%		54%
No. of members		40		70		80
Income						
Running cost fee	6,000/loan	66,000				
Emergency loan charge	500/loan	2,000				
Membership fee	500/month	240,000	1,000/year	70,000		
Entry fee	5,000	200,000	2,000	56,000	5,000	266,667
Interest on loans	22.50%	281,250	10%	265,000	20%	600,000
Loan application form			500/loan	11,000		
Adhoc contributions					750/member/yr	60,000
Total		789,250		402,000		926,667
Costs						
Reports & inspection by Coops Officer	7,000/month	84,000				
Stationary	12,000/year	12,000	36,000/year	36,000	30,000/meeting	360,000
Bank charges	200/month	2,400	200/month	2,400	200/month	2,400
Equip	50,000	50,000			120,000	80,000
Bank trips	21,000 year	21,000	15,000/month	180,000	15,000/month	180,000
Application form printing			50/form	3,500	39,000/6 months	78,000
Total		169,400		221,900		700,400
Net gain/loss		619,850		180,100		226,267
As % of revolving fund		37%		5%		4%

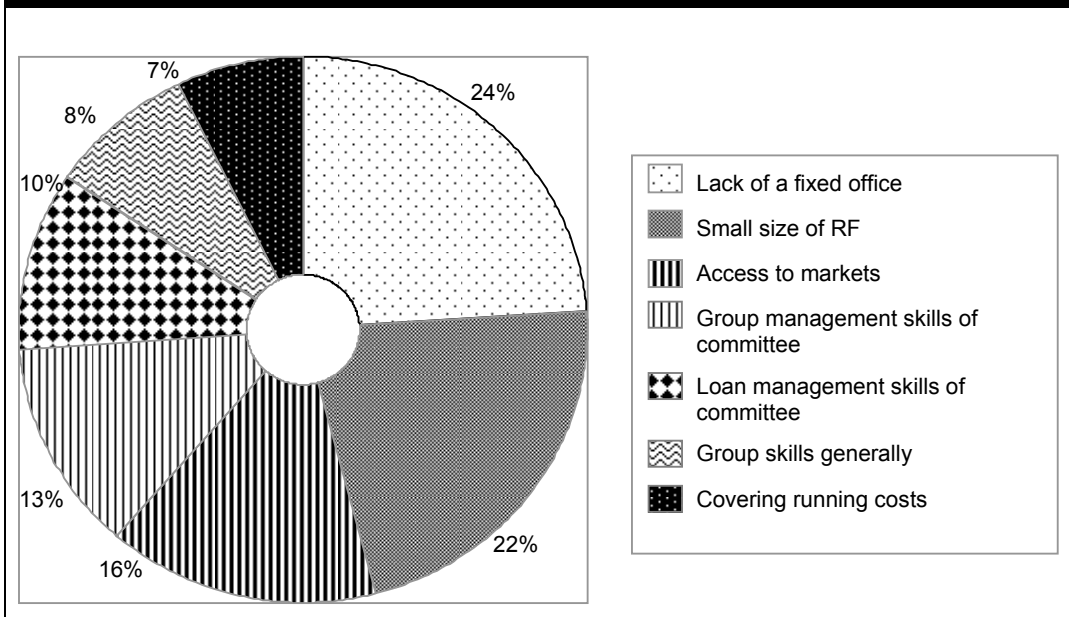
Groups were candid about their strengths and the challenges they face¹⁵ (see Figure 4). Their major group strength is the management capacity they have developed since establishing their revolving funds, particularly in terms of the training received by the elected management committee, the development of group constitutions accepted by the membership and the exchange visits that gave them the experience benefit of older groups in the area. This together with good group cohesion has attracted new members and enables the SACCOSs' membership to grow by 55 per cent over the past year.



In terms of challenges, the major concerns of SACCOSs focus on three issues – the need to establish a fixed location and office from which to run the SACCOS, enlarging the size of their revolving fund and facilitating better access to markets for their members (e.g. through construction of a group-owned crop store to enable members to store crops and market when process rise) (see Figure 5 overleaf).

¹⁵ The strengths and challenges exercise was carried out in April 2007 as a focus group discussion with management committees and a small number of members to identify and then rank agreed issues. The SWOT analysis (see Table 5) was developed in April 2006 and comparing the two confirms the consistency of group responses.

Figure 5. Main concerns of the SACCOS



Given the emphasis put on good group management when listing strengths, this is a relatively lower priority but members are nonetheless concerned about the group and loan management skills of their committees and where they will get support and training after the project has closed and their skills generally. Two of the groups have applied for substantial loans from the Cooperatives Department to boost the size of their revolving funds – Qameyu for TSh 30 million and Qameyu for TSh 20 million. The Department requires a SACCOS to have at least TSh 3 million in their revolving fund already in order to qualify, which currently excludes Gijedaboshka. These loans are repayable over three years at a 10 per cent interest rate. Qameyu plan to increase their interest rate to 12 per cent in order to repay the loan with interest and still realise a surplus to increase the size of their core revolving fund.

6. Cost benefit analysis of the Farmer Participatory Research model

6.1 Developing the analysis

In developing a cost-benefit analysis, the approach taken has been to assess benefits against the costs of a potential adopter of the model, rather than the actual costs that the project has resourced over the last two years of implementation. The potential adopter used for this calculation is the District Council and therefore certain costs, such as salaries and allowances, have been developed according to existing Government practice rather than using FARM-Africa rates. The total operating costs for the first six years of the model covering 12 farmer research groups experimenting and adopting new varieties of maize and beans and implementing local certified seed production totalled £245,118 or an average of £40,853 per annum. This compares with an actual project budget for 24 groups of £33,650 per annum for its two-year duration, a difference of £7,203 per annum¹⁶.

A number of assumptions and qualifications were made to enable the cost-benefit analysis to be constructed, including:

- The social discount rate is set at 10 per cent (the World Bank recommended rate for Tanzania).
- The time horizon is based on an implementation period of two farmer participatory research cycles (three years each) followed by a further two cycles with follow-up and monitoring support only, giving a total of 12 years.
- Costs are inflated at the current official rate of 5 per cent per annum. Benefits are not inflated on the basis of increased supply exerting a downward pressure on price of agricultural staples. The one exception to this is the rise in price from TSh 10,000 to 12,109/bag¹⁷ as increased supply in an area attracts grain traders that have not previously considered the area a potential source of supply. This one-off increase only occurs after production has improved and so is only factored into the Cost-

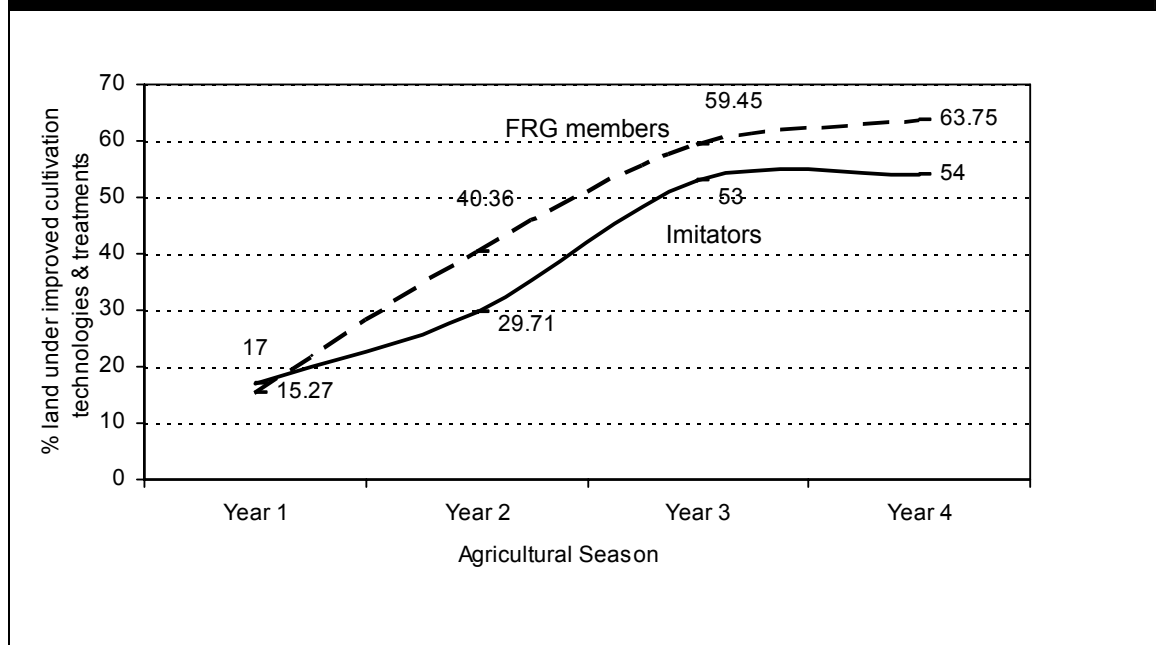
¹⁶ Comparisons are complicated by the necessary simplification of the project approach, which included credit activities and horticultural support, to those elements for which reliably measured economic results exist

¹⁷ Each bag contains 100 kg of shelled maize

Benefit Analysis (CBA) after one full three-year cycle of FPR has been completed. A similar rise in bean prices has not been measured by the project.

- Yield increases are based on four years of data showing an average increase achieved with the introduction of composite maize from 4.8 bags per acre with local maize to 12.66 bags per acre with composite. Bean yields increased over the same period from 2.4 bags per acre (intercropped) of local beans to 4.8 bags per acre (intercropped) with Lyamunga 90.
- The area of improved maize and bean production reaches a peak of 1.59 acres per farmer (63.75 of the total farm area, see Figure 6 below). The similar area for “imitator” farmers¹⁸ has been measured at 1.35 acres. Both of these are reached in year 4 of the intervention, based on research carried out by the project. Imitator farmers only begin receiving benefits in year two and therefore reach the 1.35 acre maximum in year five of the intervention. The CBA uses the progression measured (as per Figure 6) for the first four years.

Figure 6. Rate of uptake by FRG members and imitator farmers



¹⁸ There are three of these formally recognised for each FRG member, targeted to benefit from farmer-to-farmer training, field days and access to inputs

- In group discussions, members confirmed that they had a responsibility to train a further two to five imitator farmers. One group (Qameyu) went so far as to state that their five-year plan was to ensure all farmers in the village were using improved agricultural techniques developed through on-farm trials – they estimated that they had reached 75 per cent of farmers to date. The remaining 25 per cent were considered too poor to take up innovations so far. Other groups confirmed their assessment of 70-75 per cent of farmers in the village adopting improved maize varieties and cultivation practices (spacing, timely planting, use of farmyard manure/compost)¹⁹. (See Table 12 below for the innovations most popular with the imitators). Of the various ways of multiplying to innovators, direct training on a farmer-to-farmer basis was considered the most effective as it enabled FRG members to mentor their assigned imitators in a more systematic way. Adoption varied from two to five per FRG member and according to the technology – access to improved maize and bean seed were listed as the most popular and this was a significant motivation for the establishment of SACCOS to give farmers seed loans.

Table 12. Innovations most popular with imitators²⁰

Group	Innovations most popular with imitator farmers
Nanagara	Correct spacing of crops, improved varieties of composite maize and bean seed
Ayamango	Improved (1) composite maize, (2) pigeon peas, (3) beans
Tsamam	Improved maize (UCA) and beans (Jesca)
Qameyu	Hybrid maize varieties (614 and 628), potatoes

- Impact assessment results broadly confirmed the groups' assessment of the uptake of their innovations, although suggesting a levelling out of expansion at around 60 per cent of group farmers' land at village level. Imitators followed a similar pattern of expansion albeit slightly below the level of FRG members. The reasons for this would be a useful subject for further enquiry but one factor is that land may also be used for crops for which no specific on-farm trial innovations have been yet generated, such as groundnuts. The fact that the rate of adoption of FRG

¹⁹ This compares with the finding in the impact assessment of only 44 per cent for improved maize and 37 per cent for farmyard manure in two of the villages also covered by the internal review (Tsamam and Qameyu)

²⁰ Impact Assessment Study of Farmer Participatory Research – Ejigu Jonfa (December 2005)

innovations by imitators follows a similar pattern as FRG members demonstrates the relevance of the innovations to both group and non-group farmers and the effectiveness of the farmer-to-farmer approach adopted by the project.

- Average village size in Babati is 566 households, of which at least two-thirds are farming households. The number of other farmers adopting improved FPR innovations has been assessed as between 60 – 75 per cent of other farmers in the village. The CBA took the lower 60 per cent figure (as above), which translates into 162 farmers per village²¹, and assumed that these other farmers would not start to adopt any FPR-generated improvements until year three of the intervention. They would do so on the same area as imitators but would only achieve 80 per cent of the yield improvements as they have not received the training and mentoring available to FRG members and imitators. The progression based on assessment by the project staff is 20 per cent in year three, 40 per cent in year four, 70 per cent in year five and the full 162 farmers by year six.
- Labour costs are calculated at TSh 240/hour with a requirement of 481 hours per acre or 60 labour days.
- FARM-Africa's Training and Advisory Unit's support is seen as vital to successful replication. This has been budgeted at eight x three days training and mentoring sessions per annum for the first three year cycle, dropping to four for the second cycle. Local consultancy rates of TSh 40,000 per hour have been used to cost both training and preparation time.
- A number of the potential benefits of FPR, highlighted by farmers and extension staff in interviews and group discussions, are either difficult to quantify or qualitative in nature. These include:
 - increased knowledge and skills which can be applied to other farm enterprises or activities (group planning and management, gender and HIV mainstreaming, leadership skills, etc)
 - increased social capital from group formation and support
 - increased effectiveness of the extension system, especially at village level
 - improved long-term soil structure (fertility, structure, reduced erosion)²²

²¹ Based on District Council village population statistics

²² Benefits are partly captured by increased crop yields

- Costs that proved difficult to assess accurately and were therefore not included in the analysis are time FRG members allocated to group formation, training and management and the time costs associated with expert support from TOSCI and Selian Agricultural Research (although their allowances and transport costs are fully covered). Likewise the time savings of farmers being able to access seed locally rather than in Babati could not be accurately measured and were not included.

In developing the analysis, deliberate use of lowest benefit data and highest cost data was made. So yield data from composites over four years of production were used rather than the higher “all improved maize” data (see Figure 1 on page 20).

6.2 Cost-benefit Analysis results

The net present value of the basic FPR model focusing on group formation and participatory research on maize and bean varieties in 12 villages is £174,403, representing an internal rate of return of 55 per cent (see Annex 1 Table 1). Adding seed multiplication to the mix of activities increases the NPV to £186,145 and the rate of return to 56 per cent (see Annex 1 Table 2). Although this is only a marginal increase, it represents seed production of only one acre each of composite maize and improved beans per village – in practice, villages usually expand their seed production beyond this level to meet growing demand for local certified seed supplies. Due to the relatively short time since their introduction, experience with input retailing and savings and credit cooperatives (the next layers of the model, see Figure 8 on page 49) had not yet generated the data needed to extend the analysis to include these enterprises. However, an average £15,500 net present value per village for basic farmer participatory research plus seed multiplication represents a worthwhile return to extension activity. Aggregating this to district level gives a figure of £1,348,500 or £112,375 per annum.

7. Institutionalising the approach into extension systems

At a stakeholder workshop²³, both District Council staff and staff of other institutions involved (Selian Agricultural Research Centre (SARI), Tanzania Official Seed Certification Institute (TOSCI), Arusha Seed Farm) confirmed the close integration of work with the project, especially on the demand-led modifications to FPR (input shops, group seed multiplication, introduction of microfinance through SACCOSs). Seed and research stakeholders in particular highlighted the sustainable dissemination of technology within groups, the relationship between FARM-Africa Tanzania and the District Council in training FRGs and the linkage of farmers with other stakeholders. Farmers highlighted the integration of extension staff in the training they received and the District Council pointed to the training their staff had received, their involvement in field days at groups' on-farm trials and at agricultural shows.

Farmers highlighted the importance of spreading the approach to other groups in the area and enhancing their ability to access markets. These concerns were echoed by research and seed institutions who also highlighted the need to integrate various extension and marketing initiatives. Government staff focused on the both the challenges of expanding the FPR approach and demonstrating its effectiveness through the generation of data and analysis, which would promote this expansion (see Table 13 overleaf).

Two Subject Matter Specialists at District Council Agriculture Department level have been appointed to support and promote the integration of FPR and seed multiplication and certification respectively into the group-based extension work carried out by the District Council. The District Agriculture & Livestock Development Officer indicated a need to assess the best aspects of FPR and the Farmer Field Schools (FFSs) that have been developed to develop a single approach, although VEOs indicated that this would in effect entail the adoption of FPR, which already contains the best elements of FFSs, particularly with its emphasis on on-farm trials and the training of imitators by FRG members, which the FRGs visited indicated was the most effective way of multiplying farmer adoption above field days, agricultural shows, etc.

²³ Held in April 2006

Table 13. Recommendations for sustainability of the FPR approach	
Farmers	
1.	Spreading the benefits of FPR to other farmers needs support especially with on-farm trials, seed supply, integrated pest management
2.	Spread input shops and storage facilities to all groups
3.	Establish SACCOSs in all groups to strengthen access to credit for agricultural inputs
4.	Network groups together and groups with expert advice
5.	Empower groups to improve their bargaining position in the market
6.	Strengthen groups to access information on markets
7.	Increase contact between groups and private sector input suppliers and output traders
Research and seed institutions	
1.	Ensure a further two years of FARM-Africa Tanzania support to enable groups to be registered, empowered and networked
2.	District Council should actively integrate FPR with AMSDP (markets for farmers); TASAFA (networks for farmers); DADEPS (training for farmers); Technoserve (seed/markets for farmers); research and seed institutions (centres of information for farmers)
3.	Extend the project to other districts
4.	Ensure that the work is consistent with the 2003 seed policy
5.	Strengthen group seed multiplication, preparation and marketing
Government staff	
1.	Disseminate research finding in different forms – leaflets, brochures, etc
2.	Extract more data from the 3-5 years of project experience in FPR
3.	Expand to include food processing e.g. oil processing
4.	Empower groups for networking
5.	Training for groups in analysis of innovations
6.	Increase the involvement of established and successful SACCOSs in the capacity building of those newly-established

Villages Extension Officers (VEOs) have been integrated into the programme from the inception of FPR work. They all confirmed that they were involved in the establishment of FRGs and subsequent training, accompanying them on exchange visits and study tours. They were replicating FPR to one to three other farmer groups in their area and attended regular FRG quarterly meetings. VEOs had received reference materials from the project and training on issues such as seed multiplication, integrated pest management, farm budgeting, soil erosion control and FPR methodology. Not all VEOs indicated they were including FRGs in their annual workplans and budgets for submission to the District Council, but the VEO Tsamas confirmed that the FRG has received agroforestry and dairy goat support from the

Council and she was using FRG members as mentors for other groups not supported by the project. The VEO Nangara however felt that her priority was to access District Council support for other groups as FARM-Africa was already supporting the FRG. VEOs indicated their main challenges being:

- transport to cover their areas, which in some cases included sub-villages 15-20 km from their base;
- drop-outs from their own groups (crop husbandry, fodder, dairy goat, poultry groups) as members do not receive the free inputs that project FRGs do; and,
- staff turnover. The Nangara VEO had only been in post 6 months and is not as familiar with the project as her predecessor.

Both the CIAT/Selian ARI National Bean Programme and Multiflower were circumspect about their capacity to work directly with FRGs through the District Council's extension system. They liked to link through the project staff as they felt that FARM-Africa Tanzania was trusted by farmers, was relevant to their priorities and actually delivered on the ground. Working with District Council extension staff usually entailed extra costs (such as per diems) which made cooperation more costly.

8. Conclusions

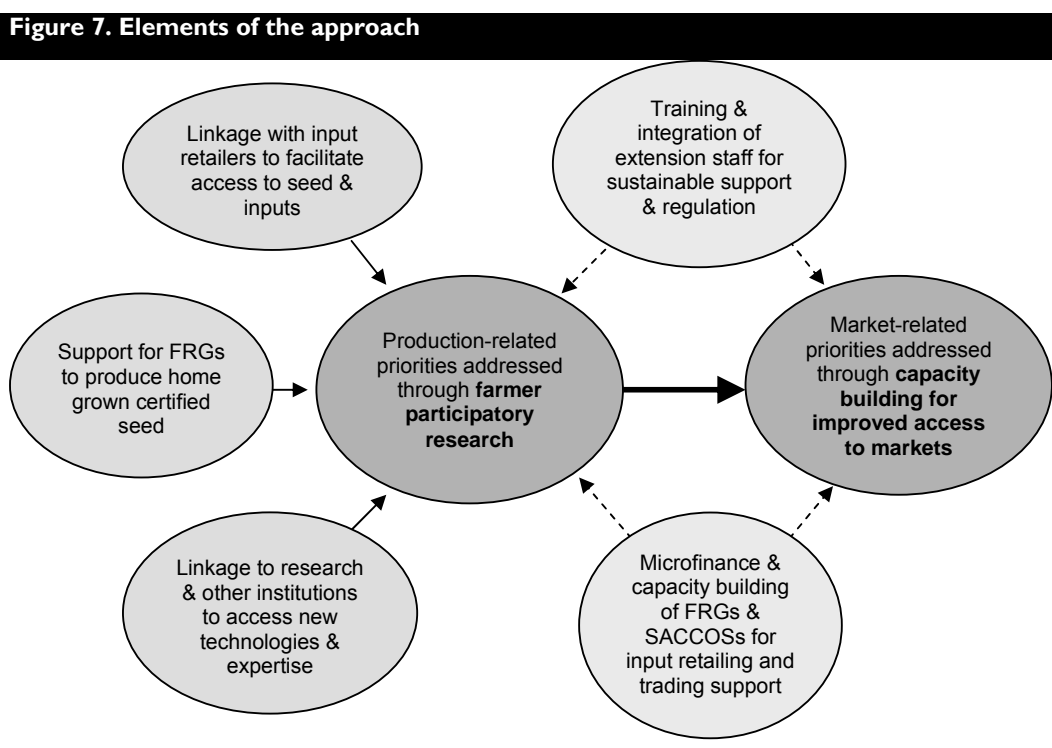
The project has clearly had a considerable impact relative in terms of the productivity improvements of the innovations tested through on-farm trials with 24 farmer research groups. This has led to a substantial degree of uptake by farmers outside the research groups, particularly in relation to maize and bean cultivation. Whilst it is too early to determine the success of the SACCOS initiative (this will be more apparent when most SACCOSs have completed a number of lending cycles), the impact of FPR work, diversification into vegetable production, seed multiplication (with the exception of potato seed multiplication affected by drought in late 2005), linkage with research partners, seed certification agencies, seed retailers and Multiflower Seeds has been particularly effective and is highly regarded by both farmers and partner agencies. Both the research partners and Multiflower Seed highlighted the trust in which the project is held by farmers as the key reason for their establishing a link with FARM-Africa Tanzania.

This success has avoided some of the group management problems that could have occurred given the limited work on capacity building for FRGs, although this has become an important focus in the strengthening of groups in credit management. The relevance and impact of technologies tested to farmer priorities has created social capital amongst the groups and a motivation from group members that may not have emerged if these had been less useful. This has been due to the participatory approach taken by the team, careful not to promote a technology without clear demand from farmers and has led to farmers and groups identifying their institutions and achievements as theirs, rather than FARM-Africa's.

SACCOSs indicated specific additional capacity building required (especially group dynamics, leadership, management and record keeping) and the need for more direct training and continuous mentoring, especially of their committees, in the critical early stages of their credit activities and in their first credit recovery phase. It is likely that prospective members are waiting to determine whether or not the association is well-managed and therefore worth joining, so further support to facilitate successful lending is likely to have some impact on the growth prospects of SACCOSs. The credit specialists in the Cooperatives Dept should ensure that SACCOSs received monitoring and mentoring through the first loan cycle to reduce the chances of collapse of SACCOSs due to committee management weaknesses. Tsamas is a relatively older association and has already increased the size of its fund through lending activities to date. They were the only group that could initially relate

their interest rate to running costs and the local bank rate²⁴ and the only group to have benefited from a study tour to other successful SACCOSs in Tanzania. This makes them a useful resource for exchanges with younger groups in the project area.

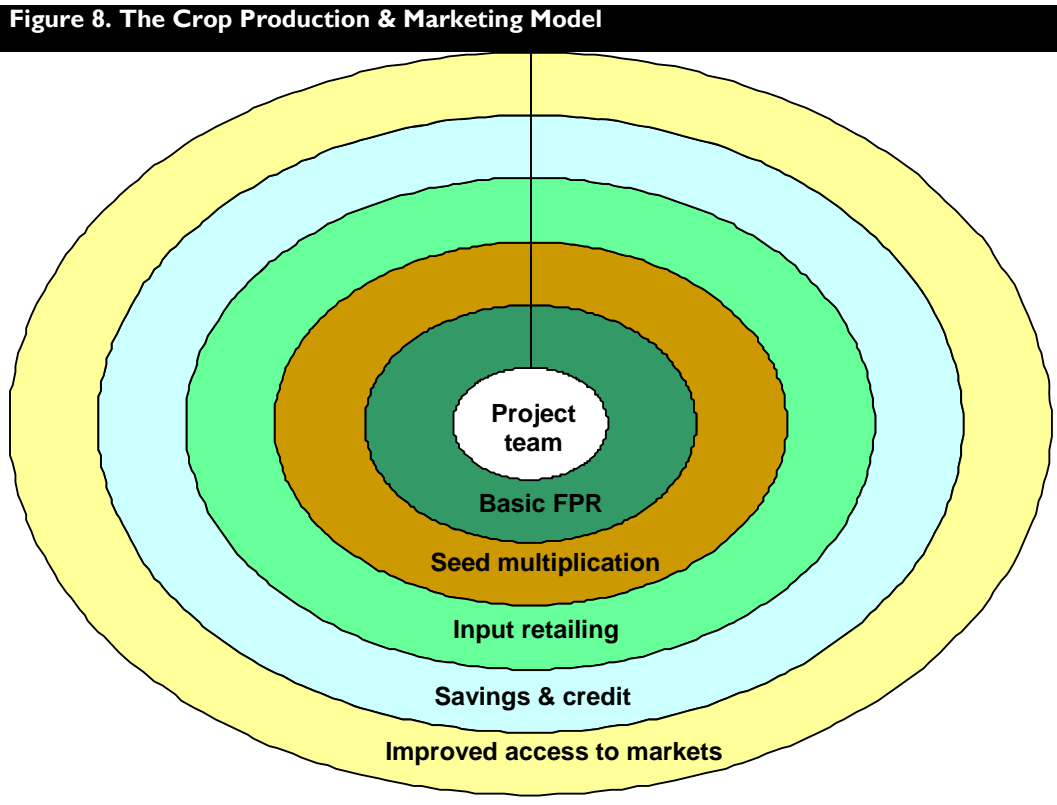
The project has evolved through a number of stages as it addressed the existing and emerging priorities of smallholder farmer in Babati District. This process has developed a demand-led participatory model of farmer research and extension, the core of which is the farmer participatory research approach and the subsequent capacity building of farmer groups in managing microfinance and input retailing. The remaining challenges in developing the model primarily revolve around issues related to extending FPR to priorities not yet addressed, the strengthening of microfinance institutions and the enhancement of smallholder marketing capacity (see Figure 7 below).



The farmer participatory research model that the project has developed has become increasingly complex as it has sought to respond to both the priorities of farmers and issues that emerge from implementation. So once demand for improved crop varieties increased as a result of on-farm trials, so access to seed issues triggered on-farm seed multiplication.

²⁴ The final evaluation in 2007 confirmed other SACCOSs recognising the importance of this link.

Once this had been established, the challenge of retailing that seed and other inputs, such as vegetable seed for horticultural enterprises, led to the establishment of input shops. As more farmers in each village sought to include improved maize, beans and other crops into their farming practices, the issue of affordability of inputs triggered the establishment of savings and credit cooperatives to extend small loans to farmers and enable them to purchase improved inputs. The model can therefore be characterised as an onion which has developed its layers as priorities have emerged from earlier work (see Figure 8 below).



The next challenge in the development of the model is, having addressed constraints in productivity resulting in farmers achieving surpluses that they can market, to develop ways in which market access and the returns smallholder farmers can achieve are improved. Issues include better access to market information, greater understanding of the marketing issues in each sub-sector, adding value through local processing where feasible and reducing the length of the market chain to enhance direct returns to the primary producer. This is the next layer of an integrated farmer group crop production and marketing model that can be replicated and scaled up in other areas of Tanzania and East Africa generally.

9. Annexes

Table I. Costs & Benefits of the basic FPR model												
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Costs												
1. Awareness creation												
District - lunch 7,500 x 6 District Council staff (incl. FPR expert)	45,000											
Village - lunch 1,000 x 25 village leaders x 12 groups	300,000											
Stationary	100,000											
2. Selection of FRG members												
Lunch allowance VEO	60,000											
Lunch allowance FPR expert	90,000											
3. FRG planning												
Selection enterprises/design of plots:												
Lunch 1,000 x 2 days x 18 parts. x 12 groups	432,000	453,600	476,280	500,094	525,099	551,354						
Lunch allowance VEO & FPR expert	162,500	170,625	179,156	188,114	197,520	207,396						

After germination: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	244,334	256,551
Tassling/flowering: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	244,334	256,551
Maturity: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	244,334	256,551
Exchange: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442						
Field day: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442						
7. Annual FPR review												
Transport 2,000 x 12 groups x 2 FRG members	48,000	50,400	52,920	55,566	58,344	61,262	64,325	67,541	70,918	74,464	78,187	82,096
Transport 2,000 x 5 VEOs	10,000	10,500	11,025	11,576	12,155	12,763	13,401	14,071	14,775	15,513	16,289	17,103
Transport 10,000 x 5 experts	50,000	52,500	55,125	57,881	60,775	63,814	67,005	70,355	73,873	77,566	81,445	85,517
Lunch 1,000 x 24 group members	24,000	25,200	26,460	27,783	29,172	30,631	32,162	33,770	35,459	37,232	39,093	41,048
Lunch 5,000 x 5 VEOs	25,000	26,250	27,563	28,941	30,388	31,907	33,502	35,178	36,936	38,783	40,722	42,758
Lunch 7,500 x 9 experts	67,500	70,875	74,419	78,140	82,047	86,149	90,456	94,979	99,728	104,715	109,950	115,448
Venue hire	30,000	31,500	33,075	34,729	36,465	38,288	40,203	42,213	44,324	46,540	48,867	51,310
Stationary	100,000	105,000	110,250	115,763	121,551	127,628	134,010	140,710	147,746	155,133	162,889	171,034
Per diem 30,000 x 4	120,000	126,000	132,300	138,915	145,861	153,154	160,811	168,852	177,295	186,159	195,467	205,241
8. District shows												
Stall construction	500,000	525,000	551,250	578,813	607,753	638,141	670,048	703,550	738,728	775,664	814,447	855,170
PR materials (leaflets, photos, etc)	85,000	89,250	93,713	98,398	103,318	108,484	113,908	119,604	125,584	131,863	138,456	145,379

Lunch 6000 x 1 group member x 12groups	72,000	75,600	79,380	83,349	87,516	91,892	96,487	101,311	106,377	111,696	117,280	123,144
Vehicle use: 25 litres x TSh 1,200 x 2 days	60,000	63,000	66,150	69,458	72,930	76,577	80,406	84,426	88,647	93,080	97,734	102,620
Vehicle hire (TSh 750/km)	60,000	63,000	66,150	69,458	72,930	76,577	80,406	84,426	88,647	93,080	97,734	102,620
9. Zonal shows												
Stall construction materials	1,000,000	1,050,000	1,102,500	1,157,625	1,215,506	1,276,282	1,340,096	1,407,100	1,477,455	1,551,328	1,628,895	1,710,339
Casual labour: 2 days x 2 labourers x TSh 2,000	8,000	8,400	8,820	9,261	9,724	10,210	10,721	11,257	11,820	12,411	13,031	13,683
FPR materials (leaflets, photos, etc)	100,000	105,000	110,250	115,763	121,551	127,628	134,010	140,710	147,746	155,133	162,889	171,034
PD: 3 staff x 8 days x TSh 20,000	480,000	504,000	529,200	555,660	583,443	612,615	643,246	675,408	709,179	744,638	781,869	820,963
Accommodation: 3 staff x 8 days x TSh 15,000	360,000	378,000	396,900	416,745	437,582	459,461	482,434	506,556	531,884	558,478	586,402	615,722
Transport: 60 litres x TSh 1,200 x 2 days	144,000	151,200	158,760	166,698	175,033	183,785	192,974	202,622	212,754	223,391	234,561	246,289
Vehicle use: 25 litres x TSh 1,200 x 2 days	60,000	63,000	66,150	69,458	72,930	76,577	80,406	84,426	88,647	93,080	97,734	102,620
Vehicle hire (TSh 750/km)	300,000	315,000	330,750	347,288	364,652	382,884	402,029	422,130	443,237	465,398	488,668	513,102
10. M&E												
Baseline study	13,000,000			15,049,125								
Annual impact assessment	8,000,000	8,400,000	8,820,000	9,261,000	9,724,050	10,210,253	10,720,765	11,256,803	11,819,644	12,410,626	13,031,157	13,682,715
External review every 3 years			11,000,000			12,733,875			14,741,052			17,064,610
FRG visits to research (once/3 years):		1,500,000			1,736,438			2,010,143			2,326,992	

Transport: 80 litres x TSh 1,200 x 2 days	192,000	201,600	211,680	222,264	233,377	245,046	257,298	270,163	283,671	297,855	312,748	328,385
PD/lunch: 1 group member x 13 groups x 2 days x TSh 11,000	286,000	300,300	315,315	331,081	347,635	365,017	383,267	402,431	422,552	443,680	465,864	489,157
11. Exchange and field day costs												
Exchange visits: 2 trips x 12 days x 50 litres x TSh 1,200	1,440,000	1,512,000	1,587,600	1,666,980	1,750,329	1,837,845	1,929,738	2,026,225	2,127,536	2,233,913	2,345,608	2,462,889
Lunch VEO & FPR x 24 exchange visits	300,000	315,000	330,750	347,288	364,652	382,884	402,029	422,130	443,237	465,398	488,668	513,102
Vehicle: 4WD x 12 round trips x 40 litres x 1,200	576,000	604,800	635,040	666,792	700,132	735,138	771,895	810,490	851,014	893,565	938,243	985,155
Vehicle hire (TSh 750/km)	720,000	756,000	793,800	833,490	875,165	918,923	964,869	1,013,112	1,063,768	1,116,956	1,172,804	1,231,444
Field days: 12 x 30 participants x lunch TSh 1,000	360,000	378,000	396,900	416,745	437,582	459,461	482,434	506,556	531,884	558,478	586,402	615,722
Lunch VEO & FPR x 12 field days	150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	244,334	256,551
Seed distribution: 2 days x 50 litres x TSh 1,200	120,000	126,000	132,300	138,915	145,861	153,154	160,811	168,852	177,295	186,159	195,467	205,241
12. Staff												
1 FPR expert/12 groups	4,236,000	4,447,800	4,670,190	4,903,700	5,148,884	5,406,329	5,676,645	5,960,477	6,258,501	6,571,426	6,899,998	7,244,998
12 VEOs x 25% salary	8,640,000	9,072,000	9,525,600	10,001,880	10,501,974	11,027,073	11,578,426	12,157,348	12,765,215	13,403,476	14,073,650	14,777,332
District & research (4 staff x 90/230)	6,630,261	6,961,774	7,309,863	7,675,356	8,059,124	8,462,080	8,885,184	9,329,443	9,795,915	10,285,711	10,799,996	11,339,996

groups x 18 members)												
Composite maize seed (7 kg/acre vs 10 kg/acre local)	533,520	1,488,942	2,292,425	2,585,073	2,714,327	2,850,043	2,992,545	3,142,172	3,299,281	3,464,245	3,637,457	3,819,330
Additional manure (7 MT vs 3.5 MT/acre)	614,779	1,715,719	2,639,438	2,977,453	3,126,326	3,282,642	3,446,774	3,619,113	3,800,068	3,990,072	4,189,575	4,399,054
Labour per season (local is 60% of composite)	3,790,126	10,577,488	16,274,589	18,358,242	19,276,154	20,239,962	21,251,960	22,314,558	23,430,285	24,601,800	25,831,890	27,123,484
Bags for marketing (TSh 500 each)	519,566	1,450,000	2,229,979	2,517,463	2,643,336	2,775,503	2,914,278	3,059,992	3,212,992	3,373,642	3,542,324	3,719,440
Storage costs (actellic dusting, TSh 2,500/200g, 50g/bag)	649,458	1,811,810	2,788,486	3,147,916	3,305,312	3,470,577	3,644,106	3,826,312	4,017,627	4,218,509	4,429,434	4,650,906
Maize for associate members (3/FRG member)												
Composite maize seed (7 kg/acre vs 10 kg/acre local)		1,857,492	3,438,638	6,438,295	6,914,419	7,260,140	7,623,147	8,004,305	8,404,520	8,824,746	9,265,983	9,729,282
Additional manure (7 MT vs 3.5 MT/acre)		2,140,402	3,959,157	7,415,544	7,963,742	8,361,929	8,780,025	9,219,027	9,679,978	10,163,977	10,672,176	11,205,784
Labour per season (local is 60% of composite)		13,195,678	24,411,884	45,722,413	49,099,900	51,554,895	54,132,639	56,839,271	59,681,235	62,665,297	65,798,561	69,088,489
Bags for marketing (TSh 500 each)		1,808,911	3,344,968	6,269,909	6,733,581	7,070,260	7,423,773	7,794,961	8,184,709	8,593,945	9,023,642	9,474,824
Storage costs (actellic dusting, TSh 2,500/200g, 50g/bag)		2,260,278	4,182,728	7,840,093	8,416,976	8,837,824	9,279,716	9,743,701	10,230,887	10,742,431	11,279,552	11,843,530
Maize for other farmers in the village (162)												
Composite maize seed (7 kg/acre vs			97,583	360,935	1,183,134	1,775,086	1,863,840	1,957,032	2,054,884	2,157,628	2,265,509	2,378,785

Table 2. Costs & Benefits of FPR + Seed Multiplication Model												
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Costs												
1. Awareness creation												
District - lunch 7,500 x 6 District Council staff (incl. FPR expert)	45,000											
Village - lunch 1,000 x 25 village leaders x 12 groups	300,000											
Stationary	100,000											
2. Selection of FRG members												
Lunch allowance VEO	60,000											
Lunch allowance FPR expert	90,000											
3. FRG planning												
Selection enterprises/design of plots:												
Lunch 1,000 x 2 days x 18 parts. x 12 groups	432,000	453,600	476,280	500,094	525,099	551,354						
Lunch allowance VEO & FPR expert	162,500	170,625	179,156	188,114	197,520	207,396						
4. Technical training												
Lunch 1,000 x 18 days x 18 parts. x 12 groups	3,888,000	4,082,400	4,286,520	4,500,846	4,725,888	4,962,183						
Lunch allowance VEO & FPR expert	2,700,000	2,835,000	2,976,750	3,125,588	3,281,867	3,445,960						
5. Identification and establishment of demo plots												
Lunch 1,000 x 1 day x 18 parts. x 12 groups	192,000	201,600	211,680	222,264	233,377	245,046						

Lunch allowance VEO & FPR expert	150,000	157,500	165,375	173,644	182,326	191,442						
Maize seed 7 kg x 1,000 x 12 groups	84,000	88,200	92,610	97,241	102,103	107,208						
Bean seed 30 kg x 1,000 x 12	360,000	378,000	396,900	416,745	437,582	459,461						
Spirit level 1,000 x 3 x 12 (Year 1 & 4 only)	36,000			41,675								
Levelling boards TSh 3,000 x 6 x 12 (Year 1 & 4 only)	216,000			250,047								
Manilla rope TSh 17 x 30m x 12 (Year 1 & 4 only)	6,120			7,085								
Grass seedlings 5 bundles x 2 strips x 1,000 x 12 (Year 1 only)	120,000											
Transport: 12 4WD trips x 20 litres x 1,250	300,000	315,000	330,750	347,288	364,652	382,884						
Vehicle hire (TSh 750/km)	360,000	378,000	396,900	416,745	437,582	459,461						
6. Monitoring & learning visits												
After germination: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	244,334	256,551
Tassling/flowering: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	244,334	256,551
Maturity: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	244,334	256,551
Exchange: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442						
Field day: Lunch x 1 day x 12 groups x 2 staff	150,000	157,500	165,375	173,644	182,326	191,442						
7. Annual FPR review												
Transport 2,000 x 12 groups x 2 FRG members	48,000	50,400	52,920	55,566	58,344	61,262	64,325	67,541	70,918	74,464	78,187	82,096
Transport 2,000 x 5 VEOs	10,000	10,500	11,025	11,576	12,155	12,763	13,401	14,071	14,775	15,513	16,289	17,103
Transport 10,000 x 5 experts	50,000	52,500	55,125	57,881	60,775	63,814	67,005	70,355	73,873	77,566	81,445	85,517
Lunch 1,000 x 24 group	24,000	25,200	26,460	27,783	29,172	30,631	32,162	33,770	35,459	37,232	39,093	41,048

13. Staff training												
Staff training (1 FPR expert)	423,600	444,780	467,019	490,370	514,888	540,633						
Staff training & mentoring by TAU (VEOs & District Council)	29,008,000	30,458,400	31,981,320	16,790,193	17,629,703	18,511,188						
14. Running costs												
Motorcycle (every 5 years)	5,000,000					6,381,408						
Motorcycle running costs	1,168,545	1,226,972	1,288,321	1,352,737	1,420,374	1,491,392	1,565,962	1,644,260	1,726,473	1,812,797	1,903,437	1,998,609
Protective clothing (FPR expert)	149,000			172,486								
Protective clothing (VEOs)	1,788,000			96,083								
Computer	2,000,000			2,315,250			2,680,191			3,102,656		
Stationary	150,000	157,500	165,375	173,644	182,326	191,442	201,014	211,065	221,618	232,699	244,334	256,551
Reference materials	100,000	105,000	110,250	115,763	121,551	127,628	134,010	140,710	147,746	155,133	162,889	171,034
Office furniture	200,000							300,000				
Office rent-shared	600,000	630,000	661,500	694,575	729,304	765,769	804,057	844,260	886,473	930,797	977,337	1,026,204
Water	72,000	75,600	79,380	83,349	87,516	91,892	96,487	101,311	106,377	111,696	117,280	123,144
Electricity	480,000	504,000	529,200	555,660	583,443	612,615	643,246	675,408	709,179	744,638	781,869	820,963
Phone	700,000	735,000	771,750	810,338	850,854	893,397	938,067	984,970	1,034,219	1,085,930	1,140,226	1,197,238
Internet	500,000	525,000	551,250	578,813	607,753	638,141	670,048	703,550	738,728	775,664	814,447	855,170
13. Increased cost of production to farmers												
a) Maize for FRG members (12 groups x 18 members)												
Composite maize seed (7 kg/acre vs 10 kg/acre local)	533,520	1,488,942	2,292,425	2,585,073	2,714,327	2,850,043	2,992,545	3,142,172	3,299,281	3,464,245	3,637,457	3,819,330
Additional manure (7 MT vs 3.5 MT/acre)	614,779	1,715,719	2,639,438	2,977,453	3,126,326	3,282,642	3,446,774	3,619,113	3,800,068	3,990,072	4,189,575	4,399,054
Labour per season (local is 60% of composite)	3,790,126	10,577,488	16,274,589	18,358,242	19,276,154	20,239,962	21,251,960	22,314,558	23,430,285	24,601,800	25,831,890	27,123,484
Bags for marketing (TSh 500 each)	519,566	1,450,000	2,229,979	2,517,463	2,643,336	2,775,503	2,914,278	3,059,992	3,212,992	3,373,642	3,542,324	3,719,440
Storage costs (actellic dusting, TSh 2,500/200g, 50g/bag)	649,458	1,811,810	2,788,486	3,147,916	3,305,312	3,470,577	3,644,106	3,826,312	4,017,627	4,218,509	4,429,434	4,650,906

Maize for associate members (3/FRG member)												
Composite maize seed (7 kg/acre vs 10 kg/acre local)		1,857,492	3,438,638	6,438,295	6,914,419	7,260,140	7,623,147	8,004,305	8,404,520	8,824,746	9,265,983	9,729,282
Additional manure (7 MT vs 3.5 MT/acre)		2,140,402	3,959,157	7,415,544	7,963,742	8,361,929	8,780,025	9,219,027	9,679,978	10,163,977	10,672,176	11,205,784
Labour per season (local is 60% of composite)		13,195,678	24,411,884	45,722,413	49,099,900	51,554,895	54,132,639	56,839,271	59,681,235	62,665,297	65,798,561	69,088,489
Bags for marketing (TSh 500 each)		1,808,911	3,344,968	6,269,909	6,733,581	7,070,260	7,423,773	7,794,961	8,184,709	8,593,945	9,023,642	9,474,824
Storage costs (actellic dusting, TSh 2,500/200g, 50g/bag)		2,260,278	4,182,728	7,840,093	8,416,976	8,837,824	9,279,716	9,743,701	10,230,887	10,742,431	11,279,552	11,843,530
Maize for other farmers in the village (162)												
Composite maize seed (7 kg/acre vs 10 kg/acre local)			97,583	360,935	1,183,134	1,775,086	1,863,840	1,957,032	2,054,884	2,157,628	2,265,509	2,378,785
Additional manure (7 MT vs 3.5 MT/acre)			112,354	415,720	1,362,685	2,090,444	2,194,966	2,304,714	2,419,950	2,540,948	2,667,995	2,801,395
Labour per season (local is 60% of composite)			692,770	2,563,226	8,401,538	12,888,647	13,533,079	14,209,733	14,920,220	15,666,231	16,449,543	17,272,020
Bags for marketing (TSh 500 each)			75,955	281,251	921,934	1,413,445	1,484,117	1,558,323	1,636,239	1,718,051	1,803,954	1,894,151
Storage costs (actellic dusting, TSh 2,500/200g, 50g/bag)			94,978	351,200	1,152,418	1,767,914	1,856,310	1,949,125	2,046,581	2,148,910	2,256,356	2,369,174
b) Beans for FRG farmers												
Bean seed	984,960	2,748,816	4,229,366	4,770,382	5,008,901	5,259,346	5,522,313	5,798,429	6,088,350	6,392,768	6,712,406	7,048,026
Bags for marketing	196,992	549,763	845,490	954,488	1,002,213	1,052,324	1,104,940	1,160,187	1,218,196	1,279,106	1,343,061	1,410,214
Storage costs	246,240	686,942	1,057,246	1,193,523	1,253,199	1,315,859	1,381,652	1,450,734	1,523,271	1,599,435	1,679,406	1,763,377
Beans for associate farmers												
Bean seed		3,429,216	6,344,050	11,880,950	12,754,584	13,392,313	14,061,929	14,765,025	15,503,277	16,278,440	17,092,362	17,946,981
Bags for marketing		685,843	1,268,234	2,377,217	2,553,016	2,680,667	2,814,700	2,955,436	3,103,207	3,258,368	3,421,286	3,592,350
Storage costs		856,977	1,585,869	2,972,547	3,191,270	3,350,834	3,518,376	3,694,294	3,879,009	4,072,960	4,276,608	4,490,438

Beans for other farmers in the village													
Bean seed			180,034	666,053	2,182,451	3,346,110	3,513,416	3,689,086	3,873,541	4,067,218	4,270,578	4,484,107	
Bags for marketing			28,792	106,615	349,480	535,798	562,587	590,717	620,253	651,265	683,828	718,020	
Storage costs			36,004	133,314	436,849	670,167	703,675	738,859	775,802	814,592	855,322	898,088	
c) Costs of contour bunds for FRG members													
Grass cuttings	2,160,000												
Labour - planting	207,360												
Labour - harvesting & bundling		5,225,472	5,486,746	5,761,083	6,049,137	6,351,594	6,669,174	7,002,632	7,352,764	7,720,402	8,106,422	8,511,743	
Contour digging	6,048,000												
Costs of contour bunds for FRG associates													
Grass cuttings		6,804,000											
Labour - planting		653,184											
Labour - harvesting & bundling			16,485,120	17,309,376	18,174,845	19,083,587	20,037,766	21,039,655	22,091,637	23,196,219	24,356,030	25,573,832	
Contour digging		19,051,200											
Costs of contour bunds for other farmers in the village													
Grass cuttings			68,040	71,474	112,558	118,195							
Labour - planting			34,344	35,251	55,598	58,320							
Labour - harvesting & bundling				864,691	1,692,058	3,113,510	4,665,600	4,898,880	5,143,824	5,401,015	5,671,066	5,954,619	
Contour digging			952,560	1,002,456	1,578,528	1,653,372							
16. Seed Multiplication													
a) Management & implementation costs													
Basic training:													
Facilitators: 4 days x 4 trainers				555,664	583,447	612,620							

x per diems+lunch											
Transport: Arusha - Babati x 4			46,304	48,619	51,050						
VEOs: 12 x 4 per diems+lunch			500,112	525,118	551,373						
Local transport for VEOs x 12			27,780	29,169	30,627						
FRGs x 12 x 3 members x 4 per diems+lunch			1,500,336	1,575,353	1,654,120						
Local transport for FRG members x 36 round trips			166,680	175,014	183,765						
Venue hire			69,456	72,929	76,575						
Stationary			115,763	121,551	127,629						
FPR specialist: Per diem + lunch			104,188	109,397	114,867						
Vehicle: 4WD x 1 round trips x 40 litres x 1,200			55,560	58,338	61,255						
Vehicle hire (TSh 750/km)			69,440	72,912	76,558						
Foundation seed for 1 acre demo plot:											
Bean seed x 30kg			416,880	437,724	459,610	482,591	506,720	532,056	558,659	586,592	615,922
Maize x 10kg			138,960	145,908	153,203	160,864	168,907	177,352	186,220	195,531	205,307
Field inspection:											
Field inspection per diems for 4 experts			1,666,992	1,750,342	1,837,859	1,929,752	2,026,239	2,127,551	2,233,929	2,345,625	2,462,906
Vehicle: 4WD x 40 litres/group			666,720	700,056	735,059	771,812	810,402	850,922	893,469	938,142	985,049
Vehicle hire (TSh 750/km)			833,280	874,944	918,691	964,626	1,012,857	1,063,500	1,116,675	1,172,509	1,231,134
Driver & FPR expert lunch			208,368	218,786	229,726	241,212	253,273	265,936	279,233	293,195	307,854
Follow-up:											
Post-germination follow-up: FPR expert & VEO lunch			416,736	437,573	459,451						
Flowering/tasseling: FPR expert & VEO lunch			416,736	437,573	459,451						
Harvest: FPR expert & VEO lunch			416,736	437,573	459,451						

Field day to promote local sales: FPR expert & VEO lunch			416,736	437,573	459,451						
Post-harvest training (1 training per 3 groups):											
Per diem & lunch for 4 (TOSCI, 2 Selian, 1 ASF) experts			555,664	583,447	612,620						
Group member lunch			166,752	175,090	183,844						
Group member overnight			333,408	350,078	367,582						
Stationary			46,304	48,619	51,050						
Vehicle fuel: 4WD for 4 (TOSCI, 2 Selian, 1 ASF) experts (within project)			64,820	68,061	71,464						
Vehicle hire (TSh 750/km)			277,760	291,648	306,230						
Transport for 4 experts (Arusha - Babati)			185,216	194,477	204,201						
Transport for group members (3/group, village - training)			222,272	233,386	245,055						
Staff:											
Supervision by District Seed Mult. Supervisor x 12 groups x 4 days			416,736	437,573	459,451	482,424	506,545	531,872	558,466	586,389	615,709
Transport (motorcycle)			155,616	163,397	171,567	180,145	189,152	198,610	208,540	218,967	229,916
FPR expert additional motorcycle running costs (4 litres/80km trip)			414,976	435,725	457,511	480,387	504,406	529,626	556,108	583,913	613,109
b) Cultivation costs to farmer of 12 acres of certified seed											
Maize:											
Additional manure (7 MT vs 3.5 MT/acre)			104,034	109,236	114,697	120,432	126,454	132,777	139,416	146,386	153,706

- FRG associates (3/member)		38,257,920	69,050,880	123,171,840	125,971,200	125,971,200	125,971,200	125,971,200	125,971,200	125,971,200	125,971,200	125,971,200
- Other farmers in the village (60% of village)			1,175,731	4,143,053	12,933,043	18,895,680	18,895,680	18,895,680	18,895,680	18,895,680	18,895,680	18,895,680
2. Environmental benefits												
Contour measurement services and digging (fee)		31,752,000	7,023,380	7,372,960	11,583,810	12,155,850						
Increased fodder availability (GM/acre/year):												
- FRG members		10,800,000	10,800,000	10,800,000	10,800,000	10,800,000	10,800,000	10,800,000	10,800,000	10,800,000	10,800,000	10,800,000
- FRG associates (5/member)			32,400,000	32,400,000	32,400,000	32,400,000	32,400,000	32,400,000	32,400,000	32,400,000	32,400,000	32,400,000
- Other farmers in the village				1,620,000	3,240,000	5,670,000	8,100,000	8,100,000	8,100,000	8,100,000	8,100,000	8,100,000
3. Saving in accessing inputs as group vs before as individuals												
- FRG members (1 bus fare per group instead of 1 per farmer)	576,000	576,000	576,000	576,000	576,000	576,000	576,000	576,000	576,000	576,000	576,000	576,000
4. Increased value of production												
Converting an acre of local maize to composite seed production				13,096,800	13,751,640	14,439,222	15,161,183	15,919,242	16,715,204	17,550,965	18,428,513	19,349,938
Converting an acre of local maize to bean seed production				6,268,800	6,582,240	6,911,352	7,256,920	7,619,766	8,000,754	8,400,792	8,820,831	9,261,873
5. Savings realised by farmers purchasing local seed vs corporate seed supplied by local seed merchant:												
- saving from difference in price				1,519,200	1,595,160	1,595,160	1,595,160	1,595,160	1,595,160	1,595,160	1,595,160	1,595,160
- saving from reduced transport cost of accessing seed merchant				3,528,000	3,704,400	3,889,620	4,084,101	4,288,306	4,502,721	4,727,857	4,964,250	5,212,463

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