Characteristics of Improved Coffee Varieties in comparison to Traditional Coffee Varieties (N 39 & KP 423).

Variety Name	Clone/Selection	Potential Yields (kg/ha) Clean coffee	Beverage Quality	Bean size AA + A %	Class	TYPE
N 39-1	SC 4	2,058	• Good acidity • Good body • Good flavour • Pleasant aroma	77	4++	BOURBON
N 39-2	SC 5	2,708	• Good acidity • Good body • Good flavour • Pleasant aroma	77	4++	BOURBON
N 39-3	SC 8	2,763	• Good acidity • Good body • Medium flavour • Pleasant aroma	74	5+	BOURBON
N 39-4	SC 12	1,961	• Good acidity • Good body • Good flavour • Pleasant aroma	80	4+	BOURBON
N 39-5	SC 3	2,633	• Light medium acidity • Light medium body • Medium flavour • Pleasant aroma	62	5+	BOURBON
N 39-6	SC 9	2,891	• Good acidity • Good body • Full flavour • Pleasant aroma	72	4+	BOURBON
N 39-7	SC 11	2,526	• Good acidity • Good body • Good flavour • Pleasant aroma	72	5+	BOURBON
KP 423-1	SC 10	2,225	• Good acidity • Good body • Good flavour • Pleasant aroma	80	4++	KENT
KP 423-2	SC 13 (Pre-released)	1,851	• Medium acidity • Medium body • Medium flavour • Fair pleasant aroma	68	5+	KENT

KP 423-3	SC 14	1,578	• Medium acidity • Good body • Medium flavour • Pleasant aroma	77	5+	KENT
Old highly Susceptible varieties						
N 39		1,283[a]	• Good acidity • Good body • Good flavour • Pleasant aroma	57	4++	BOURBON
KP 423		1,500[a]	• Good acidity • Good body • Medium flavour • Pleasant aroma	75	5+	KENT

[a]Yields obtained with heavy applications of fungicide sprays

[a]Assessed by a panel of independent liqourers selected by the coffee industry.

Ministry of Agriculture and Food Security
Directorate of Research and Training

Farmers' Assessment of Improved Coffee Hybrids in Southern Highlands of Tanzania*

By

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FARMERS' ASSESSMENT OF IMPROVED COFFEE HYBRIDS IN SOUTHERN HIGHLANDS OF TANZANIA IN 2004/2005 CROP SEASON

1.0 Background Information and Justification:

Considering the fact that the agricultural sector is the main pillar of the Tanzanian economy, which contributes about 60% of the country's GDP, 61% of the export earnings and 84% of the rural employment; accelerated agricultural growth can be achieved by increasing smallholder involvement and participation in the Technology Development and Transfer (TDT) process. Farmer participatory research has been defined as "the collaboration of farmers and scientists in agricultural research and development" (Bentley, 1994). Farmers' assessment as a participatory research method is now being used by several of the research teams in many countries including Tanzania to systematically gather farmer opinions in a more detailed manner. There is now greater appreciation of farmers' own knowledge or Indigenous Knowledge (IK) and judgement within the content of their own circumstances. Researchers are now more appreciative of the fact that farmers are able to integrate a number of site-specific factors, which are virtually invisible to researchers. Farmer opinions are therefore being given more weight than before, particularly when new varieties are concerned. Since resource - poor farmers technologies are site/location - specific, farmers play a key role in technology development. The experiences with technology development have made clear that new technologies have to be imbedded in the local society, its ecological and physical environment, its cultural experiences and its socio-economic structures.

Coffee is one of the leading cash crops in Tanzania grown by more than 400,000 households on acreage of 250,000 ha. The crop contributes about 15% of the foreign exchange in the country. The major growing areas are Kilimanjaro, Arusha, Mbeya, Ruvuma, Tanga, Morogoro, Kagera, Kigoma, Iringa, Rukwa, Mara and Manyara regions. Until 2004 the only commercial varieties grown in the country were/are Bourbon (N.39) and Kents (KP 423). N.39 was selected in the 1920s whereas KP 423 was selected in the 1930s. The estimated yields of N. 39 and K423 are 1 – 1.5 ton/ha if well managed. The main production constraints for the commercial varieties are however, high susceptibility to major coffee diseases like Coffee Berry Disease (CBD) - *Colletotrichum kahawae* (Waller & Bridge and Coffee Leaf Rust (CLR) - *Hemileia vastatrix* Ber) et. Br. The varieties are also susceptible to major insect pests like Mealy bugs, Leaf minor, Antestia, Berry moth, Berry borer, white stem and yellow headed borers.

Due to the above problems development of resistant coffee hybrid varieties started in the 50s and 60s for CLR and CBD respectively. Intensive selection and multi-locational trials was done in all coffee growing areas since 1993. In early 1996 and in 2000 on farm coffee varieties trials were started in the Northern part and in Mbeya and Mbinga districts in the Southern Highlands of Tanzania. The main objectives of the on-farm trials were to develop varieties that are high yielding, resistant to CBD & CLR diseases, with good/high cup quality, well adapted to our coffee growing conditions and also preferred by our farmers especially the resource poor ones.

Most coffee growers in the country are confronted by low coffee production due to lack of improved varieties that are potentially high yielding and resistant to diseases and insect pests infestation, high production costs due to application of pesticides to control diseases and pests, low cup quality, low prices of the produce in the world markets and consequently low household incomes for the farming communities.

Since the selection or recommendation of the two commercial varieties research and development institutions had not released or recommended any coffee varieties to the coffee growing communities that would address their above concerns until last year (2004) when some varieties were released based upon their good agronomic performances and farmers' preferences in Northern Tanzania. Some of the coffee lines tested on-station and on-farm in Southern Highlands of Tanzania have also shown very good characteristics such as high yields, high resistance to diseases and insect pests, good cup quality, drought tolerance and faster growth compared to the current commercial varieties.

Based on the superior performance of those lines the Tanzania Coffee Research Institute (TaCRI) decided to conduct a farmers' assessment of the lines this year so that the Southern Highlands farmers can select the ones that are more adapted to their environments and also preferred by them for official release and commercial use.

2.0 Objectives:

- Identify Southern Highlands farmers' criteria for coffee preference
- Identify coffee lines/varieties adapted and preferred by farmers in the Southern Highlands of Tanzania
- Release improved coffee varieties for the coffee growing communities
- Increase coffee production in Tanzania
- Improve household income for coffee growing communities

3.0 Methodology:

Two farmers' assessments were done in Mbinga and Mbeya districts in Ruvuma and Mbeya Regions on the 15th and 18th of July 2005 respectively. The one in Mbinga district was conducted at a small-scale farmer who used correct spacing and fertilizers at irregular intervals after planting. The assessment performed in Mbeya was at a large-scale farm with a correct spacing, used high rates of chemical for old coffee varieties, regular fertilizer use at planting and during growth stages. Both small scale and estate farms were intercropped with fruit trees/few banana and gravilea/acacia respectively (Appendix 7). Coffee

varieties/lines were planted in 1996 for Mbeya and in 2000 for Mbinga. Twenty one (21) famers including 16 males and 5 females from 6 villages participated in the assessment in Mbinga district whereas 17 farmers including one female from 9 villages participated in the assessment in Mbeya district. Most of these farmers had grown or were exposed to the coffee lines/varieties tested and assessed namely SC 3, SC 9, SC 11 and SC 14 for 5 – 9 years along with their old commercial variety namely KP 423. The tools used for the assessment were preference/absolute, matrix and pair wise rankings.

4.0 Brief Description of the Coffee production System in the Southern Highlands of Tanzania

The Southern Highlands of Tanzania consist of Mbeya, Iringa, Rukwa and Ruvuma regions. Coffee is produced in all the four regions with Ruvuma and Mbeya regions leading. The main type of coffee grown in the highlands is Arabica. Robusta type is grown in few areas like the Mbamba Bay area around Lake Nyasa.
Mbinga and Mbozi districts are the leading producers of coffee in Ruvuma region. The crop is mainly produced by small-scale farmers who intercrop it with gravelia or bananas. The average acreage per household ranges from 0.25 to 3.0 acres.

In the past farmers planted coffee using different spacings like 3m x 3m, 3 m x 2 m, 3 m x 2.5 m, 3 m x 2.7 m, 2.7 m x 2.7 m, 2.7 m x 2.5 m and 3m x 1.5 m. They now however prefer the 3 m x 1.5 m spacing for the new cultivars. Mbinga District receives enough rains during the rainy season and no irrigation is practiced during dry season although water canals are found almost all over the area. Average yields obtained by ordinary farmers range from 8 – 10 bags of 50kgs each per acre whereas progressive farmers get 15 – 20 bags/acre. The district has big potential for coffee production due to the fact that it has more areas for cultivation of new farms and a lot of water sources for irrigation and processing.

Mbozi, Mbeya, Rungwe and Ileje districts are main producers of coffee in Mbeya Region. The total coffee acreage in the four districts is about 57,500 ha. Mbozi, Mbeya and Ileje districts depend on the rains for their production. They don't practice irrigation with the exception of few large farms. Rungwe district has some water sources for irrigation which is however used in large/medium scale tea production. There are no large scale coffee farmers in the district. The small scale farmers in the district own about 0.25 – 1.5 acres per household.

In the other districts (Mbozi, Mbeya and Ileje) small scale farmers own acreages ranging from 1 – 10 acres, whereas medium scale farmers may own about 14 – 25 acres each. Large scale farms range from 125 -825 acres across all the districts. Some of the large-scale farms especially in Mbozi district are not well managed. Farmers intercrop their coffee with gravelia, fruit trees or bananas. The coffee spacing is 2.7 m x 2.7m, 2.5 m x 2.0 m, 2 m x 2 m and 2.7 m x 1.5 m. The new lines in Mbeya were mainly introduced to the medium and large scale farms.

In recent years rainfall trend has changed and decreased across all the 4 regions. It used to start in September but of late it goes up to December. Coffee production has decreased due to this weather change and lack of water sources for irrigation and processing. Other reasons given by the farmers for the low production were continued use of the old coffee varieties which have low yields due to lack of lower tertiary and secondary branches, disease infestation especially CBD and CLR, inadequate coffee extension services, fluctuating prices, free marketing system which does not sometimes abide to grades and hence lower prices, and expensive inputs like fertilizers and chemicals to control pests and diseases.

5.0 Results and Discussion

The main uses of coffee in the areas are shown in Table 1.

Uses	Rank	
	Mbinga	**Mbeya**
1. Cash crop	1	1
2. Firewood – pruned branches, pulped bean husks and old stems	6	5
3. Source of fertilizers (rotten pulped bean husks)	4	4
4. Stomach pain relief and application on new bruises	9	N/A
5. Prepare local brew called “wanzugi”	8	N/A
6. Mulch	7	9
7. Beverage/refreshment	3	3
8. Attracts honey bees and other insects for pollination	5	8
9. Source of employment	2	2
10. Control soil erosion from the canopy cover	N/A	6
12. Prepare utensils and small houses for poultry	N/A	11
13. Attract chameleon for control of Antestia	N/A	10
14. Raises low blood pressure	N/A	7

In both regions, coffee is mainly grown for commercial purposes. It is also a main source of employment for individuals who provide labour for different operations like weeding, chemicals application, harvesting and marketing. Other important uses are beverage/refreshment, source of fertilizer, firewood and also control for soil erosion.

Varieties/lines characteristics:

Farmers described the varieties as shown in Table 2 based on their experience with the varieties in their fields and also on the observations they made at the plots they assessed.

Table 2: Farmers’ descriptions of the coffee varieties/lines in Southern Highlands of Tanzania in 2004/2005 cropping season

Variety	Characteristics
SC 3	Retains primaries from the lowest point Resistant to CBD and CLR Easily marketable (Fairly large, heavy and good bean size that is attractive)

	Many berries in clusters per branch Stable yield production each season Excellent and attractive greenish leaves Good cup taste Fast growth Many shoots for cuttings for seedlings Good yield Main stem-from one primary branch to another length of about 3 inches Internodes length of about 3 inches
SC 11	Retains primaries from the lowest point Branching internodes of 3 inches Clustering internodes of about 1.5 – 2 inches Very good yielder Many shoots as cuttings for seedlings Easily marketable (Big heavy bean size and attractive) Good cup taste Fast growth Excellent and attractive greenish leaves
SC 14	Retains primaries from the lowest point Average to high yield Resistant to CBD and CLR Main stem-length of about 5 inches from branch to branch Internodes length of 3 inches to 4 inches from one berry cluster to another Easily marketable (Big heavy bean size and attractive) Many berry clusters Stable yield production each season Good cup taste Many shoots as cuttings Greenish and attractive leaves
KP 423 "Local"	Average yield Very susceptible to CBD and CLR Few tertiary and secondary branches - Unstable and changing yield production from one season to another Easily marketable but sometimes it needs a lot of picking bad berries from the harvest Fairly good and attractive leaves Average branches Few branches used as cuttings for seedling materials Average berries and clusters that are attractive if sprayed well against CBD Good cup taste Main stem-Internodes – branch to branch 4 inches Primaries-Internodes – cluster to cluster 2 inches
SC 9	Good yield Greenish and attractive leaves Many shoots for cuttings as seedling materials Main stem-Internodes branch to branch 6 inches Primaries-Internodes cluster to cluster 2 inches Resistant to CBD and CLR

	Good cup taste Easily marketable (Large and attractive beans) Stable yield production each season Greenish and attractive leaves

The preference ranking of the lines is shown in Table 3.

Table 3: Preference ranking of the coffee lines/varieties in Southern Highlands of Tanzania in 2004/2005 cropping season

Coffee line/variety	Rank	
	Mbinga district (sub optimal conditions)	Mbeya district (optimal conditions)
1. SC 3	1	3
2. SC 11	2	1
3. SC 14	3	2
4. KP 423 "Local"	4	5
5. SC 9	N/A	4

The preference ranking showed that SC 3 and SC 11 were the most preferred coffee lines followed by SC 14. SC 9 which was grown in Mbeya only ranked fourth among the improved varieties. The least preferred variety at both locations was KP 423.

Farmers in the two areas selected the most important criteria for coffee selection as shown in Tables 4 and 5.

Table 4: Farmers' criteria for selecting coffee lines/varieties under sub optimal Management in Mbinga District in Southern Highlands of Tanzania in 2004/2005 cropping season

Farmers' criteria	Rank
1 High yield	2
2 Good cup taste	4
3 Disease tolerance – CBD and CLR	3
4 Easily marketable- big, heavy attractive beans	1
5 Fast growth	5
6 Many branches for getting cuttings for new plants	7
7 Stable yield production each season	6

Table 5: Farmers' criteria for selecting coffee lines/varieties under optimal Management in Mbeya District in Southern Highlands of Tanzania in 2004/2005 crop season

Farmers' criteria	**Rank**
1 High yield	1
2 Many branches and big berry clusters at short internodes	6
3 Easily marketable – big, heavy attractive beans	2

4 Disease tolerance – CBD and CLR	4
5 Require less costs for chemicals and pruning	5
6 Stable and constant yield production each season	7
7 Good cup taste	3

Most of the criteria mentioned were similar despite the farmers being far away geographically. The most important criteria selected by the farmers under the two management regimes were high and stable yields, easy marketability, good cup taste and tolerance to diseases. Less costs for chemicals and pruning was not mentioned under the sub-optimal conditions because the small scale farmers don't normally apply the chemicals and neither observe the other recommended practices like pruning. It was however mentioned under the optimal management that it took about 6 years before requiring a full scale pruning of the new varieties/lines.

The criteria selected were used to conduct matrix rankings as shown in Tables 6 and 7.

Table 6: Matrix ranking of coffee lines/varieties under sub optimal management conditions in Mbinga District, Southern Highlands of Tanzania in 2004/2005 cropping season

Criteria	Coffee lines/varieties				**Total**	**Rank**
	SC 3	**SC 11**	**SC 14**	**KP 423 "Local"**		
1 High yield	5	4	4	3	**16**	**5**
2 Easily marketable	5	5	5	4	**19**	**2**
3 Disease tolerance	5	5	5	3	**18**	**3**
4 Good cup taste	5	5	5	5	**20**	**1**
5 Stable yield production	5	5	4	3	**17**	**4**
6 Fast growth	4	4	5	3	**16**	**5**
7 Many branches – cuttings for new plants	5	5	4	3	**17**	**4**
Total	**34**	**33**	**32**	**24**		
Rank	**1**	**2**	**3**	**4**		

Key: 1 – Poor; 2 – Satisfactory; 3 – Average; 4 – Good and 5 – Excellent

All varieties were highly scored for good cup taste and easiness for marketing. The new varieties were scored excellent to good in all criteria. The least scored criteria were many branches for cutting/seedlings, high yields and fast growth. The local variety was scored average in all those criteria showing that there is great variation among the new lines and the old cultivar in these aspects.

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Based on all criteria used in Mbinga district, the farmers' preference for the new improved lines were more or less the same and very much superior to the old commercial variety KP 423.

Table 7: Matrix ranking of coffee lines/varieties under optimal management conditions in Mbeya District, Southern Highlands of Tanzania in 2004/2005 cropping season

Criteria	Coffee lines/varieties					Total	Rank
	SC 9	**SC 3**	**SC 11**	**SC 14**	**KP 423 "Local"**		
1 High yield	4	5	5	4	3	**21**	**5**
2 Big clusters with many berries at short internodes	4	5	5	4	2	**20**	**6**
3 Requires less costs for chemicals and pruning	5	5	5	5	2	**22**	**4**
4 Good cup taste	5	5	5	5	5	**25**	**1**
5 Disease tolerance	4	5	5	4	2	**20**	**6**
6 Stable and constant yield production	5	5	5	5	3	**23**	**3**
7 Easily marketable	5	5	5	5	4	**24**	**2**
Total	**32**	**35**	**35**	**32**	**21**		
Rank	**2**	**1**	**1**	**2**	**3**		

Key: 1 – Poor; 2 – Satisfactory; 3 – Average; 4 – Good and 5 – Excellent

All varieties were scored excellent to good in good cup taste and easy marketability under optimal management conditions. They were also scored high in stable and constant yield production with the exception of the local variety which was scored average due to few tertiary and secondary branches that alternate in production. All new improved lines were scored excellent to good in all criteria. The least preferred characteristics in all the varieties were low costs for chemicals and pruning, high yields, big clusters with many berries at short internodes and disease tolerance due to the average and poor scores given to the local variety, KP 423.

Based on the criteria used SC 3 and SC 11 were the most preferred varieties and they were scored excellent in all the criteria followed by SC 9 and SC 14 varieties which were equally preferred by the farmers. The least preferred variety was KP 423 as was the case under sub-optimal conditions of management. The local variety was scored average and poor in all criteria with the exception of good cup taste and easy marketability.

The pair wise ranking results under sub optimal and optimal management practices are shown in Table 8.

Table 8: Pair wise rankings of the coffee lines/varieties under sub optimal and optimal management practices in Mbinga and Mbeya Districts in Southern Highlands of Tanzania in 2004/2005 cropping season

Variety	Ranking	
	Under sub-optimal management conditions in Mbinga district	Under optimal management conditions in Mbeya district
SC 3	1	2
SC 9	N/A	4
SC 11	2	1
SC 14	3	3
KP 423 (Local)	4	5

N/A - Not assessed or available

The pair wise ranking results under both the sub-optimal and optimal conditions were similar to those obtained from the preference and matrix rankings where SC 3 and SC 11 were the most preferred varieties followed by SC 14 and SC 9. The least preferred variety in both management conditions was KP 423 or the local due to its poor qualities like tolerance to diseases, high requirements for chemicals and pruning, slow growth, average and unstable yields.

5.0 Conclusions:

The most important farmers' criteria for selecting coffee varieties/lines were good cup taste, high and stable/constant yields, easy marketability of the beans, disease tolerance, low costs for chemicals and pruning and fast growth.

All varieties assessed were scored high in cup taste and easy marketability under both management conditions. However, all introduced improved lines were in addition highly scored and preferred for disease tolerance in particular CBD and CLR, less costs for chemicals and pruning, high and constant/stable yields each year and fast growth. They also retain primaries from the lowest points, the tertiary branches can alternate with secondary ones to ensure constant and stable yields and have short internodes for the branches and berries clusters. The local variety KP 423 was scored average and/or poor in all those characteristics.

Overall, the preference, matrix and pair wise rankings results under both management practices indicated that the most preferred lines were SC 3 and SC 11 followed by SC 14 and SC 9. The least preferred variety in all the rankings was KP 423 or the local.

6.0 Recommendations:

Since the introduced lines are well adapted and have performed better than the commercial line KP 423 under both sub optimal and optimal management conditions in terms of high and stable/constant yield, disease tolerance especially CBD and CLR, less costs for chemicals and pruning, fast growth and short internodes for branches and berry clusters they should be considered for release so that the Southern Highland farmers and others can have access to the varieties and consequently be able to have sustainable

increased production through use of better materials, reduced production costs from chemicals and pruning and also conserving the farming environments through less use of chemicals.

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8.0 Appendices:

Appendix 1: Farmers' disliked characteristics in coffee in Southern Highlands of
Tanzania in 2004/2005 cropping season

Disliked characteristics	Rank	
	Mbinga	Mbeya
1. Variety susceptible to diseases like CBD and CLR	1	1
2. Variety not easily marketable and fetching low price	2	2
3. Variety with little berries	8	7
4. Varieties with a tendency of high berry dropping	6	N/A
5. Varieties with unstable yield production each season	3	N/A
6. Variety with very few branches	5	3
7. Varieties susceptible to many pests	4	N/A
8. Variety producing light beans	7	6
9. Variety with excessive branches	N/A	8
10. Overbearing varieties	N/A	5
11. Variety with dull greenish appearance – less chlorophyll	N/A	4

Appendix 2: Coffee pests found in Southern Highlands of Tanzania in 2004/2005
cropping season

Pests	**Part of plant attacked**	***Rank***	
		Mbinga	**Mbeya**
1 (a) White stem borer (b) Yellow headed borer	(a) Stem (b) Branches	2	1
2. Antestia bug	Young shoots/growing points, flowers & berries	1	3
3. Green scale	Stem, branches, leaves, flowers and berries	3	5
4. Leaf minor	Leaves -underneath and in the center of the leaf	4	N/A
5. Berry borer	Berries	6	4
6. Sting caterpillar	Leaves	5	N/A
7. Cutworms	Young seedlings	8	N/A
8. Elegant grasshopper	Young seedlings	7	N/A
9. Mealy bug	Young succulent shoots, flowers and berries	N/A	2

Appendix 3: Swahili names of some pests

Pest	Swahili name
1. White stem borer	Bungua mweupe
2. Yellow headed borer	Bungua wa njano
3. Leaf minor	Kidomozi
4. Antestia bug	Kimatira
5. Green scale	Vidugamba
6. Berry borer	Ruhuka
7. Sting caterpillar	Washawasha
8. Cutworms	Sota
9. Elegant grasshopper	Senene
10. Mealy bug	Vidung'ata

Appendix 4: Coffee diseases found in Southern Highlands of Tanzania in 2004/2005 cropping season

Diseases	Part of plant attacked	Rank	
		Mbinga	Mbeya
1. CBD	Flowers/berries	1	1
2. CLR	Leaves	2	4
3 *Cecospora spp*	Leaves – attacked part resemble frogs eyes	3	N/A
4. Fusarium back disease	Stem - drying	N/A	3
5. Amillaria root rot	Roots and stem drying later	N/A	2

Appendix 5: Swahili names of some diseases

Disease	Swahili name
1. CBD	Chule buni
2. Coffee leaf rust – CLR	Kutu ya majani
3. *Cecospora spp*	Bakajani
4. *Fusarium* bark disease	Mnyauko Fusari wa Arabika
5. *Amillaria* root rot	Kuoza mizizi

Appendix 6: Yield potential and liquor quality of the assessed coffee lines/varieties in Southern Highlands of Tanzania in 2004/2005 cropping season

Variety	Yield potential (tons/ha)	Quality (FAQ)
SC 3	**2.6**	**5**
SC 9	**2.9**	**4**
SC 11	**2.5**	**5**
SC 14	**1.5**	**5**
KP 423 –Local	**1.3**	**5**

1.0 FAQ – Fair Average Quality **2.0 Liquor quality scale:** 1 – 6 Good commercially
7 – 14 Poor commercially

NB: The lower the score the higher the quality

Appendix 7: Comparison of Levels of Management under sub optimal and optimal management conditions in Southern Highlands of Tanzania in 2004/2005 cropping season

No	Activity	Site for farmers' assessment	
		Mr. Solanus Kamzoro (small-holder or sub-optimal management)	Mr. Clemence Maier (optimal management)
1	Standard hole size plus planting fertilizers	Standard as recommended	Standard as recommended
2	Application of Farm Yard Manure after planting	Regularly	Occasionally
3	Application of inorganic fertilizers	Occasionally	Standard
4	Weed control	Optimum	Optimum
5	Insect pest control	When observed	When observed
6	Pruning	When observed	Only suckers
7	Irrigation	None	Occasionally
8	Intercropping	Intercropped with fruit trees/gravelia	Intercropped with gravelia/acacia
9	CBD control	None in new cultivars	None in new cultivars
10	CLR control	None in new cultivars	None in new cultivars
11	General observation in the field	Regular	Regular

NB: - Sources of Farm Yard Manure in the order of importance in Mbinga District are: cattle, poultry,

pigs, goats, compost (covered crop residues in the soil) from Matengo pits and applied mulch in

coffee from wheat/maize/grasses/coffee husk. The FYM rate is 1 tin (12-15 kgs) per tree

– Sources of inorganic fertilizers in order of importance in Mbinga District are: CAN, Urea and S /A.

. The rate is 50 – 100 grams/tree and used by very few farmers. S/A use is quite minimal.

Appendix 8: Total coffee production in tons from a total of 10,500 ha in Mbinga district in 1992 - 2004

Year	Total production in tons
1992	10,200.0
1993	14,887.0
1994	5,188.0
1995	8,815.0
1996	12,601.0
1997	6,770.0
1998	7,100.0
1999	12,000.0
2000	7,498.0
2001	10,296.0
2002	9,000.0

2003	10,000.0
2004	7,000.0
2005	6,900.0*

* Amount sold up to now as final harvesting/processing is still going on.

Appendix 9: **Total coffee production in tons from a total of 10,500 ha in Mbeya district in 2000- 2004**

Year	Total production in tons
2000	1,150.0
2001	1,528.2
2002	1,236.5
2003	1,236.5
2004	1,979.0

Appendix 10: Total coffee production in tons from a total of 28,000 ha in Mbozi District in 2001- 2004

Year	Total production in tons
2001	12,300.0
2002	9,700.0
2003	10,850.0
2004	10,500.0
2005	11,200.0**

** Most of the harvesting/processing and selling has been done. Only very negligible amounts might be in the hands of the farmers

Appendix 11: Total coffee production in tons from 216 acres of Lunji Estate (large scale farm) in Mbeya district in 2001-2004

Year	Total production in tons
2001	69
2002	202
2003	45
2004	205

Appendix 12: Total coffee production in tons from Sinyatu Farm (medium scale farm) in Mbeya District in 2001- 2005

Year	Total production in tons
2001	6
2002	9
2003	7.2

2004	9
2005	12

Appendix 13: Coffee production problems in Mbeya Region:

- Lack of sufficient water for irrigation and processing purposes especially in Mbozi and Mbeya Districts
- Inadequate coffee extensionists
- High incidences of diseases which require money to buy chemicals for control
- Coffee price fluctuation
- Liberalized markets which buy coffee at low prices as they don't consider coffee grades.
- Lack of cooperatives societies which used to provide inputs to farmers. Farmers in Rungwe district said that most of the modern houses in their area were built during the cooperative society's era and especially when they got the second installment of payment.

Appendix 14: List of participants in Mbinga District

List of participants	**Village**	**Gender**
1. Bruno Haule	Longa	M
2. Fulgens Komba	Longa	M
3. George Ndunguru	Myangeyange	M
4. Dismas M. Kumburu	Mtama	M
5. Stephen Haule	Mtama	M
6. Alfrida Komba	Myangeyange	F
7. Philo Makarius	Myangeyange	M
8. Rotha S. Ndimbo	Tanga	F
9. Eleterius Ndunguru	Myangeyange	M
10. Inesy S. Kapinga	Tanga	F
11. Aderick F. Mbele	Tanga	M
12. Venance B. Komba	Longa	M
13. Bernadeta Kapinga	Longa	F
14. Menas B. Komba	Longa	M
15. Benjamin B. Mbepera	Longa	M
16. Gaston O. Mbepera	Longa	M
17. N. H. Mruttu – Extensionist	Mkumbi	M
18. Chrisandus Ndunguru	Myangayanga	M
19. Editha Kapinga	Longa	F
20. John Kabakuli	Myangayanga	M
21. Solanus Kamzoro	Ruico	M

Appendix 15: List of participants in Mbeya District

List of participants	Village	Gender	
1. Alexander Mwanyoka	Mbalizi	M	
2. Halinga S. Mwananzala	Isangala	M	
3. Elisha P. Mkanda	Malowe		M
4. Nazalet H. Shitindi	Iwindi		M
5. Samson M. Mwasengo	Iwejele		M
6. Amon J. Mwampelo	Malowe		M
7. Ambalile M. Katolike	Malowe		M
8. Gifti K. Ndisa	Lusungo		M
9. Saimon L. Nyembele	Mbalizi	M	
10. Laurent Y. Mwaigaga	Lusingo		M
11. Dauson N. Mwashilindi	Lusungo		M
12. Watson M. Nzuyuga	Iwejele		M
13. Samson D. Mwashilindi	Lusungo		M
14. Jeremiah S. Mwazeya	Malowe		M
15. Clemence Maier	Lunji		M
16. Mrs Clemence Maier	Lunji		F
17. Kennedy Simon	Vwawa	M	

Ministry of Agriculture and Food Security
Directorate of Research and Development

Farmers' Assessment of Improved Coffee Hybrids in Northern Tanzania*

By

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FARMERS' ASSSESSMENT OF IMPROVED COFFEE HYBRIDS IN NORTHERN TANZANIA IN 2003/2004 CROP SEASON

1.0 Background Information and Justification

With participatory research methods coming to the forefront, farmer assessment is now being used by several of the research teams in many countries including Tanzania to systematically gather farmer opinions in a more detailed manner. There is now greater appreciation of farmers' own knowledge or Indigenous Knowledge (IK) and judgement within the content of their own circumstances. Researchers are now more appreciative of the fact that farmers are able to integrate a number of site-specific factors, which are virtually invisible to researchers. Farmer opinions are therefore being given more weight than before, particularly when new varieties are concerned. Researchers are now moving towards a "consultative "and" collaborative" type of working arrangements with farmers (Stroud, 1996). Since resource - poor farmers technologies are site/location - specific, farmers play a key role in technology development. The experiences with technology development have made clear that new technologies have to be imbedded in the local society, its ecological and physical environment, its cultural experiences and its socio-economic structures.

Coffee is the number one cash crop in Tanzania grown by more than 400,000 households on acreage of 250,000 ha. The crop contributes about 15% of the foreign exchange in the country. The major growing areas are Kilimanjaro, Arusha, Mbeya, Ruvuma, Tanga, Morogoro, Kagera, Kigoma, Iringa, Rukwa, Mara and Manyara regions. The commercial varieties grown in the country are Bourbon (N.39) and Kents (KP 423). N.39 was selected in the 1920s whereas KP 423 was selected in the 1930s. The estimated yields of N. 39 and K423 are 1 – 1.5 ton/ha if well managed. The main production constraints for the commercial varieties are however, high susceptibility to major coffee diseases like Coffee Berry Disease (CBD) - *Colletotrichum kahawae* (Waller & Bridge and Coffee Leaf Rust (CLR) - *Hemileia vastatrix* Ber) et. Br. The varieties are also susceptible to major insect pests like Mealy bugs, Leaf minor, Antestia, Berry moth, Berry borer, white stem and yellow headed borers.

Due to the above problems some crossings of coffee hybrid varieties started in the 50s and 60s for CLR and CBD respectively. Intensive selection and multi-locational trials was done in all coffee growing areas since 1993. In 2000 some on-farm farmer managed trials were conducted in the sites. The main objectives of the on-farm trials were to develop varieties that are high yielding, resistant to CBD & CLR diseases, with good/high cup quality, well adapted to our coffee growing conditions and also preferred by our farmers especially the resource poor ones.

Most coffee growers in the country are confronted by low coffee production due to lack of improved varieties that are potentially high yielding and resistant to diseases and insect pests infestation, high production costs due to application of pesticides to control diseases and pests, low cup quality, low prices of the produce in the world markets and consequently low household incomes for the farming communities.

Since the selection of the two commercial varieties research and development institutions have not released or recommended any coffee varieties to the coffee growing communities that would address their above concerns. Some of the coffee lines tested on-station and on-farm since early 90s have however, shown very good characteristics such as high yields,

high resistance to diseases and insect pests, good cup quality, drought tolerance and even faster growth compared to the current commercial varieties.

Based on the superior performance of those lines the Tanzania Coffee Research Institute (TaCRI) decided to conduct a farmers' assessment of the lines so that the farmers can select the ones that are more preferred by them than the current commercial varieties for official release and commercial use.

2.0 Objectives

- **Identify farmers' criteria for coffee preference**
- **Identify coffee lines/varieties preferred by farmers**
- **Release improved coffee varieties for the coffee growing communities**
- **Increase coffee production in Tanzania**
- **Improve household income**

3.0 Methodology

Two farmers' assessments were done in Arumeru and Moshi Districts on the 16th and 17th February 2004 respectively. The one in Arumeru was conducted at a coffee estate farm where the management was optimal with regular irrigation and fertilizer use at planting and during growth stages. The one in Moshi Rural district was conducted at a small scale farmer who used correct spacing but did not use fertilizer at planting time. He occasionally used farm yard manure and inorganic fertilizers after planting. The estate crop was monocropped whereas the one at the small scale farmer was intercropped with bananas (Appendix 6).

All coffee varieties were planted in 2001 crop season. Nineteen (19) male and female farmers from fourteen (14) villages in the two districts participated in the assessment (Appendix 7). Majority of the participating farmers have grown the new coffee varieties/lines (TSC 4, TSC 5, TSC 8, TSC 10, and TSC 12) for 2-3 years along with their old commercial varieties namely KP 423 and N39.

Other farmers who have not grown the new lines were also invited to participate in the evaluation.
The tools which were used in the evaluation were absolute evaluation, matrix ranking and pair-wise comparison.

4.0 Results and Discussion

Farmers mentioned the importance and main uses of coffee in Tanzania as shown in Table 1.

Table 1: Importance and main uses of coffee in Tanzania

Uses	***Rank***
Cash crop	1
Beverage	3
Soil fertility improver	4
Controls soil erosion from the canopy cover	5
Source of employment	2
Attract useful insects for pollination	6
Fuel wood	7

Coffee is mainly grown for commercial purposes in Tanzania. It is also a source of employment in the coffee growing areas particularly where there are coffee estates. Other important uses are beverages, soil fertility improver from the husks and also control soil erosion. It is also an important source of fuel wood from the pruning, stumping or replacement.

Varieties characteristics

Farmers commented the following on the tested varieties' characteristics (Table 2)

Table 2: Characteristics of the Coffee varieties

Variety	Characteristics
TSC 4	- Very good CBD and CLR tolerance. - Fast growth rate - High yielder - Good drought tolerance. - Few suckers (minimal pruning) - Few nodes compared to TSC5 & TSC10 varieties - Good cup taste
TSC5	- Very good CBD and CLR tolerance - High yielder with big bean size - Few branches - Bears from lower branches - Faster growth and early bearing of berries compared to other varieties. - Good cup taste.
TSC8	- Very good CBD and CLR tolerance - Good branch spreading with large leaves - Taller plants compared to other varieties - High yielder with big bean size - Faster growth - Good cup taste
TSC10	- High yielder - Faster growth - Good drought tolerance. - Many branches with large leaves - Very good CBD and CLR tolerance - Good cup taste
TSC 12	- Very good CBD and CLR tolerance - Good drought tolerance - Average number of branches and leaves - Average suckers - Average plant height. - Bigger bean size compared to other varieties. - Many nodes - Good cup taste
KP 423	- Good drought tolerance - High yielder - Susceptible to CBD and CLR diseases and insect pests - Fast growth - Nodes have many berries. - Good cup taste
N 39	- Highly susceptible to CBD and CLR diseases and insect pests - High yielder - Many branches and leaves. - Good drought tolerance. - Average bean size compared to other varieties - Good cup taste.

Farmers were asked to rank the tested lines/varieties using absolute ranking tool. The exercise was done in both assessments (Table 3)

Table 3: Absolute ranking of coffee varieties in Northern Tanzania in 2003/2004 crop season

COFFEE VARIETY	Ranking under optimal management	Ranking under sub-optimal management
KP 423	6	6
N 39	7	7
TSC 4	3	5
TSC 5	1	2
TSC 8	4	3
TSC 10	2	1
TSC 12	5	4

The absolute ranking showed that TSC 5 and TSC 10 were the most preferred varieties followed by TSC 8, TSC 4 and TSC 12. The least preferred variety was N39.

Farmers were then asked to mention the criteria they use to select coffee varieties. The most important ones are shown in Table 4.

Table 4: Farmers' criteria for selecting coffee varieties in Northern Tanzania in 2003/04 crop season

Farmers' criteria	**Rank**
High Yield	3
Spreading of coffee branches	9
Leafiness	7
Disease tolerance	1
Big bean size	5
Drought tolerance	6
Good cup taste	4
Fast Growth	8
Minimal Pruning	10
Insect pest tolerance	2

The farmers used the 8 most important criteria to rank the varieties under optimum and sub-optimum management conditions as shown in Tables 5 and 6.

Table 5: Matrix ranking of coffee varieties under optimum management conditions in Arumeru District, Northern Tanzania in 2003/04 cropping season

CRITERIA	**COFFEE VARIETIES**							**TOTAL**	***RANK***
	TSC4	**TSC5**	**TSC8**	**TSC10**	**KP423**	**N39**	**TSC12**		
Disease Tolerance	5	5	5	5	2	1	5	28	5
High Yield	5	5	5	5	4*	3	5	32	3
Good cup taste	5	5	5	5	5**	5	5	35	1
Big bean size	5	5	5	5	5	4	5	34	2
Drought Tolerance	5	5	5	5	4	5	5	34	2
Leafiness	4	4	5	5	4	5	5	32	3
Fast Growth	5	5	5	5	3	3	5	31	4
Insect pest tolerance	3	3	3	3	2	1	3	21	6
Total	**37**	**37**	**38**	**38**	**29**	**27**	**38**		
Rank	**2**	**2**	**1**	**1**	**3**	**4**	**1**		

Key: 1- Poor; 2 – Satisfactory; 3 – Average; 4 – Good; and 5 - Excellent

* - If not attacked by CBD before harvesting
** - If not contaminated by an infected grain/kernel

The most preferred criteria in the varieties/lines under optimum management practices were good cup taste, big bean size, and tolerance to drought. Other criteria scored high in the lines were high yields, leafiness, and fast growth. The least scored characteristics were disease and insect pests' tolerance.

Based on the criteria used, TSC 10, TSC 8 and TSC 12 were the most preferred varieties/lines because they scored excellent in all criteria with the exception of tolerance to insect pests where they scored average. The other preferred lines were TSC 4 and TSC 5 which were scored the same as TSC 8, 10, and 12 but scored good in the leafiness criterion. The least preferred varieties were KP 423 and N39, which scored poor to average in some criteria like disease/insect pests tolerance and fast growth.

Table 6: Matrix ranking of coffee varieties under sub optimal management conditions in Moshi Rural District, Northern Tanzania in 2003/04 cropping season

CRITERIA	COFFEE VARIETIES							TOTAL	RANK
	TSC4	TSC5	TSC8	TSC 10	KP423	N39	TSC 12		
Disease Tolerance	5	5	5	5	3	1	5	29	4
High Yield	5	5	5	5	4	2	5	31	3
Good cup taste	5	5	5	5	5	5	5	35	1
Big bean size	5	5	5	5	5	3	5	33	2
Drought Tolerance	5	5	5	5	5	5	5	35	1
Leafiness	5	5	5	5	5	5	5	35	1
Fast Growth	5	5	5	5	5	3	5	33	2
Insect/pest tolerance	3	3	3	3	2	1	3	18	5
Total	**38**	**38**	**38**	**38**	**34**	**25**	**38**		
Rank	**1**	**1**	**1**	**1**	**2**	**3**	**1**		

Key: 1- Poor; 2 – Satisfactory; 3 – Average; 4 – Good; and 5 - Excellent

All varieties were highly scored for good cup taste, drought tolerance and leafiness under small holder management practices. Other criteria that were highly scored in the lines/varieties were fast growth, big bean size and high yields. All the improved lines were scored excellent in all criteria with the exception of tolerance to insects' pests where they were scored average. The least preferred criterion was tolerance to insect pests where all the improved lines were scored average while the commercial varieties were scored poor to satisfactory.

Based on the criteria used all improved lines were equally preferred by the farmers and were most preferred compared to the commercial varieties. The least preferred variety was N39. The performance of KP 423 was better under sub optimal management conditions than under optimal management practices indicating that the variety is more suitable for small holder low input production conditions than high inputs production conditions.

A pair-wise ranking was done for the lines/varieties under optimal management practices and sub-optimal conditions as shown in Tables 7 and 8

Table 7: Pair wise ranking of Coffee varieties under optimum management practices in Arumeru District Northern Tanzania in 2003/04 season

	TSC 4	TSC	TSC 8	TSC 10	KP42	N	TSC12	TOTAL	RANK
TSC 4		5	8	10	4	4	12	2	5
TSC5			5	10	5	5	5	5	2
TSC8				10	8	8	12	3	4
TSC10					10	10	10	6	1
KP423						423	12	1	6
N39							12	0	7
TSC 12								4	3

The pair wise ranking of the varieties under optimal production conditions indicated that TSC 10 and TSC 5 were the most preferred varieties by the farmers followed by TSC 12 and TSC 8. TSC 4 was least preferred among the introduced lines due to slightly less number of nodes compared to the others. The least preferred variety was N39.

Table 8: Pair wise ranking of Coffee varieties under small holder management practices in Moshi District Northern Tanzania in 2003/04 cropping season

	TSC 4	TSC 5	TSC8	TSC 10	KP423	N 39	TSC 12	TOTAL	RANK
TSC 4		5	8	10	4	4	12	2	5
TSC5			5	10	5	5	5	5	2
TSC8				10	8	8	12	3	4
TSC10					10	10	10	6	1
KP423						423	12	1	6
N39							12	0	7
TSC 12								4	3

Similar results were obtained when the lines/varieties were grown under small holder management practices whereby the most preferred lines were TSC 10, TSC 5 followed by TSC 12 and TSC 8. The least preferred variety was again N39.

5.0 Conclusions

The most important farmers' criteria for selecting coffee varieties were tolerance to diseases especially CBD and CLR, tolerance to insect pests, high yields, good cup taste and big bean size. All introduced improved lines were highly scored and preferred for disease tolerance, good cup taste, big bean size, drought tolerance, high yielding, fast growth and leafiness regardless of type and level of management practices. The commercial varieties KP423 and N39 were scored low in tolerance to diseases and insect pests. Matrix ranking of the lines under optimum management conditions showed that the most preferred varieties were TSC 8, TSC 10 and TSC 12 followed by TSC 4 and TSC 5. All introduced lines were equally preferred by the farmers under sub-optimal conditions or small-holder management practices. The commercial variety N39 was the least preferred line/variety in both matrix rankings. The pair-wise ranking of the lines/varieties under both optimal and sub-optimal conditions indicated that the farmers preferred the introduced varieties in the order of TSC 10, TSC 5, TSC 12, TSC 8, and TSC 4. TSC 4 had fewer number of nodes (14-15) compared to the other introduced lines which had an average of 16-17 nodes per branch. N39 was the least preferred variety in both pair-wise rankings.

6.0 Recommendation

Since all the introduced lines have performed better than the two commercial varieties under both optimal and sub-optimal conditions in terms of tolerance to CBD and CLR diseases and insect pests, yield, fast growth and big bean size they could be considered for release so that farmers have access to these improved varieties and consequently reduce costs of production from less use of pesticides, increase production and household income.

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8.0 Appendices

Appendix 1: Farmers' disliked characteristics in coffee in order of importance

1. Coffee Berry Disease
2. Leaf Rust
3. Susceptible to insects attack e.g stem borer, mealy bugs, leaf miner, Antestia and scales)
4. Lack of cholophyl (less chlorosis)
5. Bearing fruits/berries from top branches
6. Many suckers
7. Over bearing - cause dieback
8. Small beans

Appendix 2: Coffee pests and farmers' ranking

Type	***Rank***
Mealy bugs	1
Antestia (Kimatira)	3
Leaf minor (Kidomozi)	2
Berry moth (Uwiwi)	4
Berry Borer	5
Scales (green and Black)	7
Aphids	10
Stem borer (Bungua mweupe)	6
Shoot Borer (Bungua wa njano)	8
Moles (Fuko)	9

Appendix 3: Swahili names of some pests

Pest	**Swahili name**	**Part of plant attacked**
1. Berry Borer	Ruhuka	(Berries)
2. White stem borer	Bungua mweupe	(Stem)
3. Yellow headed borer	Bungua wa njano	(Shoots)
4. Leaf Miner	Kidomozi	(Leaves)
5. Antestia bug	Kimatira	(Berries, young shoots)
6. Berry moth	Uwivi	(Berries)
7. Mealy bug	Vidung'ata	(Young succulent shoots)
8. Scales	Vidugamba	(Young shoots)

Appendix 4: Swahili names of some diseases

CBD – Chule Buni (Fruits/Berries)
CLR – Kutu ya majani (Leaves)

Appendix 5: Yield potential and liquor quality of the assessed coffee lines/varieties

Yield potential			Quality	
KP 423	2.0	Tons/ha	6	FAQ
N 39	2.0	Tons/ha	5	FAIR
TSC 4	3.0	Tons/ha	6	FAQ
TSC 5	3.0	Tons/ha	6	FAQ
TSC 8	3.0	Tons/ha	6	FAQ
TSC 10	3.0	Tons/ha	6	FAQ
TSC 12	3.0	Tons/ha	5	FAIR

FAQ – Fair Average Quality
Liquor quality scale:
1 – 6: Good Commercially
7 – 14: Poor Commercially
NB: The lower the score, the higher the quality

Appendix 6: Comparison of Levels of Management

	Activity	***Sites for farmers' assessment***	
		Mr..E. Mtei (optimal management)	Mr.A. Kishumbua (small-holder or sub-optimal management)
1.	Standard hole size plus planting fertilizers	Standard as recommended in coffee	Direct planting Not followed recommendation
2.	Application of F. Yard Manure after planting	Regularly	Occasionally
3.	Application of inorganic fertilizers	Standard	Occasionally
4.	Weed control	Optimum	Optimum
5.	Insect pest control	When observed	When observed
6.	Pruning	Only suckers	When observed
7.	Irrigation	Regularly	None
8.	Intercropping	Mono	Intercropped with

			banana
9.	CBD Control	None	None
10.	CLR Control	None	None
11.	General observation in the field	Regular	Regular

Appendix 7: List of participants

List of Participants	Village	District	Gender
1. Augustino Kishumbua	Mkononngo	Moshi(R)	M
2. Teresia Kishimbua	Mkomongo	Moshi (R)	F
3. Barakael G Mushi	Kashashi	Hai	M
4. Elihuruma Olotu	Lyamungo Estate	Hai	M
5. Hosea Ng'unda	Nguni	Hai	M
6. Frank Mongi	Mawanjeni	Moshi (R)	M
7. Joseph Mdeo	Manushi Sinde	Moshi (R)	M
8. Johara Mtei	Nguruma	Arumeru	F
9. Yananinsia Kimaro	Losaa	Hai	F
10. Tabu . A Muro	Nguni	Hai	F
11. Albert Sanare	Kifuni	Moshi(R)	M
12. Onesmo Natai	Lukani	Hai	M
13. Edwin Kaale	Kiruweni	Moshi (R)	M
14. Ebenizeri Godfrey	Modio	Moshi (R)	M
15. Gervas Vasuri	FINCA Estate	Arumeru	M
16. Amos Shao	Mrimbouo	Moshi (R)	M
17. Fatima Faraji	FINCA Estate	Arumeru	F
18. Edwin Mtei	Nguruma	Arumeru	M
19. Albert Massawe	Mkonongo	Moshi (R)	M