Farmers' Seed Practices in Nakuru Kenya

Field survey report

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Seed Savers Network, Kenya and Agrecol, Germany

Impressum

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Table of content

1 Introduction 5

2 Methodology of the study 6

3 Some basic facts on the farming system in Nakuru 7

4 Findings on farmers' seed systems 12

4.1 The main crops cultivated 12

4.2 Crop varieties and cultivation areas 15

4.3 Management of seeds of farms 17

4.4 Seed marketing and farmers' future plans 19

4.5 Crop improvement, farmer breeding and training needs 20

5 Conclusions 21

6 Literature 22

Appendices 23

Appendix 1: Seed survey questionnaire 23

Appendix 2: Background of farming systems 28

Appendix 3: Additional data on crop varieties 28

Appendix 4: Additional data on marketing and storage 36

Table of acronyms

OSS	Open Source Seeds
PVP	Plant Variety Protection
PRA	PRA
SSN	Seed Savers Network

1 Introduction

Farm-saved seed is existential for agriculture and nutrition in Kenya. Crop varieties of most vegetables, pulses, tuber crops, sorghum, and millets depend almost entirely on farmers' breeding, and their seed production. Genetically, local cultivars are the result of generations of farmers' expert knowledge in plant breeding. As a result, local breeding lines or cultivars have proven well adapted to local and regional production. Thus, they constitute the basis of crop-agrobiodiversity.

However, these cultivars are insufficiently described and threatened with extinction. This is partly due to various reasons: weak national and international research institutions, low attention to orphan crops, sole attention of the private sector to crops with high commercial value. However, it is also a weakness that efforts within the farming community itself are scattered, and there is no or very little effort towards developing farmer-led plant breeding and seed production systems. Another problem is also that local cultivars are increasingly appropriated by national research institutions and seed companies. Plant Variety Protection (PVP) and patents constrain their free use among farming communities and restrict Farmers' Rights further. At the same time, an alternative, the reliable provision of affordable, commercial and heterogenous seeds is for many essential crops out of reach. At the same time, the Kenyan Seed Policy (2010) indicates that farmer managed seed systems contribute more in supply of seeds than the commercial seed industry. Several attempts are ongoing to improve the national seed supply such as the concept of integrated seed sector development by Munyi & De Jonge (2015). However, despite various efforts, the situation remains unsatisfactory and national food security faced another downward trend in 2022 due to prolonged droughts in several part of the country.

As a suitable support strategy, Seed Savers Network Kenya together with Agrecol decided to test the suitability of a commons approach, that enables free access to seed and supports farmers to characterize and describe their existing traditional varieties with a view to improving seed supply and ultimately provide a starting point for farmer-led plant breeding in the future. In order to protect farmers local varieties in Kenya a material transfer agreement has been introduced, that is similar to an open source seeds (OSS) license introduced by Agrecol in Germany a few years ago.

Against this background, this seed study represents a first step to gain an overview on locally available farmers crops and local varieties in Nakuru county. The current paper outlines the main findings of this study and formulates ideas for guiding the further work on seed conservation.

2 Methodology of the study

A survey was undertaken in a two-week period in February 2022 and the data were analysed in the following months.

The seed study was conducted with 10 farmer groups of SSN providing a good cross section of locations in the county of Nakuru. Four specific tools were used for the study in all 10 villages, namely:

- a formal questionnaire,
- focus group discussions,
- group ranking exercises, and
- village walks with visits to 2-3 farms located near the gathering venue.

The combination of the tools permitted to gain a very good overview on the situation on farms and the seed situation in particular. A total of 244 individual farmers with 68% female and 32% male respondents were interviewed. Out of the 10 groups visited, 8 groups were new with the collaboration established in the last 6 months. The remaining two older groups, comprised of very old groups with members that started up to 10 years ago and one medium group, with members of up to 3 years of project collaboration.

Table 1: Sample

	No. of groups	Female	Male	Sample size	% of total n
New groups	8	129	72	201	82,3
Old groups	2	36	7	43	17.7
Overall sample n	10	165	79	244	100

Since the initial data analysis provided little evidence of gender specific findings, the data of this study distinguishes only general findings (all groups combined) or data disaggregated to new and old groups separately. The reason for group selection were based on the interest of SSN to expand its farmers' network in Kenya. Taking part in the survey proved to be an attractive incentive for new farmers and a good learning opportunity for all.

Besides the formal questionnaire, the focus group discussions reached out to about 120-155 participants in all 10 villages. Since the various discussions required about 4-5 hours per day, not all participants were able to stay the full time. In five of the ten villages, seed preferences of farmers were investigated with a PRA group ranking tool.

In order to determine the priorities of crops that should be given special attention under the project, two methods were used. The first method, the popularity of crops as indicated by the number of farmers that grow the crops, was derived from the formal questionnaire. In order all for quick planning of annual project activities, the group ranking of farmers' priority crops was done in 5 out of the 10 villages. Interestingly, both methods provided very similar results, in particular regarding the ranking and choice of priority crops. For this reason, the PRA results are not reviewed in detail in the report but can be consulted in Appendix 3.

3 Some basic facts on the farming system in Nakuru

The age of respondents ranged from 24 to 82 years, with an overall average of 49 years. This finding illustrates that farmers are considerably older than the average of the population. The percentage of farmers under 40 years was only 28,7%. This finding illustrates the aging of the farming community, and it highlights, that young people do not moving into the sector as would be desirable. This is a first finding that more extension efforts will be necessary to attract a higher proportion of younger farmers to achieve a broader reach out to the Kenyan society and to have better chances for highly dynamic groups. Women are represented with almost 80% and this is certainly very good finding for promoting gender. However, emphasis should also be stronger to win younger men to engage in farming in reduce the growing over ageing of the agricultural sector.

Education levels of all respondents were typically low as it is common for rural Africa. 7,8% of respondents had no formal educational degree and about 2/3 respondent (62,1%) held primary school degree only. Secondary school degrees were held by 23,1% of farmers. A very promising fact was that each of the groups had some 1-2 members, often engaged in the boards of the groups, that held tertiary educational degrees. This proportion is clearly above standards for rural Kenya, and as such, an encouraging finding for the project.

The group discussions showed very clearly that land shortage is a major problem for all farmers. While the two smallest farmers just had tiny gardens of 40 sqm each, the two largest farms managed 10 acres each. The majority of farmers own in between 1-2,5 acres, with the median at 1,5 acres (0,6 ha). The farm size distribution is shown in the next table.

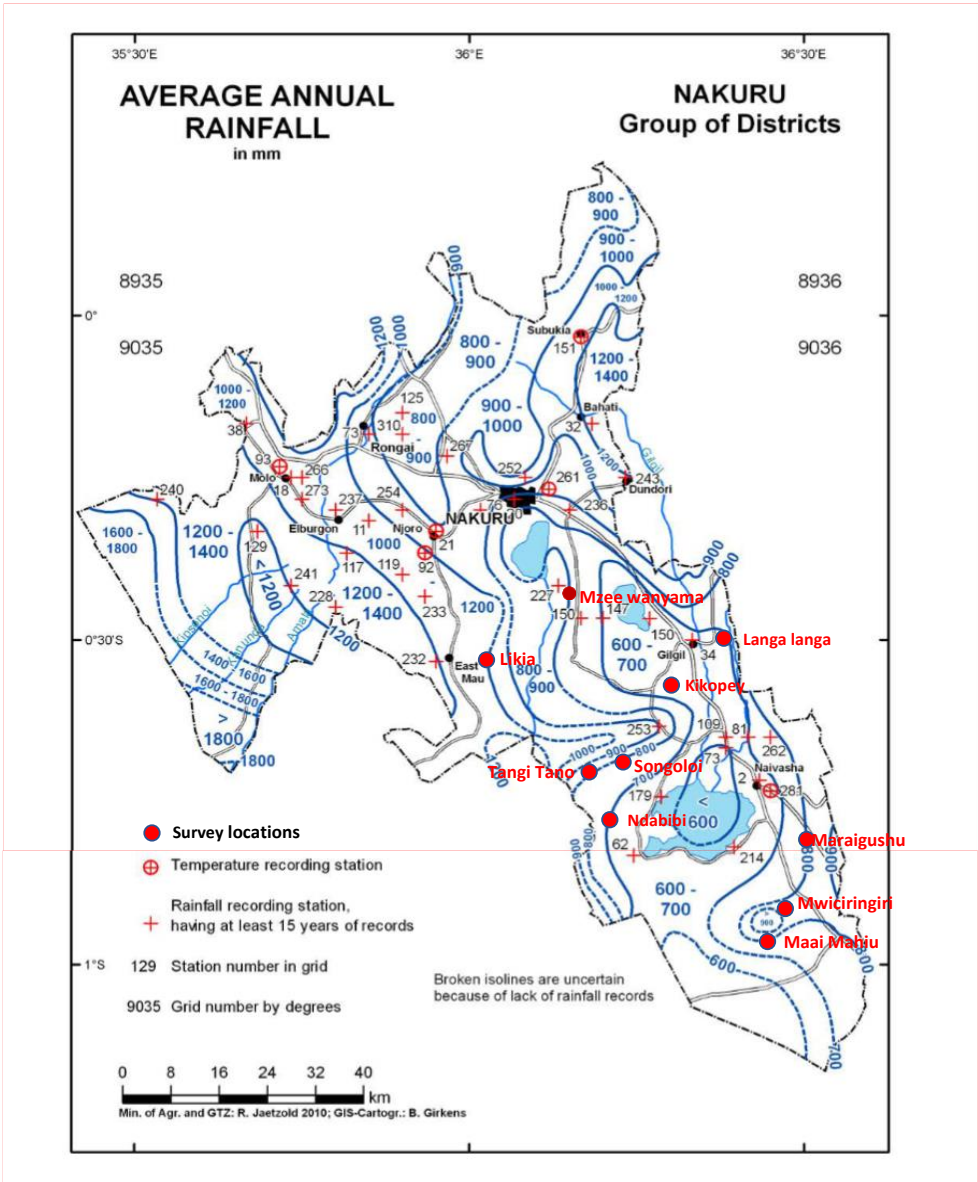
Table 2: Distribution of farms according to farm size of arable land (acres and ha) - all groups

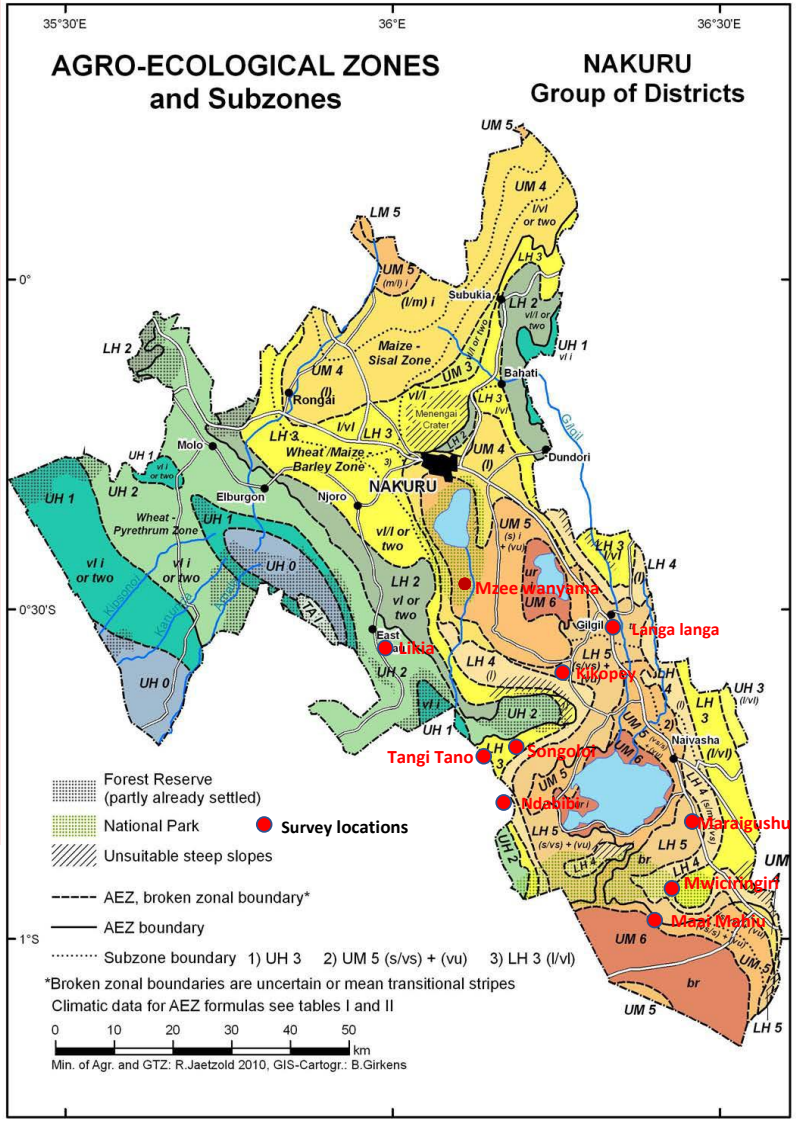
Land size classes		Share
Acres	**Ha**	**%**
<1	<0,4	20,2
1 - 2,5	0,4 - 1	52,7
>2,5	>1	27,2

The data shows, that a fifths of farmers cultivate less than 1 acre, the majority range between 1-2,5 acres and a little more than a quarter exceed 2,5 acres (>1 ha). These figures highlight very clearly that land is scarce. It can be seen even more clearly by computing the available farm land per household member. One quarter of the families have less than 666 sqm per head, while the average family has close to 0,4 acres per member of the household (1743 sqm/person).

The discussions with farmers during the field walks indicated that there are considerable differences in rainfall between the villages. Some villages in the foothills of the mountain ranges have better rainfall conditions, while the villages in the plains are characterized by drier conditions. All villages practiced water saving and water collection from house roof tops to various extends. The access to household wells is variable and generally, these water sources, do only permit a very limited supplementary irrigation to crops; therefore the production in both annual rainy seasons is predominantly rain fed.
Kenya benefits from the fact that a very detailed classification of land into agro ecological zones with consideration of long-term rainfall data is available. According to this classification (Farm management handbook for Kenya 2009) the villages visited fall in the range of 600 to1100 mm of annual rainfall (see Figure 1).

Figure 1: Rainfall in Nakuru district and Agroecological zones in Nakuru district and survey locations (Source Farm management hand-book for Kenya 2009)





Four out of the 10 villages belong to the agroclimatic zones where rainfall is considered unreliable, 4 villages are slightly reliable and only one location is rated as reliable. This highlights the high production risk of farmers in the region. Considering, that the farm management handbook is already older, it may be rather likely, that the production risk due to climate change had become even more pronounced today. The following table also gives annual rainfall and estimates on the reliability of rainfall.
Temperatures show only a few degrees variation in the course of the year with daily maxima near 26 C and nightly minima dropping to 12 C. This strong day night temperature difference has a lot of advantages for plant growth, as the lower night temperatures help to conserve evaporation losses and lower nighttime temperatures lead to lower metabolism energy losses for plants. The lower nighttime temperatures are caused by the high altitude in Nakuru districts that ranges from 1600m to 1900m in the first three of the sites given in the Table 3, and increases further in the other locations from 1900m to 2400m. The difference of 800m between the villages, translates into mean temperature differences of up to 3^{o} C.

Table 3: Sample villages and reliability of rainfall

	Villages	Group name	Rainfall mm
1	Pipeline/ Mzed Wanyama	Greencom	600-950 unreliable
3	Langa Langa -Gilgul	BELAKOM farmers group	600-950 unreliable
4	Songoloi	Songoloi Farmers CBO	600-950 unreliable
5	Nyakairu/ Mwichiringiri	Fanikisha SHG	700-900 unreliable
6	Tangi Tano	Taka Mema CBO	700-1100 somewhat reliable
7	Ndabibi	Huruma Fraternity S.H.G	700-1100 somewhat reliable
8	Maraigushu	Fou Way Road Farmers	700-1100 somewhat reliable
9	Maai Mahiu	Ujumbe Mpya	700-1100 somewhat reliable
10	Likia	Kiahiti B	900-1200 reliable

Source: Farm management handbook for Kenya 2009

The use of chemical fertilizers is quite common in Kenya and is indicated by the findings of this study. The average annual use[1] in the new groups is 76kg/farm and among the old groups, it is strongly reduced to only 22kg/farm. As SSN supported sustainable agriculture with a focus on reducing chemical inputs, the reduction can be seen as a project impact.

Table 4: Average use of chemical inputs per farm (kg/annum/farm)

	New groups	Old groups
Mean	76,3	22,4
Minimum	0	0
Maximum	500	250

However, a deeper analysis reveals that the average fertilizer consumption is not homogeneous. Among the new groups about a third of farmers does not use fertilizer at all, while this percentage is more than doubled in the old group (61%). In the old groups, the reduction is stronger again in the higher input levels of more than 100kg fertilizer use per year (see Table 17, p28).

[1] The study asked for any type of mineral fertilizer use (NPK; DAP, etc.)

Considering that there are up to 3 growing seasons in Nakuru, these annual amounts can be rated as very low to moderate. Since the risk of low production due to low rainfall is very high, farmers try to avoid losing money and use fertilizers, if at all, only in small to moderate amounts. The stronger reduction of this input among the old groups, indicates a good impact of past extension work.

Hand weeding is still the dominant practice among all farmers (60%). But chemical weeding is a growing practice. 38% of farmers indicated that they do both, partly hand weeding and partly herbicide use with a share of approximately 50 /50. Only 3% of farmers indicated that they use chemical weeding exclusively. Among the older groups, the percentage of farmers still practicing hand weeding is 10 % higher than in the new groups (67%).

Table 5: Weeding practices (% of farmers)

	New groups %	Old groups %
Predominantly hand weeding	57,8	67,4
Half/half	38,7	32,6
Predominantly herbicides	3,5	0,0

The data for chemical sprays points in a similar direction. 9% of farmers do not use any sprays at all, while 42% of all farmers use traditional remedies. About half of all farmers (49%) uses pesticides. The PRA findings illustrate this very well. Many farmers complained about various crop losses both during the growing season and as post-harvest losses. This demonstrates that better sustainable practices will need to be developed and communicated to farmers.

Table 6: Pest control practices (% of farmers)

	New groups %	Old groups %
Predominantly no treatment at all	9,7	4,7
Nonchemical applications	34,2	76,7
Chemical sprays	56,1	18,6

The farms surveyed do not keep much livestock. A high level of poverty is visible by the fact that there is a big group of farmers that do not own any livestock. The next table gives the overview. If we start with the poorest, then there are 51% that don't have a single sheep, 58% are not keeping cows, 76% are not rearing goats, 83% are without rabbits and 96% without pigs.

Table 7: Percentage of farmers that keep various types of livestock (all groups)

Number of animals	Sheep	Cows	Goats	Rabbits	Pigs
0	51,4%	58,4%	76,3%	82,6%	96,3%
1	4,9%	17,1%	3,7%	2,5%	0,8%
2-3	18,4%	19,2%	13,1%	5,4%	0,8%
4+	25,3%	5,3%	6,9%	9,5%	2,0%

The most common livestock are sheep. 18% have 2-3 animals and another 25% have 4 or more animals. Also 13% of farmers have 2-3 goats. 1 Cow is owned by 17% of farmers and 2-3 cows are owned by another 19% of farms. Rather universal is the rearing of chicken. Only 12% of farmers do not have any chicken, while 36% own up to 9 chicken and 42% rear in the range of 10 to 29 animals.

As can be seen from Table 7, there is a high percentage of farmers who do not have animals, except for chicken. The reason is that size of land are limited as well as fodder supply. This in turn has implications for manure supply and soil fertility maintenance.

Table 8: Percentage of farmers that keep poultry (all groups)

Number of animals	Chicken %
0	12,2
1-9	35,9
10 -29	42,0
30+	9,8

In summary the figures show that farmers are not very well endowed with livestock. This finding also has consequences for farming, since animal manure is an important input to cropping activities and for maintaining soil fertility.

The farming systems related questions of the survey give a broad characterisation of farms. They show, that key constraints of farmers are high variability of rainfall combined with the lack of water and irrigation possibilities. The shortage of land obliges farmers to become more innovative. At the same time, livestock numbers are small, so that also from this side, farmers cannot achieve big income gains. In the next section we take a closer look at how farmers manage their seeds.

4 Findings on farmers' seed systems

4.1 The main crops cultivated

In preparing the survey with farmers, a set of 39 crops was retained for the questionnaire to investigate farmers' most common crops. It was found that farmers in the new groups cultivate 16 crops on average, while the farmers in the old groups were more diversified and cultivated 22 crops. The next table shows the results for these most commonly grown 16 crops. The less frequently grown crops are shown in Appendix 3. Rating the frequency of crops plays a crucial role for what crops should be taken up for further support work by SSN. Selected crops are shown in bold letters throughout the tables in this chapter.

The results show that a good mixture of various crops is found among the most cultivated crops. The most important crop and major staple food is maize. Second most important is potato. In third position is Sukuma wiki, a local kale. If we group all 16 crops, then we find there is one cereal (maize), two tubers (potato and sweet potato), 6 different vegetables and 5 types of beans. From the nutritional perspective this can be rated as a well-balanced diet. Impressive, is also the diversity of crops grown by farmers. This finding is very similar to what Bender et. al. (2013) found in western Kenya. Farmers were growing 10 vegetables on average. and Diversity of crops ranged between 2 and 10 per farm for vegetables (mean= 5) and between 0 and 5 for legumes (mean= 2). Intra-species diversity was rather low: only one variety was grown for half of the crops investigated. The

Table 9: Most commonly grown crops (sorted according to frequency)

Rank	Crops	Type of crop	New groups %	Old groups %
1	White maize	Cereal	97,5	90,7
2	**Potatoes**	Tuber	94,0	97,7
3	Kales, sukuma wiki[2]	Vegetable	88,5	97,7
4	**Spinach**	Vegetable	85,0	95,4
5	**Wairimu bean**	Legume bean	85,4	88,4
6	**Spring onions**	Vegetable	84,1	93,0
7	**Kifamu bean**	Legume bean	73,1	79,1
8	**Garden Peas**	Legume bean	70,2	86,1
9	**Black nightshade**	Vegetable	70,7	76,7
10	**Kahurura**	Vegetable	69,0	83,7
11	**Pumpkin**	Vegetable	65,7	88,4
12	**Sweet potatoes**	Tuber	62,0	79,1
13	**Mwitemania bean**	Vegetable	59,7	81,4
14	Amaranth	Vegetable	58,0	81,4
15	Coriander dania	Vegetable	52,8	72,1
16	Yellow bean	Legume bean	49,0	79,1

The types of crops grown are analysed further in the next paragraphs. Crops are presented in the following 4 categories:

- Cereals
- Root crops
- Legumes
- Vegetables and other

[2] Engl. Collard green; German Blattkohl

Cereals. White maize is the most important crop in Kenya, and it is grown by almost all farmers and also testified in this study 98% (New groups). Yellow maize (27%) and mixed maize (23%) are much less important. The fact why maize is so dominant as a crop may also have to do with its strong support by Government and the fact that it is considered a food security strategic crop. Nevertheless, in particular in the context of increased droughts, farmers would be well advised, to diversify a little more, and take up more drought resistant crops such as millets. But such a trend is as yet not very articulated.

Table 10: Percentage of farmers growing cereals

	New groups %	Old groups %
White maize	97,5	90,7
Yellow maize	19,8	55,8
Mixed Maize	13,0	65,1
Sorghum	11,6	30,2
Millet	12,1	9,3

According to the survey, the number of farmers that are growing sorghum and millet is still very low (12%). This is certainly strongly influenced by culture, since among west African farmers in the Sahelian areas for example, millet and sorghum are grown almost by all households while maize is only grown by a few. It would make sense for SSN to encourage farmers to grow more sorghum and millet as a diversification strategy to cope with drier weather. Some farmers of the older groups may have taken up that idea already. Among them, growing sorghum is three times more frequent than among the new groups. The growing of sorghum and millet is also focused on the communities Pipeline and Nyakairu/Mwichiringiri that are characterised by very irregular rainfall. Obviously, more farmers take up that option, where the problem is highest.

In Kenya, the market for cereals and in particular for maize is the stronghold of commercial seed companies. Many varieties on the market are hybrids and cannot be regrown by farmers. The scope of conserving traditional varieties for maize is extremely limited. For this reason, Agrecol and SSN decided not to work on seed for cereals.

Table 11: Percentage of tuber growers

	New groups %	Old groups %
Potato	94,0	97,7
Sweet potatoes	62,0	79,1
Cassava	22,5	60,5
Arrow roots	16,7	9,5
Yam	8,2	14,3

Tubers. Potato is the most important root crop in Nakuru county, and it is grown almost universally by all farmers (94%). Second is sweet potato that is grown by about 2/3 of farmers followed by cassava that is grown by almost a third. Much less important are arrow roots and yam. Since root crops are normally propagated by roots or vines and not by seed, the study also excluded them from further attention.

Pulses comprise of various beans from the legume family (Fabaceae) and play a major role for farmers in Kenya. Various different beans are consumed almost daily. The next table

provides the details. The table reveals an impressive number of pulses diversity. Most common are the beans of the phaseolus species, notably Wairimu beans (85%), Kifamu beans (73%) and Mwitemania beans (60%). Least popular were black beans (12%)
Very popular are also garden peas (70%) and broad beans (56%). Less widespread today (13-26%) are the beans that genetically originated in Africa (Dolichos, cowpea, pigeon pea).
Besides beans, also part of the families of leguminous crops are peas and lentils. However, these much smaller lentils only play a very minor role on farms with grower percentages below 5%.

Table 12: Percentage of farmers growing pulses (sorted according to major species groups)

Crops	Type of crop	New groups %	Old groups %
Wairimu beans	Phaseolus vulgaris	85,4	88,4
Kifamu beans	Phaseolus vulgaris	73,1	79,1
Mwitemania beans	Phaseolus vulgaris	59,7	81,4
Yellow beans	Phaseolus vulgaris	49,0	79,1
Green beans	Phaseolus vulgaris	19,7	55,8
Mukura Noke beans	Phaseolus vulgaris	13,1	51,2
Other pulses			
Garden Peas (minji)	Pisum sativum	70,2	86,1
Broad beans	Phaseolus Coccineus	55,7	25,6
Black beans	Phaseolus Coccineus, Lablab purpureus	8,5	30,2
Dolichos (African)	Dolichos ssp, Lablab purpureus	26,0	24,4
Cowpeas	Vigna unguiculata	14,1	44,2
Pigeon pea	Cajanus cajan	13,6	26,2
Soy beans	Glycine max	5,5	14,0
Green grams (mung bean)	Vigna radiata	2,0	4,7
Lentil	Lens culinaris	1,0	2,3

It is somewhat surprising, that mung beans and lentils play a very marginal role only (1-3%). May be the climate is still too wet for optimal growth of lentils. The fact, that most beans and lentils are readily available in the markets, may also explain, that some farmers prefer to buy what is needed, rather than to attempt to grow everything by themselves.

Due to their popularity and high nutritional value, beans are given ample attention in the study.

The group of vegetables and other crops again demonstrates diversity (Table 13). Most common vegetables are kales, spinach, spring onions and black nightshade that range from 72% to 90% grown by farmers. Widespread vegetables and grown by more than half of farmers are Kahurura, pumpkin, coriander, spider weed and tomato. They form an important potential field of intervention for SSN.

Table 13: Percentage of growers for vegetable and other crops

Crops	Local	Exotic	New groups %	Old groups %
Kales Sukuma Wiki[3])	✓	✓	88,5	97,7
Black nightshade	✓		70,7	76,7
Kahurura (Cucumis ficifolius) Melon	✓		69,0	83,7
Pumpkin	✓		65,7	88,4
Amaranth	✓		58,0	81,4
Spider plant	✓		43,7	72,1
Comfrey (Mabati)	✓		31,8	55,8
Calabash (Kinya)	✓		3,5	20,9
Spinach (beta vulgaris)		✓	85,0	95,4
Spring onions		✓	84,1	93,0
Coriander		✓	52,8	72,1
Tomato	✓	✓	42,0	74,4
Butternut		✓	15,6	27,9

Vegetables, such as black nightshade, pumpkin and spinach are very important for the nutrition of Kenyans and often offer good selling conditions in particular for women. At the same time, these crops do not receive major attention by the formal seed market. That is why SSN is giving these crops special attention.

4.2 Crop varieties and cultivation areas

During the interviews, the discussion of crops and crop variety names showed difficulties of understanding between the researchers and farmers. Farmers were not familiar with the term "variety", which is used for all types of crop cultivars in this study.

Farmers always know the crop name, and if there are several varieties, then sometimes they know how to distinguish the varieties based on one or more specific characteristics (e.g. red / white flowers, tall – dwarf stem, early – late maturity, etc.). Sometimes there are also variety names, but more often variety names as such do not exist. For the most commonly traded seed of maize for example, variety names exist, but these names are just numbers e.g. "611" for different hybrids. Using this same logic, farmers also sometimes just talk about variety "one" or variety "two". The fact that so many different local languages are spoken, leads to differences in local names and variety names. Sometimes varieties that come from another area are called according to the main ethnic group in that area e.g. the "kikuyu variety.
Likewise, the origin of species and varieties may not always be clear. Sometimes farmers say this is an old local variety, but in many cases, they are not certain. In some cases, a variety is called "the improved one", and that means it probably came from some research station or some company, but often not very much more is known.

The following tables highlight the number of varieties identified according to farmers' knowledge during the survey and the names were screened with a few local resource persons. To provide a first overview on the potential crop diversity now found on farms in Nakuru, the Table 14 gives and overview on species and the number of varieties found. As far as variety names could be identified, these are given in Appendix 3.

[3] Sukuma wiki is a leafy Kale (engl. Collard green). It is one of the most important vegetables for Kenyans. Sukuma wiki, which in Swahili means "to push the week." It relates to the fact the food is eaten each day and keeps the family nourished and healthy.

Due to the limitations described above, it should be noted that the number of varieties presented here should be understood as rough estimates. The SSN team hopes, that in the course of the characterisation process the knowledge on local varieties will increase and that it will be possible to distinguish varieties more exactly in the coming years.

Table 14: Species and number of varieties

Cereals	**No. of varieties**
Maize	15
Millet	5
Sorghum	2
Beans	
Phaseolus vulgaris	
Other pulses	
Broad beans	9
Garden Peas (minji)	6
Cowpeas	4
Dolichos	3
Pigeon pea	2
Soybean	2
Green gram	1
Lentil	1
Vegetables and others	
Pumpkin	9
Tomato	7
Black nightshade	6
Spider plant	5
Kales Sukuma Wiki	4
Spinach	3
Amaranth	2
Coriander	2
Spring onions	2
Kahurura, (Cucumis ficifolius) Melon	1
Comfre (Mafaki)i	1
Butternut	1
Tubers	
Sweet potatoes	8
Potato	3
Cassava	2
Arrow roots	2
Yam	1

Usually, farmers usually know the cropping area of all their farm very well. However, to determine the area of each individual crops remains a challenge since most crops are intercropped. The most important crops to farmers are maize and potato. For these two crops the median areas are similar for most households, 1,0 acre for maize and 0,5 acre for potatoes. This matches very well with the overall median plot size of 1.5 acres per farm. Legumes such as beans are mostly intercropped with the maize and cultivated on a quarter to half an acre of land. Most other crops are grown only in the homestead gardens or they are equally intercropped with maize on the main plot(s). Most farmers also grow only a single variety per

species. This finding is identical to what Bender et. al. (2013) found in Western Kenya. Generally, intra-species diversity was rather low: only one variety was grown for half of the crops investigated. In Nakuru just a very small group of farmers grow a second variety and some very few farmers grow up to 4 varieties for some of the crops cultivated. The detailed areas planted for each crop are presented in appendix 3.

4.3 Management of seeds of farms

Literature on the tropical seed market for Africa, often gives the estimate that about 80% of the seed used are produced by farmers themselves. The finding of this study supports this estimate (see Appendix 4, Table 28). In addition, the study shows that farmers' seed management is very crop specific and in line with the local conservation possibilities. If we look for example at maize, the major staple is Kenya, it can be seen that here the commercial market has taken the biggest share. 88 % of farmers indicated that they buy their maize seeds in agro shops. Since all commercial white maize varieties are hybrids, farmers do no longer have the chance to maintain their own seeds and need to buy. For maize as a cross pollinator, it is almost impossible for farmers to maintain their old varieties because it is technically impossible to keep the necessary distances of at least 150m to other maize fields. For mixed maize, millets and sorghum, still about 2/3 of farmers grow own varieties, and only 28% of farmers rely on purchases from agro shops.

Table 15: Origin of seed and sources of seed purchases

	Seed purchases via main sources %		
	Local market	**Agro shop**	**F2F with and without SSN seed platform**
Cereals			
White maize	0,0	88,4	9,2
Mixed maize, millet and sorghum	45,4	27,7	29,1
Beans			
Average beans	44,8	9,4	45,8
Exotic vegetables			
Spinach	12,9	73,1	14,0
Tomato	21,7	67,4	10,9
Butternut	22,2	61,1	16,7
Kales Sukuma Wiki	13,4	59,9	26,8
Coriander	24,0	51,0	25,0
Spring onions	23,4	12,9	63,7
Local vegetables			
Amaranth	8,7	56,5	34,8
Black nightshade	16,7	43,7	39,6
Spider weed	29,4	41,2	29,4
Kahurua melon	21,1	21,1	57,8
Pumpkin	25,3	12,0	62,7
Comfrey Mabati	19,5	9,8	70,7
Calabash	21,3	8,8	69,9

For beans, the situation is very different. Close to 40% of farmers produce all the seed required by themselves, and another 63% are at least partly seed secure. Only 9% of farmers stated that they buy bean seeds from agro shops, while the remaining 91% either buy on the

local market or from neighbors. The farmer-to-farmer seed platform of SSN is also used by a growing number of farmers. So far however, the volume traded is still small.

For vegetable seed, the seed supply practice differs from crop to crop. For many exotic vegetables it is often very difficult to produce these seed in a tropical environment, and thus, a good number of farmers rather rely on purchasing seed. The data indicated that 73% of farmers bought spinach seed, 67% bought tomato seed, 60% bought kale seed or 51% bought coriander in agro shops. For local vegetables with easy seed production, like pumpkin or calabash, usually more than 90% of farmers are at least partly seed secure. The findings for a selection of major crops is presented in the next table. All crop specific results are depicted in Appendix 4.

Some of the very diverse seed practices are showed in the box below.

Many crops are stored in plastic sacks often mixing many species. This storages leads to high losses as can be seed below

Simple seed banks help groups to keep all crops and protect them from insect attacks.

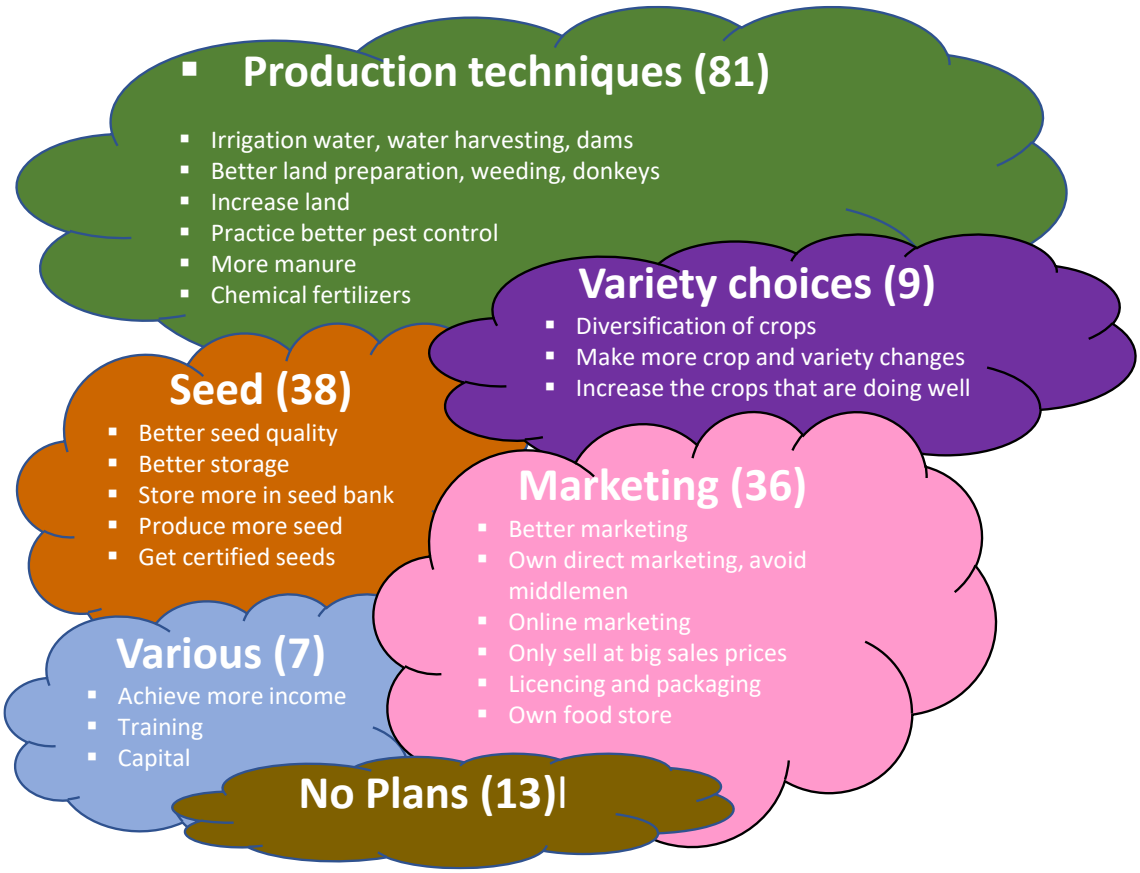
Weevil attacks on stored bean seed.

Typical homestead garden with manyfold vegetables intercropped.

4.4 Seed marketing and farmers' future plans

Only a few individual farmers have enough production to sell seed. Rather, farmers struggle to find all the seeds needed for planting each season. This problem is even more pronounced in years of drought that often require repeated sowing.
Due to this challenge, solidarity among farmers is high. 29% of farmers indicated that they regularly share seed with other farmers.
If they sell a little, then it goes mostly to neighbours and friends (39%) or they sell at the nearby local market (33%). These sale practices apply to virtually all different crops sold. The exact selling figures for each of the top four crops are given in appendix 4 (Table 26).

Figure 2: Farmers seed related future plans



Farmers identified many reasons for seed sales being limited. The biggest problem seems to be with the market, since the selling prices are seen as to low. Second biggest problem has to do with the irregular rainfall and increasing climate insecurity. Third most important problem are various pests and diseases, and this is relevant for cropping but also for storage of seed that generally is kept in the house. All detailed problems raised are given in appendix 4 (Table 31).

Asked about their future plans, the answers of farmers correspond very well with some of their current major problems as discussed above. 81 comments were received related to improving production techniques that range from addressing irrigation and moving into better fertilization with animal manures, better pest control and also include better land preparation and weeding. Second biggest cluster refers to better seed management (38 comments) with a focus on the seed banks and better storage options. Very important is also marketing (36 mentions) including better direct marketing and the creation of own food stores. Farmers also plan

to work on better variety choices (9 comments) and they think that they require more capital and training to be able to achieve better income in the future (see Figure 2).
With its various intervention programmes, SSN is making an effort to support farmers in the above raised areas. The seed and variety clusters will certainly play the major role, while examining options for increasing seed production will also be an area to be given due attention in the future.

4.5 Crop improvement, farmer breeding and training needs

Crop improvement and farmer breeding are rather new subjects to farmers. Almost half of the farmers (47%) couldn't reply to this question at all since they were not sure if they understood the question correctly or they were uncertain if they actually do some kind of crop maintenance breeding of any kind. Among the 43% of farmers that replied with yes, 65% thought that they do some level of maintenance selection. 9% of farmers reported that they observed natural cross pollinations and 3% indicated that they studied the involved parents closer. Among the crops subjected to breeding activities, farmers mentioned in particular potato, beans and garden peas. Potato improvement, which is leading in the list, maybe attributed to several factors and notably to the fact that half of the sample villages belong to potato growing areas and farmers traditionally do selection especially by sorting and grading of the tubers. (for more details on breeding crops see appendix 4, Table 22).
Concerning crop improvement objectives, farmers typically considered yield as the number one criteria for their selection work (19%). Further important breeding objectives are disease resistance (15%) or drought tolerance and early maturity (both 13%). Influencing food quality was mentioned by 9% of farmers. But as already indicated at the beginning of the chapter, the topic was difficult for farmers to understand. 31% of farmers couldn't give any answers.

Table 16: Please name subjects, which you would like to be discussed in a training

Rank	Topics	Percent
1	Storage and processing of potatoes, beans and cereals	26,7
2	Agronomic practices, soil needs, organic fertilizers, farm planning, and focus on potato, beans, tomato, maize	24,6
3	Disease problems	11,5
4	Seed management, planting densities, seed and food quality improvement	10,7
5	Storage of water for better irrigation and drought control	9,2
6	Crossing of parents, seed selection	9,2
7	Organic farming, marketing and value addition	8,4
	Number of answers (n)	**131**

The field questionnaire concluded with a question on farmers future training needs. On top of the ranking list are storage problems. Farmers loose so much food and seed in storage, a really burning issue. The storage also greatly affects the amount of seed available for sowing in two ways. Since much of the production is destroyed, it happens quite often that families even touch their seed stock for feeding the family. Thus, food and seed are very closely tied together and it will be important to address these problems together. A second big training requirement has to do with comprehensive learning on various aspects of agro ecology covering many areas of agronomic practices and of animal husbandry. In third place, better disease control was named and at rank four better seed management is mentioned. This is an important finding. It shows, that seed is not the number one problem for farmers. It is important issue, but not the most important. It can be concluded that future work will also have to address the top issues via appropriate agricultural extension for farmers.

5 Conclusions

Farmers in Nakuru grow a large number of species and this makes their farming system well diversified. Farmers in project villages interact well and their farming strategy can be seen as highly resilient in terms of climate change. Only few crops are cultivated in pure stands. Most crops are highly intercropped in the field or in the homestead garden.

Intraspecies diversity is rather low and the majority of farmers just grows a single variety per crop species. There is rather little awareness on species diversity and no culture of giving proper names to varieties. For more effective biodiversity conservation and in order to make farms more resilient, it would be important to develop more awareness and knowledge in this field.

Seed production is limited due to various factors that include the very small land area per farm, limited irrigation opportunities and poor seed storage with high post-harvest losses. Further study will be needed to investigate how farmers can be assisted in seed production, storage and marketing.

Conserving the current farming experience and developing in further by strengthening farmers local varieties by describing and naming them will be an important seed support strategy for the future of the country.

Figure 3: Farmers work on describing their indigenous crops

6 Literature

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Appendices

Appendix 1: Seed survey questionnaire

Seed Survey SSN Kenya – February 2022

0 General Information

0.1 Questionnaire running number: _____

0.2 Village / Location: please tick (√) where applicable

Maai Mahiu	Mau Narok/Likia	Nyakairu/Mwichiringiri	Songoloi	Gilgil
Maraigushu	Pipeline/Mzee wa nyama	Ndabibi	Tangi Tano	Kikopey

0.3 Name of farmer / interviewed person (optional): _____

0.4 Tel for additional inquiries (optional): _____

0.5 Since when are you working with the Kenya Seed Savers? (√ , tick where applicable)

a) Newly started (max 1 year), ____

b) since 2-3 years, ____

c) since 4 years or longer ____

0.6 What is your age: _____

0.7 Gender of respondent: male / female

0.8 What is your highest education degree? (√ , tick where applicable)

a) No formal education, _____
b) Primary school, _____
c) Secondary school, _____
d) University / tertiary education _____

1 Household and farm related information

1.1 How many people live in your household eating together _____

1.2 How much land are you farming (acres): _____

1.3 Purchase of chemical fertilizer: give numbers of kg _____

1.4 Weed control (√, tick where applicable):

a) predominantly hand weeding _____ b) half/half _____ c) predominantly herbicides _____

1.5 Control of pests and diseases (√, tick where applicable):

a) predominantly no treatment at all ____ b) traditional methods ____ c) pesticides _____

1.6 How many livestock do you own?

a) Number of sheep ____

b) Number of goats ____

c) Number of cows: ____

d) Number of pigs: ____

e) Number of chicken: ____

f) Number rabbits: ____

2 Which crops do you grow and where do the seeds come from?

Tick where applicable (√) including multiple sources			Provision of seed / propagation material							
Crops grown		2.1 grown yes/no	2.2 Degree of own farm seed					2.3 Seed purchase via (MC)		
			100% own	75% own	50% own	25% own	100% bought	local market	agro-shop	Farm to Farm inc. Seedbanks
Cereals										
1	White Maize									
2	Yellow Maize									
3	Mixed Maize									
4	Sorghum									
5	Millet									
Pulses										
6	Mwitemania beans									
7	Yellow bean									
8	Wairimu bean									
9	Kifamu bean									
10	Mukura Noke bean									
11	Black bean (Nyakairu)									
12	Broad beans (Noe)									
13	Soybean									
14	Green bean									
15	Garden peas (Minji)									
16	Pigeon pea									
17	Cowpea (Thoroko)									
18	Green gram, Ka-mande									
19	Green grams, Ndengu special									
Vegetables										
20	Calabash / Kinya									
21	Pumpkin / Malenge									
22	Butternut									
23	Tomatoe									
24	Kales (Sukuma Wiki)									
25	Amaranth (Terere)									
26	Spider weed Sageti									
27	Jutemallow (Mrenda)									
28	Comfrey (Mabati									
29	Spinach									
30	Kahurura									
31	Coriander (Dania)									

32	Spring onion (Mashaki)								
33	Black nightshade Managu								
	Vegetative propagated crops								
34	Sweet potatoes (Ngwaci)								
35	Cassava, Muhogo								
36	Potatoe								
37	Arrow roots (Nduma)								
38	Yam								
39	Dolichos (Njahi)								

3 Average cropping areas and crop varieties cultivated (if box space is not sufficient use backside of page to continue)

If it is too difficult to find out cultivated area (due to intercropping) one could estimate the kg amount of seed sown alternatively.

Crop grown		3.1 Estimate area cultivated use either acres or steps x steps		3.2 Number of varieties cultivated	3.3 Names of varieties cultivated in order of popularity
		Area in acres	Area in steps (m x m)		
Cereals					
1	White Maize				
2	Yellow Maize				
3	Mixed Maize				
4	Sorghum				
5	Millet				
Pulses					
6	Mwitemania beans				
7	Yellow bean				
8	Wairimu bean				
9	Kifamu bean				
10	Mukura Noke bean				
11	Black bean (Nyakairu)				
12	Broad beans (Noe)				
13	Soybean				
14	Green bean				
15	GardenPeas (Minji)				
16	Pigeon pea				
17	Cowpea (Thoroko)				
18	Green gram, Kamande				
19	Green grams, Ndengu special				
Vegetables					
20	Calabash / Kinya				

21	Pumpkin / Malenge				
22	Butternut				
23	Tomatoe				
24	Kales (Sukuma Wiki)				
25	Amaranth (Terere)				
26	Spider weed Sageti				
27	Jutemallow (Mrenda)				
28	Comfrey (Mabati				
29	Spinach				
30	Kahurura				
31	Coriander (Dania)				
32	Spring onion (Mashaki)				
33	Black nightshade Ma-nagu				
Vegetative propagated crops					
34	Sweet potatoes (Ngwaci)				
35	Cassava, Muhogo				
36	Potatoe				
37	Arrow roots (Nduma)				
38	Yam				
39	Dolichos (Njahi)				

4 Your channels for seed sharing or selling

4.1 Name crop cultivars and how they are distributed; tick (√) where applicable, To be done only for the four main crops, from which seed is sold.

Crop No.	Name of cultivar	Share with neighbours or seed bank	Sell to neighbours and friends	Sell at local mar-kets	other

4.2 Name the limitations for an increase of your seed sales:

4.3 Do you have a plan on how your seed sales could be further increased and if yes how?

5 Seed storage and processing

5.1 **For** which crops do you see a need for improving any storage or processing practices?

Crop	Storage / Processing problems
d	d

5.2 If there was a training on seed storage and processing, which subjects would you be interested in?
d

6 Do you improve your crop cultivars and if yes how?

6.1 Have you already done any improvement of crop cultivars? (√, tick Yes or No) _____d
If Yes, continue:

6.2 Type of improvement for three important crops (√, tick where applicable, multiple choice)

Crop No.	Crop	Maintenance selection	Selection for new varieties	Natural cross pollination	Crossing of selected parents
	d				
	d				
	d				

6.3 Which characters do you want to improve (√, tick a maximum of three when applicable, multiple choice)

Crop No.	Crop	Yield	Disease resistance	Drought tolerance	Early maturity	Food quality (e.g. colour, taste, shelf life, etc.)	Other
	d						
	d						
	d						

6.4 Please name subjects, which you would like to be discussed in a training: d

THANK YOU FOR COMPLETION OF THE QUESTIONNAIRE

THE SEED SAVERS NETWORK WILL KEEP YOUR INFORMATION STRICTLY CONFIDENTIAL

Appendix 2: Background of farming systems

Table 17: Fertilizer usage classes

Denomination kg /farm / annum	New groups %	Old groups %
0.. <5	31,3	60,5
5.. <50	13,9	18,6
50.. <100	18,4	13,9
100.. <200	22,4	4,7
200.. <501 kg	13,9	2,3

Appendix 3: Additional data on crop varieties

Table 18: Less commonly grown crops (sorted according to frequency)

Rank	Crops	New groups %	Old groups %
17	Broad beans	55,7%	25,6%
18	Spider weed	43,7%	72,1%
19	Tomato		42,0%
20	Comphrey Mabati	31,8%	55,8%
21	Cassava	22,5%	60,5%
22	Yellow maize	19,8%	55,8%
23	Green Bean	19,7%	55,8%
24	Dolichos	26,0%	24,4%
25	Mixed Maize	13,0%	65,1%
26	Mukura Noke bean	13,1%	51,2%
27	Cowpeas	14,1%	44,2%
28	Butternut	15,6%	27,9%
29	Pidgeon pea	13,6%	26,2%
30	Arrow roots	16,7%	9,5%
31	Sorghum	11,6%	30,2%
32	Black bean	8,5%	30,2%
33	Millet		12,1%
34	Jutemallow Mrenda	10,0%	18,6%
35	Yam		8,2%
36	Soy bean	5,5%	14,0%
37	Calabash Kinya	3,5%	20,9%
38	Green grams ndengu special	2,0%	4,7%
39	Green grams Kamande	1,0%	2,3%

Table 19: Names of different varieties of cereals and tubers given by farmers

Cereals	No of varieties	Variety names
Maize	15	H511, H513, H614, H624, H625, H629,H6213,H6218, Githigu makueni, Katumani Mukufu Purple

Cereals	No of varieties	Variety names
		Juma Oguko
Sorghum	2	“Red” “White”
Millet	5	Nyakairu Nyakikuru “Red” Nyamalege/nyamarege “White”
Tubers		
Potato	3	Shangi Mukorino/mukurinu Ndera mwana
Sweet potatoes	8	Githumo/gathumo Limproved (gingasha) Mmwibai ”Yellow fleshed” Muhika na ihu, ”Purple” ”White” Githinji
Cassava	2	“Red” “White”
Arrow roots	2	Mokorino, “White dotted”
Yam	1	“Cream yam”

Table 20: Names of different varieties of pulses given by farmers

Crop	No of varieties	Variety names
Beans Phaseolus vulgaris	13	Wairimu dwarf bean Wairimu small Kifamu bean Mwitemania beans “Yellow bean” KAT B 1 Green/army Bean Mukura Noke bean “Black bean” Nyota Gachuma Ciankui Nyanyo
Other pulses		
Garden Peas (minji)	6	Ambassador Gikuyu Grano Kagoci Nyaritho Thantu
Pigeon pea	2	Nyungu “White”

Crop	No of varieties	Variety names
Green gram l	1	Ndengu special
Lentil	1	Kamande
Broad beans	9	“Black” “Broad” Flowered Purple Short Small seed size Non climber “White” “Yellow”
Cowpeas	4	“Black” White spotted grain “Red” “White
Dolichos	3	“Black” “Kikuyu” Short
Soy bean	2	Cream “Red”

Table 21: Names of different varieties of vegetables given by farmers

Vegetables and others	No. of varieties	Variety names
Kales Sukuma Wiki	4	1000 Headed, Giant,Green ; Kaguru local (suckers), Thoro,
Spinach	3	Ford Hook Giant, East African Royal, Sugar Baby
Spring onions	2	Mashaki narrow, Mashiki broad
Black nightshade	6	“Black”, Broad leaved, Improved/giant, Indigenous/kienyeji/ local/ordinary Kimuhu, Narrow leaved
Kahurura (Cucumis ficifolius) Melon	1	“Local”
Pumpkin	9	“Black”, Giikamba, “Green” “Light green” Madoadoa /spotted, Nochero “Oval” “Round”, “Rudi green”,
Amaranth	2	“ improved”, kienyeji/local, ,
Coriander	2	American long standing,

Vegetables and others	No. of varieties	Variety names
		“Short leaves”
Spider plant	5	“Green”, “local” , “purple”, “red”, “yellow”,
Tomato	7	Cal J , Rio Grande, Cherry Red (Kanyoni red), Cherry Yellow (Kanyoni yellow) Money maker , Kilele, Kamongo
Comfre (Mafaki)i	1	“Local”
Butternut	1	Yellow improved

Table 22: List of crops used as examples of farmer own maintenance or crop selection work

	Cases	%
No answer	164	67,5
Potatoe	24	9,9
Beans	23	9,5
Garden Peas (minji)	9	3,7
Maize	8	3,3
Kales Sukuma Wiki	7	2,9
Tomato	2	0,8
Pumpkin	2	0,8
Sweet potato	1	0,4
Millet	1	0,4
Spring onion	1	0,4
Other answer	1	0,4
Sum answers	79	32,5
N	243	100,0

Table 23: PRA Ranking of importance of crops and varieties

PRA-rank	Crops	PRA ranking points		Rank	Crops	PRA ranking points
	Priority crops				**Optional work if time allows**	
1	Spring onion (Mashaki)	157		19	Spider weed Sageti	128
2	Spinach (Swiss chard)	156		21	Comfrey (Mabati	118
3	White Maize-(Blue,Purple)	155		23	Soybean	117
4	Sweet potatoes (Ngwaci)	154		24	Cassava, Muhogo	117
5	Black nightshade Ma-nagu	154		26	Sorghum	113
6	GardenPeas (Minji)	153		27	Millet	112
8	Kahurura, Squash	150		28	Yam	112
9	Tomatoes	149		29	Pigeon pea	112
10	Potato	149		30	Butternut	107
12	Arrow roots (Nduma)	145		31	Cowpea (Thoroko)	102
13	Broad beans (Noe)	142		32	Yellow Maize	97
14	Dolichos (Njahi)	138		33	Mukura Noke bean	97
15	Wairimu bean (Phaseolus Vulgaris)-	138		34	Jutemallow (Mrenda)	97
18	Mwitemania beans (Phaseolus Vulgaris)	132		35	Calabash / Kinya	94
20	Green bean (Phaseolus Vulgaris)	127		36	Green gram, Kamande	91
22	Kifamu bean (Phaseolus Vulgaris)	117		37	Mixed Maize	85
	Secondary crops				Classified out	
7	Pumpkin / Malenge	152		38	Green grams, Ndengu special	81
25	Yellow bean (Phaseolus Vulgaris)	116		16	Amaranth (Terere)	136
11	Kales (Sukuma Wiki)	146		17	Coriander (Dania)	133

Notes:
Regarding the procedure of the village PRA ranking, it can be explained that participants were asked to rank all crops according to low, medium or high importance for their own farm. Then the results of the five villages ranking lists were combined into one single index, calculating 3 points for high importance crops, 1.5 points for medium importance crops and 1 point for low importance crops.

Table 24: Cultivated area in acres and square meters and no. of varieties for cereals, tubers, peas and lentils

	Area acres					Area sq. meters					Number of varieties cultivated				
	Average	**Median**	**Min**	**Max**	**N**	**Average**	**Median**	**Min**	**Max**	**N**	**Average**	**Median**	**Min**	**Max**	**N**
Cereals															
Maize															
White maize	**1,2**	1,0	0,1	7,0	198		-	-	-	-	**1,5**	1	1	4	201
Yellow maize	**0,4**	0,3	0,1	2,0	45	**263**	150	35	561	11	**1,1**	1	1	2	44
Mixed Maize	**0,4**	0,3	0,1	1,0	27	**662**	150	0	5000	13	**1,2**	1	1	3	31
Other cereals															
Sorghum	**0,3**	0,3	0,1	0,5	8	**722**	431	0	5000	12	**1,6**	1	1	3	16
Millet	**0,5**	0,4	0,1	1,0	10	**320**	381	10	600	10	**1,5**	1	1	3	16
Tubers															
Potato	**0,6**	0,5	0,1	8,0	147	**531**	66	0	5000	44	**1,4**	1	1	5	136
Sweet potatoes	**0,2**	0,3	0,1	0,5	31	**190**	100	0	5000	76	**1,5**	1	1	8	79
Cassava	**0,5**	0,4	0,1	1,0	6	**64**	20	1	600	34	**1,0**	1	1	2	32
Arrow roots	**0,4**	0,4	0,1	0,5	8	**44**	7	0	200	10	**1,0**	1	1	1	15
Yam	**0,3**	0,1	0,1	0,5	3	**10**	6	2	25	4	**1,0**	1	1	1	4
Peas and lentils															
Garden Peas (minji)	**0,5**	0,3	0,0	2,0	99	**338**	100	0	5000	44	**1,3**	1	1	3	103
Pidgeon pea	**-**	-	-	-	-	**324**	50	0	5000	21	**1,0**	1	1	1	15
Green grams ndengu special	**0,3**	0,3	0,3	0,3	1	**27**	27	4	50	2	**1,0**	1	1	1	1
Green grams Kamande	**0,1**	0,1	0,1	0,1	1	**-**	-	-	-	-	**1,0**	1	1	1	1

Table 25: Cultivated area in acres and square meters and no. of varieties for pulses and vegetables

	Area acres					Area sq meters					Number of varieties cultivated				
	Average	**Median**	**Min**	**Max**	**N**	**Average**	**Median**	**Min**	**Max**	**N**	**Average**	**Median**	**Min**	**Max**	**N**
Dry/common Beans															
Wairimu bean	**0,75**	0,50	0,05	4,0	134	**495**	120	0	5000	46	**1,2**	1	1	4	126
Kifamu bean	**0,63**	0,50	0,05	4,0	105	**305**	100	0	4900	40	**1,1**	1	1	2	97
Mwitemania beans	**0,66**	0,50	0,06	4,0	102	**125**	25	0	561	25	**1,1**	1	1	4	99
Yellow beans	**0,69**	0,50	0,06	4,0	62	**195**	45	0	625	36	**1,2**	1	1	3	82
Mukura Noke bean	**0,66**	0,38	0,13	3,0	28	**276**	100	1	900	16	**1,1**	1	1	2	36
Green/army Bean	**0,56**	0,25	0,13	2,0	31	**314**	300	0	625	16	**1,1**	1	1	2	38
Black bean	**0,26**	0,25	0,06	0,5	5	**88**	65	12	210	4	**1,1**	1	1	2	9
Other pulses															
Broad beans	**0,49**	0,25	0,06	4,0	48	**203**	57	0	1200	44	**1,4**	1	1	4	69
Dolichos	**0,50**	0,13	0,06	4,0	12	**313**	100	1	5000	24	**1,0**	1	1	1	24
Cowpeas	**0,39**	0,19	0,13	1,0	10	**440**	100	1	5000	24	**1,4**	1	1	3	32
Soy bean	**0,34**	0,13	0,13	1,0	4	**3**	3	2	4	2	**1,0**	1	1	1	6
Vegetables and others															
Kales Sukuma Wiki	**0,47**	0,25	0,02	4,0	74	**169**	100	0		113	**1,2**	1	1	3	130
Spinach	**1,14**	0,25	0,03	50,0	63	**349**	50	0	10000	112	**1,1**	1	1	2	99
Spring onions	**0,46**	0,25	0,03	4,0	56	**337**	100	0	10000	87	**1,2**	1	1	3	89
Black nightshade	**0,47**	0,25	0,06	4,0	23	**179**	25	0	5000	74	**1,4**	1	1	4	73
Kahurua (Cucumis ficifolius) Melon	**0,17**	0,13	0,06	0,5	19	**41**	10	0	200	82	**1,0**	1	1	2	61
Pumpkin	**0,54**	0,25	0,02	4,0	43	**213**	25	0	5000	92	**1,4**	1	1	4	100
Amaranth	**0,50**	0,25	0,02	4,0	36	**167**	32	0	5000	64	**1,3**	1	1	3	69
Coriander	**0,32**	0,25	0,03	1,0	22	**149**	17	0	5000	59	**1,1**	1	1	3	56
Spider weed	**0,37**	0,25	0,02	1,5	23	**296**	30	0	5000	52	**1,2**	1	1	3	52
Tomato	**0,43**	0,25	0,06	2,0	39	**342**	78	0	5000	56	**1,2**	1	1	3	70
Comphrey Mabati	**0,46**	0,25	0,06	1,5	10	**76**	8	1	600	32	**1,0**	1	1	1	25
Butternut	**0,32**	0,13	0,13	1,1	7	**44**	13	1	200	16	**1,0**	1	1	1	20

Table 26: Crop sales (out)

Selling mode Share with neighbours or seed bank crops 1-4	Share with neighbours or seed bank %	Sell to neighbours and friends %	Sell at local market %
Most important crop	26,1	41,1	32,8
Second most import crop	28,0	38,0	34,0
Third most important crop	29,1	37,0	33,9
Priority sales crop 4	31,6	39,1	29,3
Average all crops	**28,7**	**38,8**	**32,5**

Table 27: What characters farmers want to improve for top three crops

	Cases	%
Yield	233	18,5
Disease resistance	194	15,4
Drought tolerance	166	13,2
Early maturity	166	13,2
Food quality	114	9,0
Other, specify	4	0,3
Without answer	384	30,5
Total	1261	100,0

Appendix 4: Additional data on marketing and storage

Table 28: Farm saved seeds

	Farm saved seed planted %	
	Entirely farm saved	**Partly farm saved**
Exotic vegetables		
Spinach	13,8	86,2
Tomato	25,8	74,2
Butternut	40	60
Kales Sukuma Wiki	30,7	69,4
Coriander	22,2	77,8
Spring onions	39,6	60,4
Local vegetables		
Amaranth	48,9	51,1
Black nightshade	43,3	56,7
Spider weed	48,6	51,4
Kahurua melon	56,3	43,7
Pumpkin	46,2	53,9
Comfrey Mabati	43,2	56,8
Calabash	33,3	66,7

Table 29: Cereals and their origin of seed

	Farm saved seed planted %		Seed purchases via %		
	Entirely farm saved	**Partly farm saved**	**Local market**	**Agro shop**	**F2F with and with-out SSN seed plat-form**
Maize					
White maize	9,9%	90,1	0,0	88,4	9,2
1.Yellow maize	46,7	53,3	35,3	20,6	52,9
2. Mixed maize	44,4	55,6	30,0	16,7	60,0
Millet	24,0	76,0	56,3	43,8	0,0
Sorghum	29,4	70,6	50,0	22,7	27,3

Table 30: Pulses and origin of seed

	Origin of seed planted %		Seed purchases via %		
	Entirely farm saved	**Partly farm saved**	**Local market**	**Agro shop**	**F2F via SSN seed platform**
Bean Varieties					
Wairimu bean	37,9	62,1	44,5	6,6	48,9
Kifamu bean	41,5	58,5	42,0	6,3	51,7
Mwitemania beans	34,0	66,0	44,7	8,6	46,7
Green Bean	40,0	60,0	46,9	15,6	37,5
Mukura Noke bean	34,1	65,9	41,7	8,3	50,0
Black bean	48,0	52,0	25,0	0,0	75,0
Other Pulses					
Broad beans	42,0	58,0	38,8	5,0	56,2
Dolichos	36,0	64,0	43,8	18,8	37,5
Cowpeas	22,0	78,1	67,9	10,7	21,4
Garden peas	31,4	68,8	52,7	14,2	33,1
Av beans	**36,7**	**63,3**	**44,8**	**9,4**	**45,8**

Table 31: Limitations for seed sales as perceived by farmers

Limitations raised	**Percent (%)**
Various market problems e.g. low prices	21
Climate insecurity (flood, drought, etc.)	13,2
Pests and diseases (wild animals, monkeys)	12,8
Insufficient land (scarcity of land?)	9,3
Lack of water	8,9
Storage, space, losses, not enough seeds, Seed bank supply	10,7
Scarcity of capital	5,4
Poor seed quality	5
Low harvest, yield	3,5
Various input related shortages: e.g. fence, input costs, stealing,	2,8
Competing with the use for food purpose	2,7
Insufficient transport	1,9
Lack of license to sell seed	1,2
Lack of skills	0,8
Big company competition	0,4
Growing the same varieties	0,4
N	245

Table 32: What are your future plans (cases and % of farmers comments)

Plans	Cases	%	Plans	Cases	%
Production techniques			**Seed**		
Irrigation water, water harvesting, dams	32	17,3	Better seed quality	11	5,9
Increase land	15	8,1	Better storage	8	4,3
Practice better pest control	10	5,4	Store more in seed bank	8	4,3
Better land preparation, weeding, donkeys	10	5,4	Produce more seed	8	4,2
Better farming practices	6	3,2	Get certified seeds	3	1,6
More manure	5	2,7			
Chemical fertilizers	3	1,6	**Variety choices**		
			Diversification of crops	4	2,2
Marketing			Make more crop and variety changes	3	1,5
Better marketing	23	12,4	Increase the crops that are doing well	2	1,1
Online marketing	3	1,6			
Own direct marketing, avoid middlemen	6	3,2	**Various**		
Only sell at big sales prices	2	1,1	Achieve more income	2	1
Licencing and packaging	1	0,5	Training	1	0,5
Own food store	1	0,5	Capital	4	2,2
No plans	13	7,0			
Answers n				185	