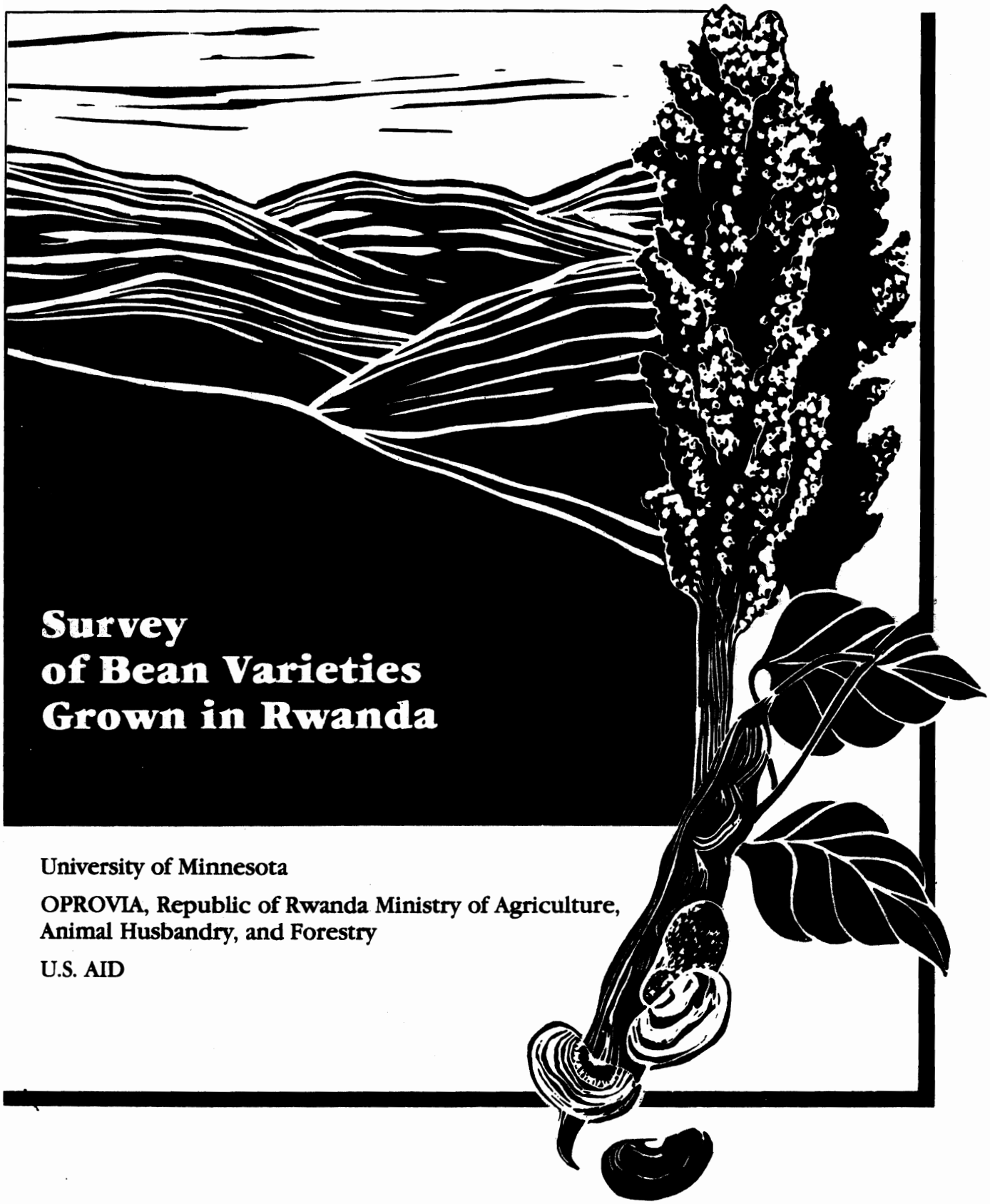

Survey of Bean Varieties Grown in Rwanda

University of Minnesota

OPROVIA, Republic of Rwanda Ministry of Agriculture, Animal Husbandry, and Forestry

U.S. AID

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SURVEY OF BEAN VARIETIES GROWN IN RWANDA

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ABSTRACT

Five hundred eighty-nine mixtures of beans (Phaseolus vulgaris) were collected from 483 farms during a survey of bean seed types grown in Rwanda. In addition, 115 mixtures were collected from 39 markets. Sixty-six samples were obtained from farmers selling beans to the National Grain Storage Board (GRENARWA) at three warehouses.

The results of the analysis of the survey questionnaire and separation of mixture components are as follows. The average number of seed types present in the collected mixtures was 11, with a range from 1 to 27. Planting and harvesting of beans occur during two distinct periods but climatic differences around the country result in variation in the specific timing of these activities. Seventy-eight percent of Rwandan farmers produce their own seed for the following season. Fifty-one percent of the farmers sell a part of their bean production. Fifty-six percent of farmers use specific mixtures for specific field conditions, including soil type, plant type, length of growing season and type of crop association. However, mixtures were stored separately on only 25 percent of the farms visited. Factors which limit production vary with area of the country but climate, soil fertility or insects are the most common. Plant and seed characteristics were associated. For example, high yield and tolerance to infertile soil were most often mentioned for small seeded types while large seeded types were often said to have good taste, fast cooking time and high market prices. Of the 171 seed types which occur most frequently in the county, 57 percent are small seeded. Forty-nine percent are monochrome with a high percentage of these being red to pink. A division of important seed types by area of the country illustrates the regional producer preferences.

Two hundred eighty-four seed types are included in a varietal reference collection at the Institute of Agronomic Sciences of Rwanda (ISAR) at Rubona. Written descriptions and color photographs of each seed types complete the collection.

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PREFACE

This report describes the research accomplished by the component 'A survey of bean varieties grown in Rwanda' of the 'Local Crop Storage (Research Component) - Rwanda' project. The objective of the research, as stated in the Request for Technical Proposal - RFTP No. ROD/LAC-83-004, is "to obtain a better understanding of local and regional varietal distribution and producer and consumer preferences of beans to facilitate orderly marketing of the crop." The work was done in cooperation with the National Office for Development and Marketing of Food and Livestock Products (OPROVIA), the National Grain Storage Board of Rwanda (GRENARWA) and the Institute of Agronomic Sciences of Rwanda (ISAR) between January 1984 and July 1985 and was based at the ISAR-Rubona station.

INTRODUCTION
Background Information on Rwanda

Geographical Aspects

Rwanda is located 1 to 3° south of the equator in east central Africa and is bordered by Uganda, Zaire, Burundi, and Tanzania (Map 1). Rwanda covers an area of 26,338 km^2. The topography is hilly with elevations of 950 masl* in the southern region to 4,500 masl in the volcanic region of the northwest. The native vegetation ranges from savannah to highland tropical forest which has now been largely cleared for farmland. Ninety percent of the soils are basic pre-Cambrian. Five percent are alluvial and are found in the marshy areas between the hills. Areas with rich volcanic soils (5%) are characterized by high population densities. Streams, rivers and lakes are well distributed throughout the country. The rainfall is bimodal, with rainy seasons occurring between February and May and October and December. Total annual precipitation is 800 to 2,000 mm. Average temperatures range from 16 to 24° C, varying with altitude.

Demographic Aspects

The population was 5.5 million in 1982 with an annual growth rate of 3.5 percent, one of the highest in Africa. The population density of the whole country is 200 inhabitants per square kilometer but rises to 400 inhabitants per square kilometer when it is calculated on the basis of arable land area. The population is still largely rural; with only 5 percent of the people living in cities. The rural organization is one of scattered homesteads rather than organized villages.

Political Division

The capitol of Rwanda is Kigali. The country is divided into 10 prefectures, each with a center of government. Prefectures are divided into communes, of which there are 143 (Map 2). Communes are divided into sectors which are divided into collines. These individual hillsides constitute the smallest political unit.

Agriculture in Rwanda

A total of 1,229,600 ha of arable land is available (1980 data). Subsistance farming makes up the greatest part of agricultural effort in the country with each family having about one hectare of disjointed small plots to cultivate. Agriculture is characterized by a lack of mechanization, intercropping, mixed crop and livestock culture and the production of multiple food crops. The cropping seasons reflect the rainfall pattern although a third season is possible in the marshy areas. The most important crops, by harvested area (1978-1980), are beans (*Phaseolus vulgaris*), banana, sorghum, sweet potato, maize, pea, cassava and Irish potato. Maize, pea and Irish potato are most important at the higher elevations. Soybean, peanut, millet, wheat, rice, taro, and yams are also grown, as well as various vegetable crops including tomato, eggplant, cabbage, leek, and onion. Fruits grown include papaya, pineapple, avocado and custard apple. The principal industrial crops are coffee, tea and pyrethrum. Cattle, goats, sheep, pigs, chickens and

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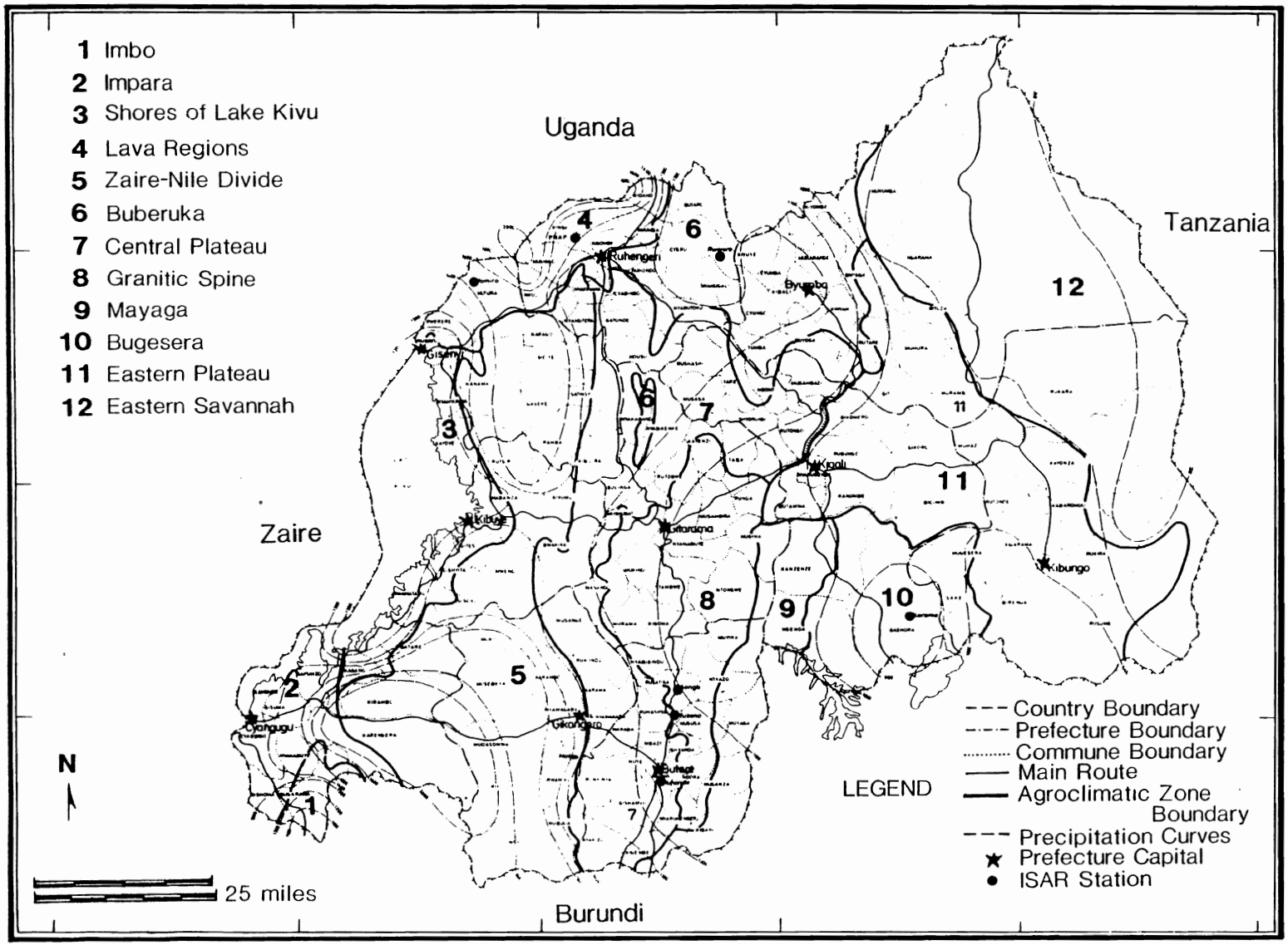
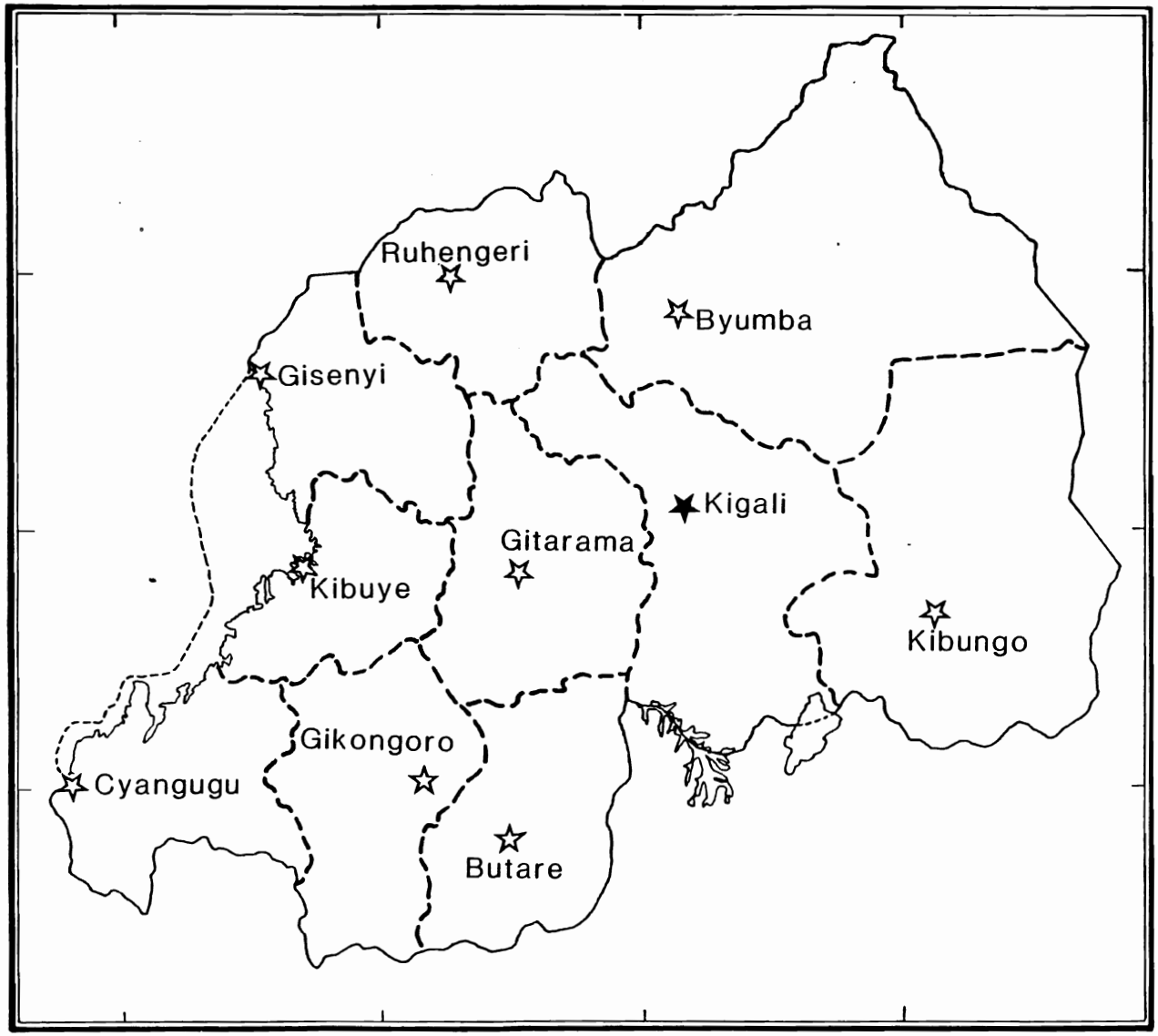
*Meters above sea level.



MAP 1. OUTLINE MAP OF RWANDA



MAP 2. PREFECTURES OF RWANDA

rabbits are produced. The country has been divided into 12 agroclimatic zones, based on elevation, rainfall, soils and types of agricultural production (Map 3, Appendix 1).

Agricultural Research

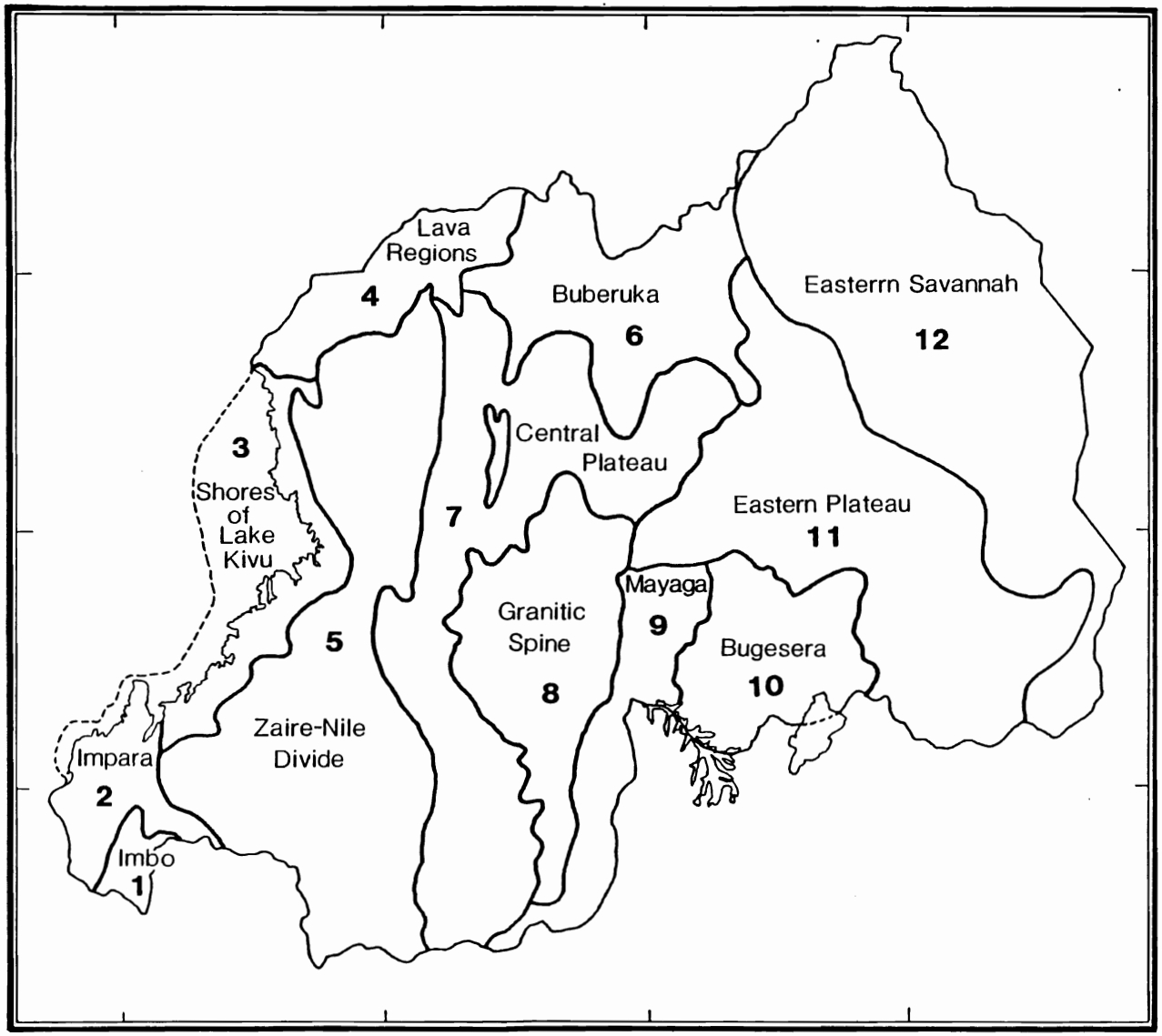
ISAR has primary responsibility for all agricultural research done in Rwanda. Seven branch stations are distributed in various regions of the country (Map 1). Research is carried out on food and industrial crops, farming systems, forestry, and livestock production. At the headquarters in Rubona, laboratory and field space is available for plant breeding, plant protection, soil and plant chemistry and microbiology. Some research is carred out by the Faculty of Agronomy of the National University of Rwanda (UNR), generally in relation to the training of students.

Bean Production, Storage and Marketing

Beans (Phaseolus vulgaris) are the major source of vegetable protein in the Rwandan diet. The estimated consumption of dry beans is 40 kg per person per year. In 1984, 98 percent of 2,100 sampled farms grew some beans during the year. Yields ranged from 417 kg/ha to 975 kg/ha with a nationwide average of 662 kg/ha. The mean yield for the first and most important season, harvested in January, was 760 kg/ha dropping to 475 kg/ha for the second season. Based on national averages, each family plants 0.35 ha to beans, either as a pure crop or the primary component in a mixed crop. Only 10.4 percent of the area used for bean cultivation is devoted to pure crops. On 71 percent of the area, beans are the primary crop and on 18 percent of the area, the secondary crop. The total harvested area of beans is approximately 240,000 ha and the total production in 1984 was 256,306 metric tons.

Beans are stored for seed and food by the farmers between harvests. Generally, they are stored in large baskets in the house. Storage cooperatives are organized where farmers may sell their beans with the possibility of purchasing beans at a later time. These cooperatives use hangar or silo-type storage structures. GRENARWA has a storage capacity of 16,000 metric tons of grain, mostly beans and sorghum. The most commonly encountered storage problems of beans are molds, insects, physical changes resulting in cookability problems and rats.

Marketing is usually done at the local level. An estimated 30 percent of total production is marketed. Excess produce may be sold at harvest or at various times during the year when money is needed. Local merchants also buy and resell beans, generally buying when the prices are low and selling when beans are more scarce and more expensive. OPROVIA also buys beans from farmers and merchants and markets them through the OPROVIA stores.



MAP 3. AGROCLIMATIC ZONES OF RWANDA

BACKGROUND RESEARCH

Seed Stocks Available at ISAR

ISAR maintains seed storage facilities at each of its research stations. Although bean varieties are tested and stored at the Rubona, Karama and Rwerere stations, the facility at Rubona is the headquarters of the Legume Programme and was the source for most of the information discussed in this report. Dr. P. Nyabyenda, head of the National Legume Programme, was extremely helpful in providing much of this information.

Seed stocks are stored either as numbered accessions, with names or identification numbers (Table 1), or as 'germplasm' which is labeled by growing season and identified only by field numbers (Table 2). Nearly 25 percent of the numbered accessions had Kinyarwandan or local place names, e.g. Gisenyi 1, 2, 3. Since some European variety names have Rwandan equivalents in common use, e.g. Bataaf is the same as Batafu, this percentage may underestimate the number of locally grown varieties in the ISAR collection. A large part of the remaining accessions are introductions from other variety development programs. The 'germplasm' material is retained from field trials of new introductions which were either locally collected or obtained from other programs. A major drawback of either collection is that little background information is available.

Some information on provenance can be gleaned from the ISAR introduction books, although most varieties are only listed by name. Dr. Nyabyenda reported that a total of 700 local varieties had been collected. Collections made in 1972 resulted in 168 accessions, but the locations were not specified. In 1979, collections were made in the prefecture of Butare, but the number of varieties collected was not specified. In 1981, 150 varieties were collected in the Ruhengeri and Gisenyi prefectures. In these surveys, two or three farmers in each selected commune were questioned during the harvest season and asked to provide the names and samples of the different seed types in their mixtures. The method of selecting the communes was not reported. A list of Rwandan variety names from the ISAR introduction books is included as Table 3. Many of these varieties were identified only by prefecture of origin and the totals do not correspond to those given by Dr. Nyabyenda, perhaps a result of duplicates in the collections.

Finally, a list of local variety names from in the ISAR introduction books, field books and seed storage lists was compiled (Table 4). It was realized that local variety names, albeit interesting, are of limited use for variety identification because one name is often used for several seed types, e.g. Mutiki 1-5 in the list of introductions. This list does, however, indicate the large number of bean varieties grown in Rwanda and, perhaps indirectly, the great importance of beans to the local people.

One result of this preliminary study was a decision that the seed stocks held by ISAR and the background information did not permit an evaluation of local producer preferences and varietal distribution. Therefore, a detailed survey of bean varieties grown in Rwanda was planned.

Table 1. Numbered accessions in the ISAR-Rubona seed storage facility, (January 1984).

Inventory number	Variety name or number	Inventory number	Variety name or number
2	VAR NO 5	157	PRIMEUR
6	TOSTADO	159	RICHMOND WONDER
9	TOSTADO	160	TENDERGREEN
16	VAR 11	162	LAZY HOUSEWIFE
17	VAR 18	163	TOP CROP
22	VAR 86	164	MASTERPIECE
59	WUL-YEL-SIAM	168	EVERBEARING
60	FAR LANG TOU	169	PRENEL
61	6488	170	MONEL
64	VERONIC	171	SORNEL
65	NANUS	172	VERNEL
67	VAR 54	174	NEGRO
69	RICORDIANUS	176	0688 COLORADO
70	JAMAPA INCREMENTO	178	6835
72	RUTUCHIA	181	6884
74	NYIRAMABUYE	182	6885
75	NKANGA	184	SABRE NAIN
78	SABAMA GRANDE	185	6870 HARVESTER
82	INYUMBA	186	6877
83	BLUE	187	6880
84	COMPRESSUS	188	6881 BURRO DI INGEGNOLI
85	AMARILLO AURO	191	C16
87	6473	192	C8
94	ACTORON	194	7093
95	6443	195	7094
96	KALIKABAGENI	196	7095
98	6467	197	7096
99	KINIHIRA	198	7045
103	NAIN BEAU PORT	199	7046
107	TANZANIE 6536	200	C10
129	PHENOMENE	201	C13
130	NAIN NOIR DE BELGIQUE	202	C15
131	SABRE A RAMES	203	BAYO 107
134	NAIN COMMONDOR AMELIORE	205	AMARILLO 154
135	NAIN CONSERVA	206	GIKOMA
136	PRINCESSE DE HUY	208	NYIRAGASEBEYA
138	NAIN PRINCESSE CORDOR	209	BAYO 158
140	NAIN PRINCESSE FLITS	210	GITSINDAYOGI
143	NAIN CONTENDER	211	KAROLINA
144	NAIN STE ESPRIT	212	NSUZUMIRUSUSHAKO
145	SUPERMETIS	213	IKINIMBA
146	NAIN MANGE TOUT	215	JOSEPHINE
148	MELANGE KABALE	216	BATAAF
149	MELANGE MBARARA	217	MBAGARUMBISE
150	NYIRAMAHORO	218	URUNYUMBA 1
151	WULMA	219	NTAMWIZA 1
155	RUVUZO	220	MELANGE JAUNE 1
156	BAYALLOTI	221	URUNYUMBA 6

continued

Table 1. Continued.

Inventory number	Variety name or number
222	KICARO
223	VAR 1/2
224	VAR 7211
225	RADIO
226	RUTAGAYISAMBU
227	MAGABALI
229	6872
232	MUTUTSI
233	IBYIRUNGO
235	MEXICAN 142
236	NYIRAMACUMA
237	BAYITUNGIRUBWIZA
238	RUGAYANDENGO
239	MUHEHA BLANC
242	NAYIRONI 370
243	KAJEMUNKANGARA
244	RUSENYINKA GATOVU 1
245	BAYO
246	NYIRAGAHINI
247	NYIRAMABUYE GATOVU
248	AMVUNARUTARO
249	RUSENYINKA GATOVU 2
252	6876
253	6879
254	6887
260	6892
261	RUVUZO
263	6875
264	6889
265	6893
267	URUNYUMBA 3
269	KINGUGWE
271	URUNYUMBA 4
272	MELANGE JAUNE 2
276	PANAMITO
277	FRIJOL BAYO
282	GISENYI 1
283	GISENYI 2
284	GISENYI 3
285	LILY
286	EMMA
287	NYIRAGAHINI 2
288	ETHIOPIA 10
289	MUHONDO 1
290	NZAMURAMBAHO
291	MUTIKI 2
292	NYIRAGASUSWE
293	GISENYI 7
294	MBAGARUMBISE
295	NYIRAKABUYE JAUNE
297	IBISETSA
301	7280
302	7281
323	GISENYI 2 BIS
324	IKINIMBA BLANC
325	NYIRAGAHINI
326	1975/2
327	MUNYU NAIN
329	CARU 3
330	MELANGE LOCAL
334	CARU 4
335	CARU 5
336	CARU 6
337	CARU 7
340	CARU 10
341	CARU 11
342	CARU 12
343	CARU 13
344	CARU 14
345	CARU 15
346	CARU 16
347	CARU 17
348	CARU 18
351	CARU 21
352	CARU 22
354	CARU 24
357	CARU 27
359	CARU 29
360	CARU 30
361	CARU 31
378	VERA CRUZ 78
471	WUCA 3
472	WUCA 4
474	WUCA 5
475	WUCA 6
476	WUCA 7
477	WUCA 8
478	WUCA 9
479	WUCA 10
480	WUCA 11
481	WUCA 13
484	WUCA 14 BIS
485	WUCA 15
486	WUCA 15 BIS
487	WUCA 16
488	WUCA 17
490	WUCA 19
491	CARU 33

continued

Table 1. Continued.

Inventory number	Variety name or number	Inventory number	Variety name or number
492	CARU 34	552	SG 92
494	MELANGE DES 4 VARIETIES	553	SG 93
495	NYIRAMABUYE JAUNE TACHE	554	SG 100
497	UBUDIDA	555	SG 101
498	VUNIMIHINI	557	SG 160
499	IBIKARA	558	SG 162
500	URUKUBANKANDA	559	SG 163
501	UBUBENGA	561	SG 165
502	NYIRAMUSHOSI	564	SG 168
503	NYIRAGIHURU GATOVU	565	SG 169
504	NYIRAGIHURU RUHENGERI	566	SG 170
505	COLUMBUS	567	SG 171
506	VOLGREEM	568	SG 173
507	MULTIMA	569	SG 174
508	COMETTA	570	SG 175
509	JULI	571	SG 176
510	HORNET	572	SG 177
512	VALJA	575	SG 185
513	URWIRUNGU	576	SG 188
514	URUSAMAZA	577	SG 189
516	SG 13	578	SG 190
517	SG 14	579	SG 191
518	SG 15	581	SG 196
520	SG 17	582	(1979A 1939)
521	SG 18	583	SG 198
522	SG 19	584	SG 199
523	SG 23	585	SG 201
524	SG 27	600	C10 VANINKINGI
525	SG 28	602	TANZANIE 6885
526	SG 29	603	SG 3
528	SG 31	604	SG 62
529	SG 34	605	SG 155
530	SG 38	606	SG 192
531	SG 39	607	SG 195
532	SG 44	608	SG 186
534	SG 52	611	IRW 3
535	SG 57	612	MI 6
536	SG 58	613	MI 8
539	SG 61	614	IRW 6
540	SG 63	615	IRW 7
541	SG 67	616	IRW 8
543	SG 70	619	IR 5
544	SG 75	620	IR 12
545	SG 78	621	IR 15
546	SG 79	622	IR 21
548	SG 82	623	IR 18
549	SG 83	624	IK 3
550	SG 84	625	IK 4
551	SG 88	626	IK 5

continued

Table 1. Continued.

Inventory number	Variety name or number	Inventory number	Variety name or number
627	IY 1	664	MWEZI MOJA
628	IY 2	665	RUBONA 1
629	IY 3	666	NDIMIRAKAGUJA
630	IY 4	667	PANAMITO SANILAC
631	IY 5	668	HABYALIMANA
632	IY 6	669	NEP 2
633	IY 7	670	BUNSI
635	IY 11	671	BUNWABUTAYIBIKA
636	MI 1	672	NONZEBABYO
637	NI 142	673	KAWATGIBISE
638	NI 555	674	BASEKA
639	NI 561	675	KIZIRANYENZI
640	NI 564	676	NSIZEBAHWERA
641	NI 565	677	BITSINDINKIKE
643	NI 568	678	AMAYOKALI
644	NI 572	679	NTABEZABAHILI
645	NI 279	680	NYIRAMAMESA
646	DIVEX 8120	681	INYUMBA MUSHINYANDENGO
647	NAYIRONI	682	NAYIRONI 2
649	IR 4 or IRW 4	683	UBUSOSERA 6
650	IR 1	684	NTAMUVIZURATA NYIRABUJA
651	IR 7	685	NYIRAGAHOMBO
652	IRW 9	686	6447
653	IR 11	687	NI 9
655	IK 2	688	RUKUBIGONGO
656	IRW 2	689	5466
657	IRW 10	690	MI 2
658	IY 9	691	ANGOLA
660	MAGURU	693	SG 32
661	MULINGA	698	SG 80
662	MUNYU VOLUBILE	711	MASOYINTAMA
663	PUKA LM	818	URUNYUMBA 12

Table 2. Germplasm tested 1983B (March-June, 1983) season at ISAR-Rubona.*

Field number	Variety name or number	Field number	Variety name or number
5001	A 185	5046	G 4727
5002	A 193	5047	G 6003
5003	BAT 1232	5048	G 7071
5004	BAT 1234	5049	VRA 81074
5005	Ikinimba	5050	Ikinimba
5006	G 4391	5051	Nyiramabuye
5007	A 276	5052	Nkanga
5008	A 293	5053	Bayo 107
5009	A 305	5054	Kalikabageni
5010	Ikinimba	5055	Ikinimba
5011	A 338	5056	Ikinimba blanc
5012	A 370	5057	Var 5
5013	A 386	5058	Master piece
5014	A 399	5059	Rugayandengo
5015	Ikinimba	5060	Ikinimba
5016	A 420	5061	1975/2
5017	A 439	5062	Nayironi
5018	A 440	5063	Nyiragihuru
5019	A 482	5064	Nyiragahini
5020	Ikinimba	5065	Ikinimba
5021	BAT 1453	5066	Caru 27
5022	Mexican 222	5067	Caru 34
5023	BAT 1459	5068	IRW - 9
5024	BAT 1463	5069	IRW - 6
5025	Ikinimba	5070	Ikinimba
5026	BAT 1490	5071	IRW - 9
5027	BAT 1492	5072	IRW - 10
5028	BAT 1654	5073	Baseka
5029	A 118	5074	Kiziranyenzi
5030	Ikinimba	5075	Ikinimba
5031	A 119	5076	Nyirambegeti
5032	EMP 103	5077	Cyuma
5033	M 92	5078	Nsizebahwera
5034	BAT 1231	5079	Ibisetsa
5035	Ikinimba	5080	Ikinimba
5036	A 171	5081	Rwasamanzi
5037	Pate 1267	5082	Nzamurambaho
5038	A 140	5083	Shikashike
5039	A 176	5084	Muhondo 2
5040	Ikinimba	5085	Ikinimba
5041	A 82	5086	Nyiramabuye
5042	A 162	5087	Nyiramugera
5043	GLPX 1131	5088	Ibinyamanza
5044	GLPX 1132	5089	Bagarumbise 1
5045	Ikinimba	5090	Ikinimba

continued

* Partial listing taken from field notes.

Table 2. Continued.

Field number	Variety name or number
5091	Mbagarumbise 2
5092	Kajenkangara
5093	Mutiki 1
5094	Ubusosera 6
5095	Ikinimba
5096	Masoyintama 1
5097	Nyirabunwabutayibika
5098	Kilyumukwe
5099	Bushakebutane 2
5100	Ikinimba
5101	Cyunyu
5102	Nyirabukara
5103	Kizungu
5104	Nyirakabonobono 2
5105	Ikinimba
5106	Ikiraki 1
5107	Ruvuvu 1
5108	Ikiraki 2
5109	Bushakebutane 3
5110	Ikinimba
5111	Kilyugaramye 2
5112	Kanyamanza 2
5113	Amashungushwa
5114	Nsizebashonje 2
5115	Ikinimba
5116	Remera 10
5117	Urumira 2
5118	Kiboho
5119	Caru 25
5120	Ikinimba
5121	Mubona 1
5122	Ubusosera 5
5123	Nsizebashonje
5124	A 171
5125	Ikinimba
5126	Rutemigongo
5127	Adera
5128	Amavunarutaro
5129	Gihoro 2
5130	Ikinimba
5131	Mbagarumbise 5
5132	Mbagalira
5133	Nyirabayobe
5134	Ntekerabasilimu
5135	Ikinimba
5136	Muhakabando
5137	Ntumarihenemunzu
5138	Ntabeza
5139	Kinyugwe
5140	Ikinimba
5141	Utugondo
5142	Nyiramugara
5143	Kibuga
5144	Caru 4
5145	Ikinimba
5146	Ikinimba bordure
5150	Ikinimba bordure
5151	Muhondo 2
5152	Ikinimba
5153	Bataaf
5154	IRW 9
5155	Ntabara
5156	Mbagarumbise 2
5157	Kajemunkangara
5158	A 21
5159	A 171
5160	Shikashike
5161	Nsizebashonje 4
5162	Mbagarumbise 5
5163	Mukwararaye 3
5164	Mbagalira
5165	Rwasamanzi 2
5166	Bushakebutane 3
5167	Munagajosi
5168	Ni 555
5169	Habyalimana 3
5170	Mbagarumbise
5171	A 21
5172	Rwasamanzi
5173	Muhondo 2
5174	Mbagarumbise
5175	Ntabara
5176	Nsizebashonje
5177	Munagajosi
5178	Mbagarumbise 5
5179	Bushakebutane
5180	Mbagarira
5181	Shikashike
5182	Mbagarumbise
5183	Ikinimba
5184	A 171
5185	Kajemunkangara
5186	Mukwararaye
5187	Habyalimana 3
5188	IRW 9
5189	Bataaf
5190	Ni 555
5191	Kajemunkangara
5192	Mukwararaye 3
5193	Bushakebutane 3

continued

Table 2. Continued.

Field number	Variety name or number
5194	Mbagalira
5195	Ni 555
5196	Mbagarumbise 5
5197	Ikinimba
5198	Shikashike
5199	Mbagarumbise
5200	Nsizebashonje
5201	A 21
5202	Rwasamanzi 2
5203	Mbagarumbise 2
5204	Muhondo 2
5205	Habyalimana 3
5206	Ntabara
5207	Bataaf
5208	Munigajosi
5209	IRW - 9
5210	A 171
5211	Rubona 5 bordure
5212	Ikiraki
5213	Pate 1276
5214	Bataaf
5215	Rubona 5
5216	Kalima
5217	Ikinimba
5218	Mushakemutane
5219	Ni 555
5220	Kiryumukwe
5221	BAT 202
5222	Nyirabunwabutayibika
5223	Naimirakaguja
5224	IRW 10
5225	BAT 1236
5226	Cyunyu
5227	Ni 1
5228	Mutiki
5229	BAT x
5230	A 74
5231	Var 11
5232	Kalima
5233	Ni 555
5234	Mushakemutane
5235	Pate 1276
5236	BAT 1236
5237	Cyunyu
5238	Mutiki 2
5239	Rubona 5
5240	Ikiraki 2
5241	BAT x
5242	BAT 202
5243	Nyirabunwabutayibika
5244	IRW 10
5245	A 74
5246	Mi - 1
5247	Ndimirakaguja
5248	Bataaf
5249	Ikinimba
5250	Var 11
5251	Kiryumukwe
5252	Ndimirakaguja
5253	Cyunyu
5254	Mutiki 2
5255	BAT 1236
5256	Ni 555
5257	Nyirabunwabutayibika
5258	Ikinimba
5259	IRW 10
5260	Mushakebutane
5261	Kalima
5262	Kiryumukwe
5263	A 74
5264	Pate 1276
5265	Pate 1276
5266	Bataaf
5267	BAT x
5268	BAT 202
5269	Ikiraki 2
5270	Mi 1
5271	Var 11
5272	Rubona 5
5273	Ikinimba bordure
5274	Muhondo 2
5275	Ikinimba
5276	Bataaf
5277	IRW - 9
5278	Ntabara
5279	Mbagarumbise 2
5280	Kajemunkangara
5281	A 21
5282	A 171
5283	Shikashike
5284	Nsizebashonje 4
5285	Mbagarumbise 5
5286	Mukweraraye 3
5287	Mbagalira
5288	Rwasamanzi 2
5289	Bushakebutane 3
5290	Munagajosi
5291	Ni 555
5292	Habyalimana 3
5293	Mbagarumbise

continued

Table 2. Continued.

Field number	Variety name or number
5294	A 21
5295	Rwasamanzi 2
5296	Muhondo 2
5297	Mbagarumbise 2
5298	Ntabara
5299	Nsizebashonje 4
5300	Munagajosi
5301	Mbagarumbise 5
5302	Bushakebutane 3
5303	Mbagalira
5304	Shikashike
5305	Mbagarumbise
5306	Ikinimba
5307	A 171
5308	Kajemunkangara
5309	Mukwararaye 3
5310	Habyalimana 3
5311	IRW - 9
5312	Bataaf
5313	Ni 555
5314	Kajemunkangara
5315	Mukwararaye
5316	Bushakebutane 3
5317	Mbagarira
5318	Ni 555
5319	Mbagarumbise 5
5320	Ikinimba
5321	Shikashike
5322	Mbagarumbise
5323	Nsizebashonje 4
5324	A 21
5325	Rwasamanzi 2
5326	Mbagarumbise 2
5327	Muhindo 2
5328	Habyalimana 3
5329	Ntabara
5330	Bataaf
5331	Munagajosi
5332	IRW - 9
5333	A 171
5334	Rubona 5
5335	Ikiraki 2
5336	Pate 1276
5337	Bataaf
5338	Rubona 5
5339	Kalima
5340	Ikinimba
5341	Mushakemutane
5342	Ni 555
5343	Kiryumukwe
5344	BAT 202
5345	Nyirabunwabutayibika
5346	Ndimirakaguja
5347	IRW - 10
5348	BAT 1236
5349	Cyunyu
5350	Mi - 1
5351	Mutiki 2
5352	BAT x
5353	A 74
5354	Var 11
5355	Kalima
5356	Ni 555
5357	Mushakemutane
5358	Pate 1276
5359	BAT 1236
5360	Cyunyu
5361	Mutiki 2
5362	Rubona 5
5363	Ikiraki 2
5364	BAT x
5365	BAT 202
5366	Nyirabunwabutayibika
5367	IRW - 10
5368	A 74
5369	Mi 1
5370	Ndimirakaguja
5371	Bataaf
5372	Ikinimba
5373	Var 11
5374	Kiryumukwe
5375	Ndimirakaguja
5376	Cyunyu
5377	Mutiki 2
5378	BAT 1236
5379	Ni 555
5380	Nyirabunwabutayibika
5381	Ikinimba

Table 3. Variety names from previous bean collection surveys as reported in ISAR introduction books (January 1984).

BUTARE - A(1)

Adela
Agaharawe
Amagabali
Amavunarutaro 1(2)
Amavunarutaro 2
Bagarumbise 1
Bagarumbise 2
Bagarumbise 4
Bagarumbise 5
Bangingero
Baseka
Bihogo
Bitsindinkike
Bunwabutayibika
Cakazinga
Cyambarantama
Cyuna
Gisabo
Gishali
Ginsunzu
Gitwe
Ibijuju
Ibinyamanza 1
Ibinyamanza 2
Ibisetsa 1
Ibisetsa 2
Ibiyungu
Impura
Irivuzemwambutsa
Jambo
Kajemunkangara
Kanyamanza
Kanyamanza 2
Kibobo
Kigondo
Kiziranyenzi
Masoyintama 1
Masoyintama 2
Mbagarumbise
Menakamuga
Merisereza
Muhakabando
Muhondo
Mukwararaye
Mukwararaye 1
Mukwararaye 2
Mukwararaye 3
Mushingandengo 1
Mushingandengo 2
Mutiki 1
Mutiki 2
Mutiki 3
Mutututsi
Nayironi
Ndimirabasilima
Nsamzebalya
Nsizebahwera
Nsizebashonje 1
Nsizebashonje 2
Nsizebashonje 4
Nsuzumira
Ntabara
Ntabeza
Ntamwizurutanyirabuja
Ntumarihenemunzu
Ntuncure
Nyirabihogo
Nyiragahombo
Nyiragahondo
Nyiragaseke
Nyiragihuru
Nyirakabuto
Nyirakabuye
Nyirakayobe
Nyirakayungu
Nyiramabuye 1
Nyiramabuye 2
Nyiramabuye 3
Nyiramacumu
Nyirambegeti
Nyiramugera 1
Nyiramugera 2
Nyiramugera 3
Nyiramugera 4
Rubarambavu
Ruhengeri
Rushingacumu
Rutemigongo
Rwasamanzi 1
Rwasamanzi 2
Ubukubankanda
Ubunyange
Ubusosera 1
Ubusosera 2
Ubusosera 3
Ubusosera 4
Ubusosera 5
Ubusosera 6
Ubusosera 7
Ubusosera 8
Urumina 1
Urumina 2
Urunyamanza
Utugabali
Utugondo
Utunyamanza

BUTARE - B

Gatovu(3)

Nbr 37
Nbr 54
Amavunarutaro
Bayitungirubwiza
Bayo Gatovu
Bunwabutayibika
Gikara
Gitsindayogo violet
Ibyirungu
Ikinimba blanc
Ikinimba violet
Inyumba
Kajemunkangara
Kajemunkara
Karolina
Magabali
Muheha blanc
Muheha violet
Mukoto blanc
Mukoto violet
Munyu (dwarf)
Munyu (climbing)
Mushali blanc
Mushali violet
Mututsi
Nsuzumirusushako
Nyiragahini (dwarf)
Nyiragahini (climbing)
Nyiragahini gatovu
Nyiramabuye
Nyiramacumu

continued

(1) A and B indicate different surveys.
(2) Numbers following the same variety name are different seed types.
(3) Commune identification.

Table 3. Continued.

Rose coco (dwarf)
Rose coco (climbing)
Rugayandengo
Rusenyinka Gatovu 2
Rutagayisambu
Urunyamanza blanc
Urunyamanza violet
Yozefina blanc
Yozefina violet

Mayaga
Ibisetsa
Mbagarumbise
Muhondo
Nayironi
Nyiragasuswe
Nyirakabuye gris
Nyirakabuye jaune
Nyiramurama
Nyiramwiza
Rwasamanyi

Rubona
Muhondo
Mulinga
NP-1
NP-2
NP-3

Ruhashya
Nyimira kaguja

GISENYI
Amashongoshwa 1
Amashongoshwa 2
Ikiraki
Kajamali
Kigufa
Kivuzo
Kizayira
Kizungu 1
Kizungu 2
Kizungu 3
Mukecuru 1
Mukecuru 2
Nyagikecuru
Nyamukecuru
Nyiragakecuru 1
Nyiragakecuru 2
Nyiragihogo
Nyiragituku
Nyirakadaga
Nyirakadendegeri
Nyirakamuga 2
Nyirakamuga 3
Nyirakamuga 4
Nyirakivuzo 1
Nyirakivuzo 2
Nyirakizungu 1
Nyirakizungu 2
Nyirakizungu 3
Nyirakizungu 4
Nyiramushali 1
Nyiramushali 2
Nyiramushali 3
Ruvuzu 1
Ruvuzu 2
Rwamasunza
Uruhwijime
Urujenone 1
Urujenone 2
Urujenone 3
Urujenone 4
Urushali
Urushalirwumweru

KIGALI
Karama
Bleue
Kalikabageni
Kinihira
Mutiki
Nkanga 1
Rouge

RUHENGERI - A
Amabenga
Amanjwe
Amashongoshwa 1
Amashongoshwa 2
Bamazihene
Barashonje
Biganzabyamadam
Bushakebutane 1
Bushakebutane 2
Cyunyu
Gihingabakeme
Ikilingiti
Ikinyombya
Ikizagiliza
Ikunge
Inyumba
Inyumbayubujige
Jambo
Kamukara
Kanyamanza
Karolina
Kicaro
Kiraki
Kiryugaramye 1
Kiryugaramye 2
Kiryugaramye 3
Kivuvu
Kizungu 1
Kizungu 2
Kizungu 3
Kwezikumwe
Merisereza
Muhondo 1
Muhondo 2
Mukecuru 1
Mukecuru 2
Mushali
Mushingandengo 1
Mushingandengo 2
Mushkemutane
Musomazuki
Mutiki 4
Mutiki 5
Mutsima
Mwenedisike
Mwirasi
Nayironi 1
Nayironi 2
Ntamukungutagilipfa
Ntamwiza 1
Ntamwiza 2
Ntamwiza 3
Nyagakecuru
Nyirabukara
Nyirabunwabutyibika
Nyirabweru
Nyiracyuma 1
Nyiracyuma 2
Nyiracyuma 3
Nyiracyunyu 1
Nyiracyunyu 2
Nyiragahini
Nyiragakara 1
Nyiragakara 2
Nyiragakecuru 1
Nyiragakecuru 2
Nyiragihunu
Nyirakabando
Nyirakabonobono
Nyirakabundi

continued

Table 3. Continued.

Nyirakagano 1	Nyiramushali 2	**RUHENGERI - B**
Nyirakagano 2	Nyiramushali 3	Kingogo
Nyirakajagasha 1	Nyiraruvuvu	IK-1 to IK-8
Nyirakajagasha 2	Parmehutu	
Nyirakamuga 1	Rumalihene	Rwankeri
Nyirakamuga 2	Ruvuvu 1	IRW-1 to IRW-11
Nyirakamuga 3	Ruvuvu 2	
Nyirakamuga 4	Ruvuzo Rw'amakoma	Rwerere
Nyirakanyamanza	Ruvuso Rw'amamera	Bataaf
Nyirakibonobono	Rwagezinyanza	Emma
Nyirakigufa	Shigisha	Gisenyi 1
Nyirakinama	Uruberege 1	Gisenyi 2
Nyirakinimba	Uruberege 2	Gisenyi 3
Nyirakinyama	Urujajinyanza 1	Lily
Nyirakireti 1	Urujajinyanza 2	Melange jaune 1
Nyirakireti 2	Urujenone 1	Melange jaune 2
Nyirakivuzo 1	Urujenone 2	Ntamwiza
Nyirakivuzo 2	Urujenone 3	Ruvuzo
Nyirakizungu 1	Urujenone 4	Urunyamanza
Nyirakizungu 2	Urujige	Urunyumba 2
Nyirakizungu 3	Urunyange	Urunyumba 3
Nyirakizungu 4	Urushingandengo 1	Urunyumba 4
Nyiramamera	Urushingandengo 2	Urunyumba 6
Nyiramuhondo	Urushingandengo 3	Urunyumba 7
Nyiramukara 1	Uruzaginyanza 1	
Nyiramukara 2	Uruzaginyanza 2	
Nyiramushali 1	Urweru	

Table 4. List of local variety names from introduction books, storage list and field books, ISAR-Rubona, (March 1984).

Adela	Kanyamanza	Ntahora	Nyiramukara
Agaharawe	Karikabageni	Ntamukungutagiipfa	Nyiramurama
Amagabali	Karolina	Ntamwiza	Nyiramushali
Amanjwe	Kawatgibise	Ntamwizurutanyirabuja	Nyiramwiza
Amashongoshwa	Kibobo	Ntekerabasiimu	Nyiranshura
Amavunarutaro	Kibuga	Ntumaihenemunzu	Nyirariveru
Amayokali	Kicaro	Ntuncure	Nyiraruvuvu
Bagarumbise	Kigayime	Nyagakecuru	Nzamurambaho
Bamazihene	Kigondo	Nyagikecuru	Parmehutu
Bangingero	Kigufa	Nyamitanzi	Rubarambavu
Barashonje	Kingugwe	Nyamukecuru	Rubona
Baseka	Kimihira	Nyarutembe	Rugayandengo
Bataaf	Kinyoma	Nyimirakaguju	Ruhengeri
Bayitungirubwiza	Kiraki	Nyirabihogo	Rukubingogo
Bayo Gatovu	Kiruli	Nyirabukara	Rumaihene
Biganzabyamadamu	Kiiyugaramye	Nyirabunwabutayibika	Rumenandeba Gatovu
Bihogo	Kiiyumukwe	Nyirabweru	Rusenyinka
Bitsindinkike	Kivuvu	Nyiracyuma	Rushingacumu
Bunwabutayibika	Kivuzo	Nyiracyunyu	Rutagayisambu
Bushakebutane	Kizayira	Nyiragahane	Rutemingoga
Cakazinga	Kiziranyenzi	Nyiragahini	Ruvuvu
Cyambarantama	Kizungu	Nyiragahombo	Ruvuzo
Cyuma	Kora	Nyiragahondo	Ruvuzo rw'amakoma
Cyunyu	Kwezikumwe	Nyiragakara	Ruvuzo rw'amamera
Gacwekane	Magabali	Nyiragakecuru	Rwagezinyanza
Gahunga	Maguru	Nyiragasebeya	Rwamasunzu
Gasebeya	Masoyintama	Nyiragaseke	Rwasamanyi
Gahingabakene	Mbagaiira	Nyiragasuswe	Rwerere
Gihoro	Mbangarumbise	Nyiragihogo	Shigisha
Gikara	Mbamurambaho	Nyiragihuru	Shikashike
Gikoma	Menakamuga	Nyiragikara	Ububenga
Gisabo	Merisereza	Nyiragitoki	Ubudida
Gisenyi	Mubiiinigisabo	Nyiragituku	Ubukunkunda
Gishali	Muhakabando	Nyirakabando	Ubunyange
Gisunzu	Muheha	Nyirakabonobono	Ubusosera
Gitsindayogi	Muhondo	Nyirakabundi	Umusibile
Gitwe	Mukecuru	Nyirakabuto	Umwirasi
Habyaiimana	Mukoto	Nyirakabuye	Uruberege
Ibijuju	Mukwararaye	Nyirakadecu	Uruhwijune
Ibikana	Muiinga	Nyirakadaga	Urujajinyanza
Ibikara	Munagajosi	Nyirakadendegeri	Urujenone
Ibinyamanza	Munyu	Nyirakagano	Urujige
Ibinyoni	Mushali	Nyirakamuga	Urukora
Ibirunga	Mushingangendo	Nyirakanyamanza	Urukubankanda
Ibisetsa	Mushakemutane	Nyirakajagasha	Urumira
Ibiyungu	Musomanzuki	Nyirakayobe	Urunyamanza
Ibunda	Mutiki	Nyirakayungu	Urushali
Ibyirungu	Mutsima	Nyirakibonobono	Urushaiirwumeru
Ikiiingiti	Mututsi	Nyirakigufa	Urushingandengo
Ikinimba	Mwenedsike	Nyirakinama	Uruvuzo
Ikiraki	Mwirasi	Nyirakinimba	Uruvuzorwamakoma
Ikizagiiiza	Nayironi	Nyirakinyama	Uruzaginyanza
Ikunge	Ndimirabasiiimu	Nyirakireti	Urweru
Impura	Nkanga	Nyirakivuzo	Urwirungu
Inyumba	Nsanzebaiya	Nyirakizungu	Utugabali
Inyumbayubujige	Nsizebahwera	Nyiramabuye	Utugondo
Iiivuzemwambutsa	Nsizebashonje	Nyiramacumu	Utunyamanza
Jambo	Nsuzumira	Nyiramahoro	Vuninkingi
Kajamali	Nuzumirurushako	Nyiramamera	Wuima
Kajemunkangara	Ntabara	Nyirambegeti	Yozefina
Kauemunkara	Ntabeza	Nyiramugera	Variete 1/2
Kamukara	Ntabezabahali	Nyiramuhondo	Variete II

Review of Appropriate Literature

Systems describing bean seed characteristics have been developed by Van Rheenen (18), Westphal (19), Martin (14), CIAT (6), and IBPGR (11). These vary from use of primary seed color, only, (14) to very complex descriptions using color, shape and size (11). A more detailed discussion of several of these descriptor systems is provided later in this report (pp. 63,65,137,138).

Seed collection methodologies vary depending upon the objectives of the study and the intensity of sampling in an area. Westphal (19) notes that his samples were collected from farms and markets in the areas of study in Ethiopia. Toll (personal communication) collected only from fields, timing her visits to coincide with harvest dates in the various agroclimatic zones of Burundi. Martin, collecting in Malawi (14), used two different methodologies: (1) 'random grabs' from storage containers, if the beans had already been harvested; or (2) taking one pod from each plant encountered while walking a planned transect across the field.

The most useful information on seed collection and survey methodology came from two versions of a research program proposed by ISAR on storage of food grains in rural areas of Rwanda (9, 10). The planned studies included an inventory of bean varieties to provide information on regional preferences and may have been a part of the original plans for this survey. In one part of the study, 500 grams of each mixture were to be collected from farm stores and the names of all varieties, as well as information on the three best varieties for yield, taste and storability, would be recorded. The number of seed of each type in a mixture would be determined to indicate farmer preferences. The other study included a questionnaire asking for plant type, seed color, when and where each type was planted (hillside or marsh), length of vegetative cycle, and yield (kg/ha) for each season. Susceptibility to diseases and storage insects, as well as the cooking time after one year of storage were to be rated. The farmer would then be asked her reason for preferring each type: taste, yield, appearance, resistance or cookability. In large part, these latter references (9, 10) were the basis for the questionnaire used in this study.

Development of the Research Plan

The three versions of the research plan are provided as Tables 5, 6 and 7. The first two versions were developed using information on bean production in Rwanda, seed stocks at ISAR-Rubona and time estimates available before the research team arrived in Rwanda. The final version was developed after initial work on the project had begun and the team had gathered certain additional information. It was decided that the background information on the ISAR seed collection was not detailed enough for purposes of the study. The sampling program developed for Mr. Wittenberger, which was to provide samples of newly harvested seed for the reference collection, was determined to be much too limited. Thus, it was decided that the personnel of the Varietal Survey component would conduct a detailed country-wide survey. This required that the first field plantings, to obtain plant characteristic information, be delayed until the start of the 1984-B season (September, 1984). The analysis of seed quality and germination tests were reassigned to the Storage Survey component. Plans for a long-term storage facility at ISAR were already in the initial phases and discussions of appropriate storage methods had already begun, so these studies were not included in

Table 5. Original research plan.

AID-Rwanda
Local Crop Storage/FSM II (Research Component)

Survey of Rwandan Bean Varieties

PROJECT OUTLINE
September 1983

Ms. Elizabeth Lamb - Resident Scientist
Dr. Leland Hardman, Agronomist - Faculty Advisor

1. Arrivals and departures.

January 1984	Lamb	10th Jan
	Hardman	14th Jan (2-3 wks.)
Sept/Oct 1984	Hardman	(2-3 wks)
Nov 1, 1984	Lamb departs	

2. Catalogue reference collection (1700 varieties at ISAR and new material).

   a. Seed characteristics - descriptions, photographs
   b. Listing of names and reference indexing

3. New harvest collection (#1 harvest).

   a. Seed quality evaluation at harvest
   b. Types grown and regional differences

4. Plant experimental plots and seed growouts.

   a. New material
   b. Reference collection

5.a On farm visits - relative to sites for new harvest collection.

   a. Site description
   b. Cultural technology
   c. Plant type

5.b Field plot care.

   a. Plant growth habit descriptions
   b. Field photographs
   c. Whole plant collections for herbarium collection

continued

Table 5. Continued.

6. Seed quality evaluation.

   a. Germination in relation to temperature and relative humidity conditions
   b. Begin standards development (classes and rules for distinguishing types)

7. Development of extension/communication materials.

8. Harvest March planting (#2 harvest).

   a. Field plots
   b. Farmers fields

9.a Observation of September planting (for major January harvest) on farmers fields.

9.b Set up long term storage of reference collection and viable seed collection.

10. Progress reports and final report.

   a. Quarterly reports: March, June, September
   b. Final project report: October

INTERRELATIONSHIPS WITH OTHER PORTIONS OF PROJECT

1. With linkages to 'Storage Conditions Survey'

   Items: 3, 5.a, 6, 7, 8

2. With linkages to 'Cookability/Sensory Preference Project'

   Items: 2, 6, 9.b

3. With linkages to 'Bean Resistance to Storage Insects'

   Items: 2, 5.a, 6, 9.b

Table 6. Revised research plan.

AID-Rwanda
Local Crop Storage/FSM II (Research Component)

Survey of Rwandan Bean Varieties

PROJECT OUTLINE
revised
28 December 1983

Ms. Elizabeth Lamb - Resident Scientist
Dr. Leland Hardman, Agronomist - Faculty Advisor

MAIN OBJECTIVES

To establish a catalogue of the bean collection already in existance at ISAR as well as other varieties cultivated in Rwanda. This catalogue, taking into account characteristics of the different varieties, will be comprised of photographs and detailed descriptions of each variety. It will allow the compilation of a list of varieties serving as a standard to be used in the studies of cookability and resistance to insects to be carried out later.

WORK PLAN

Actions to be taken:

A. As part of the January 1984 harvest, Mr. Wittenberger will take samples of beans and sorghum from the prefectures of Kibungo, Butare and Ruhengeri. These samples will be taken at three different levels: from the warehouses of GRENARWA, at the local cooperative level and from the individual producers.

B. The samples taken by Mr. Wittenberger will serve as a basis for a study of seed quality, concerning damage caused by insects and fungal growth as well as by breakage in the course of the harvest. This study, pursued by Ms. Lamb at ISAR, concerns an analysis of characteristics of seed germination in relation to temperature and relative humidity.

continued

Table 6. Continued.

C. The same samples will permit Ms. Lamb to ascertain the mixtures of varieties appropriate to each region of Rwanda in order to determine if there are local preferences concerning color and type of seed cultivated.

D. Ms. Lamb will also establish experimental fields for cultivation of many varieties of seed provided from the collection at ISAR as well as those which were collected by Mr. Wittenberger.

E. Ms. Lamb will make visits to the farms chosen by Mr. Wittenberger for sampling in order to determine the cultural practices of the producers and to inform herself of the characteristics of the fields as well as growth habits of the cultivated plants.

F. Ms. Lamb will make a study of cultivated plants in the experimental fields composed of photographs and descriptions of cultivated plants at ISAR as well as a collection of specimens to establish a herbarium.

G. From the base of collected data on the subject of seed and plant characteristics, Ms. Lamb will establish a system of classification of varieties which will serve as a reference index.

H. Seconded by Dr. Hardman, Ms. Lamb will develop materials for extension and to inform the Rwandan personnel in the area of plant breeding and to inform the producers.

I. Ms. Lamb will harvest the experimental fields sown in March and she will assist in the harvest on the producers' farms chosen for the sampling carried out by Mr. Wittenberger.

J. From a part of the seed harvested from the experimental fields, Ms. Lamb will establish a system of long-term storage to safeguard a collection of viable seed as well as a reference collection of bean varieties supplemental to the collection of ISAR.

K. Ms. Lamb will survey the planting techniques of the farms of the producers in the month of September.

L. Ms. Lamb will submit quarterly reports in March and June as well as a final report in October, 1984.

Arrivals and departures of scientists:

Elizabeth Lamb, Research Assistant
ARRIVAL January 18, 1984; DEPARTURE November 1, 1984

Dr. Leland L. Hardman, Technical Advisor
ARRIVAL-February, 1984; ARRIVAL Sept/Oct, 1984
(duration of visits 2-3 weeks)

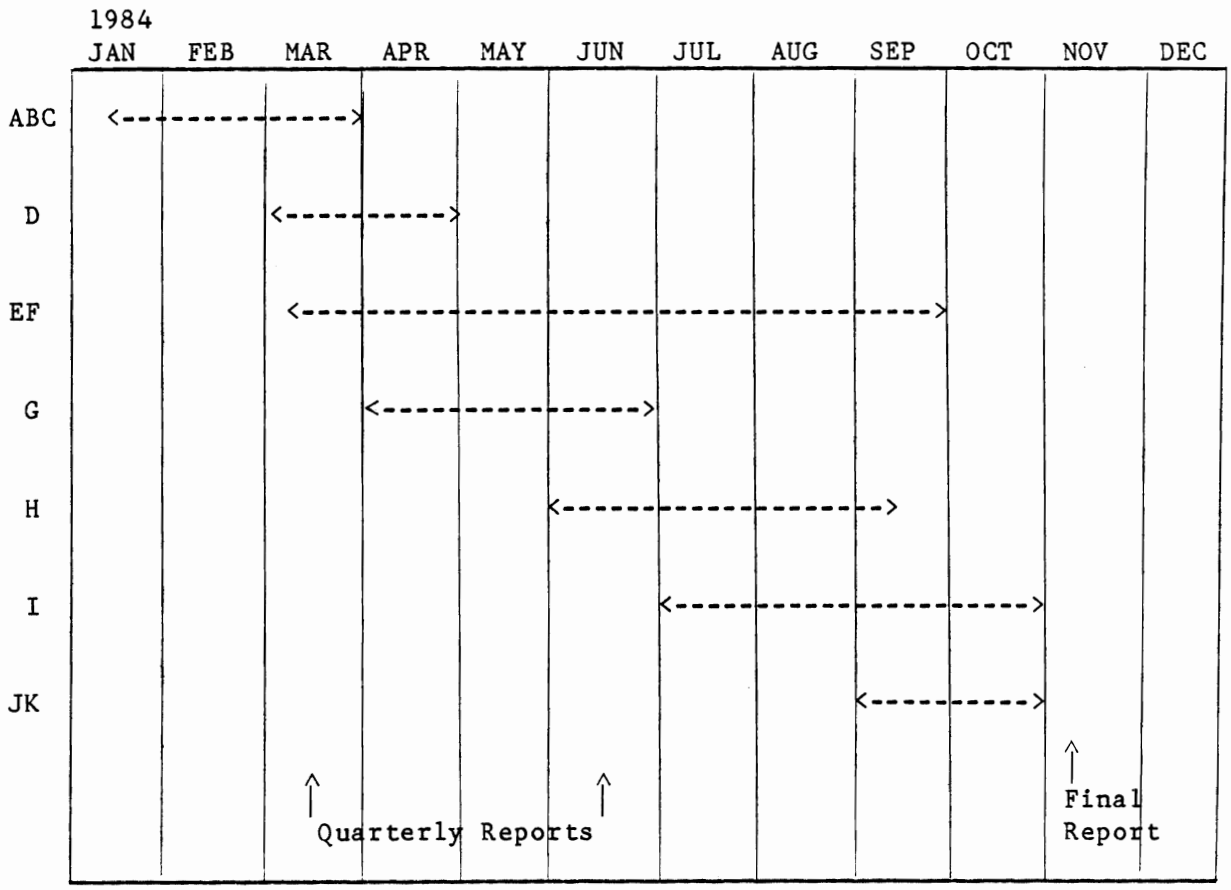
continued

Table 6. Continued.

AID-Rwanda
Local Crop Storage/FSM II (Research Component)

Survey of Rwandan Bean Varieties

TIMETABLE



Ms. Elizabeth Lamb - Resident Scientist
Dr. Leland Hardman, Agronomist - Faculty Advisor

Table 7. Final research plan.

AID-Rwanda
Local Crop Storage/FSM II (Research Component)

Survey of Rwandan Bean Varieties

PROJECT OUTLINE
revised
March 1984

Ms. Elizabeth Lamb - Resident Scientist
Dr. Leland Hardman, Agronomist - Faculty Advisor

MAIN OBJECTIVES

To establish a catalogue of the major seed types found in mixtures of beans (Phaseolus vulgaris) grown in various regions of Rwanda. This catalogue will include photographs, reference samples and detailed descriptions of mixtures and seed types. The catalogue and reference collection will be available for use by OPROVIA/GRENARWA to examine regional differences in mixtures grown in the regions sampled to aid in their marketing efforts and by ISAR as a reference and collection of seed types grown in Rwanda. In addition, the catalogue will be included as a part of the extension materials.

A. Review information available at ISAR on the following:

1. Nature of existing bean seed stocks at ISAR, Rubona.
2. Past and present bean research conducted at ISAR stations.
3. Bean (Phaseolus vulgaris) germplasm collected in Rwanda by ISAR.
4. Common names of various bean seed types.
5. Terminology used by ISAR, CIAT and other research centers for describing bean seed types.
6. Protocol used for field experiments by ISAR.

(JANUARY - MARCH, 1984)

B. Determine methodology for collection of seed types and mixtures grown by farmers as an examination of regional differences. Factors to be examined by means of a presurvey include:

1. Method for choosing farms in each region.
2. Interaction with local authorities--letter of introduction.
3. Personnel--researcher and technician.

continued

Table 7. Continued.

4. Interaction with farmers--introduction of project, willingness.

5. Form for survey--questions asked, ease of completion, time required.

6. Equipment needed.

7. Amount of sample requested and acceptable to farmers.

8. Form of payment for interview.

9. Background information required on family.

10. Number of visits possible per day.

11. Use of market samples as comparison to farm samples.

(MARCH, 1984)

C. Survey of farmers and collection of samples in major bean production zones and other regions of interest.

1. Utilization of survey form and technique developed in the presurvey.

2. Choice of regions surveyed based on importance of bean production, reported differences in varieties grown and other information from ISAR, OPROVIA and the National Agricultural Survey.

3. Method for choosing farms sampled based on estimates of time necessary for each sample and travel, statistical considerations and available information.

(APRIL - AUGUST, 1984)

D. Analysis of samples.

1. Separation of seed types in mixture, using farmer information and seed type identification protocol.

2. Written descriptions of seed type and mixture.

   a. Physical factors including seed color, shape of seed, weight per 100 seed.

3. Photographs of different seed types, appropriately labelled.

(APRIL - SEPTEMBER, 1984)

continued

Table 7. Continued.

E. Plant characteristics and seed type growouts/increase carried out at ISAR, Rubona.

1. Plant type - using CIAT classification.
2. Flower color.
3. Date of flowering.
4. Date of harvest.
5. Production of seed for later tests.

(SEPTEMBER PLANTING, 1984)

F. Organization of reference collection at ISAR, Rubona.

1. Seed and plant specimens.
2. Written descriptions.
3. Photographs.
4. Seed mounts--arrangement of mixtures and seed types by region.
5. Suggestions for maintaining reference collection.

(JANUARY - FEBRUARY, 1985)

G. Extension work.

1. Use of survey data including the reference collection and the seed mounts by OPROVIA/GRENARWA and ISAR development projects for agriculture and the extension services.
2. Writing and distribution of a small publication of practical use.
3. Seminars or workshops on the subject of regional differences with OPROVIA for improving marketing in those regions.

the final work plan. Although certain changes were made in the research schedule, the basic plan as presented in the February/March, 1984 revision (Table 7), stands as the base document for the research which is discussed in this report.

DEVELOPMENT OF QUESTIONNAIRE, SURVEY PROCEDURES, AND ANALYSIS METHODOLOGY

Preliminary Survey

Analysis of background information on bean production in Rwanda and in-country discussions about the research plan resulted in the development of a questionnaire and survey method. A preliminary survey was conducted in the commune of Maraba, Butare prefecture in March 1984 to evaluate these proposed techniques. Farms in ten sectors of the commune Maraba and in ten collines of the sector Maraba were visited (Table 8). One local market was sampled as well. A questionnaire was developed for the preliminary survey to determine how much the farmers knew about bean varieties and production practices. This form included information on sample identification, date of planting, date of harvesting, and source of the seed. In addition, information on important characteristics of each named seed type was requested.

This preliminary survey served as a test of the responsiveness of the farmers to the survey team and the questionnaire. Observations were made on the ability of the survey team to properly communicate the project objectives, as well as the questions, while allowing the farmer to respond, unprompted. Several methods of handling the samples were tested using various types of equipment and materials. Although the team was inexperienced and the samples were collected near ISAR-Rubona, sampling and travel times were measured for estimation of time required to conduct the country-wide survey.

Results of the Preliminary Survey

The preliminary survey served as a successful training period for the survey team, providing experience and insight into the possibilities and limitations of the planned national survey. The importance of introducing the project and allowing the farmers to provide their own answers to the questions was documented. In addition, the division of labor for filling out the forms and handling the samples was quickly determined. Simple equipment, such as plastic bags and stick-on labels, was adequate for maintaining and transporting the samples. A locally available enamel cup, which held approximately 250 grams of beans, was used to measure the quantity of each sample mixture collected.

With few exceptions, the farmers surveyed were interested and cooperative in responding to the questions. The appropriateness of compensating the farmers for the samples was discussed before starting the preliminary survey. Repayment in kind or with soap or rice was considered but discarded because it required the transport of bulky commodities. Providing no compensation or sending someone for beer required too much time in preliminary discussion. It was finally decided to offer a 'donation' of 50 Rwandan francs (approximately $.50) for each sample.

Following the preliminary survey, additional questions were added to obtain further detail. Men provided the sample location identification information while women were more likely to respond to questions concerning variety names and characteristics. Therefore, a section on who answered which part of the survey and how well they seemed to know the information

Table 8. Sites sampled in the preliminary survey, commune Maraba, prefecture Butare.

Sector		Colline	
Bunzazi			
Cyarumbo			
Gisakura			
Kabusanza			
Kibanda			
Maraba	(sectors within		
Nyangazi	commune, Maraba)		
Rusagara			
Simbi			
Tare			
Maraba		Kabilizi	
		Kabuye	
		Karama	
		Kizi	
		Maraba	
		Miningo	(collines within
		Nyabiduha	sector, Maraba)
		Rukari	
		Shango	
		Shyinga	

was added. Some varieties were named which were not associated with any of the listed characteristics, so a question was added to determine why these types were maintained in the mixture. Some farmers provided characteristics for seed types which they did not name. These were recorded on the form by seed description rather than name. Other questions were added concerning the preparation of mixtures for planting, the storage of seed and food beans, and the marketing of beans. A question was also added after the country-wide survey had started asking which factors limited production. The revised questionnaire (in English and Kinyarwanda) used in the country-wide survey is provided as Tables 9a and 9b.

Based on observations from the preliminary survey, the county-wide survey was planned. As multiple samples per sector would limit the total number of sectors sampled, restricting the scope of the survey, and because prefectures were considered too large a unit to adequately show regional preferences, sectors within a commune were selected as base units for sampling. The number of samples collected in each commune was determined using the per commune production figures for 1979 (Table 10, Map 4). Based on average annual rainfall (Table 11) and annual bean yields (Table 12) these 1979 figures seemed to be representative, even though local variation in climate may have altered local levels of production. Percent of annual production was chosen over yield per hectare as a better indicator of the major production areas where surpluses of beans were more likely to be available for marketing. Seven tenths of a percent of total annual production was chosen as the cutoff value so that the survey would include approximately half of the communes in the country. Production in the 67 chosen communes made up 64 percent of the total production for 1979 (Table 13). The distribution of these communes in the various agroclimatic zones is shown in Table 14.

Each interview took one-half to three-quarters of an hour to complete. It was noted that it was more difficult to find people at home during the hours of eleven to one than at other times of the day. Since the commune of Maraba was not far from Butare, but certain parts of it were not very accessible, an average of four samples a day was planned for the actual survey. Based on this estimate of time required per sample, a total of 500 farm samples was planned for the survey. Five to fifteen samples per commune were planned with a higher intensity of sampling in those communes with higher production. In certain cases, there were more samples than sectors so sectors were randomly chosen to be sampled twice. Sample sites were distributed at random throughout the commune and identified by sector names (Map 5 - numbers in circles are numbers of samples per commune). Sampling schedules were planned in the chosen communes using prefecture maps showing major roads provided by the Cartography Service of ISAR-Rubona. These schedules took into consideration travel time, proximity of areas to be sampled and availability of lodging.

In addition to farm samples, three to five mixtures were purchased at a market in each commune. These were used for comparison to the farm samples to determine if the types commonly planted in an area were also commonly marketed. Beans are purchased directly from producers at four of the GRENARWA warehouses in the country. Samples were collected at three of these--Kibungo, Nyanza and Kicukiro (Map 5), to compare with the farm samples from the same regions.

Table 9a. Farm survey questionnaire.

Survey of Varieties (types) of Beans Grown in Rwanda

Name of surveyor: _____ Date: _____
I.D. number: _____ _____

A. Identification of farm:

Prefecture: _____
Commune: _____
Sector: _____
Colline: _____
Name of farmer: _____

B. Characteristics of this sample: (mixture)
Planting date of sample: _____
Harvest date of sample: _____
Source of seed for this sample:
-self produced: /___/
-bought: /___/
-given: /___/
by whom? _____

C. This bean variety (type) has these characteristics: (14-1)

		1	2	3	4	5	6	7	8	9	10
14											
13	Good price in market										
12	Fast cooking										
11	Good taste										
10	Resistance or tolerance to insects in storage										
9	Late maturity										
8	Early maturity										
7	Tolerant of field diseases										
6	Tolerant of drought										
5	Tolerant of shade										
4	Tolerant to infertile soil										
3	High yield										
2	n: dwarf s.v: semi-climbing v: climbing										
1	Name of variety (type)										

continued

Table 9a. Continued.

D. ANSWERED BY FARMER

1. If names are given but no characteristics listed, why are these varieties in the mixture?

Name	Reason

2. Are different mixtures planted in different types of fields?

2.1.

Mixture	Conditions

2.2. When are the mixtures separated?

3. Do you sell beans?

No /____/ Yes /____/ How much of the production is sold? _____: -20% /____/
_____: 20-50% /____/
_____: 50-90% /____/

When?

4. Do you separate beans for eating from beans for seed?

No /____/ Yes /____/ When?

E. ANSWERED BY SURVEYOR

1. Who answered the questions: Men /____/ Women /____/ Children /____/

Response was: Fast /____/ Slow /____/

1. Who gave names of varieties: Men /____/ Women /____/ Children /____/

Response was: Fast /____/ Slow /____/

F. What is the limiting factor to production?

Table 9b. Farm survey questionnaire (Kinyarwanda version).

ANKETI Y'UBWOKO BW'IBISHYIMBO BIHINGWA MU RWANDA

Nom de l'enqueteur: _____ Date: _____
Numero d'identification: _____

A. Itandukaniro ly'abahinzi:

Perefegitura: _____
Komini: _____
Segiteri: _____
Umusozi: _____
Izina ly'umuhinzi: _____

B. Ibyerekeye uwo twabajije:

Italiki yatereyeho: _____
Italiki yasaruyeho: _____
Imbuto ni iyo:
-yiyejereje: /____/
-yaguze: /____/
-yahawe: /____/
nande: _____

C. Ni ubuhe bwoko bw' ibishyimbo mufite: (14-1)

		1	2	3	4	5	6	7	8	9	10
14											
13	Ibigura neza										
12	Ibishya vuba										
11	Ibilyoha										
10	Ibyihanganira udusimba iyo bihunitswe										
9	Ibitinda kwera										
8	Ibyera vuba										
7	Ibyihanganira indwara mu mulima										
6	Ibyihanira izuba										
5	Ibyihanganira igicucu										
4	Ibyihanganira ubutaka bukoya										
3	Ibifite umusaruro munini										
2	n: ibitagira urugoyi s.v: ibirugira ntibishingilirwe v: ibishingilirwa										
1	Amazina y'ubwoko										

continued

Table 9b. Continued.

D. Ibibazo by'uzuza:

1. Ni kuki buliya bwoko budafite icyo burusha ubundi muburekera muli iyi mvange?

Amazina	Impamvu

2. Imvange zitandukanye muzitera mukulikije uko ubutaka bumeze?

2.1.

Imvange	Uko ubutaka buba bumeze

2.2. Nilyali mutandukanya ubwoko?

3. Mujya mugulisha ibishimbo?

Oya /____/
Yego /____/ biba bingana iki? bike: -20% /____/
byinshi: 20-50% /____/
byinshi cyane: 50-90% /____/

Ni gihe ki mubigulisha?

4. Mutandukanya ibishyimbo byo gutera n'ibyo kulya?

Oya /____/ Yego /____/ Lyali?

E. IBIBAZO BISUBIZWA NUWAKOZE ANKETI

1. Ninde utoranya: Umugabo /____/ Umugore /____/
Abasaza /____/ Umubare /____/
Abasore /____/
2. Ninde utanga amazina y'ubwoko:
3. Ninde usubiza Vuba /____/
4. Bagiye basubiza Batinda /____/

Table 10. Bean production in Rwanda (1979).[1]

Prefecture	Commune	Annual Production tonnes	Annual Yield kg/ha	Annual Production % of total
BUTARE	Muyira	1265	683	0.7
	Kigembe	1171	693	0.6
	Muganza	1050	670	0.6
	Muyaga	1160	610	0.6
	Kibayi	968	719	0.5
	Maraba	905	489	0.5
	Ntyazo	841	703	0.5
	Nyakizu	850	600	0.5
	Nyaruhengeli	937	723	0.5
	Shyanda	846	716	0.5
	Gishamvu	674	733	0.4
	Mbazi	731	650	0.4
	Mugusa	635	683	0.4
	Nyabisindu	791	671	0.4
	Ruhashya	667	737	0.4
	Runyinya	744	524	0.4
	Rusatira	715	675	0.4
	Ndora	600	700	0.3
	Huye	346	678	0.3
	Ngoma	281	379	0.2
BYUMBA	Murambi	4567	1000	2.5
	Muvumba	2632	700	1.5
	Muhura	2345	741	1.3
	Buyoga	1767	666	1.0
	Cyungo	1737	800	1.0
	Kibali	1724	790	1.0
	Bwisige	1201	824	0.7
	Kinyami	1177	800	0.7
	Kiyombe	1326	740	0.7
	Cyumba	1065	740	0.6
	Giti	1159	860	0.6
	Gituza	1138	900	0.6
	Ngarama	1023	750	0.6
	Rutare	1013	800	0.6
	Kivuye	813	750	0.5
	Tumba	869	799	0.5
	Mukarange	704	840	0.4
CYANGUGU	Kamembe	1842	850	1.0
	Cyimbogo	1649	786	0.9
	Gishoma	1700	871	0.9
	Nyakabuye	1560	864	0.9
	Bugarama	1483	863	0.8

continued

[1] Modified from Bovry et al, 1980.

Table 10. Continued.

Prefecture	Commune	Annual Production tonnes	Annual Yield kg/ha	Annual Production % of total
CYANGUGU (continued)	Gatare	1522	769	0.8
	Kagano	1360	681	0.8
	Karengera	1490	877	0.8
	Gafunzo	1269	777	0.7
	Gisuma	1287	786	0.7
	Kirambo	811	756	0.4
GIKONGORO	Rukondo	2376	762	1.3
	Kinyamakara	1817	756	1.0
	Karama	1407	903	0.8
	Musange	1287	747	0.7
	Mubuga	900	685	0.5
	Muko	988	644	0.5
	Nyamagabe	842	774	0.5
	Rwamiko	907	670	0.5
	Karambo	739	725	0.4
	Nshili	552	500	0.3
	Kivu	238	523	0.1
	Mudasomwa	261	483	0.1
	Musebeya	254	519	0.1
GISENYI	Kayove	2341	883	1.3
	Satinsyi	2196	800	1.2
	Kanama	1521	663	0.9
	Nyamyumba	1663	762	0.9
	Rubavu	1320	943	0.7
	Mutura	1350	854	0.7
	Ramba	1094	764	0.6
	Giciye	966	698	0.5
	Kibilira	949	761	0.5
	Rwerere	794	602	0.4
	Karago	477	852	0.3
	Gaseke	301	717	0.2
GITARAMA	Ntongwe	1873	664	1.0
	Mushubati	1602	751	0.9
	Tambwe	1469	850	0.8
	Kigoma	1349	897	0.7
	Nyamabuye	1107	736	0.6
	Mukingi	1014	748	0.6
	Musambira	1055	725	0.6
	Murama	978	756	0.5
	Masango	851	698	0.5
	Taba	972	617	0.5
	Mugina	855	900	0.5
	Bulinga	725	676	0.4
	Kayenzi	710	664	0.4

continued

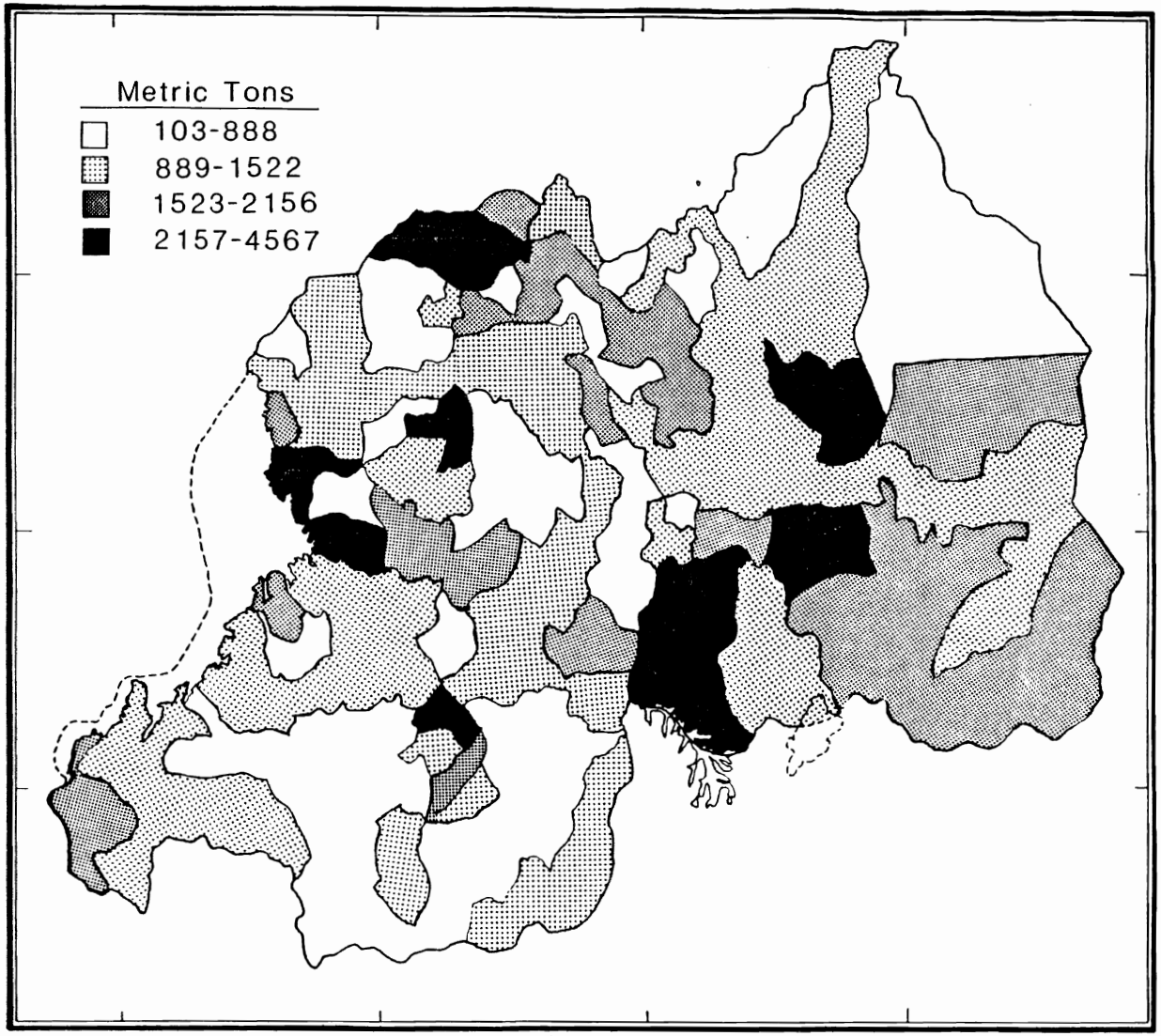
Table 10. Continued.

Prefecture	Commune	Annual Production tonnes	Annual Yield kg/ha	Annual Production % of total
GITARAMA (continued)	Nyakabanda	668	739	0.4
	Runda	798	691	0.4
	Nyabikenke	549	598	0.3
	Rutobwe	428	501	0.2
KIBUNGO	Birenga	1992	818	1.1
	Rusumo	1967	827	1.1
	Sake	2047	819	1.1
	Kigarama	1884	789	1.0
	Kabarondo	1635	770	0.9
	Mugesera	1661	843	0.9
	Rutonde	1655	822	0.9
	Rukara	1541	796	0.8
	Rukira	1403	770	0.8
	Kayonza	1340	780	0.7
	Muhazi	1256	791	0.7
KIBUYE	Mabanza	2220	865	1.2
	Gishyita	1626	855	0.9
	Kivumu	1622	799	0.9
	Rwamatamu	1303	853	0.7
	Bwakira	1017	775	0.6
	Gitesi	1067	859	0.6
	Mwendo	1178	876	0.6
	Rutsiro	862	567	0.5
	Gisovu	657	544	0.4
KIGALI	Ngenda	3420	691	1.9
	Bicumbi	2568	800	1.4
	Kanzenze	2530	691	1.4
	Tare	1800	636	1.0
	Kanombe	1643	800	0.9
	Mugambazi	1550	761	0.9
	Rutongo	1382	870	0.8
	Rubungo	1300	773	0.7
	Rushashi	1251	687	0.7
	Gashora	1082	676	0.6
	Gikomero	1006	787	0.6
	Gikoro	1114	800	0.6
	Mbogo	1022	669	0.6
	Musasa	997	687	0.6
	Butamwa	976	816	0.5
	Shyorongi	878	730	0.5
	Nyarugenge	102	797	0.1
RUHENGERI	Nkumba	2790	925	1.5
	Kigombe	2578	854	1.4

continued

Table 10. Continued.

Prefecture	Commune	Annual Production tonnes	Annual Yield kg/ha	Annual Production % of total
RUHENGERI (continued)	Kinigi	2547	856	1.4
	Cyabingo	1984	677	1.1
	Cyeru	2081	704	1.1
	Kidaho	1627	903	0.9
	Ndusu	1426	703	0.8
	Nyakinama	1175	665	0.7
	Nyarutovu	1317	695	0.7
	Butaro	905	617	0.5
	Gatonde	968	777	0.5
	Nyamugali	821	652	0.5
	Nyamutera	829	700	0.5
	Mukingo	709	866	0.4
	Nkuli	643	800	0.4
	Ruhondo	811	800	0.4



MAP 4. ANNUAL PRODUCTION (metric tons) OF BEANS, BY COMMUNE IN 1979. (Warren, 1985)

Table 11. Rainfall data for 6 locations in Rwanda (September-December 1978 and February-May 1979).[1]

Location	Average	1978/1979	1978/1979
		mm	as % of average
Byimana	1038	912	88
Mogonero	1078	1528	142
Cyanika	1126	1180	105
Kibungo	846	1035	122
Byumba	1112	1404	126
Kansi	989	1228	124
Gisenyi[2]	460	517	112

[1] Warren, 1985. [2] February-May 1979 data only.

Table 12. Annual bean yields in Rwanda (1966-1983)[1].

Year	Harvested yield kg/ha
1966	850
1967	850
1968	744
1969	900
1970	900
1971	900
1972	850
1973	831
1974	615
1975	801
1976	805
1977	804
1978	792
1979	758
1980	704
1981	735
1982	817
1983	841
Average	805

[1] Annual Reports of the Rwandan Ministry of Agriculture, (Warren, 1985).

Table 13. Sample location, date of sampling and number of samples planned.

Prefecture	Commune	Sector/Market	Date	Number
Butare	Muyira	Busoro	5/84	5
		Matara	"	
		Mukoma	"	
		Munyinya	"	
		MARKET	5/84	
Byumba	Buyoga	Burenga	12/84	8
		Busoro	"	
		Kavumu	"	
		Murambi	"	
		Muranzi	"	
		Mutete	"	
		Nyabisiga	"	
		Zoko	"	
	Bwisige	Bwisige	12/84	5
		Kabongoya	"	
		Muti	"	
		Nyagihanga	"	
		Nyarurama	"	
	Cyungo	Barayi	12/84	8
		Gitandi	"	
		Gitare	"	
		Karama	"	
		Kimihira	"	
		Kimilyi	"	
		Ruhunde	"	
		Rukozo	"	
		MARKET	12/84	
	Kibali	Muhondo	12/84	8
		Mukarange	"	
		Rugarama	"	
		Ruhenda (2)	"	
		Yaramba	"	
		MARKET	12/84	
	Kinyami	Cyuru	12/84	5
		Gicumbi	"	
		Kinyami	"	
		Mugina	"	
		Ruvune	"	
	Kiyombe	Butozo	12/84	5
		Kaniga	"	
		Kizinga	"	
		Muyumba	"	
		Nyagakizi	"	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Byumba (continued)	Muhura	Bibare	12/84	10
		Bugarura	"	
		Gahara	"	
		Mamfu	"	
		Muhura	"	
		Remera (2)	"	
		Rumuli (2)	"	
	Murambi	Gikoma	12/84	6
		Kiburara	"	
		Kiziguro	"	
		Rugarama	"	
		Rwankuba	"	
		Rwimitereli	"	
	Muvumba	Bweya	12/84	12
		Gatunda (2)	"	
		Karama (2)	"	
		Mukama	"	
		Rukomo	"	
		Shongo (2)	"	
		Tabagwe	"	
Cyangugu	Bugarama	Bugarama	10/84	6
		Bunyereli	"	
		Kibangira	"	
		Muganza	8/84	
		Muhehwe	10/84	
		Nyabintare	"	
		MARKET	8/84	
	Cyimbogo	Cyete	8/84	7
		Gihundwe	"	
		Murehe	"	
		Mururu	"	
		Nyakanyinya	"	
		Nyamagana	"	
		Winteko	"	
		MARKET	8/84	
	Gafunzo	Bugeza	10/84	5
		Bunyangurube	"	
		Gabiro	"	
		Mugera	"	
		Nyamugali	"	
	Gatare	Birembo	8/84	6
		Kagunga	"	
		Mugomba	10/84	
		Muraza	8/84	
		Mwasa	"	
		Rumapfu	"	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Cyangugu (continued)	Gishoma	Butambamo	8/84	7
		Gisagara	"	
		Kiranga	"	
		Ntenyi	10/84	
		Ruhoko	"	
		Rukunguli	"	
		Rwimbogo	"	
		MARKET	8/84	
	Gisuma	Giheke	10/84	5
		Isha	"	
		Munyove	"	
		Ntura	"	
		Rusambu	"	
		MARKET	10/84	
	Kagano	Bushekeri	10/84	6
		Butambaro	8/84	
		Kagano	"	
		Mubumbano	"	
		Nyakabingo	"	
		Rambira	"	
	Kamembe	Bugumira	7/84	8
		Cyibumba	10/84	
		Gihundwe	"	
		Kamembe	"	
		Mparwe	7/84	
		Muhari	"	
		Rusunyu	"	
		Rwahi	"	
		MARKET	7/84	
	Karengera	Butare	10/84	6
		Karambo	"	
		Nyamuhunga	"	
		Rwabidege	"	
		Rwintare	"	
		MARKET	10/84	
	Nyakabuye	Gitambi	10/84	7
		Kaboza	"	
		Kigurwe	"	
		Matare	"	
		Nyamaronko	"	
		Nyamubembe	"	
		Runyanzovu	"	
		MARKET	10/84	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Gikongoro	Karama	Cyanika	5/84	6
		Gitega (2)	"	
		Kibingo	"	
		Kiraro	"	
		Ngoma	"	
		MARKET	5/84	
	Kinyamakara	Bitare	5/84	8
		Gakomeye	"	
		Kamweru	"	
		Karama	"	
		Muhanga	"	
		Murera	"	
		Nyarusange	"	
		Rwamweru	"	
	Musange	Cyabute	5/84	5
		Kigoma	"	
		Mugote	"	
		Mwumba	"	
		Ruhinga	"	
		MARKET	5/84	
	Rukondo	Gikoni	5/84	10
		Kabilizi	"	
		Kirambi	"	
		Mbazi	"	
		Ngara (3)	"	
		Nyagisozi	"	
		Remera (2)	"	
		MARKET	5/84	
Gisenyi	Kanama	Bisizi	8/84	8
		Kanombe	11/84	
		Karambo	"	
		Kayove	"	
		Kigarama	"	
		Mukondo	"	
		Nyundo	8/84	
		Rugomero	11/84	
		MARKET	11/84	
	Kayove	Boneza	11/84	10
		Gihinga	"	
		Gishwati	8/84	
		Kayove	11/84	
		Kinunu	"	
		Musasa	"	
		Mushonyi (2)	8/84	
		Ngabo	"	
		Vumbi	"	
		MARKET	11/84	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Gisenyi (continued)	Mutura	Butaka	8/84	5
		Kabatwa	"	
		Kanzenze	"	
		Mudende	"	
		Mugongo	"	
		MARKET	8/84	
	Nyamyumba	Rushubi	8/84	9
		Kiraga	"	
		Busoro	"	
		Budaha	"	
		Kivumu	"	
		Mwufe	"	
		Gihoko	"	
		MARKET	8/84	
	Rubavu	Basa	8/84	5
		Bulinda	"	
		Byahi	"	
		Muhira	"	
		Rugerero	"	
		MARKET	8/84	
	Satinsyi	Gitega	8/84	9
		Hindira	"	
		Kiziguro	11/84	
		Matyazo	8/84	
		Mpara	11/84	
		Munini	8/84	
		Murambi	11/84	
		Ngororero	"	
		Rucana	8/84	
Gitarama	Kigoma	Gahombo	5/84	5
		Kigoma	"	
		Ngwa	"	
		Remera	"	
		Rubona	"	
	Ntongwe	Gikoma	6/84	8
		Kareba	"	
		Kinazi	"	
		Ntongwe	"	
		Nyabitare	"	
		Nyakabungo	"	
		Nyarurama	"	
		Rutabo	"	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Gitarama (continued)	Mushubati	Gifumba	6/84	7
		Giseke	"	
		Kaduha	"	
		Kagarama	"	
		Mata	"	
		Mwaka	"	
		Ntongwe	"	
		MARKET	6/84	
	Tambwe	Buhoro	6/84	6
		Gitisi	"	
		Munini	"	
		Muyunzwe	"	
		Ntenyo	"	
		Tambwe	"	
Kibungo	Birenga	Bare	7/84	9
		Birenga	"	
		Gahulire	"	
		Gashongora	11/84	
		Kibaya	7/84	
		Kibara	"	
		Kibimba	"	
		Matongo	"	
		Sakara	"	
		MARKET	7/84	
	Kabarondo	Kabarondo	7/84	7
		Kinzovu	"	
		Nkamba	"	
		Rubira	"	
		Rukira	"	
		Rundu	"	
		Rusera	"	
		Ruyonza	"	
	Kayonza	Gasogi	7/84	5
		Kayonza	"	
		Musumba	"	
		Rwinkwavu	"	
		Shyogo	"	
		MARKET	7/84	
	Kigarama	Fukwe	7/84	8
		Gasetsa	"	
		Gashanda	"	
		Kabare I	"	
		Kaberangwe	"	
		Kansana	"	
		Rurenge	"	
		Vumwe	"	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Kibungo (continued)	Mugesera	Gatare	11/84	7
		Kabilizi I	7/84	
		Kabilizi II	"	
		Kagashi	11/84	
		Karembo	7/84	
		Nyange	11/84	
		Sangaza	"	
		MARKET	7/84	
	Muhazi	Kitazigurwa	7/84	5
		Mukarange	"	
		Murambi	"	
		Nkomangwa	"	
		Nyarugali	"	
	Rukara	Gahini	7/84	6
		Kiyenzi	"	
		Nyamweru	"	
		Rukara	"	
		Rwamayoni	"	
		Rwamishinya	11/84	
		MARKET	7/84	
	Rukira	Gituku	11/84	6
		Murama	7/84	
		Mushikiri	11/84	
		Ntaruka (2)	7/84	
		Rurama	"	
		Rurenge	11/84	
	Rusumo	Gatore	7/84	9
		Kankobwa	"	
		Kigarama	"	
		Kigina	"	
		Kirehe	"	
		Musaza	"	
		Nyabitare	"	
		Nyamugali	"	
		Nyarubuye	"	
		MARKET	7/84	
	Rutonde	Kaduha	7/84	7
		Kigabiro	"	
		Nsinda	"	
		Nyarusange	"	
		Rutonde	"	
		Rwinkubo	"	
		Sovu	"	
		MARKET	7/84	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Kibungo (continued)	Sake	Birema I	7/84	9
		Gituza	11/84	
		Mabuga II	"	
		Mbuye	7/84	
		Ngoma	"	
		Nshili I	"	
		Nshili II	"	
		Rubago	11/84	
		Rukumberi	"	
		MARKET	7/84	
Kibuye	Gishyita	Gishyita	8/84	7
		Mara	"	
		Mhembe	"	
		Mubuga	"	
		Murangara	11/84	
		Musenyi	8/84	
		Ngoma	"	
	Kivumu	Gasave	11/84	7
		Kibanda	"	
		Ndaro	"	
		Rukoko	"	
		Nyange	"	
		Ngobagoba	"	
		Sanza	"	
		MARKET	11/84	
	Mabanza	Buhinga	8/84	9
		Gacaca	"	
		Gihara	"	
		Gitwa	"	
		Kibingo	"	
		Kigeyo	"	
		Mukura	11/84	
		Ngoma	"	
		Nyarugenge	"	
	Rwamatamu	Butembo	8/84	5
		Mahembe	"	
		Mugozi	"	
		Nyagahima	"	
		Nyagahinga	"	
		MARKET	8/84	
Kigali	Bicumbi	Bicumbi	10/84	11
		Gahengeri	"	
		Karenge	"	
		Murama	"	
		Murehe	"	
		Muyumba	"	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Kigali (continued)	Bicumbi (continued)	Nawe	"	
		Nyamatete	"	
		Nzige	"	
		Rubona	"	
		MARKET	10/84	
	Kanombe	Bisheshe	6/84	7
		Busanza	"	
		Gahanga	"	
		Kanombe	"	
		Masaka	"	
		Rwabutenge	"	
		Yabararaga	"	
	Kanzenze	Gicaca	6/84	11
		Kanzenze	"	
		Kayumba	"	
		Kibungo	"	
		Maranyundo	"	
		Mayange	"	
		Murama	"	
		Musenyi	"	
		Muyenzi	"	
		Ntarama	"	
		Nyagihunika	"	
		MARKET	6/84	
	Mugambazi	Burega	10/84	7
		Kiyanza	"	
		Murambi	11/84	
		Ntarabana	10/84	
		Ntyaba	"	
		Rusasa	"	
		Taba	"	
	Ngenda	Burenge	7/84	15
		Gakamba	"	
		Gakomeye	"	
		Kavumu	"	
		Kindama (2)	"	
		Mareba	"	
		Nyakayaga	"	
		Nyarugenge (2)	"	
		Nziranziza (2)	"	
		Ruhuna	"	
		Shyara	"	
		MARKET	7/84	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Kigali (continued)	Rubungo	Gisozi	7/84	5
		Kacyiru	"	
		Ndera	"	
		Remera	"	
		Rubungo	"	
		MARKET	7/84	
	Rushashi	Joma	10/84	5
		Kiruku	"	
		Minazi	"	
		Shyombwe	"	
		MARKET	10/84	
	Rutongo	Cyabingo	11/84	6
		Cyuga	"	
		Gihogwe	7/84	
		Kabuye	"	
		Kiganda	11/84	
		Muhororo	"	
		Ngiryi	"	
		Rubingo	"	
		MARKET	11/84	
	Tare	Bumba	7/84	8
		Nganzo	"	
		Ntarabana	"	
		Remera	"	
		Ruganda	"	
		Rushoki	"	
		Rutendeli	"	
		Tare	"	
		MARKET	7/84	
Ruhengeri	Cyabingo	Cyabingo	12/84	9
		Gitwa	"	
		Kiganda	"	
		Muhaza	"	
		Muhororo	"	
		Ngege	"	
		Nyundo	"	
		Rugimbu	"	
	Cyeru	Kabona	12/84	9
		Kibogo	"	
		Kinihira	"	
		Ndago	"	
		Ruhanga	"	
		Ruhombo	"	
		Rusarabuye	"	
		Ruyange	"	
		MARKET	12/84	

continued

Table 13. Continued.

Prefecture	Commune	Sector/Market	Date	Number
Ruhengeri (continued)	Kigombe	Cyure	12/84	11
		Gacaca	"	
		Gahondogo	"	
		Gasanze	"	
		Gashangiro	"	
		Kabaya	"	
		Muhoza	"	
		Musanze	"	
		Rubange	"	
	Kinigi	Bisate	12/84	11
		Gasiza	"	
		Gihora	"	
		Gihoro	"	
		Kabwende	"	
		Musanze (2)	"	
		Nyabitsinde	"	
		Nyange	"	
		Nyarugina	"	
		Rwankuba	"	
		MARKET	12/84	
	Ndusu	Busoro	12/84	6
		Janja	"	
		Kilinga	"	
		Mwumba	"	
	Nkumba	Gahunga	12/84	12
		Gatete	"	
		Giheta	"	
		Gitinda	"	
		Kabaya	"	
		Kinoni	"	
		Maya	"	
		Musanzu	"	
		Nyanga	"	
		Ruhondo	"	
		Rutamba (2)	"	
	Nyakinama	Kabere II	12/84	5
		Kitabura	"	
		Muko	"	
		Rubona	"	
		Rusanze	"	
	Nyarutovu	Gihinga	12/84	5
		Gitovu	"	
		Karambo	"	
		Kinyoma	"	
		Ruhinga I	"	

Table 14. Distribution of samples by agroclimate zone.

Agroclimatic Zone*	Sector	Commune	Prefecture
1. Imbo	Nyamarenko Gitambi	Nyakabuye	Cyangugu
	Nyabintare Muganza Bugarama Kibangiro	Bugarama	Cyangugu
2. Impara	Bunyereli Muhehwe	Bugarama	Cyangugu
	Butambaro Bushekeli	Kagano	Cyangugu
	Kaboza Nyamubembe Matare Runyanzovu Kigurwe	Nyakabuye	Cyangugu
	All samples from:	Cyimbogo Gafunzo Gishoma Gisuma Kamembe Karengera	Cyangugu
3. Bords du lac Kivu	Nyakabingo Rambira Mubumbano Kagano	Kagano	Cyangugu
	Birembo Muraza Mwasa Rumapfu Kagunga	Gatare	Cyangugu
	Mahemba Mugozi Nyagahinga Butembo	Rwamatamu	Kibuye
	Kibingo Gihara Gacaca	Mabanza	Kibuye

continued

* For descriptions see Appendix 1.

Table 14. Continued.

Agroclimatic Zone*	Sector	Commune	Prefecture
3. Bords du lac Kivu (continued)	Mubuga Musenyi Gishyita Mahemba Mara Murangara	Gishyita	Kibuye
	Rugerero Muhira	Rubavu	Gisenyi
	Nyundo Mukondo	Kanama	Gisenyi
	All samples from:	Kayove Nyamyumba	Gisenyi
4. Terre de laves	Byahi Bulinda Basa	Rubavu	Gisenyi
	All samples from:	Mutura	Gisenyi
	Butenga Gitare Butete Rugarama Cyanika	Kidaho	Ruhengeri
	Cyure Kabaya Rubange Muheza Musange Gahondogo Gashangiro	Kigombe	Ruhengeri
	Kitabura Muko	Nyakinama	Ruhengeri
	Giheta Gahunga Gatete Musanzu Rutamba Gitinda Kabaya Ruhondo Maya	Nkumba	Ruhengeri
	All samples from:	Kinigi	Ruhengeri

continued

Table 14. Continued.

Agroclimatic Zone*	Sector	Commune	Prefecture
5. Hautes terres de la Crete Zaire-Nil	Mugomba	Gatare	Cyangugu
	Nyagahima	Rwamatamu	Kibuye
	Ngoma	Gishyita	Kibuye
	Rukoko	Kivumu	Kibuye
	Gitwa Kigeyo Buhinga Nyarugenge Mukura Ngoma	Mabanza	Kibuye
	Bisizi Karambo Rugomero Mukondo Kigarama Kanomba Kayove	Kanama	Gisenyi
	Rucana Gitega Hindiro Murambi	Satinsyi	Gisenyi
	Kiraro	Karama	Gikongoro
	Rubona Rusange Kabere II	Nyakinama	Ruhengeri
6. Hautes terres de Buberuka	Karama Gatunda	Murumba	Byumba
	Bwisige Nyarurama Kabongoya	Bwisige	Byumba
	Gicumbi Kinyami Cyuru Ruvune	Kinyami	Byumba
	Busoro Burenga Muranzi	Buyoga	Byumba

continued

Table 14. Continued.

Agroclimatic Zone*	Sector	Commune	Prefecture
6. Hautes terres de Buberuka (continued)	All samples from:	Cyungo Kiyombe Kabali	Byumba
	Rugimbo	Cyabingo	Ruhengeri
	Mwumba	Ndusu	Ruhengeri
	Kagogo	Kidaho	Ruhengeri
	Gasanze Gacaca	Kigombe	Ruhengeri
	Kinoni Nyanga	Nkumba	Ruhengeri
	Gitovu Karambo Ruhinga II	Nyarutovu	Ruhengeri
	All samples from:	Cyeru	Ruhengeri
	Tare Rushashi Remera Ntarabana	Tare	Kigali
7. Plateau Centrale	All samples from:	Maraba	Butare
	Ngobagoba Sanza Gasave Ndaro Kibanda Nyange	Kivumu	Kibuye
	Munini Matyazo Mpara Kiziguro Ngororero	Satinsyi	Gisenyi
	Cyanika Kibingo Gitega Ngoma	Karama	Gikongoro
	All samples from:	Kinyamakara Rukondo Musange	Gikongoro

continued

Table 14. Continued.

Agroclimatic Zone*	Sector	Commune	Prefecture
7. Plateau Centrale (continued)	Kagarama Mata Kaduha Ntongwe	Mushubati	Gitarama
	Mugina	Kinyami	Byumba
	Zoko Mutete Kavumu Nyabisiga Murambi	Buyoga	Byumba
	Janja Rusaro Kilinga	Ndusu	Ruhengeri
	Gihinga Kinyoma	Nyarutovu	Ruhengeri
	Ngege Gitwa Nyundo Muhaza Cyabingo Kigande	Cyabingo	Ruhengeri
	Rutendeli Nganzo Bumba Ruganda	Tare	Kigali
	All samples from:	Rushashi Rutongo Mugambazi	Kigali
8. Dorsale Granitique	Ntongwe Nyarurama Karebo Gikoma Kinazi Nyakabingo Nyabitare	Ntongwe	Gitarama
	Mwaka Gifumba Giseke	Mushubati	Gitarama
	All samples from:	Tambwe Kigoma	Gitarama

continued

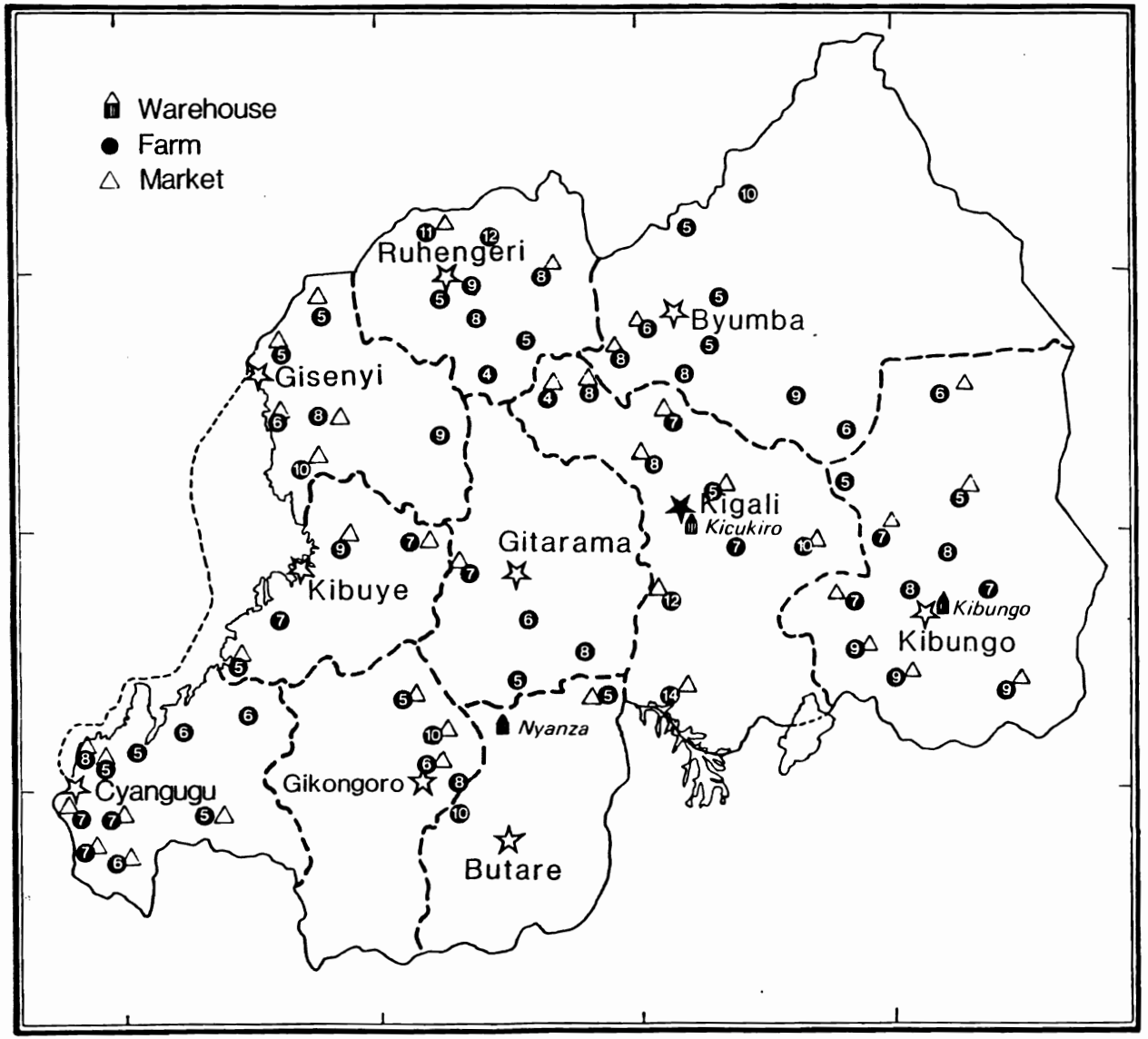
Table 14. Continued.

Agroclimatic Zone*	Sector	Commune	Prefecture
8. Dorsale Granitique (continued)	Muyira Mukorwa	Muyira	Butare
9. Mayaga	Rutabo	Ntongwe	Gitarama
	Kibungo Kanzenze Ntarana Kayumba Musenyi Gicaca Nyagihunika	Kanzenze	Kigali
	Nziranziza Shyara Gakomeye Nyarugenge Ruhuna	Ngenda	Kigali
	Busoro Munyinya Matara	Muyira	Butare
10. Bugesera	Mbuye Rubago Rukumberu Gituza Mabuga II	Sake	Kibungo
	Gatare Nyange Kagashi Sangaza	Mugesera	Kibungo
	Nyakayaga Burenge Kavumu Gakamba Kindama Mareba	Ngenda	Kigali
	Maranyundo Muyenzi Murama Mayange	Kanzenze	Kigali

continued

Table 14. Continued.

Agroclimatic Zone*	Sector	Commune	Prefecture
11. Plateau de l'Est	Kankobwa	Rusumo	Kibungo
	Gatare		
	Kirehe		
	Nyabitare		
	Kigarama		
	Musaza		
	Kigina		
	Ngoma	Sake	Kibungo
	Nshili I		
	Nshili II		
	Birema I		
	Kabilizi I	Mugesera	Kibungo
	Kabilizi II		
	Karembo		
	All samples from:	Rutonde	Kibungo
		Birenga	
		Kigarama	
		Kayonza	
		Muhazi	
		Rukira	
		Kabarondo	
	Nyagahinga	Bwisige	Byumba
	Muti		
	Gikoma	Murambi	Byumba
	Rugarama		
	Kiziguro		
	Rwankuba		
	Rwimitereli		
	All samples from:	Muhura	Byumba
	All samples from:	Bicumbi	Kigali
		Kanombe	
		Rubungo	
12. Savanes de l'Est	Nyamugali	Rusumo	Kibungo
	Nyarubuye		
	All samples from:	Rukara	Kibungo
	Kiburara	Murambi	Byumba
	Bweya	Muvumba	Byumba
	Tabagwe		
	Shonga		
	Rukemo		
	Mukama		



MAP 5. SAMPLING SITES-FARM, MARKET, AND WAREHOUSE

Analysis of Preliminary Survey Samples

A rapid, simple and repeatable method of analyzing survey samples was needed. The samples collected in the preliminary survey were used to determine which procedures were appropriate to use. The analysis form (Table 15), illustrates the information obtained for each named sample and mixture. Number of seed of each type and the weight of those seed were both recorded to allow the calculation of the weight of 100 seeds. The results of analysis of 100 grams of a sample and of the total sample were compared but were not found to be sufficiently different to warrant the extra time required to separate the larger sample.

The most important component of the analysis procedure was the description of the visual characteristics of each seed type. In order to standardize these descriptions a set of descriptors for various seed characteristics was developed. Three similar systems are discussed in the literature (2, 6, 8), (Appendices 2, 3) and parts of each are included in our system, described in Table 16. Descriptors were chosen which would adequately describe the most important seed types in Rwanda and be rapid and accurate to use. The laboratory facilities at ISAR-Rubona were suitable for the analysis and the team was easily trained in the use of the descriptor system. A set of seed mounts (Nasco Seed Mount Style S-21, Fort Atkinson, WI 53538) containing seed illustrating each descriptor was assembled for use as a reference during the early part of the analysis. Sample mixtures from the presurvey were separated by seed type. It was then decided that all types encountered with less than 3 seeds or weighing less than 1 gram would be placed in a 'miscellaneous' category. These types were not described individually, but were counted and weighed as a group. The data resulting from the preliminary survey was included with that of the country-wide survey which will be discussed later.

Survey Methodology

The survey team consisted of the research assistant (E. Lamb) and the technician (G. Harelimana) for the first portion of the nation-wide survey (May-August, 1984), and the technician with an ISAR driver for the latter part (September-December, 1984). Since few of the farmers surveyed spoke French, all interviews were carried out in Kinyarwanda with the technician serving as questioner and recorder of data. In each prefecture, the local officials were notified that the survey was taking place and when and where samples would be collected. Original plans to alert the officials of each commune were discarded because of time constraints.

Using the sampling schedules and maps as a guide and asking directions frequently, the survey team located the desired sector and chose a farm where women were seen working. During the latter part of the survey, when beans were in short supply due to poor growing conditions, the team would look for a more prosperous household on the assumption that the family would more likely have beans in storage. If no beans were available or the farmer did not wish to participate in the survey, another farm would be chosen for that sector. Once a farm was chosen, the team would introduce the project to the family members and neighbors present. The technician would explain that the survey was being done in conjunction with ISAR and OPROVIA/GRENARWA on bean varieties grown in Rwanda. He would also emphasize that farms all over the country were being visited.

Table 15. Summary form for laboratory analyses of seed type presence by sample.

Type of sample: ______________________ Date: ______________

Name and/or number: ____________________ Researcher: __________

Nº	Local name	Shape	Color pattern	Color	Shini-ness	Weight of 100 seeds	Weight of sample	# of seeds in sample

Table 16. Bean seed descriptors used for analysis of named type and mixture component bean varieties.

1. Seed shape.

	Length	Circumference
rp	rounded	flat
ro	rounded	oval
lp	elongate	flat
lo	elongate	oval

2. Seed coat color pattern.

mc	single color
zb	Zebra striped
tt	speckled
tl	mottled
tp	flecked
hl-	having a hilum ring of another color (-)
v-	having a larger area of another color (-) around the hilum area

3. Color.

n	black
bl	white
gr	grey
cr	cream
j	yellow
rg	red
rs	pink
pr	purple
v	green
br	brown
bleu	blue

Colors were used in single, double, or occasionally triple codes, e.g. jbr=yellow brown, for single color seeds. For patterned seeds, the major or primary color is given followed by the secondary color, e.g. cr/n.

4. Shininess.

b	shiny
m	dull

5. Flower color.

Bl	white
V	lavender
P	purple

continued

Table 16. Continued.

6. Stem color.

V	green
R	pink
P	purple
M	mixed

7. Pod color.

V	green
R	pink
P	purple
Sp	speckled

8. Plant type (CIAT system).

I	Determinate - shrubby
II	Indeterminate - shrubby
III	Indeterminate - prostrate
IV	Indeterminate - climbing

9. Flowering date (based on 50% flower of 3 m row).

P	early
I	intermediate
T	late

A double code, e.g. PI, suggests that the determination of the flowering date from successive plantings was not the same.

10. Pod position.

H	high
M	medium
B	low

11. Weight (in grams) of 100 seeds.

The survey interview was generally conducted in the courtyard of the house. All non-family members were asked to leave to reduce crowding and to improve candor in responses, particularly for those questions dealing with family income. To begin each interview, the farmer was asked to provide a small quantity of each stored mixture. From this sample, the farmer was asked to identify all types for which she knew a name and to select at least three seeds of each type. These seeds were placed in small plastic bags and labeled with the given name. Occasionally, several seed types were picked out by the farmer for a single name or a major component of the mixture was not identified, but the team did not attempt to prompt or correct the respondents during the interview. The name of each type was recorded on the questionnaire and the appropriate characteristics were noted. One form was completed for each mixture provided. Pure types or varieties stored with only a few seeds of other random types, were recorded on the same form as a mixture with the notation 'pure'.

When all questions were completed, a new sample of each mixture was requested. Pure types were not collected. These samples were placed in large plastic bags and identified by a location and mixture identification number. The small bags containing the named seed types were placed in the large bag. After the interview was completed, the farmer was offered 50 francs for each mixture provided.

Farmers in a region were asked for day, time and location of local markets. At each market, one kilo of each of three to five different mixtures was purchased. These market samples were put in plastic bags labeled with the location and date of purchase. For certain communes, market samples were not collected because farms were sampled on non-market days. Few market samples were collected in the prefectures of Ruhengeri and Byumba as priority was placed on farm sampling in order to complete the survey.

Farm and market samples were stored in baskets and cardboard boxes until they could be transported to the laboratory at ISAR-Rubona for analysis. In general, the coolest available location was used for the temporary storage but conditions were far from ideal.

A total of 66 were collected at the 3 warehouses by the warehouse managers, with not more than 5 collected on any one day. The managers recorded the warehouse location, sample number, name of the producer and location of the farm. The seeds and the information were placed in plastic bags which were periodically picked up by the survey team.

ANALYSIS METHODOLOGY

Initial Analysis - Named Seed Types - Mixture Components

The analysis form already described (Table 15) was used for the initial analysis of all named seed types and mixture components. The named seed types were described as soon as possible after collection. Seed weights and weight per 100 seed were not determined for these samples because the seeds selected by the farmer were often the largest of the type. If the three or more seeds selected were not of the same type, each type was described separately.

Separation of the mixture components was done in the ISAR-Rubona laboratory where appropriate space and equipment were available. One hundred grams of each mixture was used for this analysis and seed weight, seed number and weight per 100 seed were tabulated. Certain of the descriptors, especially color, are subjective in nature. To assure unformity, all seed type descriptions were done by the same person and verified by the research assistant.

Analysis of Responses to the Questionnaire - Production Questions

Table 17 is an example of the form used to summarize those responses from the questionnaire relating to production. The same form was used to analyze samples within a commune and for the compilation of data by prefecture and agroclimatic zone. Since a questionnaire was completed for each mixture and the responses varied by mixture, the total possible responses for a region reflects the number of mixtures rather than number of farmers interviewed. A farmer may have given more than one answer for those questions dealing with timing of an action, field conditions under which beans are planted and production limits. In such cases, the total percentage of responses is greater than 100%.

Analysis of Responses to the Questionnaire - Named Types

The analysis of named samples included a compilation of seed type characteristic information from the questionnaire, using the form shown in Table 18. The seed type was identified by name or by description because summaries were based on both types of identification. A seed size value (>39 g/100 seed=large; $\leq$39 g/100 seed=small) was included with the description. Seed characteristics were recorded for each sample of a given seed type by commune. These forms were also used to summarize the data by prefecture and agroclimatic zone. Results were tabulated as percent of total possible responses.

Analysis of Mixture Components

Two types of summary tables were used to summarize the mixture component results. Using the results tabulated during the initial analysis, frequency (number of samples in which the type occurred divided by the total number of samples) and percent of mixture by weight were calculated and recorded (Table 19). The product of these two values was used as an index of prevalence for a region.

Table 17. Summary form for production information.

Sample identification _____

Month	J	F	M	A	M	J	J	A	S	O	N	D
Planting date												
Harvest date												

Seed - Produced own
Bought
Given

Do you sell beans?

No
1 - 20%
21 - 50%
51 - 90%

When?

At harvest?
Before planting?
Other times

Do you separate beans to eat from beans to plant?

No
At harvest?
Before planting?
Other times

Do you plant different mixtures under different field conditions?

No
Yes
Pure varieties?

Under which conditions?

When?

At harvest?
Before planting
Other times

Do you store different mixtures separately?

What factors are limiting to production?

Table 18. Summary form for analysis of characteristics of seed types from questionnaire.

ANALYSIS FORM

Identification of the sample: _____

Name of variety or description: _____

SAMPLE NUMBER

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

9 _____

10 _____

SAMPLE NUMBER

SEED TYPE CHARACTERISTICS FROM QUESTIONNAIRE

	1	2	3	4	5	6	7	8	9	10
N										
SV										
V										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										

Table 19. Summary form for analyses of frequency and mean percent by weight of seed types.

SURVEY OF BEANS IN RWANDA

Sample analysis

(summary table)

Origin or type of sample: _____

Number of samples in this analysis: _____

Analyzed by: _____ Date: _____

Shape	Color pattern	Color	Shini-ness	Number	Fre-quency	% in varieties by weight	Index value

The form shown in Table 20 was used for analyses by seed description. The columns and rows are labeled with the seed descriptors. Frequency values for the given type were entered in the square designated by the appropriate descriptors. This table was designed for the compilation of data by prefecture and agroclimatic zone.

Table 20. Summary form for laboratory analyses of seed type presence by commune.

COLOR PATTERN: _____									
	Shape	rp		ro		lp		lo	
	Size	p	g	p	g	p	g	p	g
Color	Shininess								
	b								
	m								
	b								
	m								
	b								
	m								
	b								
	m								
	b								
	m								
	b								
	m								
	b								
	m								

RESULTS AND DISCUSSION

The sample locations and dates of sampling for the country-wide survey are listed in Table 13. A total of 483 farms were sampled and 589 mixtures were collected. It is important to note that certain biases are present in these data. A relatively small number of farms and markets in the country were sampled. The distribution of samples was influenced by the use of the 1979 bean production figures to choose sample location. A farmer may not have answered every question on the questionnaire and for certain questions, notably those relating to field conditions and limits to production, he may have given more than one answer. Most of the results are based on farmers' responses and are, therefore, subjective in nature. Given these limitations, however, the results illustrate trends which are valid for the whole country.

The results and discussion section will be divided into three parts: production factors, named seed types, and mixture components. Data are presented by prefecture and by agroclimatic zone to allow comparison on either basis. If there are no differences in trend of responses, the discussion will center on only one of the sets of results.

PRODUCTION FACTORS

Planting and Harvesting Dates

Tables 21 and 22 outline the peak months for planting and harvesting of beans by prefecture and agroclimatic zone (Appendices 7 and 8). In Rwanda, the peak planting months are September and February, with corresponding harvesting peaks in December and June. The September planting corresponds to the beginning of the rains after the long dry season and is uniform throughout the country. The first season is the most important for bean production in terms of area planted. In Byumba and Ruhengeri, and agroclimatic zones 4 and 6, the planting and harvest for the second season occurs later than for the rest of the country. This is to be expected with the cooler temperatures at higher elevations. Because of variations in elevation, temperature, and rainfall, beans are planted or harvested almost every month of the year in some area of the country. This distribution of agricultural activies is also illustrated by the agricultural calendar presented by Kayinamura (13).

Source of Seed

The results for the rest of the production questions are given in Tables 23 and 24. The units are percent of total possible responses unless otherwise noted. The country-wide totals are given in Table 23.

Seventy-eight percent of farmers produced their own seed. The two lowest percentages were in Byumba and Ruhengeri and agroclimatic zones 4 and 6, representing the higher elevation areas. Although production in these areas is normally high, the 1984B season, from which the seed would have come, was poor. Consequently, the percent of farmers who had to rely on other sources for seed would be higher. The most common alternative

Table 21. Peak planting and harvest dates by prefecture.[1]

Prefecture	Season I				Season II							
	S_2	O	N	D	J	F	M	A	M	J	J	A
BUTARE	X	-	-	O	X	X	X	-	O	-	-	-
BYUMBA	X	-	-	O	-	-	-	X	-	O	O	O
CYANGUGU	X	-	-	O	-	X	X	-	-	O	-	-
GIKONGORO	X	-	-	-	O	X	-	-	O	-	-	-
GISENYI	X	-	-	O	O	O	X	-	-	O	-	-
GITARAMA	X	-	-	O	O	X	-	-	O	-	-	-
KIBUNGO	X	X	-	-	O	X	-	-	-	O	-	-
KIBUYE	X	-	-	O	-	-	X	-	-	O	-	-
KIGALI	X	-	-	-	O	-	X	-	-	O	-	-
RUHENGERI	X	-	O	O	O	O	-	X	-	-	O	O

[1] X=peak planting months, O=peak harvest months.
[2] S-O-N-D-J-F-M-A-M-J-J-A=consecutive months September-August.

Table 22. Peak planting and harvest dates by agroclimatic zone.[1]

Agroclimatic zone	Season I					Season II						
	S_2	O	N	D	J	F	M	A	M	J	J	A
1	-	-	-	-	O	X	-	O	-	-	-	-
2	X	-	-	O	O	X	X	-	-	O	-	-
3	X	-	-	O	O	X/O	X	-	O	O	-	-
4	X	-	-	-	-	O	O	X	-	-	-	O
5	X	-	-	O	O	O	X	X	-	-	-	O
6	X	-	-	O	-	-	-	X	-	-	-	O
7	X	-	-	O	O	-	-	X	O	O	O	O
8	X	-	-	-	O	X	-	-	O	-	-	-
9	X	-	-	O	O	-	X	-	-	O	-	-
10	-	X	-	-	O	X/O	-	-	-	O	-	-
11	X	X	-	O	-	X	X	-	-	O	-	-
12	X	-	-	O	O	-	X	-	-	O	-	-

[1] X=peak planting months, O=peak harvest months.
[2] S-O-N-D-J-F-M-A-M-J-J-A=consecutive months September-August.

Table 23. Tabulation of responses from questionnaire by prefecture.

Question	Butare	Byumba	Cyangugu	Gikongoro	Gisenyi	Gitarama	Kibungo	Kibuye	Kigali	Ruhengeri	Total
	Prefecture										
	percent of total possible responses										
Number of mixtures	27	65	75	35	47	34	120	29	80	77	589
Number of farms	25	60	62	29	37	26	80	28	74	62	483
Source of seed for this sample:											
Produced own	81	55	85	80	79	88	83	76	80	74	78
Purchased	15	29	8	14	21	6	11	24	16	23	17
Market	—	9	5	3	17	—	9	10	6	10	7
Merchant	—	11	3	3	4	3	—	10	9	10	5
Neighbor/Farmer	—	—	—	3	—	3	1[1]	—	1	—	1[1]
Given	4	5	7	6	2	9	8	3	4	3	5
Parents/Family	—	3	5	—	—	3	3	—	—	—	1
Neighbors/Friends/Exchange	—	2	5	6	—	3	4	3	4	3	2
Project	—	—	1	—	—	—	—	—	—	—	< 1
Do you sell beans of this mixture?											
No	43	51	57	68	66	50	28	66	51	44	49
Percent of production											
1-20	43	25	20	26	26	15	22	28	24	40	26
21-50	14	8	17	9	6	18	43	7	20	14	20
51-90	—	11	5	3	2	9	6	—	3	3	5
When?											
At harvest	20	23	13	6	9	9	33	10	20	22	20
At planting	20	17	19	14	2	12	32	10	9	21	18
When need money/things for family	20	9	5	9	—	18	4	17	14	13	10
When price is high	—	—	—	3	—	—	2	—	1	—	1
In exchange for work	—	—	3	—	—	3	—	—	—	—	1
When have a surplus	—	—	—	3	—	—	—	—	—	—	< 1
In times of famine	—	—	—	—	—	—	—	—	1	1	< 1
It doesn't matter when	—	—	—	—	2	—	3	—	—	1	1
Do you separate beans to eat from beans to plant?											
No	64	45	44	14	66	44	31	45	35	49	39
At harvest/before storage	29	40	46	71	26	35	54	48	48	45	47
At planting	7	3	3	17	—	15	1	—	9	1	4
At the end of the stock	—	—	1	—	—	—	—	—	—	—	< 1
When there is time	—	—	—	—	—	3	—	—	—	—	< 1
Do you plant different mixtures under different field conditions?											
No	29	51	33	43	38	35	17	52	33	51	36
Yes	64	28	64	49	32	62	78	48	65	45	56
'Pure' varieties	7	18	24	11	32	24	52	31	33	26	31

continued

[1] Cooperative.

Table 23. Continued.

Question	Prefecture										
	Butare	Byumba	Cyangugu	Gikongoro	Gisenyi	Gitarama	Kibungo	Kibuye	Kigali	Ruhengeri	Total
	percent of total possible responses										
Under which conditions? (% of 'Yes' responses)											
Soil type	55	76	71	71	53	24	59	64	79	57	59
Under bananas	22	18	25	—	20	10	44	43	17	9	25
Association with sorghum	—	12	—	—	—	3	1	—	—	—	1
maize	—	6	—	—	7	—	—	—	—	3	1
cassava	—	—	—	—	—	10	—	—	—	—	1
peanut	—	—	—	—	—	—	3	—	—	—	1
Plant type	—	—	8	—	27	—	3	—	8	23	7
Vegetative cycle	—	23	8	—	—	—	13	14	6	11	9
Hillside/marsh	—	12	—	—	13	—	1	—	6	6	3
After clearing a new field	—	—	—	—	—	—	5	—	—	—	2
New introductions	—	—	—	—	—	—	1	—	—	—	< 1
Beginning of the rotation	—	—	—	—	—	—	1	—	—	—	< 1
Availability of water	—	—	—	6	—	—	—	—	—	—	< 1
Different seasons	11	—	2	—	—	24	—	—	—	—	2
When do you separate these mixtures?											
At harvest/before storage	—	2	3	—	4	—	16	—	6	1	5
Before planting	—	9	23	23	17	32	42	21	39	6	25
Before selling	—	—	1	—	—	—	—	—	—	1	< 1
During the season/when there is time	—	—	—	—	—	—	1	3	—	—	< 1
Mixtures are stored separately (% of farms)	40	7	27	31	19	15	46	32	17	26	25
Limiting factor for production of beans:											
Climatic irregularity (sun/rain;timing/amount)	NI[2]	79[3]	73	NI	87	NI	68	86	100[4]	87	79
Drought	NI	—	7	NI	—	NI	25	14	—	—	9
Soil fertility	NI	7	23	NI	—	NI	9	—	3	3	8
Poor soil	NI	2	1	NI	2	NI	3	7	3	—	2
Lack of manure	NI	2	1	NI	—	NI	1	—	—	—	1
Planting date	NI	—	1	NI	—	NI	5	—	—	1	2
Lack of stakes	NI	—	—	NI	2	NI	—	—	—	1	< 1
Hail	NI	—	5	NI	4	NI	—	10	3	—	2
Damage from cultivation	NI	—	—	NI	—	NI	2	—	—	—	< 1
Planting density	NI	—	—	NI	—	NI	2	—	—	—	< 1
Poor germination	NI	—	—	NI	2	NI	—	—	—	—	< 1
Planting under eucalyptus	NI	—	—	NI	2	NI	—	—	—	—	< 1
Lodging	NI	—	—	NI	—	NI	—	—	—	1	< 1
Aphids	NI	10	4	NI	11	NI	—	14	—	12	6
Beetle larvae	NI	—	—	NI	—	NI	—	—	—	1	< 1
Grey worm	NI	3	—	NI	—	NI	—	—	—	2	1
Bean fly	NI	—	—	NI	—	NI	—	—	3	—	< 1
Insects	NI	3	—	NI	—	NI	—	—	—	9	2
Birds	NI	—	4	NI	6	NI	—	—	—	4	2
Rats	NI	7	1	NI	6	NI	1	—	—	—	2
Hippopotomuses	NI	—	—	NI	—	NI	1	—	—	—	< 1
Diseases	NI	—	—	NI	—	NI	1	—	—	—	< 1

[2] NI=not included. [3] Not included in some samples.
[4] Can total to >100% - multiple responses given.

Table 24. Tabulation of responses from questionnaire by agroclimatic zone.

Question	Agroclimatic zone											
	1	2	3	4	5	6	7	8	9	10	11	12
	percent of total possible responses											
Number of farms	6	46	39	42	25	52	103	23	16	19	101	14
Number of mixtures	6	59	47	49	25	54	121	30	21	23	140	18
Source of seed for this sample:												
Produced own	100	85	79	69	92	54	79	83	90	74	81	78
Purchased	—	10	17	29	12	39	14	7	10	22	13	17
Market	—	7	11	12	8	9	3	—	—	13	10	6
Merchant	—	3	4	10	4	15	4	3	—	4	2	—
Neighbor/Farmer	—	—	—	—	—	—	1	3	5	—	1[1]	6
Given	—	5	6	2	—	2	6	10	—	4	6	6
Parents/Family	—	3	4	—	—	—	2	3	—	—	3	—
Neighbors/Friends/Exchange	—	2	—	—	—	2	2	3	—	4	4	6
Project	—	—	2	—	—	—	—	—	—	—	—	—
Do you sell beans of this mixture?												
No	17	57	81	43	48	57	54	47	43	35	31	22
Percent of production												
1-20	33	24	6	43	44	28	22	13	30	22	24	17
21-50	33	14	11	12	4	11	7	20	19	35	38	33
51-90	17	5	2	2	—	4	2	7	—	9	5	28
When?												
At harvest	67	8	2	27	12	17	6	13	19	35	33	39
At planting	—	20	6	16	8	13	15	3	14	30	26	28
When need money/things for family	17	5	6	14	12	13	6	20	19	—	9	11
When price is high	—	—	—	—	—	—	1	—	—	4	1	—
In exchange for work	—	3	—	—	—	—	—	3	—	—	—	—
When have a surplus	—	—	—	—	—	—	1	—	—	—	—	—
In times of famine	—	—	—	2	—	—	2	—	—	—	—	—
It doesn't matter when	—	—	—	2	4	—	—	—	—	—	1	—
Do you separate beans to eat from beans to plant?												
No	17	46	49	57	56	44	24	33	52	35	35	44
At harvest/before storage	83	46	43	35	36	43	58	37	43	48	49	39
At planting	—	2	2	2	4	4	5	20	10	9	2	—
At the end of the stock	—	2	—	—	—	—	—	—	—	—	—	—
When there is time	—	—	—	—	—	—	—	3	—	—	—	—
Do you plant different mixtures under different field conditions?												
No	50	32	55	61	48	43	32	30	52	17	22	61
Yes	50	66	40	33	40	43	50	60	47	96	76	33
'Pure' varieties	17	24	32	27	28	26	24	17	14	52	41	28

continued

[1] Cooperative.

Table 24. Continued.

Question	Agroclimatic zone 1	2	3	4	5	6	7	8	9	10	11	12
	percent of total possible responses											
Under which conditions? (% of 'Yes' responses)												
Soil type	100	64	79	44	50	61	56	56	90	59	62	100
Under bananas	—	31	37	6	20	4	16	17	10	32	38	33
Association with sorghum	—	—	—	—	—	4	—	6	—	—	2	—
maize	—	—	—	6	10	4	—	—	—	—	—	—
cassava	—	—	—	—	—	—	—	6	—	—	—	—
peanut	—	—	—	—	—	—	—	—	—	5	2	—
Plant type	—	5	11	19	20	17	8	—	—	—	3	—
Vegetative cycle	—	5	16	13	10	4	11	—	—	—	9	50
Hillside/marsh	—	3	5	—	—	9	5	—	—	13	—	—
After clearing a new field	—	—	—	—	—	—	—	—	—	5	4	—
New introductions	—	—	—	—	—	—	—	—	—	—	—	17
Beginning of the rotation	—	—	—	—	—	—	—	—	—	—	1	—
Availability of water	—	—	—	—	—	—	2	—	—	—	—	—
Different seasons	—	—	—	—	—	—	—	6	—	—	—	—
When do you separate these mixtures?												
At harvest/before storage	33	2	—	—	4	4	3	3	—	13	11	—
Before planting	17	29	26	12	12	7	18	37	24	47	39	—
Before selling	—	—	—	—	—	—	—	—	—	—	—	—
During the season/when there is time	—	2	—	2	—	2	—	—	—	—	1	—
Mixtures are stored separately (% of farms)	17	26	36	17	24	17	18	30	19	16	33	14
Limiting factor for production of beans:					(24)[3]		(62)			(11)	(126)	
Climatic irregularity (sun/rain; timing/amount)	50[2]	73	91	86	83	78	81	NI[4]	NI	100	66	72
Drought	—	7	6	—	8	—	—	NI	NI	18	20	22
Soil fertility	50	15	4	—	—	9	2	NI	NI	—	10	—
Poor soil	—	7	4	—	—	—	2	NI	NI	—	3	6
Lack of manure	—	2	—	—	—	—	—	NI	NI	—	2	—
Planting date	—	2	—	2	—	—	—	NI	NI	—	6	—
Lack of stakes	—	—	—	2	—	—	2	NI	NI	—	—	—
Hail	—	7	—	—	13	—	5	NI	NI	—	—	—
Damage from cultivation	—	—	—	—	—	—	—	NI	NI	—	2	—
Planting density	—	—	—	—	—	—	—	NI	NI	—	2	—
Poor germination	—	—	—	—	—	—	2	NI	NI	—	—	—
Planting under eucalyptus	—	—	—	2	—	—	—	NI	NI	—	—	—
Lodging	—	—	—	2	—	—	—	NI	NI	—	—	—
Aphids	17	7	2	6	25	22	3	NI	NI	—	—	—
Beetle larvae	—	—	—	—	—	2	—	NI	NI	—	—	—
Grey worm	—	—	—	4	—	4	—	NI	NI	—	—	—
Bean fly	—	—	—	—	—	2	—	NI	NI	—	—	—
Insects	—	—	—	4	—	4	—	NI	NI	—	—	—
Birds	—	2	9	2	4	4	2	NI	NI	—	—	—
Rats	—	2	4	2	—	7	—	NI	NI	—	1	—
Hippopotomuses	—	—	—	—	—	—	—	NI	NI	—	1	—
Diseases	—	—	—	—	—	—	—	NI	NI	—	1	—

[2] Can total to >100% - multiple responses given. [3] Number in parantheses is number of mixtures for which answers were given if different from total. [4] NI=not included.

sources of seed are the markets (7%) and merchants (5%). Although the team was informed that by tradition a request for seed must be honored, a low percentage of farmers reported being given seed for planting.

Marketing of Beans

Half of the respondents, over the whole country, reported that they did not sell beans. The questionnaire requested that the answer relate to general practices as the current season was poor. Kibungo and agroclimatic zones 11 and 12 are the exceptions, with 28, 31 and 22 percent 'no' responses, respectively. Bean production in this region is high, sufficient to cover family needs and provide excess for sale. By comparing the percent of annual production for 1979 with the percent of mixtures from which beans are sold (Table 25), the association of high production level and likelihood of selling beans can be readily seen. The ranking of prefectures by high, medium and low categories is the same for both factors, with the exception of Butare, which is influenced by the addition of the preliminary survey results.

Approximately half of those farmers who do sell beans, sell up to 20% of their production. There is an association between a high percentage of farmers selling beans in a region and the percent of farmers selling 21-50% of their production. Very few farmers sell more than 50% of their beans.

Most respondents said they sold beans at harvest or at planting. The responses were not specific enough to determine if those selling at harvest sold before or after harvest. The harvest would radically influence the supply of beans and consequently the price. Selling before harvest might suggest that beans were held until the price was high or that unnecessary old stocks were sold. Selling after the harvest suggests that the family's needs for food and money are known and 'excess' beans are sold. The need for money or other items was also a common reason for selling beans. In general, the responses suggest a lack of planned marketing by the farmer and emphasize the subsistence nature of Rwandan agriculture.

Separation of Bean Stocks for Food and Seed

A surprisingly large proportion of farmers do not separate food beans from seed beans. The percentage of those who separate the two types just at planting or at the end of the stock can be included in the 'no' response. More detailed questioning would be necessary to determine how the producers guarantee a high quality and adequate supply of seed of preferred varieties for the following season. The majority of those who do separate out their seed make the separation at harvest. This would seem appropriate to ensure the best quality seed.

Effects of Field Condition on Mixtures Planted

Fifty-six percent of respondents plant different mixtures under different field conditions. The results vary considerably by prefecture and agroclimatic zone. Perhaps this is affected by farm size or diversity of farm plots. The percent of farmers growing 'pure' varieties is higher than was expected from the emphasis on mixtures in the literature. Farmers who grow 'pure' varieties also grow mixtures on other parts of the farm. No reasons

Table 25. Percent of annual production (1979)[1] and percent of mixtures from which beans are sold.

Prefecture	Annual production (1979)		Mixtures from which beans are sold
	%		%
Byumba	15	high	44
Kigali	14		47
Ruhengeri	13		57
Kibungo	10		71
Butare	9	medium	57
Cyangugu	9		42
Gitarama	9		42
Gisenyi	8	low	34
Gikongoro	7		38
Kibuye	6		35

[1] Bovry et al, 1980.

for growing pure types were given, but it was suggested that a small plot of a pure type may allow the farmer to test the variety before incorporating it into the mixture. Pure types may give high yields, but lack the 'risk avoidance' of a mixture and are, therefore, planted on a limited basis only. Soil type, intercropping, plant type and vegetative cycle of the beans (early/late) are the most important factors determining which mixtures will be planted in which field. 'Soil type' is a very broad category including 'rocky', 'sandy', 'light', 'infertile', 'fertile', 'poor', 'good', and other descriptions. The reduction of available light under a canopy of bananas requires the use of varieties which tolerate low light. A large percent of total responses for this condition is reported for the major banana producing regions, Kibungo (Zones 10, 11, and 12) and Kibuye (Zones 2 and 3). The percent of total responses for other conditions reflect the regions in which certain crops or associations are important. Maize and bean associations are most commonly found in the high elevation areas of Byumba, Gisenyi and Ruhengeri (Zones 4, 5 and 6). Cassava is a very important crop in Gitarama (Zone 8) and peanuts are grown extensively in Kibungo (Zones 10 and 11). Plant growth habit is most important to farmers in Gisenyi and Ruhengeri (Zones 4, 5 and 6) where climbing beans are preferred. Vegetative cycle is important in prefectures and zones noted for cooler temperatures and drier conditions.

Most of the farmers who plant different mixtures in different fields do not store them separately, but separate the mixtures only at planting. Mixtures were stored separately at only 25 percent of farms sampled.

Factors Limiting Production

Climatic irregularity, which was a limit to production of beans for 79 percent of the respondents includes excess, lack, and timing of rainfall and sunlight. The words describing certain climatic conditions in Kinyarwanda do not always translate directly into French and English. Therefore, those responses dealing with climatic factors that were not specifically given as 'Drought' or 'Hail' are grouped. Drought is most often limiting in Kibungo and Zones 10, 11 and 12, the driest regions of Rwanda. Soil fertility appears to be most often limiting in Cyangugu (Zones 1 and 2), although these Zones are listed as being good to excellent in agricultural value. Lack of stakes for climbing beans can be limiting in those regions where climbing beans are grown. Aphid infestation was commonly reported as limiting to production. The preceding season was dry and aphids were very prevalent, particularly in the higher elevation areas of the north and the Zaire-Nile divide. Rats were a problem in the prefectures of Byumba and Gisenyi. Diseases were rarely noted as a limiting factor, perhaps because of the dry season or because disease symptoms are attributed to other factors, such as climatic irregularities.

NAMED SEED TYPES

The results of the survey dealing with plant and seed characteristics are given in Table 26, arranged by color pattern and color. Only those seed types which were described on at least 10 out of a total of 589 forms were included in this listing. The designation of plant type, (question 2) was made on the basis of the majority of responses. In cases where there was not a clear majority, a double designation was assigned. This usually occurred with n/sv, perhaps because there is not a clear distinction

Table 26. Tabulation of plant and seed characteristics from questionnaire.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3] (percent of samples)											Origin of samples				Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]	%	Agroclimatic zone	%	
rp	mc	rg	b	p	187	sv	60	71	—	—	52	—	—	—	—	—	—	Cy	17	2	12	Karolina
																		Gk	10	3	14	Magabari
																		Kb	16	7	29	Cyansoroso
																		Kg	12	11	21	Mulisi
																						Nyirarushenyi
																						Nyiramacumu
rp	mc	rg	m	p	71	n/sv	70	69	—	50	61	—	—	—	—	—	—	Cy	46	2	30	as above +
																		Kb	34	11	45	Malirahinda
																						Nangurubwe
																						Rwandarugani
ro	mc	rg	b	p	31	n	61	—	—	—	—	55	—	—	—	—	—	Gs	13	3	10	Nayironi
						v	75	—	—	50	50	—	50	50	75	75	75	Gt	10	7	10	Karolina
																		Kb	48	10	10	Murisi
																		Kg	20	11	42	Mwizarahenda
lp	mc	rg	b	g	103	sv	—	—	—	—	—	—	—	—	—	52	52	Gs	14	3	11	Kizungo
						v	71	—	—	—	—	—	—	—	65	59	71	Gt	10	4	17	Mutiki
																		Kb	18	7	25	Bihogo
																		Kg	11	11	23	Gisabo
																		Ru	15			Muneke
																						Ntamwiza
																						Cyunyu
																						Urusenda

continued

(1) Shape; color pattern; color; shininess; size: p=small < 40 g/100 seed, g=large ≥ 40 g/100 seed.

(2) Plant type: n=dwarf, sv= semiclimbing, v=climbing.

(3) Characteristics: 3=high yield, 4=tolerance to infertile soil, 5=tolerance to shade, 6=tolerance to drought, 7=tolerance to diseases in the field, 8=early, 9=late, 10=tolerance to insects in storage, 11=good tasting, 12=fast cooking time, 13=good selling price in the market.

(4) Prefectures: Bt=Butare, By=Byumba, Cy=Cyangugu, Gk=Gikongoro, Gs=Gisenyi, Gt=Gitarama, Kb=Kibungo, Ky=Kibuye, Kg=Kigali, Ru=Ruhengeri.

(5) Does not include all versions of the same name (e.g. Kinyamanza, Urunyamanza, Nyirakanyamanza, etc.). Certain names are more prevalent in certain regions.

Table 26. Continued.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3]											Origin of samples				Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]		Agroclimatic zone		
							percent of samples												%		%	
lo	mc	rg	b	g	74	sv	60	—	—	—	—	—	—	—	—	—	—	By	14	6	16	Mutiki
						v	60	—	60	—	—	—	—	—	70	30	70	Gk	18	7	22	Bihogo
																		Kb	31	11	24	Mugoga
																		Ru	16			
rp	mc	n	b	p	114	sv	60	58	—	—	—	—	50	—	—	—	—	Bt	11	2	19	Bukara, Gikara
																		By	10	3	10	Nyiramacumu
																		Cy	23	6	10	Uruberege
																		Gk	11	7	29	
																		Gt	11	8	12	
																		Kg	13	11	13	
rp	mc	n	m	p	73	sv	59	63	—	—	—	—	51	—	—	—	—	By	22	7	12	Bukara
																		Kb	47	11	48	Nyiramacumu
																		Kg	14			Imberege
ro	mc	n	b	p	95	sv	58	50	—	—	—	—	—	—	—	—	—	Bt	12	2	13	Mbagarumbise, Baya
																		By	16	7	54	Gikara, Ibikara
																		Gk	27			Gitsimbayogi
																		Kb	12			
																		Kg	14			
ro	mc	n	m	p	7	sv	71	—	—	—	—	—	—	—	—	—	—	By	43	11	71	Bukara
																		Gt	29			
																		Kg	29			
lo	mc	n	b	g	14	sv	52	—	57	—	50	—	—	—	—	—	—	Cy	64	2	64	Imikara
																		Gk	14	7	29	Gikara
lp	mc	n	b	g	76	sv	55	—	—	—	—	—	—	—	—	—	—	Cy	14	2	10	Gikara
																		Gk	17	3	10	Mukara
																		Ky	17	5	12	
																		Ru	17	7	22	
continued																				11	14	

Table 26. Continued.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3]											Origin of samples				Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]		Agroclimatic zone		
							percent of samples												%		%	
rp	mc	cr	b	p	36	sv	66	50	—	—	—	—	50	—	61	—	—	Gk	64	7	64	Baya
																				11	14	Banyeshuli
rp	mc	cr	m	p	15	sv	73	53	—	—	—	—	—	—	—	—	—	Kb	53	9	20	Baya
																		Kg	20	10	13	Mukecuru
																				11	40	
lp	mc	cr	b	g	65	sv	—	—	—	—	—	—	—	—	—	—	—	Gs	20	3	17	Urubarura
						v	79	—	52	—	—	—	—	—	52	58	58	Kb	62	7	12	Urushari
																				11	55	Ikunge
lp	mc	cr	m	g	12	sv/v	75	—	58	—	—	—	—	—	50	—	—	By	25	7	25	Gikote
																		Gs	17	11	33	Nyiramushari
																		Kb	25			
																		Ru	25			
rp	mc	jbr	b	p	10	n/sv	50	—	—	—	—	—	—	—	—	—	—	Cy	20	2	20	Nyiragahambo
																		Gt	20	6	20	Batafu
																		Kb	20	8	20	
																		Ru	20			
rp	mc	jbr	m	p	18	sv	—	—	—	—	—	50	—	—	—	—	—	Cy	17	2	17	Muhondo
																		Kb	78	11	78	Nyiramushikiri
ro	mc	jbr	b	p	69	n/sv	—	—	—	—	—	54	—	—	—	—	—	Cy	12	2	12	Muhondo, Taburini
																		Kb	28	7	19	Rwamamara
																		Kg	32	10	10	Nyiramabuye
																				11	39	
lp	mc	jbr	b	g	10	n + v	80	—	—	—	—	—	—	—	—	60	—	Gs	30	3	30	Muhondo
																		Ru	50	4	40	Mushingandengo

continued

Table 26. Continued.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3]											Origin of samples				Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]		Agroclimatic zone		
							- - - - - - - - - - percent of samples - - - - - - - - - -												%		%	
lo	mc	jbr	b	g	42	sv	—	—	—	—	—	—	—	—	—	—	—	Bt	14	2	40	Muhondo
																		Cy	50	7	26	Batafu
																		Gk	10			Mamesa
																		Gt	12			
																		Kg	12			
ro	mc	br	b	p	137	sv	59	66	—	—	50	—	—	—	—	—	—	By	13	2	15	Mukecuru, Ubusosera
																		Cy	15	4	10	Kalyokabakwe
																		Kg	18	6	12	Nyiragahombo
																		Ru	15	7	29	Nyiraghuru
																				11	20	
rp	mc	br	b	p	17	n/sv	65	76	—	—	59	—	—	—	—	—	—	Bt	12	2	35	Dalidaji
																		Cy	35	3	18	Munagajosi
																		Gt	12	7	29	
																		Ky	12			
																		Kg	12			
																		Ru	12			
lp	mc	br	b	g	11	n/sv	—	—	—	—	—	—	—	—	—	50	—	Bt	27	3	27	Nyiraghuru
						v	—	—	60	—	—	—	—	—	—	—	—	Gs	36	7	36	Munagajosi
lp	mc	pr	b	g	147	sv	—	—	—	—	—	—	—	—	53	55	55	Kb	31	4	10	Mwirasi, Mutiki
						v	78	—	—	—	—	—	—	—	61	78	58	Kg	24	7	14	Mugogo, Bihogo
																		Ru	15	11	42	Kizungo, Umugeri Ntamwiza
rp	mc	bl	b	p	12	v	75	—	—	—	—	—	—	—	—	—	—	Cy	67	3	58	Amera, Amabenga
ro	mc	bl	b	p	42	sv	—	—	—	—	—	—	—	—	—	—	—	Cy	19	2	19	Amabenga
						v	—	—	—	—	—	—	—	—	—	—	—	Kb	36	3	12	Materebuka
																		Kg	10	7	19	Nyirabweru
																		Ru	12	10	10	Urunjanjye
continued																				11	29	

Table 26. Continued.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3]											Origin of samples				Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]		Agroclimatic zone		
							percent of samples												%		%	
ro	mc	rs	b	g	12	n/sv	—	—	—	—	—	—	—	—	—	—	—	Cy	17	2	17	Kinyobwa
																		Kb	42	4	25	
																		Kg	17	11	58	
																		Ru	25			
lp	mc	rs	b	g	39	sv	—	—	—	—	—	—	—	—	—	—	51	Kb	84	11	87	Kanyobwa, Mbarare
ro	mc	gr	b	p	27	sv	55	—	—	—	—	81	—	—	52	63	63	Bt	15	8	81	Nyiraglhuru
																		Gt	78	9	15	
rp	mc	rsbr	m	p	70	n/sv	60	56	—	—	51	—	—	—	—	—	—	Cy	39	2	31	Rwandaurundi,
																		Kb	20	3	20	Mbagara, Nangurubwa
																		Ky	14	11	26	Rwandarugali
																		Kg	13			Kamembe
rp	mc	crbr	b	p	39	sv	54	51	—	—	—	—	—	—	—	—	—	Kg	33	4	28	Nyirakamuga
																		Ru	46	6	10	Urujenone
																				7	10	
																				11	26	
rp	mc	rgn	b	p	10	sv	70	60	—	50	—	—	50	—	—	—	—	By	30	6	30	Karaburunge
																		Cy	30			Amagabari
																		Ky	20			Nyirarushenyi
rp	mc	rgn	m	p	12	n/sv	83	66	66	—	66	—	50	83	—	—	—	Cy	83	2	75	Nangurubwa
																		Gs	17	3	17	Nyiramaganura
ro	mc	rgn	b	p	12	sv	58	—	75	—	58	—	—	—	—	—	—	Gs	17	3	25	Nayironi
																		Kb	56	6	33	
																		Ky	17			

continued

Table 26. Continued.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3]											Origin of samples				Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]		Agroclimatic zone		
							percent of samples												%		%	
lp	mc	rgn	b	g	36	n/sv	67	—	—	—	—	53	—	—	61	64	67	By	36	4	11	Ntamwiza
																		Kb	19	6	33	Rushare
																		Kg	19	7	19	Mutiki
																		Ru	14	12	16	Igihogo
rp	mc	rscr	b	p	27	n	59	—	—	—	—	—	—	—	—	—	—	By	11	2	26	Nyiragahombo
																		Cy	26	4	11	Mbagara
																		Kg	30	6	11	
																		Ru	15	7	20	
																				11	11	
rp	mc	crrs	b	p	12	n/sv	—	—	50	—	50	—	—	67	—	—	—	Cy	33	2	25	Mairahinda
																		Kb	50	11	50	Nyiragahombo
																						Mbagarumbise
lp	mc	bleun	b	g	21	v	66	—	—	—	50	—	—	50	56	67	56	Gs	38	3	38	Gikara
																		Ru	48	4	43	Kiiyugaramye
lp	zb	cr/n	b	g	205	sv	—	—	—	—	—	—	—	—	50	52	53	By	20	3	10	Kanyamanza
						v	66	—	—	—	—	—	—	—	55	61	55	Gs	11	4	10	
																		Kb	14	6	16	
																		Kg	17	7	18	
																		Ru	16	11	25	
ro	zb	cr/n	b	p	38	sv	—	—	—	—	—	—	—	—	—	—	—	Bt	47	2	13	Kanyamanza
																		Cy	13	7	63	
																		Gk	21			
ro	zb	bl/n	b	g	27	sv	—	—	—	—	—	—	—	—	—	—	—	Gk	81	7	85	Kanyamanza

continued

Table 26. Continued.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3]											Origin of samples				Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]		Agroclimatic zone		
							percent of samples												%		%	
lp	zb	bl/n	b	g	10	sv	60	—	—	—	—	—	—	—	50	50	—	Gt	50	8	50	Gikote
																		Kb	40	11	30	Kinyamanza
lo	zb	jbr/n	b	g	34	sv	62	—	—	—	—	—	—	—	—	—	59	Bt	21	7	21	
																		Gt	15	8	21	
																		Kg	41	9	29	
lo	zb	rg/n	b	g	20	sv	50	—	—	—	—	—	—	—	—	—	—	Gk	90	7	90	Urusebeya
lo	tl	rg/cr	b	g	233	n	61	—	50	—	—	—	—	—	55	62	59	By	12	2	10	Mutiki, Zayire
																		Cy	12	4	10	Ngeriyamuvoma
																		Kb	24	6	11	Mukwararaye
																		Ru	15	7	25	Gacurekanu
																				11	29	Kiiyugaramye
																						Igihogere
ro	tl	rg/cr	b	g	27	n	63	—	—	—	—	59	—	—	66	63	—	By	15	9	11	Ndungirabakwe
																		Kb	48	11	74	
																		Kg	19			
lo	tl	cr/rg	b	g	47	n	57	—	—	—	—	—	—	—	—	60	57	Cy	40	2	32	Nusu
																		Ky	15	7	19	Ikiganza
ro	tl	cr/rg	b	g	34	n	—	—	—	—	—	68	—	—	53	59	—	Cy	26	2	26	Kajemunkangara
																		Gk	18	7	21	Nyiragitwe
																		Kb	50	11	50	Nusu
lo	tl	jbr/rg	b	g	44	n	—	—	54	—	—	—	—	—	54	68	51	By	14	6	11	Zayire
						v	100	67	67	—	67	—	—	—	—	—	—	Cy	11	7	41	Mutiki
																		Kb	16	11	23	
																		Kg	30			

continued

Table 26. Continued.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3]											Origin of samples				Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]		Agroclimatic zone		
							percent of samples												%		%	
lp	tl	cr/pr	b	g	47	n	66	—	—	—	—	57	—	—	53	60	58	Cy	23	2	23	
																		Kb	40	4	11	
																		Kg	27	7	11	
																		Ru	13	9	13	
																				10	11	
																				11	21	
lp	tl	pr/cr	b	g	13	n	70	—	60	—	—	50	—	—	50	60	—	Gs	23	4	15	
						v	—	—	67	—	—	—	—	—	—	67	—	Kb	46	11	54	
lp	tl	n/cr	b	g	10	sv	70	—	—	—	—	—	—	—	50	80	50	Gt	20	11	50	Mukwararaye
																		Kg	60			
ro	tl	rs/rg	b	g	10	n	86	—	57	—	—	—	—	—	—	—	—	By	30	4	30	
						v	67	—	67	—	67	—	67	100	67	67	67	Ru	50	6	30	
																				7	20	
lo	tl	cr/n	b	g	43	n	74	—	—	—	—	74	—	—	58	55	65	Cy	16	3	14	Urushari
						v	100	—	75	—	58	—	50	—	75	92	75	Gs	12	5	28	Nyirakagari
																		Ru	53	6	16	Uruzayinyanza
																				7	14	
rp	tt	cr/n	b	p	158	sv	68	—	—	—	—	—	—	—	—	—	—	Bt	13	7	30	Gitsimbayogi, Baya
																		By	17	9	10	Yozefina, Baraseka
																		Gk	15	11	20	Maragisuku
																		Gt	11			Kabonobono
																		Kb	11			
																		Kg	19			
ro	tt	cr/n	b	p	21	n/sv	52	—	—	—	—	—	—	—	—	—	—	Cy	29	2	29	Baya
																		Ky	19	4	14	Kabonobono
																		Ru	14	5	19	
continued																				8	14	

Table 26. Continued.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3]											Origin of samples				Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]		Agroclimatic zone		
							percent of samples												%		%	
rp	tt	cr/brv	b	p	30	sv	63	—	—	—	—	—	—	—	—	—	—	By	57	6	30	Kabonobono
																		Kb	27	11	37	Gishoga
																				12	13	
ro	tt	cr/brv	b	p	35	n/sv	51	—	—	—	—	—	—	—	—	—	—	Bt	14	7	23	Gitsimbayongi
																		Gt	31	8	31	Nsigarashonje
																		Kb	20	11	29	Yozefina
																		Kg	17			
ro	tp	cr/n	b	g	33	sv	—	—	—	—	—	—	—	—	55	—	—	Cy	27	2	24	Rwirungu
																		Gk	12	3	24	Ikivuzo
																		Ky	30	5	12	Umwimamure
																		Kg	12	7	27	Nyiramuyenzi
lp	tp	cr/n	b	g	150	sv	—	—	—	—	—	—	—	—	—	—	—	Cy	24	2	18	Kicaro, Ibivuzo
						v	89	—	—	—	—	—	58	—	68	74	66	Gs	14	3	15	Rwirungu, Ibiyungu
																		Ru	22	4	13	Uruhwijima
																				7	20	Uruyumba
ro	tp	cr/pr	b	g	16	n/sv	—	—	—	—	—	—	—	—	—	—	—	By	19	2	19	Nyiraruvuzo
																		Cy	19	11	50	
																		Kb	50	—	—	
lp	tp	cr/pr	b	g	24	n/sv	50	—	—	—	—	—	—	—	—	—	—	Cy	29	2	25	Rwirungu
																		Kb	46	9	13	Ibyirungu
																		Kg	21	10	17	Kivuzo
																				11	33	
lo	hln	jv	b	g	70	n	53	—	—	—	—	60	—	—	—	54	51	Gt	24	7	11	Bunwabutayibika
																		Kg	44	8	21	Rugandura
																		Ru	13	9	19	Bunwa, Muhondo
																				10	11	Gicamunkoni
																				11	20	

continued

Table 26. Continued.

Seed type[1]					No. of samples	Plant type[2]	Characteristics[3]											Origin of samples			Widely used common names[5]
							3	4	5	6	7	8	9	10	11	12	13	Prefecture[4]		Agroclimatic zone	
							percent of samples												%		%	
lo	hln	j	b	g	82	n	—	—	—	—	—	52	—	—	—	—	—	Bt	11	7	18	Muhondo
																		Kb	43	11	41	Kwezikumwe
																		Kg	15			
ro	hln	j	b	g	122	n/sv	—	—	—	—	—	54	—	—	—	—	—	Bt	10	2	19	Nyiramabuye
																		Cy	22	7	16	Muhondo
																		Gt	13	8	14	Ananihira
																		Kb	16	11	18	
																		Kg	16			
lo	hln	jbr	b	g	36	n	—	—	—	—	—	83	—	—	58	50	—	By	11	4	55	Umushimandengo
																		Ru	69	6	11	Rwamamara
ro	hln	jbr	b	p	24	n	—	63	—	—	—	—	—	—	71	—	—	By	29	2	17	Rwamamara
																		Cy	17	6	25	Imihondo
																		Kb	25	7	21	
																		Kg	17	11	25	
lp	hln	br	b	g	25	n/sv	—	—	—	—	—	—	—	—	—	—	—	Cy	20	2	20	Nyiragihuru
						v	—	—	80	—	—	—	—	—	60	60	60	Gs	24	4	12	
																		Gt	28	7	16	
rp	hljbr	cr	b	p	37	sv	68	65	—	—	—	—	—	—	—	—	—	Bt	14	4	57	Abanyeshuli
																		Ru	70	5	16	Nyirakamuga
																				6	19	

between dwarf and semi-climbing to the farmers. Therefore, in the following discussion, emphasis will be placed on the comparison of responses for climbing vs. non-climbing types. The answers to questions 3 through 13 (Table 9a) were tabulated and a percentage of total responses calculated. A questionnaire is a very imprecise method of determining plant characteristics. Therefore, a character would be considered important for a seed type only if 50 percent or greater of the respondents mentioned it.

The characteristic of high yield was mentioned for 69 percent of the seed types. It may be uneconomic for the farmer to maintain poor yielding varieties in a mixture, even if they have other important qualities. However, farmers may know the names of or have more of those types which yield well and these could have been preferentially chosen for the survey team. When these results were analyzed by seed size, 81 percent of the small seeded types were high yielding compared to 57 percent of large seeded types. This is expected if one describes yield as number of seed per pod, as small seeded types tend to produce greater numbers of seed than larger types.

Tolerance to infertile soil seems to be characteristic of small seeded types, since 94 percent of tolerant seed types were small seeded. Very few climbing beans were noted for having tolerance to soil infertility, although this may be explained by the association between large seed size and climbing habit.

Tolerance to shade seems to be characteristic of large rather than small seeded types but not of climbing as compared to non-climbing types. In most plant associations with beans, the climbing habit is an advantage in allowing the bean plants to reach the light. Perhaps in an association with bananas, a climbing bean fares no better than a non-climber in reaching the light and any plant must actually tolerate the shading rather than avoid it.

Tolerance to drought was considered a characteristic of only 3 of the 83 types listed, all small seeded, red beans. This may reflect the linguistic difficulties already discussed rather than the number of tolerant varieties.

Resistance to diseases in the field tends to be associated with small seeded varieties; 64 percent for small seeded types, 38 percent for large seeded types.

No climbing beans were described as early although a majority of early types were large seeded. Climbing beans have a longer flowering period because of their indeterminate growth, making them longer season. The association of earliness with large seed size and lateness with small seed size may be due to the rapidity of germination of larger seeds, although this may also be affected by seed coat color.

Resistance to insects in storage was noted for 6 percent of the seed types. Sixty percent of these responses were for climbing beans, which predominate in the northern areas where the cooler temperatures limit the damage done by bruchids, perhaps suggesting resistance. It may be that insect damage is considered for the mixture as a whole and types which are

less damaged are not particularly noticed, or that losses on farm are of a low enough level to prevent detection of differences in damage between types in a mixture.

Good taste, fast cooking time and a good market price seem to be related characteristics and are all highly associated with large seed size. One notable exception to the association of large seed size with good taste and high price is the large seeded black varieties, presumably because of the leaching of the black color during cooking. The respondents frequently noted that it was difficult to distinguish the taste of a single seed type as the beans were consumed as a mixture. Consequently, all named types in the mixture were often said to have good taste.

Some of the widely used common names for each type are given in Table 26. One name may be used for several seed types. For example, Kanyamanza is used for many of the zebra striped (cr/n or bl/n) types. Names which describe the seed color or color pattern, for example, Gikara--black or Muhondo--yellow, are used for varieties of the appropriate color regardless of seed shape or size. Alternatively, one seed type may have several different names which vary by region.

MIXTURE COMPONENTS

The distribution of numbers of component varieties in the collected mixture is shown in Figure 1. The range of components is 1 to 27 with a mean of 11. The percent of samples having only one variety is not a true estimate of 'pure' varieties because samples of 'pure' varieties were not collected. In all cases, the number of varieties is slightly underestimated as those varieties occurring at a low percent by weight were grouped into the 'Miscellaneous' category.

One hundred seventy-one seed types occurred with a frequency of 1 percent or greater of the total samples (Table 27). Of these seed types 26 percent were rounded and flat, 30 percent were rounded and oval, 29 percent were long and flat and 15 percent were long and oval. Small seeded types (57%) were slightly more common that large seeded types (43%). Forty-nine percent of the seed types had a monochrome color pattern. Of these, 55 percent were red- or pink-toned, 29 percent were yellowish-brown, 24 percent were cream-colored, 18 percent were brownish and 18 percent were purple-toned.

Those seed types which occurred in at least 25 percent of the samples for each prefecture and agroclimatic zone are listed in Tables 28 and 29. The two seed types with the highest frequency and the two seed types with the highest index value in each region are listed in Tables 30 and 31.

It is interesting to note that the use of frequency and index as criteria for selecting the most important seed types does not always give the same results. One example of this situation is lo tl rg/cr b g which is not important in any prefecture or agroclimatic zone by frequency but occurs in 9 out of a possible 44 cases when the index value is the criterion. A possible explanation is that when this seed type does occur in a sample, it makes up a large percentage of the weight. One of the varieties released by ISAR, Mutiki 2, is of the same seed type. It is possible that the discrepancy between frequency and index lists is the result of successful

Figure 1. Distribution of the number of component varieties in sampled mixtures.

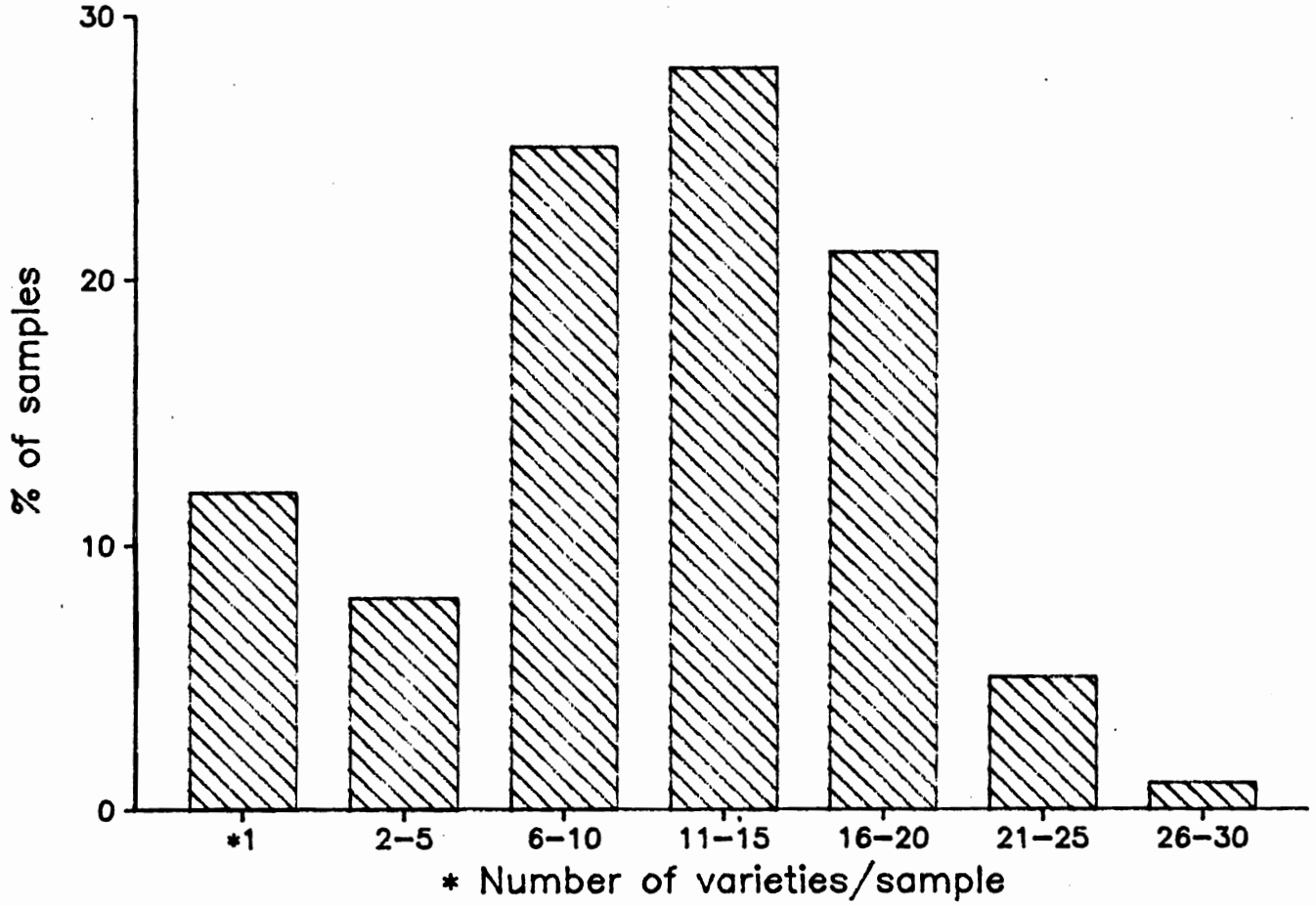


Table 27. Seed types occurring in at least 1% of samples for whole country (560 samples).

Shape	Color pattern	Color	Shininess	Size	Frequency	Mean percent by weight	Index
rp	mc	rg	b	p	39	7	3
ro	mc	rg	b	p	11	8	-
lp	mc	rg	b	g	35	11	4
lo	mc	rg	b	g	23	9	2
rp	mc	rg	m	p	22	13	3
rp	mc	n	b	p	22	6	1
ro	mc	n	b	p	25	6	2
lp	mc	n	b	g	22	8	2
lo	mc	n	b	g	7	8	-
rp	mc	n	m	p	27	5	1
rp	mc	br	b	p	6	6	-
ro	mc	br	b	p	35	9	3
lp	mc	br	b	g	3	-	-
lo	mc	br	b	g	2	-	-
rp	mc	br	m	p	2	-	-
rp	mc	cr	b	p	15	7	1
ro	mc	cr	b	p	1	-	-
lp	mc	cr	b	g	13	9	1
lo	mc	cr	b	g	2	-	-
rp	mc	cr	m	p	7	4	-
lp	mc	cr	m	g	5	10	-
ro	mc	v	b	g	1	-	-
rp	mc	rs	b	p	1	-	-
ro	mc	rs	b	p	4	-	-
lp	mc	rs	b	g	7	10	-
rp	mc	rs	m	p	2	-	-
lp	mc	rs	b	g	3	-	-
ro	mc	gr	b	p	5	18	-
rp	mc	bl	b	p	3	-	-
ro	mc	bl	b	p	6	6	-
lp	mc	bl	b	g	1	-	-
rp	mc	bl	m	p	1	-	-
rp	mc	pr	b	p	6	3	-
ro	mc	pr	b	p	2	-	-
lp	mc	pr	b	p	37	10	4
lo	mc	pr	b	p	6	5	-
rp	mc	jbr	b	p	14	3	-
ro	mc	jbr	b	p	25	4	1
lp	mc	jbr	b	g	5	10	-
lo	mc	jbr	b	g	16	7	1
rp	mc	jbr	m	p	5	3	-
ro	mc	jbr	m	p	2	-	-
lp	mc	jbr	m	g	1	-	-
lo	mc	jbr	m	g	1	-	-
lp	mc	bleun	b	g	6	8	-
lo	mc	bleun	b	g	1	-	-
rp	mc	rsbr	m	p	20	7	1

continued

Table 27. Continued.

Shape	Color pattern	Color	Shininess	Size	Frequency	Mean percent by weight	Index
rp	mc	rgbr	b	p	1	-	-
ro	mc	rgbr	b	p	1	-	-
lp	mc	rgbr	b	g	2	-	-
rp	mc	rgbr	m	p	1	-	-
rp	mc	rgn	b	p	9	4	-
ro	mc	rgn	b	p	10	5	-
lp	mc	rgn	b	g	18	11	2
lo	mc	rgn	b	g	2	-	-
rp	mc	rgn	m	p	10	12	1
rp	mc	crrs	b	p	14	5	-
ro	mc	crrs	b	p	3	-	-
rp	mc	crrs	m	p	5	7	-
rp	mc	rscr	b	p	10	6	-
ro	mc	rscr	b	p	2	-	-
rp	mc	rscr	m	p	5	4	-
rp	mc	crbr	b	p	22	5	1
ro	mc	crbr	b	p	3	-	-
lo	mc	crbr	b	g	2	-	-
rp	mc	brv	b	p	1	-	-
ro	mc	brv	b	p	2	-	-
ro	mc	crj	b	p	2	-	-
lp	mc	crj	b	g	2	-	-
rp	mc	crj	m	p	1	-	-
rp	mc	jbrbr	b	p	4	-	-
ro	mc	jbrbr	b	p	3	-	-
lp	mc	jbrbr	b	g	1	-	-
rp	mc	jbrbr	m	p	1	-	-
ro	mc	brn	b	p	2	-	-
lp	mc	brn	b	g	1	-	-
rp	mc	prn	b	p	2	-	-
ro	mc	prn	b	p	2	-	-
lp	mc	prn	b	p	4	-	-
lp	mc	bleugr	b	g	2	-	-
ro	mc	prcr	b	p	1	-	-
ro	mc	jbrrs	b	p	3	-	-
rp	mc	rsrg	m	p	1	-	-
rp	zb	cr/n	b	p	1	-	-
ro	zb	cr/n	b	p	14	4	-
lp	zb	cr/n	b	g	38	7	3
lo	zb	cr/n	b	g	1	-	-
rp	zb	cr/n	m	p	3	-	-
lp	zb	cr/n	m	g	4	-	-
ro	zb	bl/n	b	p	3	-	-
lo	zb	bl/n	b	g	1	-	-
lp	zb	cr/brv	b	g	3	-	-
lp	zb	jbr/n	b	g	3	-	-
lo	zb	jbr/n	b	g	11	10	1
ro	zb	rs/n	b	p	2	-	-

continued

Table 27. Continued.

Shape	Color pattern	Color	Shininess	Size	Frequency	Mean percent by weight	Index
lp	zb	rgbr/n	b	g	1	-	-
lp	zb	cr/pr	b	g	1	-	-
lp	zb	rg/n	b	g	2	-	-
lp	tl	n/rs	b	g	1	-	-
lp	tl	jbr/rg	b	g	1	-	-
lp	tl	n/rgbr	b	g	1	-	-
lp	tl	jbr/pr	b	g	1	-	-
ro	tl	rs/n	b	p	1	-	-
lp	tl	n/cr	b	g	3	-	-
lp	tl	cr/br	b	g	1	-	-
ro	tl	jbr/rg	b	p	3	-	-
lp	tl	jbr/rg	b	g	2	-	-
lo	tl	jbr/rg	b	g	5	19	1
rp	tl	cr/n	m	p	1	-	-
lp	tl	cr/n	m	g	3	-	-
lp	tl	cr/n	b	g	8	10	1
lp	tl	rs/rg	b	g	1	-	-
ro	tl	rs/rg	b	p	4	-	-
lp	tl	prn/cr	b	g	1	-	-
lo	tl	rgn/n	b	g	1	-	-
lp	tl	cr/rgn	b	g	2	-	-
lp	tl	pr/cr	b	g	3	-	-
lo	tl	pr/cr	b	g	2	-	-
ro	tl	pr/cr	b	p	1	-	-
lo	tl	cr/pr	b	g	3	-	-
lp	tl	cr/pr	b	g	14	10	1
ro	tl	cr/pr	b	p	4	-	-
ro	tl	cr/rg	b	p	12	8	1
lp	tl	cr/rg	b	g	8	7	1
lo	tl	cr/rg	b	g	5	11	1
ro	tl	rg/cr	b	p	7	7	-
lp	tl	rg/cr	b	g	2	-	-
lo	tl	rg/cr	b	g	35	16	6
rp	tt	cr/br	b	p	3	-	-
rp	tt	crrs/rs-rg	b	p	1	-	-
rp	tt	crbr/n	b	p	1	-	-
rp	tt	crbr/n	m	p	1	-	-
rp	tt	cr/brv	b	p	4	-	-
ro	tt	cr/brv	b	p	4	-	-
ro	tt	cr/brv	m	p	1	-	-
ro	tt	cr/brv	m	p	7	5	-
rp	tt	cr/n	b	p	29	7	2
ro	tt	cr/n	b	p	7	7	-
lp	tt	cr/n	b	g	1	-	-
rp	tt	cr/n	m	p	3	-	-
ro	tt	cr/n	m	p	1	-	-
ro	tp	rs/pr	b	p	1	-	-
lp	tp	jbr/n	b	g	1	-	-

continued

Table 27. Continued.

Shape	Color pattern	Color	Shininess	Size	Frequency	Mean percent by weight	Index
rp	tp	cr/n	b	p	4	-	-
ro	tp	cr/n	b	p	11	6	1
lp	tp	cr/n	b	g	23	8	2
lo	tp	cr/n	b	g	3	-	-
ro	tp	cr/pr	b	p	4	-	-
lp	tp	cr/pr	b	g	5	10	-
ro	hln	j	b	p	28	6	2
lp	hln	j	b	g	2	-	-
lo	hln	j	b	g	20	5	1
lo	hln	jv	b	g	15	11	2
ro	hln	jpr	b	p	1	-	-
lo	hln	jpr	b	g	2	-	-
ro	hln	jbr	b	p	12	9	1
lp	hln	jbr	b	g	2	-	-
lo	hln	jbr	b	g	6	8	-
ro	hln	br	b	p	3	-	-
lp	hln	br	b	g	4	-	-
lo	hln	br	b	g	8	5	-
ro	hln	brv	b	p	1	-	-
rp	hljbr	cr	b	p	4	-	-
rp	hljbr	cr	m	p	2	-	-
lp	hljbr	cr	b	g	3	-	-
ro	vbr	bl	m	p	1	-	-
ro	vbr	gr	m	p	1	-	-
ro	vn	grbl	m	p	1	-	-
ro	vbr	grbl	m	p	1	-	-
rp	vbr	blgr	b	p	1	-	-
ro	vn	gr	m	p	1	-	-

Table 28. Seed types occurring in at least 25% of samples by prefecture.

Prefecture	No. of samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
BUTARE	28	rp	mc	rg	b	p	61	7	4
		lp	mc	rg	b	g	39	7	3
		lo	mc	rg	b	g	29	5	1
		rp	mc	n	b	p	43	10	4
		ro	mc	n	b	p	61	6	4
		rp	mc	br	b	p	25	4	1
		ro	mc	br	b	p	50	8	4
		ro	mc	jbr	b	p	46	4	2
		lo	mc	jbr	b	g	57	11	6
		rp	mc	rsbr	m	p	36	12	4
		ro	zb	cr/n	b	p	57	5	3
		lo	zb	jbr/n	b	g	39	11	4
		lo	tl	rg/cr	b	g	32	10	3
		rp	tt	cr/n	b	p	68	8	5
		lp	tp	cr/n	b	g	29	4	1
		ro	hln	j	b	g	64	5	3
		lo	hln	j	b	g	39	8	3
		lo	hln	jv	b	g	25	7	2
		rp	hljbr	cr	m	p	25	4	1
BYUMBA	60	rp	mc	rg	b	p	52	5	3
		lp	mc	rg	b	g	63	15	9
		rp	mc	n	b	p	32	4	1
		rp	mc	n	m	p	52	5	3
		lp	mc	n	b	g	43	4	2
		ro	mc	br	b	p	38	7	3
		lp	mc	pr	b	g	40	5	2
		ro	mc	rgn	b	g	32	4	1
		lp	mc	rgn	b	g	68	13	9
		lp	zb	cr/n	b	g	70	8	6
		lo	tl	rg/cr	b	g	53	20	11
		rp	tt	cr/n	b	p	45	11	5
		rp	tt	cr/br	b	p	30	5	2
CYANGUGU	69	rp	mc	rg	b	p	41	5	2
		rp	mc	n	b	p	30	10	3
		rp	mc	n	m	p	32	8	3
		ro	mc	n	b	p	26	10	3
		lp	mc	n	b	g	30	11	3
		ro	mc	br	b	p	74	12	9
		rp	mc	rsbr	b	p	59	9	5
		rp	mc	rgn	b	p	28	4	1
		rp	mc	rgn	m	p	49	17	8
		rp	mc	crrs	b	p	26	5	1
		lo	tl	rg/cr	b	g	28	18	5
		ro	tl	cr/rg	b	g	30	9	3
		lp	tp	cr/pr	b	g	30	4	1
		ro	tp	cr/n	b	g	39	4	2
		lo	tp	cr/n	b	g	55	8	4
		ro	hln	j	b	g	33	5	2
GIKONGORO	35	rp	mc	rg	b	p	66	13	9
		lp	mc	rg	b	g	37	9	3
		lo	mc	rg	b	g	31	6	2
		ro	mc	n	b	p	89	11	10
		lp	mc	n	b	g	31	10	3
		lo	mc	n	b	g	51	10	5
		rp	mc	br	b	p	31	7	2
		ro	mc	br	b	p	51	5	3
		rp	mc	cr	b	p	49	6	3

continued

Table 28. Continued.

Prefecture	No. of samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
Gikongoro (continued)		ro	mc	jbr	b	p	54	3	2
		lo	mc	jbr	b	g	60	5	3
		rp	mc	crbr	b	p	34	5	2
		ro	zb	cr/n	b	p	63	6	4
		lp	zb	cr/n	b	g	57	6	3
		lo	zb	rg/n	b	g	34	4	1
		lo	tl	rg/cr	b	g	31	7	2
		lp	tl	cr/pr	b	g	34	4	1
		rp	tt	cr/n	b	p	57	6	3
		ro	hln	j	b	g	57	3	2
GISENYI	45	rp	mc	rg	b	p	38	14	5
		lp	mc	rg	b	g	44	20	9
		lp	mc	cr	b	g	33	18	6
		lp	mc	pr	b	g	62	10	6
		lp	mc	bleun	b	g	27	5	1
		lp	zb	cr/n	b	g	38	15	6
		lp	tp	cr/n	b	g	58	9	5
GITARAMA	34	rp	mc	rg	b	p	35	5	2
		ro	mc	rg	b	p	32	5	2
		lp	mc	rg	b	g	26	5	1
		lo	mc	rg	b	g	56	7	4
		ro	mc	n	b	p	50	3	2
		lo	mc	n	b	p	29	7	2
		ro	mc	br	b	p	26	6	2
		ro	mc	gr	b	p	59	22	13
		lp	mc	pr	b	g	41	5	2
		lo	mc	jbr	b	g	29	5	1
		lp	zb	cr/n	b	g	32	4	1
		lo	zb	jbr/n	b	g	50	7	4
		lo	tl	rg/cr	b	g	29	17	5
		rp	tt	cr/n	b	p	47	7	3
		ro	tt	cr/brv	b	p	32	5	2
		lp	tp	cr/pr	b	g	32	7	2
		ro	hln	j	b	g	76	8	6
		lo	hln	j	b	g	44	3	1
		lo	hln	jv	b	g	65	7	5
		lp	hln	br	b	g	44	6	3
KIBUNGO	115	rp	mc	rg	b	p	35	6	2
		lo	mc	rg	b	g	45	11	5
		rp	mc	rg	m	p	60	15	9
		rp	mc	n	m	p	44	4	2
		ro	mc	br	b	p	28	7	2
		lp	mc	cr	b	g	26	8	2
		lp	mc	rs	b	g	25	9	2
		lp	mc	pr	b	g	55	7	4
		rp	mc	jbr	m	p	37	3	1
		rp	mc	rsbr	m	p	25	5	1
		rp	mc	crrs	b	p	29	8	2
		lo	tl	rg/cr	b	g	51	25	13
		lo	hln	j	b	g	26	6	2
KIBUYE	26	rp	mc	rg	b	p	73	6	4
		lp	mc	pr	b	g	58	13	8
		rp	mc	n	b	p	46	11	5
		rp	mc	n	m	p	27	10	3
		ro	mc	n	b	p	42	7	3
		lp	mc	n	b	g	42	17	7

continued

Table 28. Continued.

Prefecture	No. of samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
Kibuye (continued)		ro	mc	br	b	p	46	12	5
		rp	mc	rsbr	m	p	42	6	3
		lp	zb	cr/n	b	p	38	4	2
		lo	tl	rg/cr	b	g	46	20	9
		rp	tt	cr/n	b	p	31	11	3
		ro	tt	cr/n	b	p	31	8	2
		ro	tp	cr/n	b	p	38	10	4
		ro	hln	j	b	g	54	4	2
KIGALI	76	lp	mc	rg	b	g	37	10	4
		rp	mc	n	m	p	33	7	2
		ro	mc	n	b	p	26	4	1
		ro	mc	br	b	p	38	9	3
		lp	mc	pr	b	g	42	12	5
		ro	mc	jbr	b	p	45	5	2
		lp	mc	rgn	b	g	25	7	2
		rp	mc	crbr	b	p	46	5	2
		rp	mc	rscr	b	p	24	9	2
		lp	zb	cr/n	b	g	47	4	2
		lo	zb	jbr/n	b	g	30	13	4
		lo	tl	rg/cr	b	g	30	12	4
		lp	tl	cr/pr	b	g	34	11	4
		rp	tt	cr/n	b	p	43	7	3
		ro	hln	j	b	p	58	6	3
		lo	hln	j	b	p	34	6	2
		lo	hln	jv	b	g	39	14	5
RUHENGERI	69	lp	mc	rg	b	g	62	8	5
		lp	mc	n	b	g	43	6	3
		rp	mc	cr	b	p	41	13	5
		lp	mc	pr	b	g	58	13	8
		rp	mc	crbr	b	p	39	8	3
		lp	zb	cr/n	b	g	49	8	4
		lo	tl	rg/cr	b	g	46	22	10
		lp	tl	cr/n	b	g	32	12	4
		lp	tp	cr/n	b	g	49	10	5
		lp	hln	jbr	b	g	29	13	4
		lo	hln	br	b	g	26	8	2

Table 29. Seed types occurring in at least 25% of samples by agroclimatic zone.

Agroclimatic zone	No. of samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
ZONE 1	6	ro	mc	br	b	p	50	2	1
		rp	mc	rgn	m	p	67	48	32
		lp	tl	cr/rg	b	g	50	32	16
		lp	tl	cr/rgn	b	p	33	60	20
ZONE 2	3	rp	mc	rg	b	p	40	3	1
		rp	mc	n	b	p	34	10	3
		rp	mc	n	m	p	38	6	2
		ro	mc	n	b	p	28	10	3
		lp	mc	n	b	g	30	15	5
		ro	mc	br	b	p	79	13	10
		rp	mc	rsbr	m	p	64	7	4
		rp	mc	rgn	b	p	36	6	2
		rp	mc	rgn	m	p	55	13	7
		rp	mc	crrs	b	p	30	5	2
		lo	tl	rg/cr	b	g	30	16	5
		lp	tl	cr/rg	b	g	34	8	3
		lp	tp	cr/pr	b	g	36	4	1
		ro	tp	cr/n	b	g	45	8	4
		lo	tp	cr/n	b	g	55	7	4
		ro	hln	j	b	g	36	5	2
ZONE 3	12	rp	mc	rg	b	p	40	12	5
		ro	mc	rg	b	p	26	5	1
		lp	mc	rg	b	g	26	11	3
		lo	mc	rg	b	g	31	11	3
		rp	mc	n	b	p	29	11	3
		lp	mc	n	b	p	33	4	1
		ro	mc	br	b	p	45	11	5
		lp	mc	pr	b	g	38	12	5
		rp	mc	rsbr	m	p	38	10	4
		lp	zb	cr/n	b	g	45	13	6
		ro	tp	cr/n	b	p	26	10	3
		lp	tp	cr/n	b	g	62	7	4
ZONE 4	13	lp	mc	rg	b	g	72	14	10
		rp	mc	rg	b	p	28	11	3
		lp	mc	n	b	g	35	5	2
		rp	mc	cr	b	p	40	10	4
		lp	mc	pr	b	g	60	14	8
		rp	mc	crbr	b	p	42	9	4
		lp	zb	cr/n	b	p	42	6	3
		lo	tl	rg/cr	b	g	53	18	10
		lp	tl	cr/n	b	g	35	10	4
		lp	tp	cr/n	b	g	56	9	5
		lp	hln	jbr	b	g	33	14	5
		lo	hln	br	b	g	26	7	2

continued

Table 29. Continued.

Agroclimatic zone	No. of samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
ZONE 5	26	rp	mc	rg	b	p	54	8	4
		lp	mc	rg	b	g	48	13	6
		ro	mc	n	b	p	27	8	2
		lp	mc	n	b	g	31	24	7
		ro	mc	br	b	p	35	8	3
		lp	mc	pr	b	g	54	15	8
		lp	zb	cr/n	b	g	38	10	4
		ro	tt	cr/n	b	p	27	10	3
		lp	tt	cr/n	b	g	27	18	5
		ro	hln	J	b	g	27	5	1
ZONE 6	50	lp	mc	rg	b	g	70	10	7
		rp	mc	n	b	p	30	4	1
		rp	mc	n	m	p	38	6	2
		lp	mc	n	b	g	38	3	1
		ro	mc	br	b	p	38	6	2
		lp	mc	pr	b	g	44	9	4
		ro	mc	rgn	b	p	26	4	1
		lp	mc	rgn	b	g	60	17	10
		rp	mc	crb	b	p	34	3	1
		lp	zb	cr/n	b	g	70	11	8
		lo	tl	rg/cr	b	g	50	24	12
		rp	tt	cr/n	b	p	34	9	3
ZONE 7	114	rp	mc	rg	b	p	51	8	4
		lp	mc	rg	b	g	36	7	3
		rp	mc	n	m	p	25	7	2
		ro	mc	n	b	p	41	9	4
		lp	mc	n	b	g	25	12	3
		ro	mc	br	b	p	46	8	4
		lp	mc	pr	b	g	30	6	2
		ro	mc	jbr	b	p	36	3	1
		lo	mc	jbr	b	g	35	7	2
		ro	zb	cr/n	b	p	39	5	2
		lp	zb	cr/n	b	g	43	5	2
		lo	tl	rg/cr	b	g	37	12	4
		rp	tt	cr/n	b	p	43	7	3
		lp	tp	cr/n	b	g	27	7	2
		ro	hln	J	b	g	44	4	2
ZONE 8	30	rp	mc	rg	b	p	27	5	1
		ro	mc	rg	b	p	30	6	2
		lo	mc	rg	b	g	73	6	4
		ro	mc	n	b	p	53	3	2
		ro	mc	gr	b	p	60	23	14
		lp	zb	cr/n	b	p	33	4	1
		lo	zb	jbr/n	b	g	57	6	3
		lo	tl	rg/cr	b	g	33	16	5
		rp	tt	cr/n	b	p	37	5	2
		ro	hln	J	b	g	77	8	6
		lo	hln	jv	b	g	60	6	4
		lp	hln	br	b	g	50	6	3

continued

Table 29. Continued.

Agroclimatic zone	No. of samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
ZONE 9	22	lp	mc	rg	b	g	32	11	4
		lo	mc	rg	b	g	45	7	3
		lp	mc	pr	b	g	36	8	3
		lo	mc	pr	b	g	27	5	1
		ro	mc	jbr	b	p	64	5	3
		lo	mc	jbr	b	g	41	5	2
		rp	mc	crbr	b	p	55	7	4
		lo	zb	jbr/n	b	g	73	15	11
		lp	tl	cr/pr	b	g	41	10	4
		rp	tt	cr/n	b	p	59	5	3
		ro	hln	j	b	p	77	8	6
		lo	hln	j	b	g	77	10	8
		lo	hln	jv	b	g	68	13	9
ZONE 10	23	lo	mc	rg	b	g	52	5	3
		lp	mc	pr	b	g	35	5	2
		ro	mc	jbr	b	p	57	7	4
		lo	mc	JBR	b	g	39	5	2
		rp	mc	crbr	b	p	35	5	2
		lo	zb	jbr/n	b	g	65	14	9
		lo	tl	rg/cr	b	g	30	17	5
		lp	tl	cr/pr	b	g	43	12	5
		rp	tt	cr/n	b	p	48	7	3
		ro	hln	j	b	p	65	4	3
		lo	hln	jv	b	g	35	7	2
		ro	hln	jbr	b	p	35	14	5
ZONE 11	134	rp	mc	rg	b	p	37	7	3
		lp	mc	rg	b	g	27	9	2
		lo	mc	rg	b	g	36	11	4
		rp	mc	rg	m	p	57	14	8
		rp	mc	n	m	p	44	4	2
		ro	mc	br	b	p	35	7	2
		lp	mc	cr	b	g	28	8	2
		lp	mc	pr	b	g	47	11	5
		lp	zb	cr/n	b	g	31	7	2
		lo	tl	rg/cr	b	g	47	23	11
ZONE 12	17	rp	mc	rg	b	p	29	4	1
		lp	mc	rg	b	g	47	39	18
		rp	mc	n	m	p	35	5	2
		lp	mc	pr	b	g	35	5	2
		lp	mc	rgn	b	g	59	7	4
		rp	mc	crbr	b	p	35	3	1
		lp	zb	cr/n	b	g	53	4	2
		lo	tl	rg/cr	b	g	35	20	7
		rp	tt	cr/brv	b	p	29	7	2

Table 30. Most common seed types in each prefecture by frequency and index.

Prefecture	By frequency					By index				
Butare	rp	tt	cr/n	b	p	lo	mc	jbr	b	g
	ro	hln	j	b	g	rp	tt	cr/n	b	p
Byumba	lp	mc	rgn	b	g	lo	tl	rg/cr	b	g
	lp	mc	rg	b	g	lp	mc	rg	b	g
Cyangugu	ro	mc	br	b	p	ro	mc	br	b	p
	rp	mc	rsbr	b	p	rp	mc	rgn	m	p
Gikongoro	ro	mc	n	b	p	ro	mc	n	b	p
	rp	mc	rg	b	p	rp	mc	rg	b	p
Gisenyi	lp	mc	pr	b	g	lp	mc	rg	b	g
	lp	tp	cr/n	b	g	lp	mc	pr	b	g
Gitarama	ro	hln	j	b	g	ro	mc	gr	b	p
	lo	hln	jv	b	g	ro	hln	j	b	g
Kibungo	rp	mc	rg	m	p	lo	tl	rg/cr	b	g
	lp	mc	pr	b	g	rp	mc	rg	m	p
Kibuye	rp	mc	rg	b	p	lo	tl	rg/cr	b	g
	lp	mc	pr	b	g	lp	mc	pr	b	g
Kigali	ro	hln	j	b	p	lp	mc	pr	b	g
	lp	zb	cr/n	b	g	lo	hln	jv	b	g
Ruhengeri	lp	mc	rg	b	g	lo	tl	rg/cr	b	g
	lp	mc	pr	b	g	lp	mc	pr	b	g

Table 31. Most common seed types in each agroclimatic zone by frequency and index.

Agroclimatic zone	By frequency					By index				
1	rp	mc	rgn	m	p	rp	mc	rgn	m	p
	lp	tl	cr/rg	b	g	lp	tl	cr/rgn	b	p
2	ro	mc	br	b	p	ro	mc	br	b	p
	rp	mc	rsbr	m	p	rp	mc	rgn	m	p
3	lp	tp	cr/n	b	g	lp	zb	cr/n	b	g
	ro	mc	br	b	p	ro	mc	br	b	p
4	lp	mc	rg	b	g	lp	mc	rg	b	g
	lp	mc	pr	b	g	lo	tl	rg/cr	b	g
5	rp	mc	rg	b	g	lp	mc	pr	b	g
	lp	mc	pr	b	g	lp	mc	n	b	g
6	lp	mc	rg	b	g	lo	tl	rg/cr	b	g
	lp	zb	cr/n	b	g	lp	mc	rgn	b	g
7	rp	mc	rg	b	p	lo	tl	rg/cr	b	g
	ro	mc	br	b	p	rp	mc	rg	b	p
8	ro	hln	j	b	p	ro	mc	gr	b	p
	lo	mc	rg	b	g	ro	hln	j	b	g
9	ro	hln	j	b	p	lo	zb	jbr/n	b	g
	lo	hln	j	b	g	lo	hln	jv	b	g
10	lo	zb	jbr/n	b	g	lo	zb	jbr/n	b	g
	ro	hln	j	b	p	lp	tl	cr/pr	b	g
11	rp	mc	rg	b	p	lo	tl	rg/cr	b	g
	lp	mc	pr	b	g	rp	mc	rg	m	p
12	lp	mc	rgn	b	g	lp	mc	rg	b	g
	lp	zb	cr/n	b	p	lo	tl	rg/cr	b	g

promotion and distribution of this variety. Although black beans are reportedly non-preferred, two different black seeded types are included in these lists. One can easily see from the tables that seed type preferences are independent of prefectural and agroclimatic zone boundaries. Certain contiguous regions are similar in important types while other regions differ widely.

Seed types occurring with a frequency of 50 percent or greater in market samples are listed in Table 32. A comparison of important varieties from markets and farms within a prefecture is given in Table 33. Those seed types of importance in warehouse samples (Table 34) are compared to farm samples in the same prefecture in Table 35. The degree of similarity between market and farm mixtures is variable, ranging from 29 to 100 percent of seed types which are important in both mixtures. About half of the seed types which are important in farm mixtures are also important in market and warehouse mixtures.

The correspondance between market and farm mixtures is important to the farmer who must buy beans for seed to reconstitute a preferred mixture. The similarity between warehouse purchased mixtures and farm mixtures could affect the ability of GRENARWA to sell beans for seed. However, the major part of the beans handled by GRENARWA come from merchants, not farmers, and are often mixed without regard to origin. Because it is difficult to separate producer preferences from consumer preferences using our data, the effect of similarity of seed type on the marketing of beans for food is not clear.

The regional distribution of the thirty-six most important seed types in the country (Table 36) indicates the wide adaptation of certain seed types. The most widely adapted types were found in 8 different agroclimatic zones across an elevation rage of 1,100 to 2,100 masl (e.g. type 5, ro mc br b p) and a range in precipitation of 650 to 1,600 mm (e.g. type 4, lp mc rg b g) Most of the less well adapted types occurred in groups of contiguous agroclimatic zones. For example, type 31, lo zb jbr/n b g, is found in Zones 8, 9 and 10. However, several, such as type 33, ro mc rg b p, occur in widely separated areas--Zones 3 and 8--suggesting that the dispersal of a seed type around the country is not limited to spread through neighboring areas.

Thirty percent of the important seed types are round and flat, 32 percent are round and oval, 23 percent are long and flat and 17 percent are long and oval. Round flat types are more common in Zones 1 and 2, long flat types in Zones 3, 5 and 6, and long oval types in Zones 8, 9 and 10. Small seeded types are most common in Zones 1 and 2 and large seeded varieties are most commonly found in the northern and eastern regions--Zones 4, 9, 11 and 12. Sixty-four percent of the 36 listed seed types are monochrome. Seeds with reddish coloring occur more often in Zone 8 and less frequently in Zones 7 and 10. Black seeded types are listed most often for Zones 2, 5, 6 and 7 while yellow-brown types and purple types are most common in Zones 9 and 10. These data suggest that producer preferences for seed color, size and color pattern do occur and can be defined.

Table 32. Seed types occurring in at least 50% of market samples by prefecture.

Prefecture	No. of markets	No. of samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
Butare	1	3	lo	mc	br	b	g	67	11	7
			lo	zb	jbr/n	b	g	67	8	5
			ro	hln	j	b	g	67	19	13
			lo	hln	j	b	g	67	3	2
			lo	hln	jv	b	g	67	54	30
Byumba	2	5	rp	mc	rg	b	p	80	2	2
			lp	mc	rg	b	g	80	7	6
			lp	mc	n	b	g	80	3	2
			ro	mc	br	b	p	80	8	6
			lp	mc	pr	b	g	80	5	4
			ro	mc	rgn	b	p	80	4	3
			lp	mc	rgn	b	g	100	10	10
			rp	mc	crbr	b	p	80	6	5
			lo	tl	rg/cr	b	g	100	16	16
			rp	tt	cr/n	b	p	60	2	1
Cyangugu	7	22	lp	tp	cr/n	b	g	50	6	3
Gikongoro	3	9	rp	mc	rg	b	p	67	14	9
			ro	mc	n	b	p	89	9	8
			lo	mc	n	b	g	67	16	10
			ro	mc	jbr	b	p	56	4	2
			lo	mc	jbr	b	p	67	3	2
			rp	tt	cr/n	b	p	78	4	3
			ro	hln	j	b	p	56	2	1
Gisenyi	5	14	lp	mc	rg	b	g	64	10	6
			lp	mc	pr	b	g	50	12	6
			lp	tl	cr/n	b	g	64	18	12
			lp	tp	cr/n	b	g	71	10	7
Gitarama	1	2	rp	mc	rg	b	p	100	6	6
			lo	mc	rg	b	g	100	4	4
			ro	mc	gr	b	g	100	4	4
			ro	zb	cr/n	b	p	100	2	2
			rp	tt	cr/n	b	p	100	9	9
			lp	hln	br	b	g	100	3	3
Kibungo	8	23	rp	mc	n	m	p	57	3	2
Kibuye	2	8	rp	mc	rg	b	p	88	8	7
			ro	hln	j	b	p	75	3	2
Kigali	8	23	ro	mc	br	b	p	83	7	6
			lp	zb	cr/n	b	p	57	4	2
Ruhengeri	2	6	lp	mc	rg	b	g	67	8	5

Table 33. A comparison of varietal composition of farm and market mixtures.

Prefecture	Percentage of major (≥ 50% frequency) seed types in both markets and farms	No. of markets	No. of farms
Butare	100	1	5
Byumba	60	2	62
Cyangugu	29	7	62
Gikongoro	64	3	29
Gisenyi	50	5	26
Gitarama	33	1	37
Kibungo	37	8	80
Kibuye	35	2	28
Kigali	56	8	75
Ruhengeri	42	2	62
Total	48	39	466

Table 34. Seed types occurring in at least 50% of samples from warehouses.

Warehouse	No. of samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
Kicukiro	25	rp	mc	rg	b	p	88	3	3
		lp	mc	rg	b	g	68	5	3
		ro	mc	br	b	p	76	19	14
		rp	mc	cr	b	p	56	9	5
		lp	mc	pr	b	g	72	6	4
		ro	mc	jbr	b	g	72	7	5
		rp	mc	rsbr	m	p	68	8	5
		rp	mc	crbr	b	p	60	7	4
		rp	tt	cr/n	b	p	56	5	3
		ro	hln	j	b	g	76	7	5
Nyanza	25	rp	mc	rg	b	p	76	8	6
		lp	mc	rg	b	g	84	12	10
		rp	mc	n	b	p	72	3	2
		ro	mc	n	b	p	60	4	2
		ro	mc	gr	b	g	56	10	6
		ro	zb	cr/n	b	g	60	4	2
		lo	zb	jbr/n	b	g	64	5	3
		lo	tl	rg/cr	b	g	52	14	7
		ro	hln	j	b	p	56	6	3
		lo	hln	br	b	g	56	10	6
Kibungo	16	rp	mc	rg	b	p	56	11	6
		lp	mc	rg	b	g	75	11	8
		rp	mc	n	m	p	56	7	4
		ro	mc	br	b	p	50	2	1
		lp	mc	cr	b	g	50	3	2
		lp	mc	rs	b	g	56	8	4
		lp	mc	pr	b	g	83	4	3
		rp	mc	jbr	m	p	69	4	3
		rp	mc	rgn	m	p	56	16	9
		rp	mc	rsrg	m	p	56	5	3
		lo	tl	rg/cr	b	g	56	31	17

Table 35. A comparison of varietal composition of farm and warehouse mixtures.

Warehouse	No. of samples	Prefecture	No. of samples	Percentage of major (≥50% frequency) seed types in both warehouses and farms
Nyanza	25	Butare	5	42
Kicukiro	25	Kigali	75	69
Kibungo	16	Kibungo	80	41

Table 36. Regional distribution of the 36 most important seed types in Rwanda by prefecture and agroclimatic zone.

Seed type					Prefecture										Agroclimatic zone												Whole country frequency
					Bt	By	Cy	Gk	Gs	Gt	Kb	Ky	Kg	Ru	1	2	3	4	5	6	7	8	9	10	11	12	
rp	mc	rg	b	p	X	X	X	X	X	X	X	X	–	–	–	X	X	X	X	–	X	X	–	–	X	X	39
lp	zb	cr/n	b	g	–	X	–	X	X	X	X	–	X	X	–	–	X	X	X	X	X	X	–	–	X	X	38
lp	mc	pr	b	g	–	X	–	–	X	X	X	X	X	X	–	–	X	X	X	X	X	–	X	X	X	–	37
lp	mc	rg	b	g	X	X	–	X	X	X	–	–	X	X	–	–	X	X	X	X	X	–	X	–	X	X	35
ro	mc	br	b	p	X	X	X	X	–	X	X	X	X	–	X	X	X	–	X	X	X	–	–	–	X	–	35
lo	tl	rg/cr	b	g	X	X	X	X	–	X	X	X	X	X	–	X	–	X	–	X	X	X	–	X	X	X	35
rp	tt	cr/n	b	p	X	X	–	X	–	X	–	X	X	–	–	–	–	–	X	X	X	X	X	X	–	–	29
ro	hln	j	b	p	X	–	X	X	–	X	–	X	X	–	–	X	–	–	X	–	X	X	X	X	–	–	28
rp	mc	n	m	p	–	X	X	X	–	–	X	X	X	–	–	X	–	–	–	X	X	–	–	–	X	X	27
ro	mc	jbr	b	p	X	–	–	X	–	–	–	–	X	–	–	–	–	–	–	–	X	–	X	X	–	–	25
ro	mc	n	b	p	X	–	X	–	–	X	–	X	X	–	–	X	–	–	X	–	–	X	–	–	–	–	25
lp	tp	cr/n	b	g	X	–	X	–	X	–	–	–	–	X	–	X	X	X	–	–	X	–	–	–	–	–	23
lo	mc	rg	b	g	X	–	–	X	–	X	X	–	–	–	–	–	X	–	–	–	–	X	X	X	X	–	23
rp	mc	rg	m	p	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	22
rp	mc	n	b	p	X	X	X	–	–	–	–	X	–	–	–	X	X	–	–	X	X	–	–	–	–	–	22
lp	mc	n	b	g	–	X	X	X	–	–	–	X	–	X	–	X	X	X	X	X	X	–	–	–	–	–	22
rp	mc	crbr	b	p	–	–	–	X	–	–	–	–	X	X	–	–	–	X	–	X	–	–	X	X	–	X	22
rp	mc	rsbr	m	p	X	–	X	–	–	–	X	X	–	–	–	X	X	–	–	–	–	–	–	–	–	–	20
lo	hln	j	b	g	X	–	–	–	–	X	X	–	X	–	–	–	–	–	–	–	–	–	X	–	–	–	20
lp	mc	rgn	b	g	–	X	–	–	–	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	–	X	18
lo	mc	jbr	b	g	X	–	–	X	–	X	–	–	–	–	–	–	–	–	–	–	X	–	X	X	–	–	16
lo	hln	jv	b	g	X	–	–	–	–	X	–	–	X	–	–	–	–	–	–	–	–	X	X	X	–	–	15
rp	mc	cr	b	p	–	–	–	X	–	–	–	–	–	X	–	–	–	X	–	–	–	–	–	–	–	–	15
rp	mc	jbr	b	p	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	14
rp	mc	crrs	b	p	–	–	X	–	–	–	X	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	14
ro	zb	cr/n	b	p	X	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	14
lp	tl	cr/pr	b	p	–	–	–	X	–	–	–	–	X	–	–	–	–	–	–	–	–	–	X	X	–	–	14
lp	mc	cr	b	g	–	–	–	–	X	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	13
ro	tl	cr/rg	b	p	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	12
ro	hln	jbr	b	p	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	12
lo	zb	jbr/n	b	g	X	–	–	–	–	X	–	–	X	–	–	–	–	–	–	–	–	X	X	X	–	–	11
ro	tp	cr/n	b	p	–	–	X	–	–	–	–	X	–	–	–	X	X	–	–	–	–	–	–	–	–	–	11
ro	mc	rg	b	p	–	–	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	X	–	–	–	–	10
ro	mc	rgn	b	p	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	10
rp	mc	rgn	m	p	–	–	X	–	–	–	–	–	–	–	X	X	–	–	–	–	–	–	–	–	–	–	10
rp	mc	rscr	b	p	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	10

CONCLUSIONS

The bean germplasm available in Rwanda is diverse in appearance and in production characteristics. This diversity can be seen at the farm or regional level. The use of varietal mixtures by the farmer reduces the risk of crop failure by increasing the stability of response of the crop to the production environment so that some part of the seed types in the mixtures will always produce yield. Regional producer preferences also relate to the adaptation of the seed types to varied environmental conditions and cultural practices but may also result from introduction and distribution patterns.

DEVELOPMENT OF A REFERENCE COLLECTION OF BEAN VARIETIES COLLECTED IN RWANDA

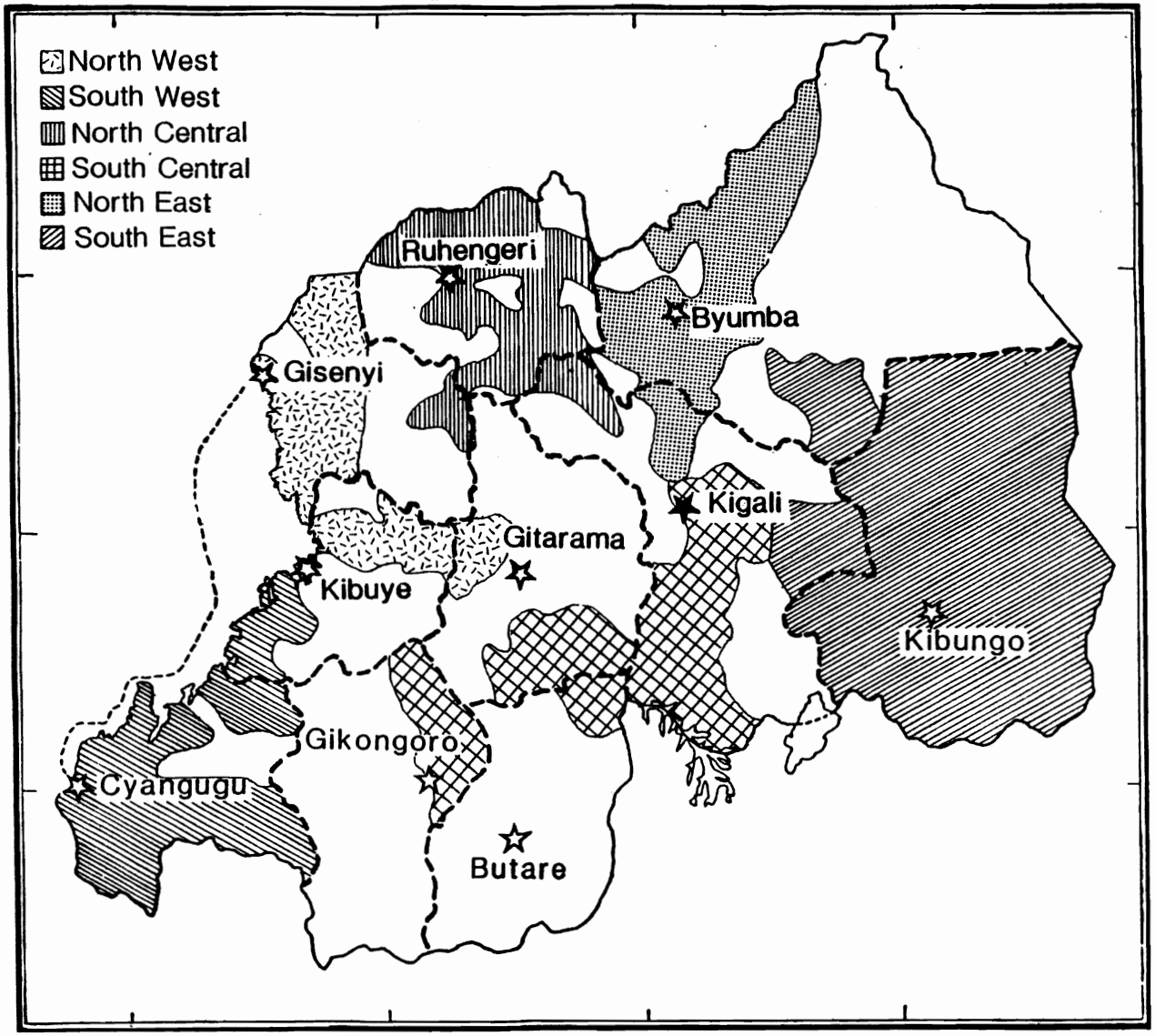
A permanent collection of seed samples of bean varieties of Rwanda is maintained at ISAR-Rubona. Written descriptions of seed and plant characteristics and photographs of all seed types are included in the collection. This is a variety reference collection as opposed to a germplasm collection because the samples of each seed type were prepared from seeds collected in several regions and bulked on the basis of visual characteristics.

The selection of materials to be grown in test plots during the 1985-A season to provide seed for this collection was based on the results of the mixture component analyses completed prior to October 1984. The nationwide survey had not yet been completed and certain regions (Ruhengeri and Byumba) had only been partially sampled so certain seed types were not included in this first planting. Table 37 lists the seed types and origin of seed planted in October 1984. Northeast, north central, northwest, southeast, south central and southwest designations were used to divide the country into groups of sampled communes (Map 6). Most types were planted in one or two rows, five meters long, unless the seed supply was limited, in which case a single 1-meter row was planted. For certain seed types, more rows were planted because seed was required by other project researchers. Row spacing was 50 centimeters and seeding rate was approximately 15 seeds per meter. Two fields at the ISAR-Rubona station were used for planting and each field was enclosed by a border row of mixed beans. The planting was done by the ISAR field workers October 7-8, 1984.

Field notes were taken throughout October and November. Mean flowering date, stem and flower color and plant type data were taken at the beginning of the flowering period. Plant type, pod color and pod position were recorded as soon as pods developed. A list of the descriptors used for these characteristics is given in Table 16. Plants differing from the predominant type in a row for any characteristic were labelled so they could be harvested separately.

The plots were harvested in January, 1985. Pods were removed from the plants in the field and placed in labelled paper bags. These were dried for several days before threshing. Most were threshed by hand; but for those lines with a large amount of seed, a mechanical thresher was used. The seeds from the individual "off-type" plants which were determined to be the same by seed and plant descriptors were bulked. All seed was then placed in a freezer to kill any insects and stored in covered plastic buckets.

A list of new material which was planted in the second planting is given in Table 38. Some types from the first planting were included to verify certain characteristics. The fields were planted March 1 and 8, 1985, using the same procedures as before. The second season plantings were affected by dry soils at the beginning but most seeds germinated well. During the flowering and pod fill period, field notes were taken. The plots were harvested, threshed and sorted in June.



MAP 6. DISTRIBUTION OF SAMPLES BY REGION

Table 37. Seed types and origin of seed planted in first season growout, October 1984-January 1985.

Field No.	Shape	Color pattern	Color	Shininess	No. of rows (5 m)	Regions of origin of seed[1]						
						NW	NC	NE	SW	SC	SE	Mixed
1	ro	mc	br	b	11	X	X	X	X	-	X	-
2	lo	mc	rg	b	30	X	-	X	X	X	X	-
3	rp	mc	rg	b	23	X	X	X	X	X	X	-
4	ro	hln	j	b	29	X	X	X	X	X	X	-
5	ro	mc	n	b	20	X	X	X	X	X	X	-
6	lp	zb	cr/n	b	32	X	X	X	X	X	-	X
7	lo	tl	rg/cr	b	33	X	X	X	X	X	X	-
8	lp	mc	pr	b	2	X	-	-	-	X	-	-
9	ro	mc	jbr	b	2	-	-	-	X	-	X	-
10	rp	tt	cr/n	b	10	X	-	X	-	X	-	-
11	lo	hln	j	b	3	-	-	-	-	X	X	-
12	rp	mc	rg	m	2	-	-	X	-	-	X	-
13	rp	mc	rsbr	m	15	-	-	-	X	X	X	X
14	lo	mc	jbr	b	1	X	-	-	-	-	-	-
15	lp	mc	rg	b	2	X	-	-	-	-	X	-
16	rp	mc	n	b	2	X	-	-	-	X	-	-
17	lo	hln	jv	b	2	-	-	-	-	X	X	-
18	lp	tp	cr/n	b	2	X	-	-	-	-	-	X
19	rp	mc	crbr	b	2	-	X	-	-	X	-	-
20	lp	tl	cr/pr	b	3	X	-	-	X	X	-	-
21	lo	zb	jbr/n	b	2	-	-	-	-	X	-	-
22	lp	mc	cr	b	11	X	X	-	-	X	X	X
23	ro	tl	cr/rg	b	2	-	-	-	X	-	X	-
24	ro	mc	rg	b	3	-	-	-	-	X	X	X
25	rp	mc	n	b	11	X	X	-	X	X	-	-
26	lp	mc	n	b	2	X	-	-	-	-	-	X
27	ro	zb	cr/n	b	1	-	-	-	-	-	-	X
28	lo	mc	n	b	2	-	-	-	X	-	-	X
29	rp	mc	crrs	b	2	-	-	X	-	-	X	-
30	lo	mc	pr	b	2	X	-	-	-	X	-	-
31	rp	mc	cr	m	3	-	-	-	-	X	X	-
32	ro	mc	gr	b	2	X	-	-	-	X	-	-
33	rp	mc	jbr	b	2	-	-	-	-	-	X	X
34	lp	hln	br	b	2	X	-	-	-	-	-	X
35	rp	mc	cr	b	2	-	-	-	-	X	-	X
36	ro	tt	cr/brv	b	2	-	-	-	-	X	X	-
37	rp	mc	rg	m	2	-	-	-	-	-	-	X
38	ro	hln	jbr	b	2	-	-	-	X	X	-	-
39	lp	tl	cr/rg	b	2	-	-	-	X	X	-	-
40	ro	mc	br	m	2	-	-	X	X	-	-	-
41	lp	mc	cr	m	1	-	-	X	-	-	-	-
42	ro	tl	rg/cr	b	3	-	-	-	-	X	X	X
43	lo	tl	rgn/cr	b	2	-	-	-	-	-	X	X
44	lp	tp	cr/pr	b	3	-	-	-	X	X	-	X
45	rp	mc	pr	b	2	-	-	-	-	-	X	X
46	lo	tl	n/rg	b	2	-	-	-	-	X	-	-

continued

[1] NW=northwest; NC=north central; NE= northeast; SW=southwest; SC=south central; SE=southeast.

Table 37. Continued.

Field No.	Shape	Color pattern	Color	Shininess	No. of rows (5 m)	Regions of origin of seed[1] NW	NC	NE	SW	SC	SE	Mixed
47	rp	mc	bl	m	2	-	-	-	-	X	-	-
48	lo	mc	prn	b	2	-	-	X	-	X	-	-
49	ro	zb	bl/n	b	2	-	-	X	-	X	-	-
50	rp	tt	cr/brv	b	3	-	-	X	-	X	-	X
51	lo	tl	br/rg	b	2	X	-	-	-	X	-	-
52	ro	mc	rg	m	3	-	-	-	X	X	X	-
53	ro	mc	rs	b	2	X	-	-	-	-	-	-
54	ro	tl	pr/cr	b	1	-	-	-	-	-	-	-
55	lp	tl	pr/cr	b	2	-	-	-	-	-	-	X
56	ro	mc	n	m	2	X	-	-	-	-	-	-
57	ro	mc	rs	b	1	-	-	-	-	-	-	X
58	lp	mc	prn	b	2	-	-	-	-	X	-	-
59	lp	mc	jbr	b	2	-	-	-	-	-	X	X
60	rp	mc	crrs	m	2	X	-	-	-	-	X	-
61	ro	mc	jbrbr	b	1	-	-	-	X	-	-	-
62	rp	mc	brrg	b	2	-	-	-	-	X	-	-
63	lo	hln	br	b	2	-	-	-	-	X	-	-
64	ro	tl	jbr/rg	b	2	-	-	-	-	-	-	X
65	lo	zb	rg/n	b	2	-	-	-	-	X	-	-
66	ro	vbr	grbl	m	1	-	-	-	-	X	-	-
67	ro	mc	crrs	b	2	-	-	-	X	X	-	-
68	ro	tt	crbr/n	b	2	-	X	-	-	-	-	-
69	ro	vbr	grbl	b	1	-	-	-	-	-	-	X
70	rp	mc	rgn	b	1	X	-	-	-	-	-	-
71	lp	mc	rgn	b	2	X	-	-	-	-	-	-
72	lo	mc	rgn	b	2	-	X	-	-	X	-	-
73	rp	mc	prn	b	1	-	-	-	-	-	-	X
74	ro	mc	prn	b	1	-	-	-	-	-	-	X
75	rp	mc	rgn	m	2	X	-	-	X	-	-	-
76	lp	mc	bleun	b	2	X	X	-	-	-	-	-
77	ro	vbr	blgr	m	1	-	-	X	-	-	-	-
78	ro	vn	grbl	m	1	-	-	-	-	-	-	X
79	rp	hljbr	cr	b	2	-	X	-	-	X	-	-
80	ro	vbr	jv	m	2	-	-	-	-	X	-	-
81	rp	zb	cr/n	b	1	-	X	-	-	-	-	-
82	ro	hln	jpr	b	2	-	-	-	-	X	-	-
83	ro	mc	bl	b	2	-	-	-	X	X	-	-
84	ro	vn	gr	m	2	-	-	-	-	X	-	-
85	lp	tl	n/cr	b	1	-	-	-	-	X	-	-
86	rp	hlbr	bl	m	2	-	-	-	-	-	X	-
87	lp	vgrandn	bl	b	2	-	-	-	-	-	X	X
88	rp	tp-zb	cr/n	b	2	-	X	-	-	-	-	-
89	ro	mc	pr	b	3	-	-	-	-	-	X	X
90	lp	tp	cr/rg	b	2	-	-	-	-	X	-	-
91	ro	mc	jbr	m	1	-	-	-	-	X	-	-
92	lp	hln	bl	b	1	-	-	-	-	-	X	-
93	rp	mc	crbr	m	1	-	-	-	-	-	X	-
94	ro	hln	br	b	1	-	-	-	-	-	-	X
95	ro	mc	crj	b	1	-	-	-	X	-	-	-
96	lp	mc	crj	b	2	X	-	-	-	-	-	-

continued

Table 37. Continued.

Field No.	Shape	Color pattern	Color	Shininess	No. of rows (5 m)	Regions of origin of seed[1] NW	NC	NE	SW	SC	SE	Mixed
97	ro	mc	brn	b	2	X	-	-	-	-	-	-
98	lo	hln	jbr	b	2	-	-	-	-	X	-	-
99	rp	mc	jbrbr	b	1	-	-	-	-	X	-	-
100	ro	mc	rscr	b	1	-	-	-	-	-	-	X
101	lo	mc	vbr	b	1	-	-	-	-	-	X	-
102	lp	zb	cr/brv	b	2	-	-	-	-	-	X	X
103	lp	mc	bl	b	1	-	-	-	-	-	-	X
104	lo	zb	cr/jbr	b	2	-	-	-	-	-	X	-
105	ro	tt	cr/n	m	1	X	-	-	-	-	-	-
106	ro	mc	rgn	b	1	-	-	-	-	-	-	X
107	ro	tp	cr/pr	b	2	-	-	-	-	-	X	X
108	ro	tp	rs/pr	b	1	-	-	-	-	-	-	X
109	lo	mc	vcr	b	1	-	-	-	-	-	X	-
110	lo	mc	brn	b	1	-	X	-	-	-	-	-
111	ro	mc	bleun	b	1	-	-	-	-	-	X	-
112	lp	mc	rs	b	2	-	X	-	-	-	X	-
113	rp	mc	rscr	b	2	-	-	-	X	-	-	X
114	ro	tp	cr/n	b	2	-	-	-	X	-	-	X
115	ro	tt	cr/n	b	2	-	-	-	X	X	-	-
116	rp	mc	jbr	b	1	-	-	-	-	-	-	X
117	ro	mc	brcr	b	1	-	-	-	-	-	-	X
118	ro	tl	rs/rg	b	1	-	-	-	-	-	-	X
119	ro	tl	rs/n	b	1	-	-	-	-	-	-	X
120	lo	tl	prn/cr	b	1	-	-	-	-	-	X	-
121	rp	tt	rs/brv	b	1	X	-	-	-	-	-	-
122	lp	tt	cr/n	b	The remaining types were of mixed origin, and were planted in ≤ 1 row.							
123	ro	tt	bl/grn	b								
124	ro	tt	cr/brv	m								
125	ro	zb	cr/brv	b								
126	rp	zb	vbr/brv	b								
127	lo	zb	rs/rg	b								
128	lp	zb	cr/prbr	b								
129	ro	zb	cr/jbr	b								
130	lp	zb	cr/pr	b								
131	lp	zb	jbr/brv	b								
132	ro	hln	pr	b								
133	lp	vgrndn	bl	m								
134	ro	vbr	grbl	m								
135	ro	vbr	blgr	b								
136	lp	vgrandrg	bl	b								
137	ro	vgrandrg	bl	b								
138	ro	vgrand 1/2	bl/n	b								
139	ro	vbr	j	b								
140	lp	tp	jbr/n	b								
141	lp	tp	rs/n	b								
142	lp	tp	rs/pr	b								
143	lp	zb	jbr/n	b								
144	ro	zb	vn/n	b								
145	lo	zb	rs/n	b								

continued

Table 37. Continued.

Field No.	Shape	Color pattern	Color	Shininess	No. of rows (5 m)	Regions of origin of seed[1] NW	NC	NE	SW	SC	SE	Mixed
146	lo	zb	bl/brv	b		Mixed origin, planted in ≤ 1 row. (continued)						
147	ro	zb	rs/n	b								
148	ro	zb	bl/n	b								
149	lo	zb	bl/n	b								
150	lo	zb	br/brv	b								
151	ro	zb	cr/brv	b								
152	rp	zb	rs/br	b								
153	ro	zb	cr/prcr	b								
154	lo	tp	cr/n	b								
155	rp	tt	cr/brv	b								
156	ro	tt	rs/n	b								
157	lp	tt	bleun/bl	b								
158	lp	tt	vn/bl	b								
159	lo	tt	n/cr	b								
160	rp	tt	n/cr	b								
161	rp	tt	bleun/cr	b								
162	rp	tt	rs/rg-pr	b								
163	ro	tl	pr/cr	b								
164	lp	tl	bleun/cr	b								
165	lp	tl	n/rs	b								
166	ro	tl	cr/n	b								
167	lp	tl	cr/rg	b								
168	lo	tl	cr/rg	b								
169	lp	tl	cr/jbr	b								
170	lo	tl	rg/jbr	b								
171	lp	tl	cr/pr	b								
172	ro	tl	cr/rg	b								
173	lo	tl	rs/rg	b								
174	lo	tl	rg/jbr	b								
175	ro	tl	cr/jbr	b								
176	ro	tl	rg/rs	b								
177	lp	tl	jbr/rg	b								
178	rp	mc	rgbr	b								
179	lo	mc	br	b								
180	lp	mc	n	m								
181	lp	mc	br	b								
182	ro	mc	cr	b								
183	rp	mc	bl	b								
184	rp	mc	crpr	b								
185	ro	mc	v	b								
186	rp	mc	vbr	b								
187	ro	mc	bl (pet)	b								
188	ro	mc	brrg	b								
189	rp	mc	bleun	b								
190	rp	mc	vn	b								
191	lo	mc	v	b								
192	rp	mc	crj	m								
193	ro	mc	brn	b								
194	lo	mc	brv	b								
195	rp	mc	crj	b								
196	lp	mc	crj	m								
197	lo	mc	bleugr	b								

Table 38. Seed types planted in second growout, March-June 1985.

Shape	Color pattern	Color	Shininess
ro	mc	brn	b
ro	mc	bleu	b
ro	mc	v	b
lo	mc	pr	b
lp	mc	rgbr	b
rp	mc	jbr	m
ro	mc	br	m
rp	mc	brgr	b
lp	mc	vn	b
ro	mc	jrs	m
rp	mc	jrs	b
rp	mc	jbrbr	b
ro	mc	cr	m
rp	mc	crrs	m
rp	mc	brjbr	b
rp	mc	jbrbr	m
lp	mc	cr	b
lp	mc	crj	m
ro	mc	rs	b
lp	mc	cr	b
rp	mc	prbr	b
rp	mc	nbr	b
lo	mc	rgn	m
lp	mc	rgn	m
lp	mc	br	m
lp	mc	rgbr	b
ro	mc	brrs	m
lp	mc	gr	b
ro	mc	bl	m
ro	mc	jcr	b
rp	mc	bleubr	m
rp	mc	n	m
lp	mc	jbrrg	b
ro	mc	brrs	b
rp	mc	brn	b
lo	zb	crgr/n	b
lp	zb	cr/prcr	b
ro	zb	rs/rg	b
lo	zb	cr/j	b
ro	tl/hln	j/cr	b
rp	tl	rs/rg	b
rp	tl	rs/br	b
rp	tl	rs/rg-rs	b
lo	tl	bleu/bleugr	b
lp	tl	rg/jbr	b
lp	tl	rs/rg	b
lp	tl	rg/rs	b
lp	tl	jbrcr/rg	b
lo	tl	jbrcr/rg	b
lp	tl	rs/n	b
lp	tl	jbrcr/prcr	b
lo	tl	jbrcr/n	b
ro	tl	cr/rgn	m
lo	tl	rg/rs	b
ro	tl	rg/jbr	b
lp	tl	pr/prbl	b
lp	tl	rg/crbr	m
lp	tl	pr/rs	b
ro	tl	br/crbr	b
ro	tl	rg/jbr	m
lp	tl	pr/n	b
ro	tl	br/n	b
rp	tl	crbr/crv	b
lo	tl	crjbr/pr	b
ro	tl	jbrcr/rgn	b
ro	tp	prcr/pr	b
rp	tp/tl	rs/pr	b
rp	tp	cr/n	b
lp	tp/tl	cr/n	b
lp	tp/tl	cr/crbr	b
ro	tp	cr/n	b
lp	tp	cr/gr	b
lp	tp/tl	cr/grn	b
rp	tp/tl	cr/pr	b
lp	tp	crj/rg	m
lo	tt	bleun/cr	b
ro	tt	rs/n	b
lo	tt	n/cr	b
lo	tt	prn/cr	b
rp	tt	bleu/cr	b
lp	tt	cr/br-n	b
ro	tt	crbr/br	b
rp	tt	crbr/br	b
ro	tt	crbr/n	m
rp	tt	crbr/br	b
rp	tt	cr-br/n	b
ro	tt	n/cr	b
rp	tt	prn/n	m
lo	hln	br	b
ro	hln	brn	b
rp	hljbr	cr-j	m
rp	hlrs	cr	b
ro	hljbr	cr	b
ro	hlrs	crj	b
lo	hln	rsn	b
rp	hln	br	b
lp	hlrs	crbr	m
ro	hlbr	rsbr	b
ro	hln	jpr	b
ro	vbrrg	jv	m
rp	vbr	grbl	m
ro	vbr	cr	m
rp	vbr	cr	m

The list of the varieties in the reference collection is given in Table 39. For each variety, a clean seed sample was placed in a 9-dram, screw-top vial (Kimble, Toledo, Ohio 43666). The vials and their contents were then frozen to kill any insects and the seed was allowed to dry in a dessicator over $CaCo_3$ for two weeks. It was reported (Dessert, M., personal communication) that moisture contents near 8 percent slow color changes in seeds and that 2 weeks is sufficient to reduce seed moisture content to 8 percent. It is hoped that this process, plus dark storage conditions, will maintain the original colors as long as possible. Color photographs accompanying the vials should maintain their color longer than the seed itself. The written descriptions of seed and plant characters complete the reference collection which is housed at the ISAR-Rubona station. A duplicate set of seed samples is stored at the OPROVIA offices in Kicukiro. Viable seed of all varieties was given to the ISAR legume improvement project for further observation and use in the breeding program.

Table 39. Seed types and related information included in the reference collection.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
1	lp	mc	n	b	P	V	V(p)	II	P	m	35
2	ro	mc	n	b	P	P	P	II	P	m	26
3	rp	mc	n	m	P	R	P	II	I	m	22
4	lp	mc	n	b	P	R	V	II	IT	m	35
5	rp	mc	n	b	P	P	P	II	IT	m	22
6	lo	mc	n	b	P	R	V	II	P	m	38
7	ro	mc	n	m	P	R	P	II	I	m	30
8	rp	mc	n	m	P	P	V	II(I)	T	m	17
9	ro	mc	n	b	P	P	P	III	P	m	29
10	lp	mc	bl	b	Bl	V	V	I	PI	m	33
11	rp	mc	bl	m	Bl	R	V	II	P	m	25
12	ro	mc	bl	b	Bl	V	V	II	IT	m	26
13	lp	mc	bl	b	Bl	V	V	II	IT	m	43
14	ro	mc	bl	m	Bl	V	V	II	I	m	15
15	ro	mc	rg	b	V	V	V	I	P	m	31
16	rp	mc	rg	b	Bl	R	R	II	IT	m	20
17	lp	mc	rg	b	Bl	V	V	II	PI	m	40
18	lo	mc	rg	b	Bl	V	V	II	PI	m	38
19	lp	mc	rg	b	V	V	V	II	PI	m	40
20	ro	mc	rg	b	V	R	V	II	P	m	44
21	rp	mc	rg	m	V	R	R	II	T	m	22
22	rp	mc	rg	b	Bl	R	R	II(III)	IT	m	22
23	rp	mc	rgn	m	Bl	R	R	II	I	m	23
24	lp	mc	rgn	b	V	R	V	II	PI	m	46
25	ro	mc	rgn	m	P	R	P	II	IT	m	24
26	ro	mc	rgn	m	V	V	P	II	P	m	36
27	ro	mc	rgn	m	Bl	R	V	II	T	m	32
28	rp	mc	rgn	b	V	V	R	II	P	m	28
29	rp	mc	rgn	b	Bl	R	R	III	T	m	20
30	rp	mc	rgbr	m	Bl	R	R	II	T	m	19
31	rp	mc	rgbr	m	Bl	V	R	II	IT	m	18
32	lo	mc	rgpr	b	V	R	V	IV	PI	m	45
33	rp	mc	rgrs	b	Bl	R	R	II	IT	m	22
34	lp	mc	rgjbr	b	V	V	V	IV	T	m	43
35	ro	mc	rgcr	b	Bl	R	V	II	T	m	27

continued

Table 39. Continued.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
36	ro	mc	rs	b	V	V	V	II	T	m	47
37	rp	mc	rs	b	BI	R	R	II	T	m	29
38	lp	mc	rs	b	V	V	V	IV	IT	m	45
39	rp	mc	rscr	b	BI	R	R	II	IT	m	22
40	rp	mc	rscr	m	BI	R	R	II	IT	m	20
41	rp	mc	rscr	b	BI	R	P	II	T	m	24
42	rp	mc	rsbr	m	BI	R	R	II	I	m	19
43	lp	mc	rsrg	m	V	V	V	IV	IT	m	34
44	lp	mc	pr	b	P	R	V	II	P	m	42
45	ro	mc	pr	b	P	V	V	II	P	m	34
46	lo	mc	pr	b	V	R	V	II(IV)	T	m	34
47	ro	mc	prn	b	P	R	P	I	P	m	39
48	rp	mc	prn	b	P	R	P	II	T	m	29
49	ro	mc	prn	b	P	R	Sp	II	P	m	39
50	rp	mc	prn	b	P	P	P	II	I	m	30
51	lp	mc	prrg	b	P	R	V	II	I	m	49
52	ro	mc	prrg	b	V	R	P	II(IV)	T	m	33
53	rp	mc	prcr	b	P	P	P	II	I	m	20
54	rp	mc	prrs	b	?	?	?	?	?	m	23
55	rp	mc	prbr	b	P	P	P	?	I	m	20
56	lp	mc	prbleu	b	P	R	P	IV	IT	m	31
57	ro	mc	prbleu	b	?	?	?	?	?	m	36
58	rp	mc	bleu	b	P	R	P	II	I	m	30
59	ro	mc	blue	b	P	R	P	II(IV)	T	m	22
60	rp	mc	bleubr	m	P	P	V	II	T	m	17
61	ro	mc	bleugr	b	?	?	?	?	I	m	35
62	ro	mc	gr	b	P	R	P	II	PI	m	35
63	lo	mc	gr	b	P	R	V	II	I	m	45
64	rp	mc	grbleu	b	P	P	P	II	I	m	35
65	ro	mc	v	b	BI	V	V	II(IV)	I	m	42
66	lp	mc	vbleu	b	BI	V	V	II	P	m	38
67	lp	mc	vbr	b	?	?	?	?	P	m	32
68	ro	mc	br	b	BI	R	R	II	I	m	20
69	ro	mc	brn	b	P	V	Sp	I	P	m	31
70	lp	mc	brn	b	BI	V	V	II	IT	m	37

continued

Table 39. Continued.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
71	ro	mc	brn	b	V	V	V	II	P	m	30
72	ro	mc	brv	b	BI	R	V	II	I	m	35
73	rp	mc	brv	b	P	P	?	II	IT	m	27
74	rp	mc	brv	b	BI	R	?	III	IT	m	16
75	rp	mc	brv	m	?	?	?	?	?	m	21
76	rp	mc	brjbr	m	P	P	R	III	IT	m	24
77	lp	mc	brrg	b	BI	V	?	IV	IT	m	35
78	ro	mc	brrs	b	BI	R	V	II	T	m	26
79	ro	mc	brpr	b	?	?	?	?	?	m	22
80	lp	mc	cr	m	BI	R	V	II	IT	b	29
81	ro	mc	crj	b	V	R	R	II	T	m	22
82	rp	mc	crj	m	P	R	R	II	I	m	24
83	rp	mc	crj	m	BI	R	V	II	I	m	18
84	ro	mc	crj	m	BI	R	V	II	I	m	26
85	lp	mc	crj	m	BI	R	V	II	I	m	29
86	rp	mc	crbr	b	BI	R	R	II	I	m	28
87	rp	mc	crbr	m	BI	R	R	II	P	m	21
88	ro	mc	crbr	b	?	?	?	?	P	m	24
89	rp	mc	crrs	b	BI	R	R	II	IT	m	37
90	rp	mc	crrs	b	BI	R	V	III	IT	m	18
91	rp	mc	crv	b	?	?	?	?	?	m	24
92	rp	mc	crbrv	b	?	?	?	?	P	m	27
93	lo	mc	crgr	b	P	R	Sp	II	IT	m	41
94	rp	mc	crpr	m	P	P	P	II	T	m	26
95	rp	mc	J	b	BI	R	V	II	I	m	28
96	lp	mc	jbr	b	V	V	V	I	P	m	28
97	ro	mc	jbr	b	V	R	R	II	P	m	35
98	rp	mc	jbr	m	BI	R	R	II	PI	m	16
99	rp	mc	jbr	m	BI	V	R	II	I	m	23
100	rp	mc	jbr	b	BI	R	V	II	I	m	30
101	rp	mc	jbr	m	BI	R	V	II	T	m	22
102	rp	mc	jbr	m	BI	R	V	II	T	m	23
103	ro	mc	jbrbr	b	BI	R	R	II	T	m	19
104	rp	mc	jbrbr	b	BI	R	R	II	T	m	29
105	rp	mc	jbrbr	b	?	R	V	II	?	m	21

continued

Table 39. Continued.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
106	ro	mc	jbrbr	b	Bl	R	V	II	T	m	25
107	rp	mc	jbrbr	m	Bl	R	V	II	T	m	20
108	rp	mc	jrs	b	Bl	R	V	II	T	m	21
109	rp	mc	jrs	m	Bl	R	V	II(I)	I	m	15
110	rp	mc	jcrrs	m	Bl	V	V	I	T	m	21
111	lp	mc	jbrcr	b	V	V	V	II	T	m	36
112	ro	mc	jbrrs	b	V	V	V	II	PI	m	32
113	lp	mc	jbrrg	b	V	V	V	II(IV)	T	m	44
114	lp	zb	cr/n	b	P	R	P(V)	II	IT	m	44
115	ro	zb	cr/n	b	P	R	V	II	P	m	33
116	lp	zb	cr/n	b	P	R	P(V)	IV	IT	m	39
117	ro	zb	cr/n	b	P	R	V	IV	P	m	32
118	ro	zb	bl/n	b	P	R	V	II	P	m	29
119	lo	zb	crgr/n	b	P	R	V	II	I	m	37
120	lo	zb	jbr/n	b	P	V	Sp	II	P	m	38
121	ro	zb	rs/n	b	Bl	V	V	II	T	m	37
122	ro	zb	rs/n	b	P	P	V	II	T	m	21
123	lp	zb	rscr/n	m	Bl	V	V	II	T	m	37
124	lp	zb	rspr/n	b	P	R	V	II(IV)	P	m	52
125	lp	zb	cr/brv	b	V	V	R	II	P	m	41
126	ro	zb	cr/brv	b	V	V	V	II	IT	m	38
127	lp	zb	cr/prcr	b	V	V	V	II	P	m	50
128	lo	zb	cr/jvb	b	V	V	V	II	P	m	46
129	lp	zb	cr/prrg	b	V	R	V	I	P	m	42
130	lp	zb	cr/prrg	b	V	R	V	II	IT	m	41
131	lp	zb	cr/pr	b	Bl	R	V	II	T	m	33
132	lp	zb	cr/jbr	b	V	V	V	II	P	m	43
133	lp	zb	cr/prj	b	V	V	V	I	P	mh	40
134	ro	zb	cr/prj	b	V	R	V	I	P	mh	30
135	lp	zb	rs/rj	b	V	V	V	II	IT	m	46
136	ro	zb	rs/r	b	V	V	V	II	I	m	41
137	lp	tl	cr/n	b	P	R	P(V)	IV	IT	m	41
138	lp	tl	crj/n	b	P	R	P(V)	IV	IT	m	41
139	lp	tl	crj/n	b	P	R	R	II(IV)	T	m	34
140	lo	tl	crj/n	b	P	R	R	II(IV)	T	m	33

continued

Table 39. Continued.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
141	lp	tl	cr/pr	b	V	V	R	IV	T	m	37
142	rp	tl	cr/pr	b	V	V	R	IV	T	m	32
143	lo	tl	rg/n	m	P	R	P	II	PI	m	33
144	lp	tl	rs/n	b	P	R	V	II	P	m	42
145	lp	tl	cr/br	b	BI	R	V	II	I	m	22
146	rp	tl	crbr/br	b	BI	R	V	II	T	m	22
147	lp	tl	jbr/br	m	V	V	R	II	T	m	36
148	rp	tl	rs/br	b	BI	R	V	II	T	m	17
149	ro	tl	cr/jv	b	V	V	?	II	IT	m	40
150	lo	tl	rg/cr	b	V	V	V	I	I	mh	35
151	lo	tl	rg/cr	b	BI	V	V	I	I	mh	41
152	ro	tl	rg/cr	b	V	R	V	II	P	m	39
153	lo	tl	rg/cr	m	V	V	V	II	P	m	43
154	lp	tl	rg/cr	b	P	V	?	II	IT	m	37
155	ro	tl	cr/rg	b	V	V	Sp	I	PI	m	38
156	lp	tl	cr/rg	b	V	V	V	I	I	m	30
157	ro	tl	cr/rg	b	V	V	Sp	II	PI	m	34
158	lp	tl	cr/rg	b	V	V	Sp	II	P	m	48
159	lp	tl	cr/rgn	b	V	V	Sp	I	P	m	41
160	lp	tl	cr/rgn	b	P	V	Sp	II	P	m	39
161	ro	tl	cr/rgn	m	P	V	Sp	II	IT	m	32
162	ro	tl	cr/rgn	m	P	V	Sp	II	P	m	47
163	lp	tl	cr/pr	b	P	V	Sp	II	P	m	37
164	ro	tl	cr/pr	m	V	V	V	II	T	m	39
165	ro	tl	jbrcr/rg	m	V	V	Sp	II	P	m	35
166	lo	tl	rgn/cr	b	V	V	Sp	I	P	m	45
167	lp	tl	rgn/cr	b	V	R	Sp	II	P	m	34
168	lp	tl	pr/cr	b	P	V	Sp	II	I	m	46
169	ro	tl	pr/cr	b	V	R	?	II	IT	m	41
170	lp	tl	prn/cr	b	P	V	Sp	I	P	m	46
171	lp	tl	prn/cr	b	P	V	Sp	II	I	m	49
172	lp	tl	prn/cr	m	P	R	Sp	II	P	m	42
173	lo	tl	prn/cr	b	P	V	?	II	IT	m	33
174	lo	tl	jbr/rg	b	V	V	Sp	II	T	m	39
175	ro	tl	jbr/rg	b	V	V	Sp	II	T	m	41

continued

Table 39. Continued.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
176	ro	tl	rs/rg	b	V	V	Sp	II	P	m	39
177	lp	tl	rs/rg	b	Bl	V	V	II(IV)	T	m	41
178	ro	tl	rs/rgn	b	V	V	V	II	T	m	41
179	ro	tl	rs/rgn	b	V	V	Sp	II	I	m	37
180	lo	tl	rg/rs	b	Bl	V	V	I	I	m	37
181	lp	tl	rg/rs	b	V	V	V	II(IV)	I	m	48
182	ro	tl	rscr/pr	b	V	V	V	II	T	m	45
183	lp	tl	pr/rs	b	V	R	?	II	IT	m	38
184	lp	tl	n/rs	m	P	V	Sp	II	P	m	61
185	rp	tl	crrs/rg	b	Bl	V	R	II	PI	m	18
186	rp	tl	rscr/rsrg	b	Bl	R	R	II	I	m	26
187	ro	tl	n/cr	m	P	V	Sp	I	PI	m	40
188	lp	tl/zb	prn/prcr	b	V	R	V	?	?	m	39
189	lp	tp	cr/n	b	P	V	Sp	I	P	m	44
190	lp	tp	cr/n	b	V	V	V	II	IT	m	34
191	lp	tp	cr/n	b	P	V	V	II	IT	m	63
192	lp	tp	cr/n	b	Bl	V	?	IV	IT	m	45
193	rp	tp	cr/n	m	V	V	V	II(IV)	T	m	30
194	rp	tp	cr/n	b	?	?	?	?	P	m	29
195	lp	tp	cr/pr	b	V	V	V	I	I	m	45
196	lp	tp	cr/pr	b	V	V	V	II	P	m	40
197	ro	tp	cr/pr	b	V	V	Sp	II	P	m	38
198	ro	tp	cr/pr	b	P	V	V	II	T	m	22
199	lp	tp	cr/prn	b	V	V	Sp	II	P	m	38
200	ro	tp	cr/prn	b	P	V	Sp	II	P	m	37
201	lp	tp	crj/rg	m	V	V	?	IV	IT	m	46
202	ro	tp	rs/pr	b	V	V	V	II	P	m	37
203	lp	tp	rs/pr	b	P	V	Sp	II	IT	m	33
204	lp	tp	rs/rg	b	V	V	V	II	T	m	44
205	lp	tp	jbr/n	b	V	V	V	II	IT	m	39
206	rp	tp	cr/pr	b	P	P	V	II	?	m	74
207	rp	tp	cr/pr	b	P	V	Sp	II(IV)	P	m	63
208	lp	tp/tt	cr/n	b	V	R	V	II(IV)	T	m	59
209	lp	tp/tt	crj/n	b	V	R	V	II(IV)	T	m	46
210	rp	tt	cr/n	b	P	R	Sp	II	P	m	31

continued

Table 39. Continued.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
211	ro	tt	cr/n	m	P	R	Sp	II	IT	m	26
212	ro	tt	cr/n	b	P	R	Sp	III	P	m	27
213	ro	tt	crbl/n	m	P	P	P	II	I	m	30
214	rp	tt	cr/brv	b	Bl	R	Sp	II	IT	m	33
215	ro	tt	cr/brv	m	Bl	R	V	III	?	m	24
216	rp	tt	cr/br	b	P	P	Sp	II	I	m	32
217	ro	tt	cr/br-n	m	V	V	Sp	II	P	m	30
218	ro	tt	bl/n-gr	b	P	V	Sp	II	P	m	33
219	rp	tt	rs/n	b	V	V	V	II	P	m	23
220	rp	tt	rs/n	b	V	V	Sp	II	I	m	21
221	ro	tt	rs/n	b	P	P	P	II	T	m	24
222	rp	tt	prn/n	b	P	P	V	?	I	m	33
223	rp	tt	bleu/n	m	P	P	V	?	I	m	39
224	rp	tt	bleu/n	b	P	P	V	?	I	m	44
225	lo	tt	n/cr	b	P	V	?	I	PI	m	54
226	rp	tt	bleu-cr/n	b	V	R	V	II	T	m	29
227	lo	tt	bleu/cr	b	P	V	V	II	T	m	33
228	lo	hljbr	cr	b	P	R	V	II	I	m	38
229	rp	hljbr	cr	m	Bl	R	V	II	P	m	31
230	rp	hljbr	cr	m	Bl	R	P	II	T	b	21
231	lp	hljbr	cr	m	P	R	V	II	T	m	35
232	rp	hljbr	cr	b	Bl	R	R	II	T	m	29
233	rp	hljbr	cr	m	Bl	R	R	II	P	m	27
234	ro	hljbr	cr	b	P	R	R	II	I	m	29
235	ro	hljbr	cr	b	Bl	V	V	II	I	m	42
236	lp	hljbr	cr	b	P	P	?	II	PI	m	55
237	lp	hljbr	cr	b	P	R	Sp	II	PI	m	38
238	rp	hljbr	cr	m	Bl	R	V	III	I	m	32
239	lp	hljbr	cr	b	P	V	V	IV	T	m	37
240	lp	hljbr	crbr	b	P	R	V	II	I	m	44
241	rp	hljbr	crbr	m	P	R	P	II	T	b	22
242	rp	hljbr	crbr	m	P	V	P	II	IT	m	23
243	lp	hljbr	crbr	b	Bl	R	Sp	II	I	m	43
244	rp	hlrs	crrs	b	Bl	R	R	II	I	m	22
245	rp	hlrs	crrs	b	Bl	R	?	II	PI	m	29

continued

Table 39. Continued.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
246	ro	hlbr	cr	b	P	V	V	II	T	m	18
247	lo	hln	j	b	V	V	V	I	I	mh	36
248	ro	hln	j	b	V	V	V	II	P	m	33
249	lo	hln	j	b	V	V	V	II	P	mh	32
250	lo	hln	jpr	b	V	R	V	I	P	m	37
251	lo	hln	jpr	b	V	V	R	I	P	m	36
252	ro	hln	jpr	b	V	V	V	II	P	m	37
253	lo	hlgr	j-cr	b	V	V	V	II	P	m	41
254	ro	hlrs	jcr	b	Bl	V	?	II	IT	m	20
255	ro	hln	jbr	b	V	R	V	I	P	m	34
256	lo	hln	jbr	b	V	V	V	II	P	m	38
257	lo	hln	br	b	V	V	V	I	P	m	37
258	rp	hln	br	b	V	V	V	II	P	m	32
259	lp	hln	br	b	V	V	V	II	P	m	42
260	lp	hln	br	b	V	R	V	IV	P	m	41
261	ro	hln	br	b	V	V	V	II(IV)	T	m	42
262	ro	hln	brn	b	V	V	V	II	IT	m	36
263	lo	hln	brv	b	Bl	R	R	II	P	m	37
264	lo	hln	brj	b	?	?	?	?	P	m	25
265	ro	hlbr	rsbr	b	Bl	R	R	II	I	m	28
266	lo	hlrgn	rg	b	V	V	?	II	IT	m	35
267	ro	hln	prcr	b	V	V	V	II	P	m	27
268	rp	tl-hljbr	cr/j	m	Bl	V	?	III	PI	m	22
269	ro	vbr	grbl	m	P	P	P	II	IT	m	26
270	rp	vbr	grbl	m	P	P	Sp	II	?	m	30
271	rp	vbr	grbl	m	P	P	P	II	I	m	31
272	rp	vbr	bl	m	P	R	P	II	I	m	30
273	rp	bvr	cr	b	P	P	P	II	I	m	22
274	ro	bvr	crbr	b	Bl	V	V	II	I	m	21
275	ro	vbr	gr	m	P	P	Sp	II	IT	m	25
276	ro	vbr	jv	m	Bl	R	R	II	IT	m	24
277	ro	vbr	jr	m	Bl	V	V	II	I	m	24
278	rp	vpr	crpr	m	P	R	P	II	I	m	31
279	lp	vrg	bl	m	Bl	V	V	I	P	m	37
280	lp	vrg	bl	m	Bl	V	V	II	T	m	54

continued

Table 39. Continued.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
281	ro	vbl	rg	b	Bl	V	V	I	P	m	33
282	lp	vn	bl	m	Bl	V	V	II	IT	mb	49
283	lo	vn	bl	m	Bl	V	V	II	I	m	40
284	ro	tl	cr/br	b	V	V	?	II	PI	m	33
CP 1	rp	mc	vbleu	b	P	R	P	II	I	m	29
CP 2a	lp	mc	Jbrn	m	P	V	P	II	PI	m	45
CP 2b	lp	mc	Jbr	m	P	V	P	II	PI	m	42
CP 3a	rp	mc	pr	b	P	P	P	II	I	m	33
CP 3b	rp	mc	crpr	b	P	P	P	II	I	m	21
CP 4a	rp	mc	Jbrv	m	P	P	Sp	II	I	m	29
CP 4b	rp	mc	brvn	b	P	P	Sp	II	T	m	26
CP 5a	rp	mc	rgn	b	V	P	?	II	PI	m	15
CP 5b	rp	mc	vJbrcrbr	m	V	P	?	II	PI	m	25
CP 6a	rp	tt	crbn/n	b	Bl	V	V	II	I	m	31
CP 6b	rp	mc	bleuv	b	Bl	V	V	II	I	m	31
CP 7a	lp	tl	pr-prcr/n	b	V	R	V	II	T	m	45
CP 7b	lp	tl	pr-prrs/n	b	V	R	V	II	T	m	48
CP 8a	rp	mc	brJ	b	V	V	P	II	T	m	23
CP 8b	rp	mc	crbr	b	V	V	P	II	T	m	20
CP 9a	lo	tl	prbleu/cr	b	V	V	V	II(IV)	T	m	27
CP 9b	lp	tl	prbleu	b	V	V	V	II(IV)	T	m	30
CP 9c	lp	tl	prcr/cr	b	V	V	V	II(IV)	T	m	32
CP10a	lp	tl	crbr/n	m	P	P	P	II	T	m	36
CP10b	rp	tl	crbr/n	b	P	P	P	II	T	m	31
CP10c	rp	tl	rs/n	m	P	P	P	II	T	m	28
CP11a	rp	tl	vcr/pr	b	Bl	V	V	II	I	m	31
CP11b	rp	tt	vbr/br	b	Bl	V	V	II	I	m	26
CP11c	rp	tt	cr/Jbr	b	Bl	V	V	II	I	m	29
CP11d	rp	tt	Jbr/br	b	Bl	V	V	II	I	m	34

continued

Table 39. Continued.

No.	Shape	Color pattern	Color	Shininess	Flower color	Stem color	Pod color	Plant type	Flowering date	Pod position	Weight of 100 seeds (grams)
CP12a	rp	tt	jbr/br	m	BL	R	V	II(IV)	I	m	27
CP12b	rp	tt	rs/cr	m	Bl	R	V	II(IV)	I	m	7 (?)
CP12c	rp	tt	cr/j	m	Bl	R	V	II(IV)	I	m	34
CP12d	rp	mc	brn	m	Bl	R	V	II(IV)	I	m	27
CP13a	lo	tl	n/cr	b	P	P	V	II	I	m	51
CP13b	ro	mc	prn	b	P	P	V	II	I	m	38
CP13c	lo	tl	n/rs	b	P	P	V	II	I	m	40
CP13d	ro	tl	vn/cr	b	P	P	V	II	I	m	38
CP13e	lo	tl	crbr/cr	b	P	P	V	II	I	m	44

MAJOR CONTRIBUTIONS

This survey of bean varieties grown in Rwanda was undertaken to obtain a better understanding of local and regional distribution of varieties as well as producer/consumer preferences of bean types. The results discussed earlier in this report demonstrate that these goals were achieved, but as is the case with most scientific research, much additional information was collected. The eight items listed below are the major contributions of this work.

(1) Techniques and appropriate materials for surveying Rwandan farmers were developed and successfully used in the national survey. Copies of all materials are included in this report.

(2) The results of the survey, including local names of important varieties, specialized cropping techniques and detailed information on production, storage and marketing, are published in this final report. Other data on varieties collected, grown, and/or tested in Rwanda by the ISAR staff are also included in the report. This document should serve as a valuable resource for further studies of bean production in Rwanda.

(3) A simple system to describe bean seeds was developed using color, color pattern, shape, size and surface appearance. Another system was developed and used to describe the growth habit, flower color, early stem color and pod color of the plants produced from each seed type.

(4) A reference collection consisting of vials containing seed, color photographs and detailed background information for each seed type was developed and stored at ISAR-Rubona. Another collection is housed at OPROVIA-Kicukiro.

(5) Viable seed of all seed types collected in the survey were provided to Dr. Pierre Nyabyenda, Head of the Vegetable Production Department at ISAR-Rubona.

(6) Rwandan technicians and other project scientists were provided opportunities to learn survey techniques as well as field plot evaluation and laboratory analysis methods.

(7) The personnel of the survey team provided important information to the employees of the insect resistance, cookability/consumer preference, traditional/alternative storage, and grain grading standard components of the Local Crops Storage Project.

(8) Portions of the data gathered in this survey have been presented at scientific meetings or published in scientific journals. Several additional publications are planned.

APPENDICES

Appendix 1. Summary of agroclimatic zones.[1]

No.	Region	Altitude (masl)[2]	Rainfall (mm)[2]	Soils	Main products	Agricultural value
1.	Imbo	970-1100-1400	1050-1200-1600	Alluvial soils	Plantain, cassava, beans, peanuts sweet potatoes, cotton, rice, sugar cane, citrus fruits	Excellent
2.	Impara	1400-1700-1900	1300-1400-2000	Heavy red soils derived from basalts	Plantains, beans, maize, sorghum sweet potatoes, cassava, peanuts, coffee, tea, quinine	Good
3.	Shores of Lake Kivu	1460-1600-1900	1150-1200-1300	Clay loam surface soils	Plantain, beans, maize, sorghum, sweet potatoes, cassava, peanuts, coffee	Bugoyi and Kanage, excellent; the others, good
4.	Lava Region	1600-2200-2500	1300-1500-1600	Volcanic soils	Plantain, beans, maize, sweet potatoes, sorghum, peas, potatoes, pyrethrum, tobacco	Excellent
5.	Zaire-Nile Divide	1900-2100-2500	1300-1600-2000	Humic, acid soils	Peas, maize, potatoes, Eleusine sp., buckwheat, summer wheat, tea sunflower, lumber	Fair
6.	Buberuka	1900-2000-2300	1100-1200-1300	Lateritic soils	Plantain, beans, sorghum, sweet potatoes, maize, potatoes, peas, summer wheat, barley	Good
7.	Central plateau	1500-1700-1900	1100-1200-1300	Different humic soils	Beans, sorghum, maize, sweet potatoes, plantain, taro, yams, coffee, soybeans	Good
8.	Granitic spine	1400-1600-1700	1050-1100-1200	Light gravelly soils	Plantain, beans, sorghum, maize, sweet potatoes, yams, taro, peanuts, cassava, coffee, livestock	Fair
9.	Mayaga	1350-1450-1500	1000-1050-1200	Clay soils derived from slates	Coffee, beans, sorghum, maize, plantain, sweet potatoes, cassava, peanuts, soybeans, (rice)	Very good
10.	Bugesera	1300-1400-1500	850- 900-1000	Clay, highly altered soils	Beans, sorghum, maize, plantain, sweet potatoes, cassava, peanuts, livestock	Poor
11.	Eastern plateau	1400-1500-1800	900- 950-1000	Lateritic soils	Beans, sorghum, maize, plantain, sweet potatoes, cassava, peanuts, coffee	Fair in the North, good in the South
12.	Eastern savannah	1250-1400-1600	800- 850- 900	Old soils of variable texture	Cassava, peanuts, beans, sorghum, maize, sweet potatoes, livestock	Very poor

[1] Nyabyenda, et al, 1981. [2] Figures given are minimum - average - maximum.

Appendix 2. Bean seed descriptors for IBPGR, CIAT and GLP, Kenya.

IBPGR	CIAT	GLP, Kenya
Seed shape:		
1. Round	1. Rounded	1. Globular
2. Oval	2. Elongated	2. Oval
3. Cuboid	3. Kidney	3. Oblong
4. Kidney		
5. Truncate fastigate		
Seed coat color pattern:		
0. Absent	1. Primary/Secondary color	1. Monocolor
1. Constant mottled	2. Hilum ring	2. Varigated[1]
2. Striped		3. Zebra
3. Rhomboid spotted		
4. Speckled		
5. Circular mottling		
6. Marginal color pattern		
7. Broad striped		
8. Bicolor		
9. Spotted bicolor		
10. Pattern around hilum		
11. Other		
Color[2] (for primary/secondary or ground/cover color):		
1. Black	1. White	1. White
2. Brown, pale to dark	2. Cream beige	2. Cream
3. Maroon	3. Yellow	3. Grey
4. Grey, brownish to greenish	4. Brown maroon	4. Yellow
5. Yellow to greenish yellow	5. Pink	5. Green
6. Pale cream to buff	6. Red	6. Pink
7. Pure white	7. Purple	7. Red
8. Whitish	8. Black	8. Brown
9. White, purple tinged	9. Other	9. Purple
10. Chlorophyll green		10. Black
11. Green to olive		
12. Red		
13. Pink		
14. Purple		
15. Other		
Shininess:		
3. Matte[3]	1. Brilliant	
5. Medium	2. Opaque	
7. Shiny		

[1] With ground and cover color and percent of testa covered by cover color.
[2] These three systems do not use multiple color codes.
[3] And intermediate types.

Appendix 3. Comparisons of several seed descriptor systems.[1]

GRENARWA II	IBPGR	CIAT	GLP, Kenya
Seed Shape			
rp	2	1	2
ro	1	1	1
lp	3, 5	2, 3	3
lo	4	2, 3	3
Seed Coat Color Pattern			
mc	0	1	1
zb	7	1	3
tt	3	1	2
tl	2	1	2
tp	4	1	2
hl-	10	2	2
v-	6, 9	1	2
Color			
n	1	8	10
bl	7	1	1
gr	4	-	3
cr	6	2	2
j	5	3	4
rg	12	6	7
rs	13	5	6
pr	14	7	9
v	11	-	5
br	2	4	8
bleu	-	-	-
Shininess			
b	7	1	not used
m	3	2	not used

[1]Numbers refer to Appendix 2 listing descriptor terms.

Appendix 4. Analysis of farm and market samples compiled by commune-seed types occurring in at least 50% of samples.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
BUTARE	Maraba	20	rp	mc	rg	b	p	95	6	6
			rp	mc	r	b	p	85	8	7
			ro	mc	r	b	p	75	8	6
			ro	mc	br	b	p	60	9	5
			ro	mc	jbr	b	p	55	4	2
			lo	mc	jbr	b	g	55	14	8
			ro	zb	cr/n	b	p	75	6	5
			rp	tt	cr/n	b	p	85	9	8
			ro	hln	j	b	g	65	4	3
	Muyira	8	lo	mc	jbr	b	g	63	5	3
			lo	zb	jbr/n	b	g	75	16	12
			ro	hln	j	b	g	63	8	5
			lo	hln	j	b	g	50	12	6
			lo	hln	jv	b	g	50	10	5
	Muyira (mkt)	3	lo	mc	jbr	b	g	67	11	7
			lo	zb	jbr/n	b	g	67	8	5
			ro	hln	j	b	g	67	19	13
			lo	hln	j	b	g	67	3	2
			lo	hln	jv	b	g	67	54	36
BYUMBA	Buyoga	8	lp	mc	rg	b	g	63	10	6
			rp	mc	n	m	p	50	2	1
			lp	mc	rgn	b	g	100	5	5
			lp	zb	cr/n	b	g	88	7	6
			lo	tl	rg/cr	b	g	75	26	20
			rp	tp	cr/pr	b	g	63	3	2
	Bwisige	5	lp	mc	rg	b	g	60	8	5
			rp	mc	n	m	p	80	7	6
			rp	mc	jbr	b	p	60	4	2
			lp	zb	cr/n	b	g	60	7	4
			ro	zb	bl/n	b	p	60	7	4
			rp	tt	cr/n	b	p	80	21	17
	Cyungo	8	lp	mc	rg	b	g	88	4	4
			rp	mc	n	m	p	50	6	3
			lp	mc	rgn	b	g	63	8	5
			lp	zb	cr/n	b	g	63	7	4
			lo	tl	rg/cr	b	g	63	37	23
			rp	tt	cr/n	b	p	50	4	2
	Cyungo (mkt)	1	rp	mc	rg	b	p	100	2	2
			lp	mc	rg	b	g	100	7	7
			lp	mc	n	b	g	100	3	3
			ro	mc	br	b	p	100	12	12
			lp	mc	pr	b	p	100	4	4
			rp	mc	jbr	b	p	100	4	4
			ro	mc	rgn	b	g	100	4	4
			lp	mc	rgn	b	g	100	10	10
			rp	mc	crbr	b	p	100	2	2
			lp	zb	cr/n	b	p	100	7	7
			lo	tl	rg/cr	b	g	100	9	9
			lp	tl	pr/cr	b	g	100	3	3
			lp	tp	cr/n	b	g	100	4	4

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
BYUMBA (continued)	Kibali	5	rp	mc	rg	b	p	100	3	3
			ro	mc	br	b	p	60	7	4
			rp	mc	jbr	b	p	60	4	2
			ro	mc	rgn	b	p	100	7	7
			lp	mc	rgn	b	g	100	18	18
			rp	mc	crpr	b	p	80	2	2
			lp	zb	cr/n	b	g	80	9	7
			lo	tl	rg/cr	b	g	80	4	3
			lp	tp	cr/n	b	g	60	5	3
	Kibali (mkt)	3	rp	mc	rg	b	p	67	2	1
			lp	mc	rg	b	p	67	7	5
			rp	mc	n	b	p	67	8	5
			lp	mc	n	b	p	67	2	1
			ro	mc	br	b	p	67	3	2
			lp	mc	pr	b	g	67	7	5
			ro	mc	rgn	b	p	67	3	2
			lp	mc	rgn	b	g	100	9	9
			rp	mc	crbr	b	p	67	10	7
			lo	tl	rg/cr	b	g	100	23	23
			rp	tt	cr/n	b	p	100	2	2
			ro	hln	jbr	b	g	67	3	2
	Kinyami	5	rp	mc	rg	b	p	100	5	5
			lp	mc	rg	b	p	80	17	14
			rp	mc	n	b	p	60	10	6
			rp	mc	n	m	p	60	4	2
			lp	mc	n	b	g	80	5	4
			ro	mc	br	b	p	100	5	5
			ro	mc	rgn	b	p	80	3	2
			lp	mc	rgn	b	p	60	7	4
			rp	mc	crbr	b	p	80	3	2
			lp	zb	cr/n	b	p	100	6	6
			rp	tt	cr/n	b	p	80	3	2
			rp	tt	cr/brv	b	p	60	2	1
			ro	hln	j	b	p	60	3	2
	Kiyombe	5	lp	mc	rg	b	g	100	16	16
			lp	mc	pr	b	g	100	6	6
			lp	mc	rgn	b	g	100	31	31
			lp	zb	cr/n	b	g	80	6	5
			lo	tl	rg/cr	b	g	60	28	17
	Muhura	8	rp	mc	rg	b	p	50	2	1
			lp	mc	n	b	g	67	2	1
			rp	mc	n	m	p	67	4	3
			ro	mc	br	b	p	75	8	6
			lp	mc	pr	b	g	50	4	2
			rp	mc	crbr	b	p	50	2	1
			ro	zb	cr/n	b	p	75	2	2
			lp	zb	cr/n	b	g	88	3	3
			lo	zb	bl/n	b	g	50	5	3
			rp	tt	cr/n	b	p	88	11	10
	Murambi	6	rp	mc	rg	b	p	83	16	13
			rp	mc	rg	m	p	67	3	2
			lp	mc	n	b	g	50	3	2
			rp	mc	n	m	p	83	5	4

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
BYUMBA (continued)	Murambi (continued)		ro	mc	br	b	p	50	5	3
			rp	mc	jbr	b	p	50	3	2
			lp	mc	rgn	b	g	67	4	3
			lo	tl	rg/cr	b	g	83	3	2
			lp	hijbr	cr	b	g	50	18	9
	Muvumba	10	lp	mc	rg	b	g	70	35	25
			lp	mc	n	b	g	50	2	1
			lp	mc	pr	b	g	70	7	5
			rp	mc	rgn	b	p	50	3	2
			lp	mc	rgn	b	g	80	13	10
			lp	zb	cr/br	b	g	60	21	13
			rp	tt	cr/br	b	p	50	7	4
CYANGUGU	Bugerama	5	rp	mc	rgn	m	p	60	41	25
			lp	tl	cr/rg	b	p	80	27	22
	Bugerama (mkt)	4	rp	mc	rg	b	p	50	3	2
			rp	mc	n	b	p	50	3	2
			rp	mc	rsbr	m	p	75	11	8
			rp	mc	rgn	b	p	50	4	2
			rp	mc	rgn	m	p	75	8	6
			ro	tl	cr/rg	b	p	75	23	17
			lp	tl	cr/rg	b	p	50	16	8
			lp	tp	cr/n	b	g	50	5	3
			ro	hln	j	b	g	50	3	2
	Cyimbogo	8	ro	mc	n	b	p	63	10	6
			ro	mc	br	b	p	100	14	14
			rp	mc	rsbr	m	p	75	5	4
			rp	mc	rgn	b	p	50	5	3
			rp	mc	rgn	m	p	75	15	11
			ro	mc	jbrbr	b	p	50	3	2
			ro	tp	cr/n	b	g	63	4	3
			lp	tp	cr/n	b	g	100	8	8
	Cyimbogo (mkt)	3	ro	mc	cr	b	p	67	3	2
			ro	mc	jbr	b	p	67	3	2
			lo	mc	jbr	b	g	67	2	1
			rp	mc	rgn	b	p	67	6	4
			rp	mc	rgn	m	p	67	10	7
			rp	mc	jbrbr	b	p	67	4	3
			ro	tl	cr/rg	b	g	67	24	16
			lp	tl	cr/rg	b	g	67	21	14
			lo	hln	br	b	g	67	3	2
	Gafunzo	5	lp	mc	rg	b	g	60	3	2
			rp	mc	n	b	p	60	15	9
			lp	mc	n	b	g	60	6	4
			ro	mc	br	b	p	80	20	16
			rp	mc	rsbr	m	p	60	6	4
			rp	mc	rgn	b	p	80	12	10
			lp	zb	cr/n	b	p	60	14	8
			ro	hln	j	b	p	60	6	4
	Gafunzo (mkt)	2	rp	mc	rg	b	p	100	4	4
			rp	mc	n	b	p	100	12	12
			rp	mc	rsbr	m	p	100	25	25
continued			lo	tl	rg/cr	b	p	100	6	6

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
CYANGUGU (continued)	Gatare	5	rp	mc	rg	b	p	60	33	20
			rp	mc	n	b	p	60	10	6
			ro	mc	br	b	p	80	7	6
			rp	mc	rsbr	m	p	80	20	16
			ro	tl	cr/rg	b	g	60	2	1
			lp	tp	cr/n	b	g	60	7	4
	Gishoma	10	rp	mc	rg	b	p	50	2	1
			rp	mc	n	m	p	50	6	3
			ro	mc	br	b	p	90	23	21
			lo	mc	jbr	b	g	50	4	2
			rp	mc	rsbr	m	p	90	10	9
			rp	mc	rgn	m	p	70	12	8
			ro	tp	cr/n	b	g	60	5	3
	Gishoma (mkt)	3	rp	mc	jbr	b	p	67	10	7
			rp	mc	rgn	m	p	67	28	19
			rp	mc	crrs	b	p	67	2	1
			rp	mc	rgn	b	p	67	18	12
			lp	tp	cr/pr	b	g	67	5	3
			lp	tp	cr/n	b	g	67	6	4
			lo	hln	jbr	b	g	67	8	5
	Gisuma	5	rp	mc	n	b	p	60	6	4
			ro	mc	br	b	p	80	13	10
			rp	mc	rsbr	m	p	60	4	2
			lo	tl	rg/cr	b	p	60	5	3
			ro	tp	cr/n	b	p	60	9	5
	Gisuma (mkt)	3	rp	mc	rg	b	p	67	5	3
			rp	mc	n	b	p	100	6	6
			rp	mc	n	m	p	67	3	2
			lp	mc	n	b	g	67	8	5
			rp	mc	br	b	g	100	7	7
			rp	mc	jbr	m	p	67	2	1
			rp	mc	rsbr	m	p	67	3	2
			rp	mc	rgn	m	p	100	7	7
			rp	mc	rscr	b	p	100	4	4
			rp	mc	jbrbr	b	p	67	9	6
			ro	tp	cr/n	b	g	67	2	1
			lp	tp	cr/n	b	g	100	5	5
	Kagano	9	lo	mc	rg	b	g	56	4	2
			ro	mc	n	b	p	56	6	3
			lo	tl	rg/cr	b	g	56	37	21
			lp	tl	cr/pr	b	g	56	28	16
			lp	tp	cr/n	b	g	100	10	10
	Kamembe	12	rp	mc	rg	b	p	67	2	1
			lp	mc	n	b	g	67	7	5
			ro	mc	br	b	g	83	6	5
			ro	mc	bl	b	p	50	2	1
			rp	mc	rsbr	m	p	67	6	4
			rp	mc	rgn	m	p	58	11	6
			lp	tp	cr/n	b	g	67	5	3
			ro	tp	cr/n	b	g	50	5	3

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
CYANGUGU	Kamembe	2	rp	mc	n	b	p	100	11	11
(continued)	(mkt)		ro	mc	br	b	p	100	5	5
			rp	mc	rgn	m	p	100	24	24
			ro	tp	cr/n	b	g	100	4	4
			ro	hln	jbr	b	p	100	2	2
			ro	hln	br	b	p	100	4	4
	Karengera	4	rp	mc	rg	b	p	50	3	2
			rp	mc	n	b	p	75	8	6
			rp	mc	n	m	p	75	5	4
			ro	mc	br	b	p	75	5	4
			rp	mc	jbr	b	p	50	6	3
			rp	mc	rsbr	m	p	75	7	5
			rp	mc	rgn	m	p	50	2	1
			rp	mc	crrs	b	p	50	7	4
			lp	mc	rgn	b	g	50	11	6
			ro	zb	cr/n	b	p	50	2	1
			rp	tt	cr/n	b	p	75	11	8
			lp	tp	cr/pr	b	g	100	5	5
			ro	tp	cr/n	b	g	50	3	2
			ro	hln	j	b	p	50	3	2
	Karengera	4	rp	mc	rg	b	p	75	13	10
	(mkt)		lp	mc	n	b	g	100	4	4
			rp	mc	bl	b	p	75	15	11
			lp	mc	pr	b	g	100	5	5
			rp	mc	rgbr	b	g	50	3	2
			rp	mc	nbrv	b	p	50	8	4
			lp	zb	cr/n	b	g	100	21	21
			lp	tp	cr/n	b	g	100	6	6
			lo	hln	br	b	g	50	3	2
	Nyakabuye	6	lp	mc	n	b	p	50	21	11
			ro	mc	br	b	p	67	4	3
			rp	mc	jbr	b	p	50	3	2
			rp	mc	rgn	m	p	67	44	29
			lp	zb	jbr/br	b	g	50	3	2
			lp	tp	cr/pr	b	g	50	4	2
			ro	hln	j	b	g	50	12	6
	Nyakabuye	3	lp	mc	rg	b	g	67	3	2
	(mkt)		lp	mc	rgn	b	g	67	8	5
			lp	tl	cr/rg	b	p	67	6	4
			ro	tl	cr/rgn	b	p	67	5	3
			lp	tp	cr/pr	b	g	67	31	21
GIKONGORO	Karama	7	rp	mc	rg	b	p	71	14	10
			lp	mc	rg	b	g	57	3	2
			ro	mc	n	b	p	100	14	14
			lp	mc	n	b	p	86	8	7
			ro	mc	jbr	b	p	71	5	4
			lp	zb	cr/n	b	g	57	7	4
			lp	zb	rg/n	b	p	71	3	2
			rp	tt	cr/n	b	p	71	4	3
	Karama	2	ro	mc	n	b	p	100	12	12
	(mkt)		ro	mc	jbr	b	p	100	3	3
			rp	tt	cr/n	b	p	100	4	4
continued			ro	hln	j	b	p	100	2	2

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
GIKONGORO (continued)	Kinyamakara	9	rp	mc	rg	b	p	78	12	9
			lp	mc	rg	b	g	67	8	5
			ro	mc	n	b	p	78	5	4
			lp	mc	n	b	p	67	7	5
			ro	mc	br	b	p	78	6	5
			rp	mc	cr	b	p	67	7	5
			lp	mc	pr	b	g	56	4	2
			ro	mc	jbr	b	p	67	2	1
			lo	mc	jbr	b	g	100	6	6
			rp	tt	cr/n	b	p	78	6	5
			ro	hln	j	b	g	89	3	3
			lo	hln	j	b	g	67	3	2
	Musange	7	ro	mc	rg	b	p	71	12	9
			ro	mc	n	b	p	86	11	9
			lo	mc	n	b	g	57	18	10
			ro	mc	br	b	p	57	5	3
			ro	mc	jbr	b	p	71	3	2
			rp	mc	crbr	b	p	57	9	5
			ro	zb	cr/n	b	p	71	4	3
			rp	tt	cr/n	b	p	57	8	5
	Musange (mkt)	4	rp	mc	rg	b	p	75	19	14
			lo	mc	rg	b	g	75	7	5
			ro	mc	n	b	p	75	6	5
			lo	mc	n	b	p	100	17	17
			ro	mc	br	b	p	50	6	3
			rp	mc	cr	b	p	50	2	1
			lo	mc	jbr	b	p	75	2	2
			ro	mc	rscr	b	p	50	2	1
			ro	zb	cr/n	b	p	50	3	2
			ro	zb	bl/n	b	p	50	3	2
			lo	tl	rg/cr	b	g	75	8	6
			rp	tt	cr/n	b	g	75	3	2
	Rukondo	12	rp	mc	rg	b	p	67	7	5
			lo	mc	rg	b	g	75	11	8
			ro	mc	n	b	p	92	13	12
			lo	mc	n	b	g	92	12	11
			rp	mc	cr	b	g	83	7	6
			lo	mc	jbr	b	g	58	4	2
			lp	zb	cr/n	b	g	75	6	5
			lo	zb	rg/n	b	p	50	5	3
			ro	hln	j	b	g	50	4	2
	Rukondo (mkt)	3	rp	mc	rg	b	p	100	8	8
			lp	mc	rg	b	g	100	4	4
			ro	mc	n	b	p	100	10	10
			lo	mc	n	b	g	67	14	9
			ro	mc	jbr	b	p	100	4	4
			lo	mc	jbr	b	p	100	3	3
			ro	zb	cr/n	b	p	67	6	4
			lp	zb	cr/n	b	p	67	3	2
			lp	zb	rg/n	b	p	67	7	5
			lp	tl	cr/rg	b	p	67	3	2
			ro	tl	cr/pr	b	p	67	2	1
			rp	tt	cr/n	b	p	67	4	3
			ro	hln	j	b	p	100	2	2

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
GISENYI	Kanama	8	lp	mc	rg	b	g	75	25	19
			lp	mc	pr	b	p	63	24	15
	Kanama (mkt)	3	lp	mc	rg	b	g	67	18	12
			lp	mc	cr	b	p	67	8	5
			lp	mc	pr	b	g	100	12	12
			lp	tl	cr/n	b	g	100	13	13
			lp	tp	cr/n	b	p	67	21	14
	Kayove	8	lp	mc	cr	b	g	63	48	30
			lp	zb	cr/n	b	g	75	12	9
			lp	tl	cr/n	b	g	50	21	11
			lp	tp	cr/n	b	g	88	3	3
	Kayove (mkt)	5	lp	mc	rg	b	g	100	6	6
			lp	mc	cr	b	g	80	35	30
			lp	tl	cr/n	b	g	80	28	22
			lp	tp	cr/n	b	g	80	6	5
	Mutura	3	ro	mc	br	b	p	67	3	2
			lp	mc	pr	b	g	67	6	4
			lp	zb	cr/n	b	g	67	18	12
			ro	tl	rs/n	b	p	67	13	9
	Mutura (mkt)	12	ro	hln	j	b	g	100	7	7
	Nyamyumba	9	lp	zb	cr/n	b	g	89	25	22
			lp	mc	cr	m	g	89	23	20
			lp	tp	cr/n	b	g	78	7	5
			lp	mc	pr	b	g	89	5	4
			lp	mc	bleun	b	g	67	5	3
			lp	mc	rg	b	g	56	5	3
	Nyamyumba (mkt)	2	rp	mc	rg	b	p	100	8	8
			lp	mc	rg	b	p	100	17	17
			lp	mc	pr	b	p	100	14	14
			lp	mc	jbr	b	p	100	4	4
			lp	zb	rs/pr	b	p	100	8	8
			lp	tl	cr/n	b	p	100	13	13
			lp	tp	cr/n	b	p	100	12	12
	Rubavu	5	rp	mc	rg	b	p	80	29	23
			lp	mc	rg	b	g	80	28	22
			lp	mc	pr	b	g	100	17	17
			lp	tp	cr/n	b	g	60	5	3
	Rubavu (mkt)	2	lp	mc	pr	b	g	100	10	10
			lp	tp	cr/n	b	g	100	3	3
	Satinsyi	12	lp	mc	pr	b	g	58	6	3
			lp	zb	cr/n	b	g	50	13	7
			lp	tp	cr/n	b	g	58	10	6
GITARAMA	Kigoma	6	ro	mc	rg	b	p	67	10	7
			lp	mc	rg	b	g	50	7	4
			lo	mc	rg	b	g	50	8	4
			ro	mc	n	b	g	67	3	2

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
GITARAMA (continued)	Kigoma (continued)		ro	mc	gr	b	g	67	9	6
			lo	mc	jbr	b	g	50	9	5
			lo	zb	jbr/n	b	g	67	5	3
			lo	tl	rg/cr	b	g	67	17	11
			rp	tt	cr/n	b	p	50	3	2
			ro	tt	cr/brv	m	p	50	10	5
			ro	hln	j	b	g	100	5	5
			lo	hln	j	b	g	67	3	2
			lo	hln	jv	b	g	67	6	4
			lp	hln	br	b	g	83	11	9
	Mushubati	10	rp	mc	rg	b	p	50	8	4
			ro	mc	n	b	p	50	18	9
			ro	mc	br	b	p	60	8	5
			lp	mc	pr	b	g	50	6	3
			lp	tl	cr/pr	b	g	50	4	2
			rp	tt	cr/n	b	p	50	11	6
	Mushubati (mkt)	2	rp	mc	rg	b	p	100	6	6
			lo	mc	rg	b	g	100	4	4
			ro	mc	gr	b	g	100	4	4
			ro	zb	cr/n	b	p	100	2	2
			rp	tt	cr/n	b	p	100	9	9
			lp	hln	br	b	g	100	3	3
	Ntongwe	11	lo	mc	rg	b	g	73	6	4
			ro	mc	n	b	p	55	3	2
			ro	mc	gr	b	p	73	35	26
			lp	zb	cr/n	b	p	82	3	2
			lo	zb	jbr/n	b	g	91	9	8
			ro	tt	cr/brv	m	p	55	3	2
			ro	hln	j	b	g	91	7	6
			lo	hln	jv	b	g	82	9	7
	Tambwe	7	rp	mc	rg	b	p	57	3	2
			lo	mc	rg	b	g	86	9	8
			ro	mc	n	b	p	57	4	2
			lo	mc	n	b	p	71	6	4
			ro	mc	gr	b	p	86	17	15
			lp	zb	cr/n	b	g	57	5	3
			ro	hln	j	b	g	86	15	13
			lo	lhn	j	b	g	71	2	1
			lo	hln	jv	b	g	71	5	4
KIBUNGO	Birenga	15	rp	mc	rg	m	p	60	18	11
			lo	mc	rg	b	g	53	18	10
			lo	tl	rg/cr	b	g	60	24	14
			ro	tl	cr/rg	b	g	67	28	19
	Birenga (mkt)	2	lp	mc	rs	b	g	100	5	5
			lo	tl	rg/n	b	g	100	45	45
	Kabarondo	10	lo	mc	rg	b	g	60	11	7
			rp	mc	rg	m	p	70	14	10
			ro	mc	br	b	p	80	13	10
			lp	mc	pr	b	g	60	8	5
			rp	mc	jbr	m	p	60	2	1

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
KIBUNGO (continued)	Kayonza	7	rp	mc	rg	b	p	57	8	5
			lo	mc	rg	b	g	71	6	4
			rp	mc	rg	m	p	86	16	14
			ro	mc	br	b	p	57	10	6
			lp	mc	pr	b	g	57	10	6
	Kayonza (mkt)	3	rp	mc	rg	b	p	67	3	2
			lp	mc	rg	b	g	100	21	21
			rp	mc	cr	m	p	67	2	1
			rp	mc	n	m	p	67	3	2
			lp	mc	cr	b	g	67	2	1
			lp	mc	rs	b	g	67	2	1
			lp	mc	pr	b	g	100	6	6
			rp	mc	rsrg	m	p	67	8	5
			lp	zb	cr/n	b	p	67	11	7
	Kigarama	16	rp	mc	rg	m	p	75	14	11
			rp	mc	n	m	p	56	4	2
			lp	mc	pr	b	g	69	4	3
			rp	mc	crrs	b	p	63	4	3
			lo	tl	rg/cr	b	g	50	38	19
			ro	tl	cr/rg	b	g	50	10	5
	Mugesera	8	rp	mc	rg	m	p	50	33	17
			rp	mc	n	m	p	63	3	2
			rp	mc	rscr	m	p	50	4	2
			lo	tl	rg/cr	b	g	50	36	18
	Mugesera (mkt)	3	rp	mc	rg	m	p	67	7	5
			lp	mc	rg	b	g	67	10	7
			rp	mc	n	m	p	100	4	4
			lp	mc	cr	b	p	67	11	7
			lp	mc	cr	m	g	67	2	1
			lp	mc	pr	b	g	100	3	3
			rp	mc	jbr	m	p	67	4	3
			lp	zb	cr/n	b	g	67	6	4
			lo	tl	rg/n	b	g	67	31	21
	Muhazi	7	rp	mc	rg	b	p	86	15	13
			rp	mc	rg	m	p	57	40	23
			lo	mc	rg	b	g	57	13	7
			rp	mc	n	b	p	57	3	2
			rp	mc	n	m	p	57	4	2
			ro	mc	br	b	p	57	11	6
			lp	mc	rs	b	g	57	2	1
			lp	mc	pr	b	g	86	4	3
			rp	mc	jbr	m	p	57	2	1
			rp	mc	rsbr	m	p	57	3	2
	Rukara	7	rp	mc	n	m	p	57	6	4
	Rukara (mkt)	3	rp	mc	rg	b	p	100	33	33
			lp	mc	rg	b	g	67	10	7
			lp	mc	n	b	p	67	6	4
			lp	mc	cr	b	g	67	2	1
			lp	mc	pr	b	g	67	5	3
			lo	tl	rg/cr	b	g	67	8	5
			lp	hln	jbr	b	g	67	21	14

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
KIBUNGO (continued)	Rukira	8	rp	mc	rg	m	p	63	2	1
			rp	mc	n	m	p	63	6	4
			lp	mc	rs	b	g	50	8	4
			lp	mc	pr	b	g	63	7	4
			rp	mc	jbr	m	p	50	3	2
			lo	tl	rg/cr	b	g	50	31	16
	Rusumo	13	rp	mc	rg	b	p	69	3	2
			rp	mc	rg	m	p	69	8	5
			lo	mc	rg	b	g	54	15	8
			lp	mc	pr	b	g	54	5	3
			ro	mc	jbr	b	p	54	11	6
	Rusumo (mkt)	3	rp	mc	rg	b	p	67	14	9
			rp	mc	n	m	p	100	3	3
			lp	mc	pr	b	p	100	3	3
			lp	mc	jbr	b	p	100	3	3
			ro	mc	jbr	b	p	100	21	21
			ro	mc	rgn	b	p	67	3	2
			lp	mc	rgn	b	g	67	18	12
			rp	mc	crrs	b	p	67	4	3
			rp	mc	crj	b	p	67	3	2
			rp	mc	rsrg	m	p	67	6	4
			rp	tt	cr/brv	b	p	67	2	1
	Rusumo (cmc)	3	lp	mc	rg	b	g	67	7	5
			rp	mc	n	m	p	67	2	1
			lp	mc	cr	b	g	67	2	1
			lp	zb	jbr/n	b	g	67	15	10
			lp	tp	cr/pr	b	p	67	29	19
			ro	hln	j	b	p	67	5	3
			lo	hln	jv	b	g	100	30	30
			ro	hln	jbr	b	p	67	5	3
	Rutonde	11	lp	mc	cr	b	g	55	9	5
			lp	mc	pr	b	g	73	12	9
			rp	mc	jbr	m	p	55	2	1
			lp	tl	rg/cr	b	g	91	19	17
	Rutonde (mkt)	3	rp	mc	rg	b	p	67	2	1
			rp	mc	rg	m	p	67	2	1
			lp	mc	rg	b	g	67	27	18
			rp	mc	n	m	p	100	2	2
			rp	mc	jbr	b	p	67	2	1
			lp	mc	rgn	b	g	67	16	11
			lo	tl	rg/cr	b	g	67	7	5
			ro	tl	cr/rg	b	g	67	18	12
	Sake	13	lo	tl	rg/cr	b	g	69	30	21
	Sake (mkt)	3	lp	mc	cr	b	g	67	8	5
			ro	mc	jbr	b	g	67	29	19
			lp	mc	jbr	b	g	67	2	1
			lo	hln	j	b	g	67	3	2
KIBUYE	Gishyita	7	rp	mc	rg	b	p	71	7	5
			rp	mc	n	b	p	57	13	7
			ro	mc	n	b	p	57	10	6

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
KIBUYE (continued)	Gishyita (continued)		ro	mc	br	b	p	100	10	10
			lo	mc	rg	b	g	57	11	6
			rp	mc	rsbr	m	p	86	9	8
			ro	mc	jbrbr	b	p	71	3	2
			lo	tl	rg/cr	b	g	57	33	19
			ro	tp	cr/n	b	p	57	9	5
			ro	hln	j	b	g	71	3	2
	Kivumu	6	rp	mc	rg	b	p	67	6	4
			lp	mc	rg	b	p	50	3	2
			lp	mc	n	b	g	50	25	13
			lp	mc	pr	b	g	83	9	7
			rp	mc	jbr	b	p	50	2	1
			lo	mtl	rg/cr	b	g	50	9	5
			rp	tt	cr/n	b	p	50	6	3
			ro	hln	j	b	p	50	3	2
	Kivumu (mkt)	3	rp	mc	rg	b	p	100	12	12
			rp	mc	n	b	p	100	5	5
			ro	mc	n	b	p	67	6	4
			lp	mc	pr	b	g	100	18	18
			rp	mc	jbr	b	p	67	3	2
			rp	mc	crbr	b	g	67	3	2
			lp	zb	cr/n	b	p	100	4	4
			ro	hln	j	b	p	100	3	3
			lo	hln	jv	b	g	67	7	5
	Mabanza	9	rp	mc	rg	b	p	67	17	11
			ro	mc	br	b	p	67	2	1
			lp	mc	pr	b	g	78	19	15
			lp	zb	cr/n	b	p	56	4	2
			lo	tl	rg/cr	b	g	67	15	10
			ro	tt	cr/n	b	p	56	9	5
			lo	hln	j	b	g	56	5	3
	Rwamatamu	4	rp	mc	rg	b	p	75	5	4
			rp	mc	n	b	p	50	17	9
			ro	mc	n	b	p	50	7	4
			ro	mc	br	b	p	100	15	15
			ro	mc	bl	b	p	50	2	1
			rp	mc	rsbr	m	p	75	6	5
			ro	mc	rgn	b	p	75	11	8
			rp	mc	jbrbr	b	p	50	7	4
			lp	tl	cr/rg	b	g	50	2	1
			rp	tt	cr/n	b	p	50	4	2
			ro	tp	cr/n	b	p	75	17	13
			ro	hln	j	b	g	50	5	3
	Rwamatamu (mkt)	5	rp	mc	rg	b	p	80	3	2
			rp	mc	rsbr	m	p	60	6	4
			rp	mc	rscr	b	p	60	10	6
			lo	tl	rg/cr	b	g	60	25	15
			ro	hln	j	b	g	60	3	2
KIGALI	Bicumbi	10	rp	mc	rg	m	p	50	3	2
			ro	mc	br	b	p	50	3	2
			rp	mc	crrs	m	p	50	13	7
			rp	mc	crbr	b	p	50	5	3

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
KIGALI (continued)	Bicumbi (continued)		lp	zb	cr/n	b	g	60	6	4
			rp	tt	cr/n	b	p	70	6	4
	Bicumbi (mkt)	3	rp	mc	rg	b	p	100	11	11
			lp	mc	rg	b	g	100	7	7
			ro	mc	br	b	p	67	9	6
			lp	mc	cr	b	p	67	2	1
			lp	mc	pr	b	p	67	7	5
			rp	mc	rsbr	m	p	67	3	2
			lp	mc	rgbr	b	p	67	3	2
			rp	mc	rscr	b	p	100	2	2
			rp	mc	crbr	b	p	67	2	1
			lp	zb	cr/n	b	p	67	2	1
			lo	tl	rg/cr	b	g	67	12	8
	Kanombe	8	lp	mc	rg	b	g	75	7	5
			lp	mc	pr	b	g	100	25	25
			ro	mc	jbr	b	p	88	6	5
			lp	zb	cr/n	b	p	63	2	1
			lp	tl	rg/cr	b	g	50	7	4
			ro	hln	j	b	p	50	4	2
			lo	hln	j	b	p	50	4	2
			lo	hln	jv	b	g	75	23	17
	Kanzenze	13	lo	mc	rg	b	p	62	6	4
			ro	mc	jbr	b	p	100	7	7
			lo	mc	pr	b	g	85	5	4
			rp	mc	crbr	b	p	69	6	4
			lp	zb	cr/n	b	p	62	3	2
			lp	zb	jbr/n	b	g	62	8	5
			lp	tl	cr/pr	b	g	69	16	11
			rp	tt	cr/n	b	p	62	9	6
			ro	hln	j	b	p	100	9	9
			lo	hln	j	b	g	69	4	3
			lo	hln	jv	b	g	92	7	6
	Kanzenze (mkt)	3	ro	mc	br	b	p	67	2	1
			lo	mc	pr	b	p	67	4	3
			ro	mc	jbr	b	p	100	8	8
			rp	mc	rsbr	m	p	67	9	6
			rp	mc	rscr	b	p	100	21	21
			rp	mc	crbr	b	p	100	3	3
			lp	zb	cr/n	b	p	100	4	4
			lo	zb	jbr/n	b	g	67	5	3
			lp	tl	cr/pr	b	g	100	18	18
			rp	tt	cr/n	b	p	100	5	5
			ro	hln	j	b	p	67	3	2
			lo	hln	j	b	p	67	3	2
			lo	hln	jv	b	g	67	9	6
	Mugambazi	7	rp	mc	rg	b	p	86	5	4
			rp	mc	n	m	p	86	5	4
			ro	mc	br	b	p	71	21	15
			ro	mc	jbr	b	g	57	3	2
			rp	mc	jbr	b	p	57	2	1
			ro	mc	rgn	b	p	71	2	1
			lp	mc	rgn	b	g	86	6	5
			lp	zb	cr/n	b	g	57	6	3
continued			lo	tl	rg/cr	b	g	57	18	10

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
KIGALI (continued)	Mugambazi (mkt)	2	rp	mc	n	b	p	100	4	4
			ro	mc	br	b	p	100	7	7
			ro	hln	j	b	g	100	6	6
			lo	hln	j	b	g	100	4	4
	Ngenda	15	lo	mc	rg	b	g	60	6	4
			ro	mc	n	b	p	50	2	1
			ro	mc	jbr	b	p	60	3	2
			lo	mc	jbr	b	g	60	5	3
			rp	mc	crbr	b	p	67	7	5
			lo	zb	jbr/n	b	g	80	19	15
			rp	tt	cr/n	b	p	60	8	5
			ro	tt	cr/n	m	p	50	3	2
	Ngenda (mkt)	3	lo	mc	rg	b	p	67	3	2
			ro	mc	n	b	p	67	2	1
			ro	mc	br	b	p	100	1	1
			ro	mc	bl	b	p	67	4	3
			lp	mc	pr	b	g	67	3	2
			rp	mc	jbr	b	p	67	10	7
			ro	mc	jbr	b	p	67	2	1
			lo	mc	jbr	b	g	67	4	3
			lo	zb	jbr/n	b	g	100	20	20
			lo	zb	cr/jbr	b	g	67	2	1
			rp	tt	cr/n	b	p	67	6	4
			ro	tt	cr/brv	m	p	67	2	1
			lp	tp	cr/n	b	p	100	6	6
			ro	hln	j	b	p	67	2	1
			lo	hln	j	b	p	67	2	1
			lo	hln	jv	b	g	67	7	5
	Rubungo	6	lp	mc	rg	b	g	50	20	10
			lp	mc	pr	b	g	83	14	12
			ro	mc	jbr	b	p	67	2	1
			rp	mc	crbr	b	p	50	4	2
			lo	tl	rg/cr	b	g	50	11	6
			rp	tt	cr/n	b	p	50	4	2
			ro	hln	j	b	g	50	8	4
			lo	hln	j	b	p	50	4	2
	Rubungo (mkt)	3	rp	mc	rg	b	p	67	2	1
			lp	mc	rg	b	g	100	21	21
			ro	mc	br	b	p	100	7	7
			rp	mc	cr	b	p	67	2	1
			ro	mc	gr	b	g	67	6	4
			lp	mc	pr	b	p	67	6	4
			ro	mc	jbr	b	p	67	8	5
			lo	mc	jbr	b	p	67	9	6
			rp	mc	crbr	b	p	67	4	3
			lp	zb	cr/n	b	g	100	3	3
			lp	tl	rg/cr	b	g	100	8	8
			rp	tt	cr/n	b	p	67	2	1
			lo	hln	jv	b	g	67	8	5
	Rushashi	5	rp	mc	rg	b	p	60	3	2
			rp	mc	n	b	p	60	4	2
			rp	mc	n	b	p	100	2	2
			ro	mc	br	b	p	60	8	5

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
KIGALI (continued)	Rushashi (continued)		rp	mc	rscr	b	p	80	4	3
			lo	tl	jbr/rg	b	g	60	15	9
			rp	tt	crrs/rs-rg	b	p	80	15	12
	Rushashi (mkt)	3	rp	mc	rg	m	p	67	3	2
			ro	mc	br	b	p	67	12	8
			ro	zb	cr/n	b	p	67	2	1
			lo	tl	jbr/rg	b	g	100	36	36
	Rutongo	6	lp	mc	rg	b	g	50	6	3
			rp	mc	n	b	p	67	5	3
			rp	mc	n	m	p	50	14	7
			ro	mc	br	b	p	67	6	4
			ro	mc	rgn	b	p	50	2	1
			lp	mc	rgn	b	g	67	4	3
			lp	zb	cr/n	b	g	50	4	2
			lo	tl	rg/cr	b	g	83	15	12
			ro	hln	j	b	g	50	4	2
	Rutongo (mkt)	3	rp	mc	rg	b	p	100	10	10
			rp	mc	rg	m	p	67	7	5
			lp	mc	rg	b	g	100	5	5
			ro	mc	n	b	p	67	9	6
			ro	mc	br	b	p	67	7	5
			ro	mc	rgn	b	p	67	3	2
			lp	mc	rgn	b	g	67	5	3
			ro	mc	crbr	b	p	67	2	1
			lp	zb	cr/n	b	p	67	5	3
			lo	tl	rg/cr	b	g	100	14	14
			ro	hln	j	b	p	67	2	1
	Tare	8	lp	mc	rgn	b	g	63	10	6
			rp	mc	rscr	b	p	50	2	1
			ro	hln	j	b	g	63	4	3
			ro	hln	jbr	b	g	63	14	9
	Tare (mkt)	3	rp	mc	rg	b	p	67	5	3
			rp	mc	n	m	p	100	9	9
			ro	mc	n	b	p	67	4	3
			ro	mc	br	b	p	67	8	5
			ro	mc	jbr	b	p	67	10	7
			rp	mc	crrs	b	p	67	2	1
			ro	zb	cr/n	b	p	100	2	2
			lp	zb	cr/n	b	p	100	4	4
			lo	tl	jbr/rg	b	p	67	2	1
RUHENGERI	Cyabingo	9	lp	mc	n	b	g	78	10	8
			rp	mc	cr	b	p	56	22	12
			lp	tl	cr/n	b	g	89	17	15
	Cyeru	5	lp	mc	rg	b	g	80	6	5
			rp	mc	n	b	p	60	2	1
			ro	mc	br	b	p	80	4	3
			lp	mc	pr	b	g	80	4	3
			lp	mc	rgn	b	g	60	24	14
			lp	zb	cr/n	b	g	80	12	10
			rp	hljbr	cr	b	p	60	17	10

continued

Appendix 4. Continued.

Prefecture	Commune	No. of Samples	Shape	Color pattern	Color	Shininess	Size	Frequency	Mean % by weight	Index
RUHENGERI (continued)	Cyeru (mkt)	4	lp	mc	pr	b	p	50	5	3
			lp	mc	rgn	b	g	50	46	23
			rp	zb	cr/n	b	p	50	7	4
			rp	hljbr	cr	b	p	50	4	2
	Kidaho	5	lp	mc	rg	b	p	80	8	6
			ro	mc	br	b	p	60	2	1
			rp	mc	cr	b	p	80	16	13
			lp	mc	pr	b	g	60	5	3
			rp	mc	crbr	b	p	80	12	10
			lo	tl	rg/cr	b	g	60	22	13
			lp	tp	cr/n	b	p	60	3	2
	Kigombe	10	lp	mc	rg	b	g	50	7	4
			rp	mc	cr	b	p	60	7	4
			lp	mc	pr	b	g	60	11	7
			lp	tl	cr/n	b	g	50	10	5
	Kinigi	15	lp	mc	rg	b	g	80	11	9
			lp	mc	pr	b	g	60	18	11
			lp	zb	cr/n	b	g	60	5	3
			lo	tl	rg/cr	b	g	67	31	21
			lp	tp	cr/n	b	g	53	2	1
	Kinigi (mkt)	2	lp	mc	rg	b	g	100	10	10
			lo	tl	rg/cr	b	g	100	57	57
	Ndusu	4	lp	mc	n	b	p	50	7	4
			rp	mc	cr	m	g	50	15	8
			lp	mc	pr	b	p	75	35	26
			lp	zb	cr/n	b	g	50	5	3
			lp	tl	cr/n	m	g	50	10	5
			ro	tl	jbr/rg	b	g	50	2	1
	Nkumba	10	lp	mc	rg	b	g	90	9	8
			lp	mc	n	b	p	60	6	4
			rp	mc	crbr	b	p	80	11	9
			lp	zb	cr/n	b	p	60	9	5
			lo	tl	rg/cr	b	g	90	17	15
			lp	tp	cr/n	b	g	80	7	6
			lo	hln	jbr	b	g	60	24	14
	Nyakinama	5	lp	mc	rg	b	g	60	11	7
			lp	mc	n	b	g	60	6	4
			rp	mc	cr	b	p	60	12	7
			lp	mc	pr	b	g	80	7	6
			rp	mc	crbr	b	p	60	4	2
			lp	zb	cr/n	b	g	100	10	10
			lp	tp	cr/n	b	g	80	9	7
			lo	hln	jbr	b	g	60	6	4
	Nyarutovu	7	rp	mc	rg	b	p	71	4	3
			rp	mc	n	b	p	71	5	4

Appendix 5. Original Component Research Plan from Response to RFTP No. ROD/LAC-83-004.

II. A. 2. Inventory of Bean Varieties and Consumer Preferences (with ISAR)

a) Objective:

Obtain a better understanding of local and regional varietal distribution and producer/consumer preferences of beans to facilitate orderly marketing of the crop.

b) Work Plan:

i. Approximately 1000 accession of local types of beans are reportedly housed at the National Institute of Agricultural Research in Butare (A.M. Evans, 1980, Annual Report of the Bean Improvement Cooperative 23: 7-9). Large collections of East African bean varieties (races) also are held by the surrounding countries of Burundi, Tanzania, Uganda, Kenya and Malawi. Several of these countries also have research studies in progress of bean culture and utilization.

The initial part of the USAID project would require a literature review of the recent studies conducted in Africa on crop culture, variety development, variety use, crop storage and handling, disease and insect problems and total/yield/variety as well as an evaluation of germplasm collections maintained in the various research centers. Of particular interest would be those reports published by previous AID projects in Rwanda since 1975. Careful attention will be paid to the local nomenclature for varieties. Consumer preference data on file at ISAR will also be studied.

Specific tasks that would be accomplished under this subobjective are as follows:

Catalog and cross reference the bean seed collection at the Butare research facility-

-utilize local and international names
-identify each as to geographic locations
-photograph each type for use in reference manual
-set up a permanent reference collection of all types after removing duplicates

continued

Appendix 5. Continued.

Examine, describe and photograph growth type differences-

-set up field plots to compare types
-use growth habit descriptions as per S.P. Singh 1982, Annual Report of Bean Improvement Cooperative 25:92-95

ii. The importance of each type to local producers by surveying quantities received and sold at cooperative and mission storage facilities personnel (and by interviewing procedures and consumers).

iii. Through the monitrices or ± extension workers and coordinated with the expressed needs of GRENARWA a consumer survey would be conducted. Following is a brief statement of work we would propose in relationship to the Consumer Preference Survey with would, at this institution, be coordinated with experts from the Department of Food Science and Nutrition and the Department of Agricultural and Applied Economics. The former would carry out the cookability analysis and survey consumers for their preferences regarding the sensory, tactical, and cooking characteristics of beans for food. Hedonic (likability or preference) tests will be conducted on the different bean varieties available in Rwanda. Rwandan homemakers will be asked to indicate on a culturally appropriate, nonverbal scale how well they like the cooked samples of several bean varieties. Then the subjects would be asked to explain the reasons for their preferences (Figure 5.)

However, determining preferences for particular bean characteristics or varieties without considering their cost and household constraints of time and money (or barter) does not provide sufficient information for policies designed to improve general nutrition. Additional expertise of the Agricultural and Applied Economics Department in surveying consumers' preferences relates to determining what they will be most likely to actually buy (or consume) given relative prices, the value of the cooking fuel required and the time of the person preparing the beans, household income, and consumption from their own home bean production. These factors can be particularly important to the development of marketing strategies and agricultural pricing policies designed to improve nutrition. We propose to gather data that can be used to predict choice of beans in the market place. Specific questions on household resources, labor time, and income (of whatever form) as well as normal expenditures for currently used beans would be asked in a consumer survey (Figure 5).

continued

Appendix 5. Continued.

iv. The effect of varietal preferences on interregional trade will also be assessed.

In conclusion, East Africa produces 1.6 million tons of beans annually. Burundi, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia are responsible for 60% of this production. Data from other independent work, such as the Tanzanian Title XII Bean CRSP program will add to the studies proposed here for Rwanda. The Rwandan program will form part of a contractual picture of bean production, crop storage management and preparation techniques.

Appendix 6. Frequency of planting and harvest date by prefecture.[1]

Prefecture	Month[2] S	O	N	D	J	F	M	A	M	J	J	A
	- - - - - percent of total possible responses - - - - -											
PLANTING												
Butare	85	15	-	-	4	-	4*	-	-*	-	-	-
Byumba	31	3	-	-*	2	-	7	16	-	2	-	11
Cyangugu	3	1*	-	-	3	40	41	15	-	-	-*	-*
Gikongoro	60	23	-	-	3	9	6	-	-*	-	-	3
Gisenyi	9	2	-*	-	2	21	32	17	-	2	-	2*
Gitarama	9	-	-	-	12	68	9	-	-*	-*	-	-
Kibungo	5	5	-*	-	4	43	29	2	-	1	-*	-
Kibuye	3	-	-*	-	3	21	24	7	7	7	-	-*
Kigali	20	9*	-*	-	-	20	31	6	5	10*	-*	-
Ruhengeri	14	-	-	-*	-	-	9	42	14	1	-	3
HARVEST												
Butare	-	-	4	63	15	-	-*	-	7*	-	-	-
Byumba	2	-	2	43*	7	-	-	-	-	10	7	7
Cyangugu	-	-*	-	3	-	1	1	8	31	39	9*	3*
Gikongoro	-	-	3	31	46	9	-	-	14*	-	-	-
Gisenyi	-	6	-*	4	2	6	2	-	6	26	17	15*
Gitarama	-	-	-	2	5	-	-	27	60*	6*	-	-
Kibungo	-	-	-*	3	6	2	1	8	23	47	1*	-
Kibuye	7	7	-*	3	-	-	-	3	21	24	-	10*
Kigali	-	-*	-*	15	14	-	-	1	16	22*	3*	-
Ruhengeri	3	-	4	6	1	4	1	-	1	6	26	31

[1] Asterisks indicate months when samples were taken.
[2] S-O-N-D-J-F-M-A-M-J-J-A=consecutive months September-August.

Appendix 7. Frequency of planting and harvest date by agroclimatic zone.[1]

Agroclimatic zone	Month[2]											
	S	O	N	D	J	F	M	A	M	J	J	A
	- - - - - percent of total possible responses - - - - -											
PLANTING												
1	-	-	-	-	17	67	17	-	-	-	-	-*
2	3	-*	-	-	2	34	37	17	-	-	-*	-*
3	9	2	-*	-	2	33	39	7	-	-	-	-*
4	12	-	-	-*	2	-	10	35	16	2	-	2*
5	4	-*	-*	-*	16	20	24	-	4*	-	4	8*
6	20	-	-	-*	-	-	9	27	5	2	-*	7
7	42	11*	-*	-*	2	10	4*	13	2*	2*	1	2*
8	3	-	-	-	13	65	10	-	-*	-*	-	-
9	29	10	-	-	-	14	33	5	-*	-*	-*	-
10	-	9	-*	-	-	45	27	5	-	5*	-*	-
11	11	7*	-*	-*	4	36	30	1	-	-*	-*	2
12	10	-	-*	-*	6	10	22	6	-	-	-*	-
HARVEST												
1	-	-*	-	-	17	-	-	67	17	17	-	-*
2	-	-*	-	2	2	-	-	2	29	42	12*	3*
3	-	-	-*	4	2	4	-	7	24	30	9	9*
4	2	4	2	2*	2	6	4	-	-	6	18	33*
5	4	-*	-*	8*	8	-	-	8	16*	12	24	-*
6	4	-	5	24*	-	-	-	-	2	4	11*	22
7	2	2*	1*	31*	23	2	-*	2	7*	7*	7	6*
8	-	-	-	-	3	-	-	23	61*	3*	-	-
9	-	-	5	19	14	-	-	-	14*	38*	-*	-
10	-	-	-*	-	5	5	-	-	27	50*	5*	-
11	-	-*	-*	13*	7	1	1	7	26	32*	-*	-
12	-	-	-*	5*	6	-	-	-	6	39	6*	-

[1] Asterisks indicate months when samples were taken.
[2] S-O-N-D-J-F-M-A-M-J-J-A=consecutive months September-August.

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