Existing rhizobiology laboratories upgraded

Milestone 3.4.2

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N2Africa

Putting nitrogen fixation to work for smallholder farmers in Africa

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1. The East and Central African Hub (ECA Hub)

In the original project document, it was intended that each of three Hubs improve one key rhizobiology laboratory and was provided $150,000 to do so (original Milestone 3.4.2, Year 1 Month 12). At the project inception meeting in January 2010, however, national partners insisted that a laboratory be upgraded in every country so in the case of the ECA Hub, these funds were directed toward three laboratories, one each in DR Congo, Kenya and Rwanda. This task presented a challenge in terms of funds but also the different conditions of the laboratories targeted for upgrading. In Kenya, the University of Nairobi MIRCEN Laboratory had operated for over 30 years but its equipment was aging and the facility was directed toward student training rather than research. In DR Congo, the Faculty of Agriculture was in the process of moving from its Bukavu Campus to Kalombo, about 15 km distant, and a large laboratory in the shell of its new building was earmarked to become the Soil Science Laboratory. In Rwanda, the Rhizobium Laboratory at ISAR-Rubona had a long history of research and inoculant production, but the facility was ransacked during the 1994 civil war and had been re-established in a piecemeal fashion and without greenhouse facilities. In this setting we sought to develop rhizobiology research facilities that would meet the other ambitious activities required within Objective 3.

1.1. DR Congo

At first, the project considered developing the Plant Phytopathology Laboratory at the Bukavu Campus to undertake additional rhizobiology activities, and trained one of its technicians at the Nairobi workshop (Milestone 5.1.1), but this alternative was rejected when it became apparent that a better longer-term option was to invest in the new Faculty of Agriculture Campus being constructed at Kolombo. At this point, the Soil Science Building was just a shell, but steady progress was being made and a large room on the ground floor was earmarked as the Soil Microbiology Laboratory. For this reason, a large proportion of funds were directed toward finishing the laboratory (71%) and additional key equipment was purchased as well (Table 1). This facility, complete with a new greenhouse, was commissioned in September 2011. The M.Sc. student attending the University of Nairobi will soon return to DR Congo and undertake the research phase of their studies at the Kolombo Facility (see Milestone 5.1.1). One problem is that the supplies and chemicals provided to the laboratory (only 2% of the total) do not entirely reflect the research needs under Activities 3.1 and 3.2 and adjustments must be made in the near future to assure the facility's research momentum.

Table 1. Summary of materials provided for laboratory upgrading at the new Kalombo Facility by the N2Africa Project in DR Congo.

material	items number	cost US$	%	major items
equipment	17	18,739	26	transfer hood, oven & incubator
glassware	17	1081	2	flasks, beakers & pippettes
supplies	10	424	1	weighing & autoclaving supplies
chemicals	14	470	1	culture media & disinfectant
construction	na	50,000	71	laboratory built at Kalombo
total	58	70,714	1.00	

1.2. Kenya

The MIRCEN Laboratory was asked to, and quickly produced, a list of needed laboratory equipment, glassware, supplies and chemicals. Need existed to provide these materials quickly as this laboratory was hosting the ECA Technician Training in Rhizobiology Workshop (see Milestone 5.1.1) in

September 2010. To upgrade this laboratory, the N2Africa Project provided 91 different items worth $56,798 with most of these funds earmarked to replace and upgrade aging equipment (Table 1). Because this laboratory was already operational, the materials requested reflect their needs to specifically address N2Africa project activities addressing the need to inoculate (Activities 3.1.2 & 3.1.3) and rhizobium germbank establishment (Activity 3.2.2). This laboratory was quickly brought into project operations, allowing it to also assist both DR Congo and Rwanda to meet some of their obligations under Activity 3.1.3 by isolating and testing strains originating from these two countries. In addition, the laboratory now provides better quality testing services to BIOFIX inoculants produced in Kenya by MEA Fertilizers (K) Ltd. (Milestone 3.4.4). N2Africa has also constructed a $45,093, state-of-the-art greenhouse for both rhizobiology and agronomy studies at the UoN campus that is used by project graduate students (see Milestone 5.2.1) to address Activities 3.1.2 and 3.1.3 that does not appear within Table 2, bringing the "real" cost of laboratory upgrading in Kenya to $100,889.

Table 2. Summary of materials provided to the University of Nairobi MIRCEN Rhizobium Laboratory during laboratory upgrading by the N2Africa Project in Kenya.

material	item number	cost US$	%	major items
equipment	27	49,623	87	autoclave, hammermill, microscope
glassware	20	1,668	3	autoclavable bottles, beakers, test tubes
supplies	10	1,042	2	culture preservation supplies
chemicals	34	4,463	8	culture and diagnostic media
total	91	$56,796	100	

1.3. Rwanda

The Microbiology Laboratory at ISAR-Ribona was once considered one of the most productive facilities in Africa until its operations were disrupted by the civil war and genocide in 1994. Not only was the laboratory ransacked, but senior scientists were murdered leaving both a material and human resource gap. Recently, however, Ms. Mathilde Uwizerwa returned after M.Sc. training at Makerere University in rhizobiology and leads three other staff in laboratory operations. Prior to laboratory upgrading by the project, the laboratory had resumed many basic rhizobiology activities and the team was quick to respond to requests for needed equipment and supplies. N2Africa provided the laboratory with 42 items worth $15,913, primarily as needed new equipment, but also as glassware and supplies (Table 3). As a condition to participation in N2Africa, ISAR agreed to rehabilitate a small greenhouse for use in rhizobiology studies relating to Activities 3.1.2 and 3.1.3. The laboratory upgrading appears timely and effective. Once these equipment and supplies were provided to the laboratory, it quickly isolated and characterized 80 cultures of bean rhizobia and produced 700 packets of rhizobial inoculant. In addition, an MSc. student undertaking studies at the University of Nairobi will join the ISAR laboratory for their field work within the next few months. Again, the supplies and chemicals provided during the upgrading activity did not closely reflect those needed to complete Activities 3.1 (Need to Inoculate), 3.2 (Rhizobium Germplasm) and 3.3 (Inoculant Quality Assurance), and there is need to provide additional supplies in the near future.

Table 3. Summary of materials provided to the ISAR-Ribona Rhizobium Laboratory during laboratory upgrading by the N2Africa Project in Rwanda.

material	items number	cost US$	%	major items
equipment	10	13,736	86	transfer hood, oven and balance
glassware	16	966	6	flasks, beakers & pippettes
supplies	9	1,095	7	media preparation & cleaning supplies
chemicals	7	116	1	mannitol, diagnostic media & sterilant
total	42	$15,913	1.00	

1.4. Hub Overview

Of the $150,000 earmarked toward laboratory upgrading in the ECA Hub, equipment, glassware, supplies and chemicals costing $143,423 was allocated to cooperators in DR Congo, Kenya and Rwanda. As a result, we now have three laboratories fully equipped to undertake their respective research responsibilities within Objective 3 Rhizobiology research (Table 4). In achieving this goal, TSBF Headquarters incurred some costs, notably $3,938 for shipping and $1,525 for sterile experimental growth containers. The cost of constructing a greenhouse suited for plant-microbe interaction studies at the University of Nairobi ran $10,093 over its project budget of $35,000. The process of laboratory upgrading is not complete, however, as a small three wheeled vehicle needed to

Table 4. Summary of rhizobium laboratory upgrading activities in the East and Central African Hub of the N2Africa Project.

Laboratory Country	Initial laboratory status	Upgrade materials Items (no)	Cost (US$)	Current status
Kalombo DRC	No rhizobium laboratory or greenhouse facilities, partial access to Phytopathology lab at Catholic University of Bukavu	58	70,714	Upgrade contributes to new rhizobium laboratory and greenhouse at Kalombo Facility jointly operated by TSBF and the Catholic University of Bukavu
MIRCEN Kenya	Fully operational rhizobium laboratory, limited greenhouse facilities	91	100,899	Laboratory now provides quality control services for private sector inoculants, supports four project graduate students, laboratory and greenhouse activities better integrated
ISAR Rwanda	Partially operational rhizobium laboratory, no greenhouse facilities available	42	15,913	Laboratory now produces both agar and broth cultures and inoculants, greenhouse facilities renovated and operational
TSBF Headquarters	National partners required assistance in the procurement and shipping of laboratory materials, some cost overruns	2	5,463	Strong contacts forged with both local and overseas suppliers of microbiological products and new supply chains initiated
Total		193	$187,526	Cost overrun of $2,526

transport supplies between the University of Nairobi MIRCEN Laboratory and its Greenhouse Complex has not yet been delivered and key incidentals including sterile Petri dishes and growth pouches are needed by the laboratories in DR Congo and Rwanda. Nonetheless, project staff have met the difficult challenge of upgrading three laboratories using funds ($185,000) originally intended for only one with cost overruns of $2,526 (Table 4). And will continue to backstop the operations of our partners' improved facilities.

2. West Africa

2.1. Ghana

The Soil Research Institute, Kumasi has received equipment supplies worth about USD 20000. In response to the results of the needs assessment, the Institute received various equipment s including: Water purification unit, Aquatron® water still, Large Stirrer Hotplate with Ceramic Top,Incubators, Orbital Shaker, Autoclave, Model 25X, Hand-Operated Vacuum Pump to attain and hold vacuum of 25in (635mm) Hg. The laboratory has benefited immensely from assorted glassware and other accessories to facilitate Rhizobium isolation, culture storage and laboratory level inoculums production. These supplies include screw neck test tubes, disposable micropipette tips, glass pipettes, sterilizing boxes for Petri dishes, Bunsen burners, and assorted Erlenmeyer flasks. Soil Research Institute has made additional contributions by refurbishing the entire laboratory, creating additional microbiological work surfaces including Transfer Hoods which together with the N2Africa inputs have improved significantly the standard of their microbiological laboratory. With the employment of a laboratory technician through funds support from N2Africa, the Institute is now able to conduct standard microbiological assays including MPN counts, isolation of rhizobia for further greenhouse and field evaluation. Review has been arranged with the Director, SRI to consider other needs.

2.2. Nigeria

Various sets of equipment, glassware and supplies had earlier been ordered for co-operator laboratories at the commencement of the N2Africa project in 2010 to support project activities. In Nigeria, the Institute of Agricultural Research (IAR) Zaria was selected as the hub for West Africa. However, the equipment in the laboratory was either obsolete or in a state of disrepair. Hence, the laboratory is being equipped from scratch. Nigeria

The consignment of equipment, glassware and supplies ordered for IAR Zaria was delivered to the institute on 22nd June 2011. Ten items of equipment worth $31,067 were purchased, including an autoclave, laminar flow, incubator, shaker, fridge-freezer and compound microscope. Twenty items of supplies worth $861 and 8 items of glassware costing $682 were also supplied. All the pieces of equipment have been installed and have been put to operation.

A major source of concern is the delay in the completion of the greenhouse, the construction of which commenced in May 2011. The framework had been fabricated by the manufacturer in the UK and has been awaiting shipping since July 2011. The non remittance of the outstanding funds from IITA to allow for the delivery of this material is due to the inability of IAR to as yet send a financial report for the previous reporting period. I have had discussions with the Principal Investigator, Dr Ado Yusuf, on the need to send the overdue report. He has severally assured that the report would be sent but these promises are yet to be kept.

3. Southern Africa

3.1. Malawi

Malawi has had a functional laboratory since 1964 although inoculant production and research activities had taken a downward trend in the 1990s. The laboratory still has functional equipment although they are now aging. Five items of equipment worth $5,996 have been purchased for the Soil Microbiology laboratory at the Chitedze Research Laboratory, Lilongwe. These are made up of two balances, a vortex mixer and 2 auto pipettes. Supplies and glassware worth $2,890 and $1,534 respectively have also been purchased. The items purchased are in the custody of the Country Coordinator, Dr Anne Turner, and will be delivered to the laboratory once the MOU on Rhizobiology activities is signed between IITA and the Department of Agricultural Research Service (DARS). Following Dr Abdullahi Bala's visit to the laboratory, an additional set of equipment that needs to be purchased for the laboratory has been identified. These are an autoclave, fridge-freezer, pH meter, incubator and a microscope. The Malawi Country Coordinator, Dr Anne Turner, is to get quotations for supply, possibly from South Africa.

Some investment will also be made in the rehabilitation of one of the greenhouses at the station. The work involves general cleaning of the glasshouse, especially the glass panels roofing the house which have become opaque to solar radiation; construction of bench tops and the repair of the mechanical rig for opening and closing of the roof panels. A professional cleaner has already been identified and is preparing a quotation for the cleaning component of the work. The Station's electrician has been contacted to advice on what is required to get the roof rig to work. IITA had earlier spent about $900 in helping DARS to complete repairs within the laboratory, which was the pre-condition for project activities to take off in the laboratory.

3.2. Zimbabwe

The laboratory at the Soil Productivity Research Laboratory Marondera, Zimbabwe, which serves as the hub for Southern Africa, has been in operation since the 1960s and has supported inoculant production activities during this period.

Assorted equipment worth $57,442 have been purchased from vendors in Zimbabwe, the US and UK and delivered to SPRL. These include a freeze dryer, autoclave, distillation unit, shaker, balances, and a pH meter. All of the equipment, except the autoclave, have been delivered to the laboratory and are being installed. The autoclave arrived Customs on 11th October 2011 and is being cleared. Supplies worth $9,046 and glassware of $2,180 have also been delivered to the laboratory. Taxes, and freight costs amounted to $1758 and $4,166 respectively.

The renovation of the greenhouse at SPRL has not started because the Public Works Ministry is yet to give a go-ahead.

3.3. Mozambique

In Mozambique, the laboratory being built by IIAM is almost at completion but it will take a while before it becomes operational. Therefore, activities for Mozambique will for now continue to be handled by the Soil Microbiology Laboratory at IITA Ibadan and at EMBRAPA in Brazil.

Annex: lists of equipment

1. DRC

Table 1. Lab equipment for DRC

	Item	Quantity	Cost
1	Laminar flow cabinet/transfer hood	1	9,336
2	Wire loop (holder and wire)	1	8
3	Conical flask 500ml	50	301
4	Pipettes (25 ml)	10	82
5	Pipette 10ml	10	44
6	Pipette 20ml	10	57
7	Conical flask 5L	1	53
8	Conical flask 200ml	2	38
9	stainless steel sterilization containers (for 9cm diameter Petri dishes)	1	251
10	3 stainless steel sterilization containers (one canister for 1 ml, 5 ml and 10 ml pipettes)	3	752
11	At least 20 McCartney bottles (wide mouth)	50	60
12	Wire basket (for bottles)	1	57
13	Alcohol sprayer bottle	1	19
14	Wash bottles	1	2
15	Bottle brushes (2)	2	19
16	Aluminium foil	5	11
17	Parafilm tape	1	31
18	Cotton wool absorbent	5	7
19	Cotton wool non-absorbent	1	57
20	Conical Flask 1000 ml superior	5	54
21	Beakers 1000ml glass superior	2	18
22	Beakers 500ml glass	2	9
23	Beakers 100ml Glass Superior	2	13
24	Electric Balance	1	418
25	Calcium hypochlorite 500gm	1	3
26	NaOH 500 G	2	11
27	5 Litres of Sodium Hydrochlorite	3	9
28	Erlenmeyer Flask 500ml	2	12
29	Yeast BPE (OXOID) 500g	1	79
30	Agar 500g	1	124
31	Magnesium Sulphate 500 g	1	27
32	Potassium Hydrogen Orthophosphate 500g	1	30
33	Sodium Acid 100g	1	53

34	Bromothymol blue 25g	1	23
35	Congo red 25g	1	11
36	Gram stain chemical solution 25gm	1	15
37	Plastic bottle for sterile distilled water 5 litres	1	44
38	Glass beakers 100ml (20)	20	61
39	Glass beakers 250ml (4)	4	19
40	20 ml syringes & 50 ml syringes (2)	4	11
41	18gm needles (1 pkt)	1	3
42	Pair of Industrial Gloves	1	9
43	Methanol AR 2.5 Ltr	2	35
44	Hydrochloric acid AR	1	18
45	Beaker Low form 600ML	15	143
46	100 ml of Test tube 12x100 medium wall	1	35
47	Test tube rack for 12 x 100 tubes	3	29
48	Sieve 200MM x 212 Um	1	139
49	Mannitol	1	32
50	Aspirator 25L	1	82
51	1 Vial Insert support, sleeve rubber chromacol	1	89
52	Wrist action shaker	1	317
53	1 Distillation apparatus	1	1,394
54	Bottle dispenser	1	621
55	25c - 35 c Incubator	1	2,471
56	20L urn	1	82
57	Laboratory Oven Binder	1	2,720
58	Weighing Boat Square S White	1	266

2. KENYA

Table 2. Equipment purchased for The University of Nairobi

No	Item	Quantity	US$
1	Autoclavable 2 ltr bottles	12	281
2	Tweezers	15	90
3	Balance 0.0001gms	1	1,711
4	Glass slides	1	2
5	Ethanol ER	1	40
6	Coverslips (22x22)	1	2
7	Gram's Fuchsin solution (fluka)	1	68
8	Glass beakers 100ml	12	37
9	Glass beakers 600ml	12	68
10	Glass beakers 1000ml	12	144
11	pH meter (Italy)	1	570
12	500 ml Erlenmeyer flask	10	60
13	25ml syringes and needles (20ml)	12	7
14	1-5 ml screw topped vialsor test tubes		183
15	Refrigerator Freezer (-20c to -5C375 Ltr)	1	2,877
16	Microwave oven (Germany) 53 litres	1	2,345
17	Glass ampoules	1	373
18	Manifold piping	1	255
19	Oxygen cylinder	1	1,980
20	Glass Knife	1	136
21	Alkathene	1	444
22	2-5 bottles	1	15
23	Dispenser for bottles 20ml (Germany)	1	741
24	Tronocular stereomicroscopic (10-50x)	1	5,072
25	Wire loop 5.0ul	1	66
26	Loopholder Nickel plated brass	1	22
27	Petri dishes	5	41
28	Autoclave 60 ltrs	1	14,290
29	Set of auto pipettes (20um-200um)	1	323
30	Set of auto pipettes (10um-100um)	1	323
31	Set of auto pipettes (100um-1m)	1	323
32	Pipette tips (1-200ul)	1	15
33	Pipette tips (200-1000ul)	1	15
34	Balance (2kg, 2 decimal place)	1	188
35	Microscopic binocular	1	1,544
36	Peristaltic pump	1	4,778
37	250 Erlenmeyer flasks	10	44
38	1000 erlenmyer flasks	4	41

39	2000 erlenmyer flasks	4	76
40	1-5ml screw topped vials or test tubes	1	158
41	Water filter purifier	1	882
42	Hammer mill	1	7,608
43	Rubber sleeves	1	103
44	Desicant trap	1	235
45	Gas torch (2arms)	1	81
46	Wrist action shaker	1	2,426
47	20L urn	1	82
48	250ml glass beakers	12	53
49	400m glass beakers	12	61
50	2L glass beakers	1	213
51	Balance (200g-2 Kg)	1	188
52	25ml glass beakers	12	23
53	50ml glass beakers	12	23
54	Magnesium sulphate	1	11
55	Potassium Hydrogen Phosphate	4	79
56	Sodium Chloride AR SO160 Rankem	1	12
57	Yeast Extract	5	507
58	Bromcresol purple 25gm	1	31
59	Potassium Nitrate 2kg	2	35
60	Calcium Chloride dihydrate	2	28
61	Potassium Sulphate	2	32
62	Manganese Sulphate Hydrate	2	48
63	Zinc Sulphate Seven molecules of water	2	50
64	Copper Sulphate Pentahydrate	2	71
65	Hydrochloric Acid	1	21
66	Manitol	5	289
67	HMEDIA or BIOTEC	5	570
68	Potassium Hydrogen Phosphate	2	75
69	Congo red	1	21
70	Sodium Molybdate Hydrate	1	202
71	Agar Local pack	2	81
72	Bromthymol blue 25g	1	15
73	Fe-citrate	4	765
74	Boric acid	2	71
75	Sulphuric Acid AR	1	22
76	33 Magnesim Sulphate LR (M0040) 500GM	1	11
77	33 Sodium Chloride AR (s0160) 500GM	2	12
78	10** Yeast Extract Agar M456 500GM	10	588
79	33 Potassim Nitrate LR (P0510) 500G	6	35
80	33 Calcium Chloride Dihydrate LR(C0600) 500G	4	28
81	33 Potassium Sulphate LR (P0590) 500 G	4	32

82	33 Manganese (11) Sulphate LR (M0070) 500G	4	48
83	33 Zinc Sulphate 7 Hydrate (z0070) 500G	4	50
84	33 Cooper Sulphate Pentahydrate LR (C0390) 500 gm	4	71
85	Autoclavable 1 Ltr bottle		133
86	Parafilm		216
87	100 ml glass beakers		30
88	250 ml glass beakers		37
89	400ml glass beakers		63
90	Vortex stirrer		246
91	Hot plate with magnet stirrer		434

3. RWANDA

Table 3. Equipment purchased for ISAR Laboratory

No.	Item	Quantity	US$
1	Laminar flow cabinet/transfer hood	1	9,336
2	Wire loop (holder and wire)	1	8
3	Conical flasks 500ml	50	301
4	Conical flasks 5L	1	53
5	Conical flasks 200ml	2	19
6	Pipettes (25 ml)	10	82
7	1 stainless steel sterilization containers (for 9cm diameter Petri dishes)	1	251
8	3 stainless steel sterilization containers (one canister for 1 ml, 5 ml and 10 ml pipettes)	3	752
9	McCartney bottles (wide mouth)	50	60
10	Wire basket (for bottles)	1	57
11	Alcohol sprayer bottle	1	19
12	Wash bottle	1	2
13	Bottle brushes	2	19
14	Aluminium foil	5	11
15	Parafilm tape	1	31
16	Calcium hypochlorite 500gm	1	3
17	NaOH 500 G	2	11
18	Erlenmeyer Flask 500ml	2	12
19	Conical Flask 1000 ml superior	5	54
20	Beakers 1000ml glass superior	2	18
21	Beakers 500ml glass	2	9
22	Beakers 100ml Glass Superior	2	13
23	Electric Balance	1	418
24	Bromothymol blue 25g	1	23
25	Congo red 25g	1	11
26	Plastic bottle for sterile distilled water 5 litres	1	44
27	Glass beakers 100ml (20)	20	61
28	Glass beakers 250ml (4)	4	19
29	Beakers 250ml	20	62
30	Beakers 100ml	1	25
31	20 ml syringes & 50 ml syringes (2)	4	11
32	18gm needles (1 pkt)	1	3
33	Pair of Industrial Gloves	1	9
34	Methanol AR 2.5 Ltr	1	18
35	Hydrochloric acid AR	1	18

36	Beaker Low form 600ML	15	143
37	100 ml of Test tube 12x100 medium wall	1	35
38	Sieve 200MM x 212 Um	1	139
39	Laboratory oven binder	1	2,720
40	Mannitol	1	32

4. GHANA

In Ghana, the Soil Research Institute (SRI), Kumasi, has refurbished a laboratory to be dedicated for N2Africa activities at the institute. They also have received delivery of assorted equipment (Table 4) in April 2011; thus putting them in standing to fully commence activities.

Table 4. List of equipment delivered to SRI, Kumasi, Ghana

Item	Code	Description	Unit	Qty	Unit Price (GH¢)	Amount (GH¢)
1	T702-701	Tubes, screw neck vials, tall form, neutral glass with polypropylene screw cap, capacity 3.50ml, 46 x 12. 5mm. Pack of 666 **Lab Cat Page No 331**	Pack	1	416.44	416.44
2	S442-281	Rack, test tube, kit form, polypropylene, white , 21 places, max tube dia. **Lab Cat Page No 294**	Pack	1	82.34	82.34
3a	P367-231	Micropipettors Tips Disposable, Plain, 200µl, yellow, for uni micropipettor; pack of 1,000 **Lab Cat Page No 221**	Pack	1	96.43	96.43
3b	P367-243	Micropipettor Tips Disposable, Blue, Maximum volume: 1000µl, Pkt. 1000. **Lab Cat Page No 221**	Pack	1	120.06	120.06
4	P362-140	Pipettes, One Mark, Class B • Capacity: 10ml	Pack	2	25.13	50.26

		• Tolerance: +/-0.040ml • Delivery time: 8-40sec • Pack of 5 **Lab Cat Page No 208**				
5	A2146-N	Ethanol rectified 96% GRG 1L UN 1170/3, Pkg II	Each	1	16.53	16.53
6	P276-981	Petri Dish Sterilising Box Stainless Steel, Dimensions: 254 x 115mm, Capacity: 10 dishes. **Lab Cat Page No 198**	Each	4	251.56	1,006.24
7	B757-160	Bunsen burner, universal, push ignition, lock/on mechanism, battery powered, butane gas fill. **Lab Cat Page No 58**	Each	1	444.65	444.65
8	W085-414	Water purification, Aquatron® water still, 8 litres/hr, single distilled, 240V, 50-60Hz, single phase pH 5.0 - 6.5, conductivity 1.0 - 2.0 µScm-1, resistivity 0.5 - 1.0 Ohm-cm, 25 - 35ºC, Pyrogen free, water supply 1 litre/hour 3-100psi (20-700kPa). **Lab Cat Page No 348**	Each	1	10,925.64	10,925.64
9	A1519-M	Cotton wool, white, non-absorbent 1kg Un-restricted	Each	5	60.88	304.39
10a	M735-214	Vortex Mixer ZX3 Variable speed control with continuos and manual modes. These mixers are devised for mixing substances in test tubes or small flasks. Sturdy cast aluminium construction. Strong sucker feet to prevent movement. **Lab Cat Page No 193**	Each	1	491.80	491.80
11	S519-541	Large Stirrer Hotplate with Ceramic Top	Each	1	2,152.46	2,152.46

		Analogue; Max plate temp: 450ºc, chemically resistant ceramic top plate; flashing HOT warning light to warn when top plate is too hot to touch (over 70ºC); independent safety circuit to protect against overheating; powerful stirring action; supplied with magnetic followers; goes to speeds of 1500rpm with volumes of up to 15 litres. 220-240V 50Hz. **Lab Cat Page No 299**				
12	P756-162	Hand-Operated Vacuum Pump to attain and hold vacuum of 25in (635mm) Hg. Pumping Rate of 15cc/ stroke and 3 psig (.21 bar) postive pressure. Supplied with 600mm plastic tubing. **Lab Cat Page No 224**	Each	1	111.50	111.50
		<u>Inoculant Preparation</u>				
1a	F510-831	Flasks, Erlenmeyer, Narrow Neck - Borosilicate glass. - Complies to ISO 1773. - 250ml Capacity - Pack of 10 **Lab Cat Page No 127**	Pack	1	41.82	41.82
1b	F510-835	Flasks, Erlenmeyer, narrow neck, 500ml. Pack of 10 **Lab Cat Page No 127**	Pack	1	55.00	55.00
1c	F510-839	Flasks, Erlenmeyer, narrow neck, 1000ml. Pack of 10. **Lab Cat Page No 127**	Pack	1	148.90	148.90
1d	F510-877	Flask, Conical,Pyrex narrow neck, graduated, capacity: 2000ml, White enamel graduations. Pack of 10 **Lab Cat Page No 127**	Pack	1	459.17	459.17
2	S952-380	Needles, microlance, sterile, 25 gauge, 16mm. Pack of 100 **Lab Cat Page No 310**	Pack	1	17.28	17.28

		Lot 2				
1	I520-100	Incubators, General Purpose Suits most biological analysis and routine general laboratory applications. Includes the following features: • Aluminium coated steel interior. • Interior is fitted with fixed shelf runners with removable chrome plated steel wire grid shelves. • Natural convection; incoloy sheathed elements are located below the chamber floor. • Solid door. • Direct reading hydraulic controls with safety thermostat and over-heat indicators. Technical information: • Temperature range 5ºC above ambient (natural convection) to 100ºC • Fluctuation (hydraulic control) ± 0. 25ºC at 38ºC • Volume: 30L • Shelf positions: 3 • Shelves: 2 • Shelf size: 280x280mm • Power: 500W **Lab Cat Page No 160**	Each	1	2,160.71	2,160.71
2a	S308-352	Orbital Shaker Available with orbital or reciprocating action; Digital speed selection to 300rpm with soft start; Built-in digital timer; Reliable quiet drive mechanism Fully adjustable cradle system accommodating a wide variety of vessels, dishes, flasks including 8 x 500ml, or 6 x 1L or 2 x 2Litres. Platform size 355 x 355mm; **Lab Cat Page No 283**	Each	1	3,883.87	3,883.87
2b	S308-356		Each	1	1,054.45	1,054.45
1	P756-322	Accessory Platform Pumps, Diaphragm, ME2 **Lab Cat Page No 224**	Each	1	2,406.31	2,406.31

5. NIGERIA

In Nigeria, some glassware and reagents had in September 2010 been procured locally for the laboratory at the Institute of Agricultural Research Zaria. The list of these items is presented in Table 5.

Table 5. Equipment purchased locally for IAR Zaria, Nigeria

S/N	Item	Quantity	cost$
1	Sodium hypochlorite	1	44.70
2	Sodium chloride (500g)	1	21.28
3	Sodium azide (100g)	1	95.30
4	Silica gel (500g)	1	19.65
5	Potassium dihydrogen orthophosphate (500g)	4	36.74
6	Sodium hydroxide (500g)	1	45.45
7	Calcium hypoclorite (500g)	1	45.30
8	Congo red (5g)	1	25.30
9	Bromothymol blue (25g)	1	64.70
10	Magnesium sulfate heptahydrate (500g)	1	24.04
11	Yeast Extract powder (500g)	1	56.35
12	Hydrochloric acid (2.5litre)	1	64.00
13	Methanol (2.5litre)	1	31.91
14	Ethanol 96% (2.5l)	1	29.20
15	Aluminium foil	1	9.487
16	Beaker (plastic 250ml)	5	135.36
17,	Beaker (Plastic 500ml)	10	131.55
18	Flask (2000ml) (conical)	8	57.37
19	Petri dish (1000pcs)	2boxes	133.49
20	Conical flask (1litre)	2	30.70
21	Conical flask (500ml)	5	135.40
22	Parafilm	7	101.78
23	Microscope glass cover slip (100pieces)	1	21.68
24	Spray container (500ml)	1	5.28
25	Cotton wool	5	70.38
26	Paper bag (size 25)	2	48.32
			1484.71

Additional equipment (Table 6) ordered from the UK arrived in May 2011 and was delivered to the institute on 22nd June 2011. The construction of a greenhouse at the Institute has also commenced. The institute has already employed an MSc graduate in soil microbiology to be assigned to the laboratory when it becomes fully operational.

Table 6. Laboratory equipment procured for IAR Zaria

Line No	Item No	Item Desc	Supplier Item No	UOM	Qty	Price (GBP)	Total (GBP)
1		Balance (100g, 3-4d.p); cat No: BFE-210-015H, Model: PL83-SI03		EACH	1	879.49	879.49
2		Balance (200g-2.00kg)		EACH	1	1,403.74	1,403.74
3		High powered compound Microscope (50-5000e);cat no: 450-712 Model lynx		EACH	1	4,479.00	4,479.00
4		Laminar flow cabinet, SIZE 1.2 CAT No: BPG-575-010V		EACH	1	5,347.00	5,347.00
5		Microwave Oven; Cat No: OVM-100-030F, Model; SANYO		EACH	1	223.31	223.31
6		Refridgerator freezer (20c to -5c); cat no: RFN-132-0100		EACH	1	1,010.37	1,010.37
7		Wrist action shaker (Cat no: SGM-200-010F)		EACH	1	925.57	925.57
8		autoclave (cat no. AUX-512-010G, Model: Astell (A)		EACH	1	4,970.00	4,970.00
9		autoclave 1l &2l bottles Cat No: BTF-400-1130S		EACH	1	57.69	57.69
10		pH meter; Cat No: PHL-565-010N, model Mettler toledo		EACH	1	467.88	467.88

6. MALAWI

In Malawi, the laboratory at Chitedze has been renovated as a condition for funds to be committed for Rhizobiology activities to be undertaken by the laboratory. Some equipment and reagents had earlier been sent from IITA Ibadan and the go-ahead has been given for local purchases of some other equipment, such as refrigerators and microwave oven.

Table 7. Laboratory materials that have already been purchased for Malawi

	LIST OF MATERIALS - MALAWI		
	Item	**Quantity**	**Cost $**
1	Conical glass (2000ml)	2	**57.38**
2	Conical glass (1000ml)	5	**475.40**
3	Beakers(250ml)	10	**33.08**
4	Beaker(1000ml)	2	**57.38**
5	Parafilm sealing tape	1	**14.61**
6	Foil aluminium	5	**137.10**
7	Agar yeast (500g)	1	**56.35**
8	Agar Powder (500g)	1	**22.60**
9	Magnesium sulphate	1	**24.04**
10	Sodium Chloride	1	**31.56**
11	Methanol (2.5l)	1	**40.64**
12	Sodium hypochlorite(1lire)	1	**32.71**
13	Hydrochloric Acid(2.5litre)	1	**31.42**
14	Silical gel	1	**117.33**
15	Bromothylmol blue (25g)	1	**35.90**
16	Potassium hydrogen orthophosphate	1	**475.40**
17	Sodium Azide (100grm)	5	**25.27**
18	Congo red (5g)	1	**23.20**
19	Calcium hypochlorite	1	**42.40**
20	Pipettes (20ml)	2	**10.60**
21	Pipettes (25ml)	2	**10.60**
22	Test tube (1pk - 95mm)	100pieces	**133.00**
23	Test tube (100mm-1000pieces)	100pieces	**133.00**
24	Conical flask (500ml)	50pieces	**43.22**
25	Conical flask (5000ml)	2	**139.62**
26	Cotton wool absorbent	5	**70.38**
27	Stainless steel sterilization -dish (9cm	1	**116.22**
28	Gas burner	2	**46.48**
29	Brushes bottle (10/pack)	2	**119.54**
30	Cottonwool (Non absorbent-500g)	5	**66.40**
31	Vortex mixer	1	**630.89**
32	Test sieve(212mic)	1	**162.70**
33	Syringe&needle (20ml -2.5l)	1pk	**29.88**
34	Syringe&needle (50ml -2.5l)	1pk	**43.17**
35	Syringe&needle 50ml -10ml)	1pk	**56.45**
36	Needle (18g)	1pk	**29.88**
37	syringe&needle (10ml - 20ml)	1pk	**29.88**
38	Screw topped vials 91.5ml x 500)	1	**122.86**
39	Erlenmeyer flask (250ml)	2	**16.60**

40	Erlenmeyer flask (2l)	2	**112.90**
41	Industrial gloves (pair	1	**19.92**
42	Glass wool (500g)	1	**69.73**
43	Glass beaker(100ml)	10pieces	**56.30**
44	Glass beaker(2l)	1	**56.43**
45	Marcartney bottle (wide)	50pieces	**198.90**
46	Stainless steel ster-dish (9cm)	1	**116.00**
47	Stainless steel canister -Pipettes (1m)	1	**89.50**
48	Stainless stel canister pipettes (5ml)	1	**80.30**
49	Stainless stel canister pipettes (10ml)	1	**85.71**
50	Balance (2decimal-2kg)	1	**2132.00**
51	Balance (3decimal-110g-analytical type)	1	**2778.00**
52	Auto pippette (20micron)	1	**219.60**
53	Auto pippette (1000micron)	1	**235.79**
54	Growth pouches	1box	**424.00**
	TOTAL:		**10419.70**

7. ZIMBABWE

Table 8. Equipment purchased or being purchased locally for SPRL Marondera, Zimbabwe

QTY	ITEM #	DESCRIPTION	UNIT PRICE	LINE TOTAL
$10.00	10*500g	NaOH pellets ar	$20.00	$ 200.00
$2.00	2*5g	Congo red indicator ar	$16.00	32.00
$5.00	5*500g	Sodium hypochlorite ar	$20.00	100.00
$10.00	10 Rolls	Autoclave tape sterilizing indicator	$28.00	280.00
$2.00	2*1000/pk	Disposable petri dishes	$120.00	240.00
$1.00	1 pair	Industrial Gloves	$10.00	10.00
$50.00	50*150ml	Medical flat bottles	$11.00	550.00
$5.00	5*1000ml	Conical flasks: (Autoclavable)	$15.00	75.00
$5.00	5*500ml	Conical flasks: (Autoclavable)	$10.00	50.00
$5.00	5*1000ml	Graduated Beakers (Autoclavable)	$15.00	75.00
$2.00	2 boxes	Glass slides	$5.00	10.00
$10.00	10*1000ml	Autoclavable Duran bottles	$20.00	200.00
$2.00	2 Rolls	Parafilm "M"	$85.00	170.00
$5.00	5*500ml	Wash bottles	$8.00	40.00
$2.00	2*20l	Plastic bottle for sterile distilled water	$75.00	150.00
$1.00	1*10l	10L polythene bottles	$65.00	65.00
$1.00	1*20l	Urn	$100.00	100.00
$2.00	2*500g	Calcium hypochlorite ar	$18.00	36.00
$20.00	20*2.5l	Alcohol/methanol(98%) ar	$30.00	600.00
$10.00	10*2.5l	Ammonia Solution	$19.00	190.00
$2.00	2*25g	Bromothymol blue indicator ar	$49.00	98.00
$70.00	$70.00	Petri dishes autoclavable (pyrex) - 9.4cm dia.	$5.00	350.00
$5.00	5*2000ml	Graduated Beakers (Autoclavable)	$27.00	135.00
$1.00	1 Unit	Distillation unit/Water still 4l/hr	$2,500.00	2,500.00
$2.00	$2.00	Laboratory stools	$30.00	60.00

$2.00	$2.00	Tweezers or forceps		$6.00	12.00
$5.00	5*250ml	Graduated Beakers (Autoclavable)		$7.00	35.00
$5.00	5*2000ml	Conical flasks:(Autoclavable)		$48.00	240.00
				SUBTOTAL	$ 6,603.00
				VAT 15%	990.45
				TOTAL	**$ 7,593.45**

Table 9. List of equipment ordered from the USA for SPRL, Zimbabwe

QTY	ITEM #	DESCRIPTION	BUDGET CODE	UNIT PRICE	LINE TOTAL
1.00	48925-40	2.0 Camera Micro 110-220V		$ 1,399.00	$ 1,399.00
2.00	11220-17	Toploader balance 2100 x 0.1G		695.00	1,390.00
2.00	11422-67	Balance 150G X 0.001G 230V		1,020.00	2,040.00
1.00	86579-20	Vortex Mixer		441.00	441.00
1.00	86579-22	Microtube adapter		81.50	81.50
1.00	86579-23	Microplate adapter		81.50	81.50
1.00	86579-24	Test tube adapter		81.50	81.50
1.00	86579-25	Rubber Platform		40.00	40.00
1.00	86579-26	Foam Platform		46.00	46.00
1.00	86579-27	Soft Foam Platform		59.00	59.00
1.00	99249-00	Easypure RODI		4,610.00	4,610.00
1.00	51100-35	CC Shaker 12 Flasks 230V/60H		2,690.00	2,690.00
1.00	05014-04	Oven 1.7 CU FT 240V GRAV CONV		1,060.00	1,060.00
1.00	01850-24	Bacti Cinerator IV 240V		447.00	447.00
5.00	14203-24	Loop Nichrome W/Handle 2mm 6pk		53.00	265.00
10.00	14212-02	Cell Spreader bacterial 25mm		17.25	172.50
1.00	09900-82	Kit Technician Wheeled case		1,200.00	1,200.00
2.00	07878-30	Dispenser Seripettor 1-10ml		149.00	298.00
2.00	07878-32	Dispenser Seripettor 2.5-25ml		187.00	374.00
1.00	04656-40	Stirrer 15-Position 100-240V		1,960.00	1,960.00

1.00	03336-30	6L Consle Freez Dry 230V 50HZ		13,050.00	13,050.00
10.00	07250-00	Container W/Cover SS 1/2QT		78.00	780.00
10.00	07252-00	Container W/Cover SS 2 1/8QT		105.00	1,050.00
5.00	07253-00	Container W/Cover SS 3QT		111.00	555.00
5.00	36130-30	Burner Natural Gas		32.50	162.50
50.00	08008-27	Esy-Rd Therm- 10/110C Part		9.70	485.00
				SUBTOTAL	$ 34,818.50
				Freight	1,959.79
				TOTAL(CIF HARARE)	**$ 36,778.29**

Table 10. List of equipment ordered from the UK for SPRL, Zimbabwe

1.00	AUX-513-050L	Autoclave 40L (AMB430BT) (HS Code84192000)		$ 11,180.00	$11,180.00
1.00	PKT-125-010G	pH/mV/C meter (HS Code:90278011)		879.09	879.09
1.00	PKT-120-525D	pH electrode Eutech double junction, 1m cable (HS Code 90278011)		146.54	146.54
1.00	SGM-366-020Y	Platform shaker (HS Code:84798200)		2,924.00	2,924.00
1.00	CNW-350-D	Colony counter, Man Darkfield (HS Code:90189085)		1,204.00	1,204.00
2.00	PMP-132-005F	Research plus 0.1-2.5ul Pipettor Eppendorf (HS Code: 90330000)		319.06	638.12
2.00	PMP-132-020J	Research plus 2-20ul yellow Pipettor Eppendorf (HS Code: 90330000)		319.06	638.12
2.00	PMP-132-025W	Research plus 10-100ul Pipettor Eppendorf (HS Code: 90330000)		319.06	638.12
2.00	PMP-132-040D	Research plus 100-1000ul Pipettor Eppendorf (HS Code: 90330000)		319.06	638.12

2.00	PMP-132-045Q	Research plus 500-5000ul Pipettor Eppendorf (HS Code: 90330000)			319.06	638.12
					SUBTOTAL	$ 19,524.23
					Freight	3,118.00
					TOTAL	**$ 22,642.23**

List of project reports

1. N2Africa Steering Committee Terms of Reference
2. Policy on advanced training grants
3. Rhizobia Strain Isolation and Characterisation Protocol
4. Detailed country-by-country access plan for P and other agro-minerals
5. Workshop Report: Training of Master Trainers on Legume and Inoculant Technologies (Kisumu Hotel, Kisumu, Kenya-24-28 May 2010)
6. Plans for interaction with the Tropical Legumes II project (TLII) and for seed increase on a country-by-country basis
7. Implementation Plan for collaboration between N2Africa and the Soil Health and Market Access Programs of the Alliance for a Green Revolution in Africa (AGRA) plan
8. General approaches and country specific dissemination plans
9. Selected soybeans, common beans, cowpeas and groundnuts varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project
10. Project launch and workshop report
11. Advancing technical skills in rhizobiology: training report
12. Characterisation of the impact zones and mandate areas in the N2Africa project
13. Production and use of Rhizobial inoculants in Africa
18. Adaptive research in N2Africa impact zones: Principles, guidelines and implemented research campaigns
19. Quality assurance (QA) protocols based on African capacities and international existing standards developed
20. Collection and maintenance of elite rhizobial strains
21. MSc and PhD status report
22. Production of seed for local distribution by farming communities engaged in the project
23. A report documenting the involvement of women in at least 50% of all farmer-related activities
24. Participatory development of indicators for monitoring and evaluating progress with project activities and their impact
25. Suitable multi-purpose forage and tree legumes for intensive smallholder meat and dairy industries in East and Central Africa N2Africa mandate areas
26. A revised manual for rhizobium methods and standard protocols available on the project website
27. Update on Inoculant production by cooperating laboratories
28. Legume Seed Acquired for Dissemination in the Project Impact Zones
29. Advanced technical skills in rhizobiology: East and Central African, West African and South African Hub
30. Memoranda of Understanding are formalized with key partners along the legume value chains in the impact zones
31. Existing rhizobiology laboratories upgraded

Partners involved in the N2Africa project

Caritas Rwanda

Diobass

Eglise Presbéterienne Rwanda

Resource Projects-Kenya

Université Catholique de Bukavu

University of Zimbabwe