B FIELD EXAMPLES

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1 Implementation

1.1 Quantity estimates

This estimate allows the unit cost of the works to be calculated, and the quantity of materials necessary to ensure the supply of the sites to be estimated. It is frequently drawn up in the form of tables (Tables 7.III to 7.V).

Table 7.III: Quantity estimate for different works.

Quantities / Tasks	Number of units	Unitary cost	Total cost	Cement No. of bags/m	Cement total	Reinforcement quantity /m	Reinforcement total	Sand quantity /m	Sand total	Gravel quantity /m^3	Gravel total
140 mm well lining											
Surface and bottom anchorage											
100 mm cutting ring											
100 mm independent intake											
Slab, apron, headwall											
Labour /m											
Others											
TOTAL											

Table 7.IV: Materials for the construction of a 1.4 m diameter well with a 1 m diameter independent intake.

	Cement		Gravel		Sand		Reinforcement	
	(m^3)	(kg)	(m^3)	(kg)	(m^3)	(kg)	(m)	(kg)
Well lining per m 350 kg cement/m^3	0.126 or 3.4 bags	144	0.4	800	0.2	340	50	20
Anchorage 1 surface + 1 bottom 350 kg cement/m^3	0.25 or 6.7 bags	326	0.74	1 488	0.37	632	71	29
Intake per m 300 kg cement/m^3	0.104 or 2.8 bags	138	0.276	552	0.138	235	34	14
Cutting ring 400 kg cement/m^3	0.03 or 0.8 bag	42	0.084	168	0.042	71	31	12
Surface works (headwall, apron, drain)	0.62 or 17 bags	830	1.9	3 792	0.95	1 615	324	130
100 l drinking trough	0.028 or 0.7 bag	37	0.08	167	0.042	72	18	7

Table 7.V: Materials for the construction of a 1.8 m diameter well with a 1.4 m diameter independent intake.

	Cement		Gravel		Sand		Reinforcement	
	(m^3)	(kg)	(m^3)	(kg)	(m^3)	(kg)	(m)	(kg)
Well lining per m 350 kg cement/m^3	0.16 or 4.3 bags	209	0.48	955	0.24	406	64	26
Anchorage 1 surface + 1 bottom 350 kg cement/m^3	0.33 or 9.1 bags	444	1.02	2 032	0.51	867	99	40
Intake per m 300 kg cement/m^3	0.14 or 3.8 bags	189	0.38	754	0.19	320	46	18
Cutting ring 400 kg cement/m^3	0.04 or 1.1 bags	53	0.107	213	0.053	91	41	16
Surface works (headwall, apron, drain)	0.62 or 17 bags	830	1.9	3 792	0.95	1 615	320	128

1.2 Time necessary for the construction of a well

The time required for constructing a well depends on the nature of the ground (stability and hardness), the participation of the community, and the depth of the well. An example is given in Table 7.VI.

Table 7.VI: Time necessary for the construction of a 1.4 m diameter well, 15 m total depth, with an independent intake, by a team of trained well diggers.

Operations to be carried out	Approximate period of time per operation
Installing and packing up the site	2 days
Excavation (1.6 m diameter)	
– stable and soft ground	1 m/day
– stable and semi-hard ground	0.8 m/day
Well lining (1.4 m diameter)	
– top-down	1 m/day
– bottom-up	2 m/day (2 superimposed passes)
Intake (1 m diameter)	
– rings cast at the surface	2 rings/day/mould during digging
– intake column cast at the bottom of the well	2 m/day
Well digging / intake sinking	
– soft ground	1 m/day
– semi-hard ground	0.6 m/day
Development and pumping tests	1 to 2 days
Surface works	4-5 days
Summary	
Installing the site	1 day
12 m excavation	12 days
Well lining, 12 m	6 days
Intake cast *in situ*, 4 m	2 days
3 m intake sinking	3 days
Development, pumping test	2 days
Surface works	4 days
Packing up the site	1 day
TOTAL	31 days

1.3 Planning the construction of ten wells

The project involved the construction of 10 wells of 1.4 m diameter, and 10 m average depth. Two teams of well diggers were trained, and the village was asked to participate, which is essential for the success of such a project (Table 7.VII).

Table 7.VII: Planning for the construction of 10 1.4 m diameter wells, 10 m average depth.

Month	Activities
1	Purchase of equipment (dewatering pump, tripods, moulds etc.)
	Recruitment of workers
	Contact with local partners
	Visit and choice of first sites
	Meeting and organisation of project with communities
	Classroom training for digging teams
2	Construction of well 1 with two teams under training
	Planning of meetings with villagers
3	Construction of well 2 with two teams to complete practical training
	Surveys and choice of 8 future sites
	Discussion with villagers for organisation of the work
4	Construction of wells 3 and 4 by two teams separately
	Continuation of community mobilisation programme (until end of programme)
5	Construction of wells 5 and 6 by two teams
	Starting of sites 7 and 8
6	End of construction of wells 7 and 8
	Starting of wells 9 and 10
	Evaluation of programme
	Possible proposal of new actions

2 Resources required

2.1 Human resources

It is necessary to plan for one or more teams of well diggers depending on the timescale for the programme. As an example, 10 wells of average depth 15 m can be done by one team of well diggers in 6 to 8 months; for anything beyond that, it is preferable to work with more teams. For efficiency, it is advisable to have one team specialised in working below water level and the other in simple digging and lining.

Each team has a leader, who is directed by a person responsible for the project or by a supervisor (Table 7.VIII). The communities must be involved in the work, for example by making up the labour force for the following tasks:

– creating access routes to the sites;
– collecting and sieving aggregates;
– supplying water for the site;
– digging and extracting cuttings, under the close supervision of the team;
– mixing cement, and other unskilled jobs.

Table 7.VIII: Staff required for a well-construction programme.

Personnel	Activities
Management	
1 manager	Technical assessment, planning, team management, relations with partners
1 logistics officer	Supplies to the sites, tracking of material and vehicles
Digging and lining team (down to water level)	
1 well digger	Site foreman
1 builder	Placing shuttering and reinforced concrete
4 labourers	Well digging, concrete mixing, winch operation
Intake-section team	
1 well digger/builder	Site foreman
4 labourers	Digging, sinking the intake column, concrete mixing, winch operation

2.2 Materials

The costs shown in Tables 7.IX and 7.X correspond to an average of all ACF well-building projects in Africa.

Table 7.IX: Example of costs of a new well.

Diameter (cm)	Depth (m)	Cement (kg) (US$ 250/t)	Aggregates (m^3) (US$ 10/m^3)	8 mm reinforcement (m) (US$ 0.7/m)	Cost (US$)
140	5	2 610	8.7	850	1 335
	10	3 330	11.7	1 100	1 720
	15	4 050	14.7	1 350	2 105
	20	4 770	17.7	1 600	2 490
	25	5 490	20.7	1 850	2 875
180	5	3 310	11.1	1 010	1 645
	10	4 360	15.0	1 330	2 170
	15	5 410	18.6	1 650	2 690
	20	6 450	22.5	1 970	3 220
	25	7 500	26.1	2 290	3 740

Table 7.X: Example of the rehabilitation cost of a well including a 5 m intake and surface works.

Diameter (cm)	Materials	Quantities necessary	Cost (US$)
140	Cement	1 890 kg	
	Aggregates	6 m^3	950
	Reinforcement 8 mm 600 m		
180	Cement	2 270 kg	
	Aggregates	7.5 m^3	1 125
	Reinforcement 8 mm 690 m		

2.3 Equipment

Indicative lists of the tools and equipment necessary for two teams of well diggers working simultaneously are shown in Table 7.XI.

Table 7.XI: Average cost of tools and equipment for two teams of well diggers.

	Quantities	Price (US$)
Heavy equipment		
Dewatering kit[1]		
– pneumatic dewatering pump and compressor	1	10 000
– or electric dewatering pump and generator	1	5 000
Water-level sensor (dipper)	1	700
Shuttering set		
– sliding shuttering	2	1 600
– mould for intake rings[2]	2	3 000
– mould for headwall	1	600
– mould for cutting ring	1	800
Tripod and manual winch (8/10 mm cable, 1.5 t)[3]	2	4 000
Derrick and well-digging grab bucket (for deep wells and special works)	1	14 000
Light tools and equipment		
– tools (pickaxes, shovels, trowels, chisels, builder's buckets, wheelbarrows)	10	
– 3 kg sledge hammer, hammer, saw	5	
– bolt cutter for concrete reinforcement bars	2	
– set of spanners for assembling the moulds	5	
– wire brush	5	
– safety rope (25 mm)	2	
– sieves: 5, 10 and 20 mm	2	
– water drums (200 l)	4	
– plumb line, shock-resistant spirit level, double measuring tape, builder's ruler	5	
– helmets	10	
– gloves	20	
– safety harness	4	
– first aid kit	2	
TOTAL		39 700

1. Pneumatic dewatering pumps have numerous advantages: simplicity, sturdiness, ability to lift muddy water, ease of use (light and not bulky), possible use of a pneumatic hammer vibrating rods etc.
2. A complete set of ring moulds includes the internal and external moulds, a cover for the upper lip, and two covers for the lower lip (it is possible to cast two rings a day).
3. Pyramid tripod composed of tubes of 60 or 80 mm diameter, to which a pulley is hitched (free height 2 m). A manual winch is usually located at the base of the frame to lift the cuttings to the surface. It can also be fixed directly onto the headwall.

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