An Inventory of Agricultural Water Technologies and Practices in ZAMBIA

I. GENERAL	Technology 1= name	Technology 2 =name	Technology 3 = name	Technology 4 = name	Technology 5 = name	Technology 6 = name	Technology 7 = name
1. Name of water technology or practice	**Clay pot sub-surface Drip Irrigation**	**Zilili River flood plain recession Irrigation**	**Micro-basin water harvesting (Conservation Farming)**	**Inland valley swamp Irrigation (Dambos)**	**Hill-spring water Gravity head sprinkler Irrigation**	**Low-cost Bucket/Drum Kit Drip Irrigation**	**Treadle Pumps**
1.0 Detailed description of technology or practice (give technical description, refer to Annexes 1 & 2; attach an illustation/picture if technology is not in the lists)							
1.1 Source of technology (Indigenous or Imported)	Indigenous	Indigenous	Imported	Indigenous	Indigenous	Imported	Imported
1.2 If imported, any modifications done (Yes or No)	na	na	yes	na	na	Yes	Yes
1.3 Provider of technology[b]	Agriculture Research branch	Indigenous knowledge	Conservation Farming Unit(CFU) and Co-operative League of the USA (CLUSA)	Indigenous knowledge	Indigenous knowledge	IDE and World Vision Zambia	FAO-Special Programme for Food Security in conjunction with IDE-Zambia
1.4 Who developed/designed the technology package[c]	Government Researcher	Farmers themselves	Zimbabwean CFU consultant	Farmers themselves	Farmers themselves	IDE-Bangladesh	International Development Enterprises (IDE)
1.5 Who installed the technology package[c]	Agriculture Research branch	Farmers themselves	Conservation Farming Unit(CFU) and Co-operative League of the USA (CLUSA)	Farmers themselves	Farmers themselves	IDE and World Vision Zambia	IDE-Zambia in selected pilot areas
1.6 Source of water (surface, groundwater, harvested rainwater, wastewater, etc.)	Surface, ground, harvested rain water and waste water	Groundwater capillary rise	Rainwater	Rainwater and ground water	Rock-spring	Groundwater from wells/rivers	Groundwater shallow wells
1.7 Is the technology used for more than one use (multiple uses)? (Yes/No)	Yes	No	No	Yes	Yes	Yes	Yes
1.8 If yes, what are they?	Irrigation and drainage	na	na	Crop production, domestic water and livestock grazing	Irrigation and water supply	Irrigation water supply and fertigation to crops	Irrigation of crops and drawing domestic water
1.9 If yes, how is the technical design adapted compared to the design for single use?	When soil is saturated water moves in clay pot and drainage takes place and same pot is filled with water to irrigate when needed	na	na	Vegetable gardens are fenced off from grazing cattle and separate wells for domestic water as opposed to those for irrigating are used.	Spring water is channelled in a small canal into a storage reservoir constructed on a hill 10m high from ground but close to a spring. Stored water is allowed to flow out from a reservoir through a pipe and operates a set of sprinklers for irrigating crops at field level. water is also used for domestic purposes.	The bucket and drum kit uses the same reservoir for irrigation water to mix fertilizer and apply nutrients as solute to plants.	There are two types of pumps; one adapted for installation on shallow wells to draw domestic water and the other meant for pumping water from rivers and shallow wells for irrrigation purposes.The latter can also draw domestic water.
1.10 What is seen as advantages of multiple use systems as compared to the design for one single use?	Regulates soil moisture around rootzone for optimal crop growth;Gives long irrigation intervals due to water savings	na	na	Multiple use provides for a holistic livelihood system at household level.	The system is cost effective as it does not call for a separate conveyance system for domestic water. The spring water is of good quality for both irrigation and domestic purposes.	The dual role of irrigating and fertilizing saves on labour and also directly locates nutrient to the rootzone resulting in savings. The system also optimizes on water use giving higher yields than the traditional bucket irrigation.	Multiple use systems are inexpensive as they have dual purposes and thus allows farmer to own one pump for multiple uses.
1.11 What are the disadvantages of multiple use systems?	Bailing out water when pots are full	na	na	Competing uses in Dambos result conflicts and low adoption rates by users.	nil	High concentrations may be hazardous to plants and the drip emmitters sometimes clog from chemical conentration in water.	Breakdown of multiple use system disables users on all operations dependent on the system.

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1.0 Detailed description of technology or practice (give technical description, refer to Annexes 1 & 2; attach an illustation/picture if technology is not in the lists)							
2. Specific location/address & distance from main urban center (km)	Has been piloted at Kaunga Irrigation scheme in the Luangwa valley about 280km from Lusaka	Commonly used on the fringe of the Zambezi river at Siatwinda and surrounding areas some 400km from Lusaka. The system is also applied in seepage zones of Dambos.	The technology has widely been adopted in almost all the Provinces in Zambia.	Dambo use is scattered around the country in low-lying areas and are accessed by a great majority of small-scale farmers.	The described system is located in Katete at Mphangwe Hills and irrigates over 20ha of orchard. Elsewhere in Chadiza the system has been applied.	The system has been piloted by Zambia Export Growers Association (ZEGA) in Lusaka and farmers in peri-urban areas of Lusaka.	Treadle Pumps have been installed in all provinces of Zambia particularly where Dambos offer easy access to shallow water tables.
3. Main source(s) of income in site	Fishing and river bank gardening	Upland crops and vegetable growing	Upland rainfed crop especially staple maize	Vegetable growing in Dambos and rain fed upland crops like maize, cassava, sorghum and groundnuts.	Upland cultivation of Cotton, maize and sorghum/millet	Income from vegetables grown in backyard gardens	Growing of vegetables in Dambos and Maize in surrounding upland fields.
4. Other source(s) of income in site	Collection of wild fruits and wildlife hunting	Fishing	casual employment	Fishing and casual labour	Orchard fruits	Formal employment and casual labour.	Fishing, reed mat making and selling and thatching grass selling
5. Type of user (community or individual households)	Community	Individual households	individual households	Community and Individuals	Individual	Individual households	Individuals
6. No. of benefitted households; average size of households	50 households; 7members per household	>500;7members per household	250,000 households; 7 members per household	>400,000 households; 7 members per household	100 households; 7 members per household.	440 households: 23m2 - 125m2 per individual and 5ha/individual	>5000 Households; 7 members per household
7. Total size for all beneficiaries (ha) -note average size per beneficiary	0.5ha; 0.01ha/beneficiary	20-50ha; 0.25ha/beneficiary	300,000ha; 0.25ha/beneficiary	100,000ha;0.20ha per beneficiary.	20ha single enterprise benefitting above households	10ha:0.01ha per individual as average but one person has installed 5ha	1,200ha;0.25ha per beneficiary
8. Profile of beneficiaries (if mostly ultra poor, poor, non-poor or mixed)[a]	Mixed	Poor	ultra poor to poor	Poor	poor	Mixed	Mixed
8.1 Was project/program area selected based on available data on comparative incidence of poverty? (Yes/No)	No	No	yes	No	No	No	Yes
8.2 If yes, indicate the poverty status of the project area relative to all other regions of the country	na	na	The poverty status of most beneficiaries of this technology is ultra poor and poor compared to other regions of the country	Poor	poor	na	Mixed poverty level status from poor to less poor obatains among users
8.3 Were particular populations or groups targeted within the project area (e.g., based on baseline socioeconomic surveys or participatory poverty assessment, etc)? (Yes/No)	Yes	No	yes	No	No	No	Yes
8.4 If yes, indicate the poverty status of the beneficiaries relative to the non-beneficiaries in the project/programme area	75% are Poor	na	80% of beneficiaries were categorized as poor by criteria developed by the community baseline survey.	na	na	na	80% of beneficiaries were poor but with experience in vegetable growing using traditional methods of buckets
8.5 Indicate the proportion of women beneficiaries	60%	80%	>80%	>80	90%	1%	35% of users are women
9. Month & year technology was introduced	September, 1995	1960's	March, 2000	1960's	1980's	September, 1999	September, 1997
10. No. of years of adoption	10	45	5Years	>45years	25 years	5 years	8 Years
11. Is technology still in use (Yes or No)	No	Yes	Yes	Yes	Yes	Yes	Yes
12. If not anymore, why? (STOP here for this technology)	Poor extension service to popularize it and inadequate capacity to manufacture the clay pots.	na	na	na	na	na	na
13. Type of technology (water capture such as small dams, rainwater harvesting OR distribution/water use such as treadle pumps, drips, etc.)		Residual soil moisture use post flooding.	Rainwater harvesting	Rainwater and ground water utilizing technology	Water capture from spring to resrvoir	Distribution	Distribution/water use

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1.0 Detailed description of technology or practice (give technical description, refer to Annexes 1 & 2; attach an illustation/picture if technology is not in the lists)							
14. Describe the counterfactual or the old technology (practice) the new water management technology/practice replaces.		The bucket irrigation drawing water from shallow wells	Ox-drawn ploughing	Farmers' indigenous knowledge has been backed by scientific approaches to cultivating flood prone areas like Dambos by planting on raised flat beds for drainage purposes and sometimes on flat ground in seepage zones to adapt to changing water regimes.	na	The Bucket and drum kits reserve water in an elevated reservoir and waterflows at low pressure by gravity through dripper lines and emmitters replacing the old watering system that used water drawn in buckets and watered physically crop by crop.	Before the treadle pumps farmers would draw water from shallow wells using rope and buckets and irrigate crops by bucket.
14.1 Is the change partial or complete?		partial	partial	Partial	na	complete	Partial
14.2 If the change is partial, describe the elements of the old system that were preserved and those that were discarded		Digging shallow wells and use of buckets to lift water is discarded in this system but small planting holes are dug to access water table	Tillage is done by hand hoe in selected land areas as opposed to full soil tillage and planting stations are permanent as opposed to changing planting stations yearly in the old system. Planting dates have remained the same but the new system enforces adherance to early land preparation and planting.	In the old system, the flooded areas were abandoned but planting on ridges/raised beds allows restitution of the water table to create a normal rootzone for crop growth.Grazing livestock has been preserved in the present system.	na	Irrigation after soil moiture depletion has been discarded since water is applied continously keeping the soil rootzone at field capacity all the time.	The pumping of water is restricted to 8m suction head and the distribution is limited by the terrain and length of the delivery line. This forces the user to use rope and bucket to draw and deliver water to crops as in the traditional system.
II. Profitability of the TECHNOLOGY							
a. The new technology or management practice (Note: prepare an enterprise or partial budget)							
15. What is the estimated and actual life of the technology? (in years)		Lifetime system	lifetime system	Lifetime	10 Years	2years estimated lifetime and 3years actual lifetime.	10 Years estimated lifetime and actual lifetime is 7 years
16. Was technology given out for free?		na	na	na	No	No	No
17. If NOT totally free, what is the capital cost of technology (reference YEAR of cost estimate; separate costs for equipment/tool/parts, pipes for conveyance into farm, installation, water source development)		na	na		US$1000 for construction of simple canal and surface storage reservoir including pipes and sprinkler set	Bucket kit=US$7 Drumkit=US$35 (125m2) US$1,600(1ha)	Capital cost of treadle pump: 1997=US$52; 1999 = US$74 2005=US$80 cost of pipe for 0.25ha is US$86 at the current period and was US$90 in 1999 and US$94 in 1997
18. Cost of operation & maintenance per ha (indicate what items are included-- cost of pumping in terms of fuel, energy/electricity, labor costs; maintenance and repair costs, etc.)		na	na	na	No pumping cost as water flows freely and drops over a 10m head to operate sprinlkers. Canal maintenance is about US$20/Annum.	nil	Operation and maintenance costs of technology is about US$80/ha/year involving repairs of treadles, replacement of valves and ropes and labour for sixteen irrigations in 2 cropping seasons
18.1. Does the new technology reqiure more or less labour than the old technology?		Less labour and low-cost	Labour intensive for digging and weeding in the first year but reduces drastically in subsequent years especially the third year.	na	Less labour than the conventional pumped sprinkler operated irrigation system.	Less labour intensive than the old technology	No
19. Crops produced (indicate main crops vs. secondary crops)			Maize, Soya, Groundnutd and Paprika as main crops with sorghum and millets being secondary.	Maize, Cabbage and Sugarcane as main crops and cassava, sorghum and millet as secondary crops.	Pineapples and oranges as main crops	Maize, cabbage, Tomatoes as major and Beans	Maize, Cabbage and Tomatoes as main crops and cassava, sorghum and millet as secondary crops.

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20. Changes in crops grown (into what & when) & reason for new crops or switching		Green maize cabbage into Tomatoes,peas,	Soya beans and maize have become move popular crops under this system	Diversified into Cabbage varieties,Tomatoes,Rape, carrot,peas, chinese cabbage, irish potatoes as main crops due to new innovation of extending the growing season and adaptability of crops as a result of planting on raised ground. Improved markets for produce has contributed to this diversity.	With new water distribution system, new crops from Maize and cotton to Oranges, pineapples and Bananas are now grown as main crops.	Tomatoes, peas, maize, Rape, Cabbage	Diversified into Cabbage varieties,Tomatoes,Rape, carrot,peas, chinese cabbage, irish potatoes as main crops due to new innovation of extending the growing season and adaptability of crops as a result of planting on raised ground. Improved markets for produce has contributed to this diversity.
21. Indicate how many croppings per year (1, 2, or 3)		2 croppings	1 cropping per year	2 croppings per year	all year round production	2 croppings	2 croppings per year
22. Increase in production (in kg/ha) due to technology (including amount used for own consumption & amount sold to market)		nil	The technology has proven to increase maize yields from <1ton/ha to >4ton/ha with small-scale farmers; soya beans yield s have more than trebbled from 0.8 ton/ha to 3.0 ton/ha.	Farmers' indigenous knowledge has been backed by scientific approaches to cultivating flood prone areas like Dambos by planting on raised flat beds for drainage purposes and sometimes on flat ground in seepage zones.	Oranges:70ton/ha Pineapples:60ton/ha Bananas: 100ton/ha with technology - this represents average increases of 250% over yields without technology.	Yields of crops increased by 300% - 400% compared to conventional technology	Maize yields have increased from 1ton/ha to about 6ton/ha; tomatoes from 2.5ton/ha to 35ton/ha; Cabbage from 5ton/ha to 29ton/ha
22. Increase in revenues (in local currency) due to technology (less amount used for own consumption)		nil	300% to 400% increase in income attributed to new technology compared to old system	Average household incomes have increased from ZK350,000 to ZK1,800,000 per annum using 2 cropping cycles.	Average enterprise income rose from ZK86Million to ZK260Million representing an increase of 203%	nil	Average income per household per year has increased from US$550 to US$2,450 per hectare per household per year
23. Estimated & actual financial profits (gross revenues-costs of all cash inputs)		nil		The estimated financial profits were ZK1,200,000 versus actual profits of ZK1,650,000	Actual finacial profit of ZK221Million per annum were recorded.	nil	The estimated financial profits were US$1,800 versus actual profits of US$2,100
b. Old water management technology or practice (prepare an enterprise budget) LEAVE OUT QUESTION 24-29 IF NO OLD TECHNOLOGY WAS REPLACED							
24. What is the estimated and actual life of the technology? (in years)		Lifetime	Lifetime	3 Year cycle of replacing raised beds and ridges	10 Years	2-3 years	Lifespan estimated at 10 years against actual of 7 years
25. What is the capital cost of technology?		na	na	ZK200,000 per hectare	US$1000	Bucket kit=US$7 Drumkit=US$35	Capital cost of treadle pump technology is US$52.
26. Cost of operation & maintenance per ha (indicate what items are included-- cost of pumping in terms of fuel, energy/electricity, labor costs; maintenance and repair costs, etc.A61)		na	na	ZK60,000/ha per year in form of reforming the ridges and flat beds after a crop cycle	US$30/Annum	nil	Capital cost of technology per hectare per year is US$220 full installation of treadle pump and pipe including repair costs,replacement parts and field layout.
27. Crops produced (indicate main crops vs. secondary crops)		Green maize,okra, tomatoes & Rape vegetable vs cleome, amaranthus	Maize, soyabeans,paprika and sorghum	Maize, Cabbage and Sugarcane as main crops and cassava, sorghum and millet as secondary crops.	Oranges, pineapples and bananas as main and maize as secondary	Maize, Tomatoes and Peas as major crops	Green maize,okra, tomatoes & Rape vegetable vs cleome, amaranthus
28. Indicate how many croppings per year (1, 2, or 3)		2	1	2 croppings per year	Year round	2 croppings per year	2 croppings per year
29. Estimated & actual financial profits (gross revenues-costs of all cash inputs)		nil	nil	nil	US$8,500/Annum	nil	The estimated financial profits were US$1,800 versus actual profits of US$2,100

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III. ROLE OF INSTITUTIONS/ORGANIZATIONS							
30. Support by NGOs (specify the NGO & indicate if international or local)							FAO, IDE,World Vision and CLUSA
30.1 Indicate the total value of the support (in Dollars or local currency)		n/a	CLUSA = US$650,000 CFU=US$300,000 WFP=US$850,000	No direct support has been rendered by NGOs both local and International	na	IDE = US$5,000; World Vision = US$1000	CLUSA/Total Land Care = US$600,000; IDE = US$203,000; FAO-SPFS= US$25,000 World Vision=US$15,000
30.2 Is the support still on-going or withdrawn? (1. Ongoing; 2. Withdrawn)		n/a	Withdrawn	na	na	On-going	Withdrawn except for IDE and World Vision
30.3 If the institutional support is withdrawn, is the system still functioning?		n/a	Yes but at a reduced scale	na	na	Yes	Yes
30.4 If the system is still functioning, is the pace of technology/practice uptake continuing at the same or better pace than when there was NGO institutional support? (1. Same pace; 2. Better pace; 3. Slowed down)		same pace	Slowed pace	The system is continuing at an increased pace despite lack of external support.	Yes	Adoption at reduced pace	The technology uptake is contuing at the same pace
30.5 Give reasons for the response to 30.4		The system is affordable	Some farmers perceive the technology to be labour intensive although they value the incremental benefits obtained from increased yields	Drought prevalence the last fifteen years has led to Dambo cultivation by most small-scale farmers. Reduced inputs for production is possible because Dambos act as sinks for nutrients from surrounding high ground.	na	Drip kits are not made available regularly	The benefits from the technology are clearly noticeable and impacting among the users. With IDE continuing to make the technology available, uptake has been sustainable.World vision provides training to users given treadle pumps by themselves.
31. Specific support provided[d]				na	na	IDE makes technology available and provides training whereas World Vision provides training and technology on credit.	Training in operation and maintence,credit provision and service parts provision
32. Support by government extension workers & other government agency (specify which agency & whether local or national government) (yes or no)							
32.1 Indicate the total value of the support (in Dollars or local currency)			US$1,800,000	na	Gvt. Extension support offered but not quantified	nil	US$828,000
32.2 Is the support still on-going or withdrawn? (1. Ongoing; 2. Withdrawn)			Withdrawn but partial capacity building from CFU is on-going	na	Yes	na	Withdrawn support except IDE
32.3 If the institutional support is withdrawn, is the system still functioning?			Yes	na	na	na	Yes
32.4 If the system is still functioning, is the pace of technology/practice uptake continuing at the same or better pace than when there was Government institutional support? (1. Same pace; 2. Better pace; 3. Slowed down)			Slowed down pace	na	na	na	Same pace as before
32.5 Give reasons for the response to 32.4			Support from CLUSA came to an end after project ceassation but farmer groups are slowly providing self-extension for upscaling because of the benefits the system accrues.	na	na	na	Some local NGOs buy treadle pumps from IDE to support their farmer groups by giving the technology on credit.

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33. Specific support provided[d]			Technology transfer provided by CFU and CLUSA;Input access facilitated by CLUSA; Output market access facilitated by CLUSA; Credit provision facilitated by CLUSA; Training support provided by CLUSA, CFU & PLAN International	na	Training in citrus production and water management	na	World vision, Africare, ZNFU,CARE and Plan Internationalbuy treadle pumps to give to their groups.
34. Support by private enterprises (specify enterprise)							
35. Specific support provided[d]			Support from from SHEMP was through market linkages for surplus produce as a result of the technology and also training farmer groups in Business planning and Marketing for them to be sustainable.	na	nil	nil	ZESCO Gwembe Tonga project provided treadle pumps for promotion of vegetable gardening along the banks of the Zambezi river.
36. Support by other organization (specify organization - e.g. community organization) or private sector service provider (e.g. manufacturers/dealers/retailers)							
36.1 Indicate the total value of the support (in Dollars or local currency)			Africare, CARE, World Vision, PAM and ADRA supported farmer groups to adopt Conservation Farming via World Bank Food Security Project.The total value of in-kind support was about US$4.5Million	na	Economic Expansion in Outlying Areas offered entrepreneural skills	na	US$10,000 for purchase of treadle pumps and its accessories.
36.2 Is the support still on-going or withdrawn? (1. Ongoing; 2. Withdrawn)			Withdrawn but PLAN International is still promoting Conservation Farming among some communities in Southern Province.	na	Withdrawn	na	Support is withdrawn
36.3 If the institutional support is withdrawn, is the system still functioning?			Yes	na	Yes	na	Yes the system is functioning
36.4 If the system is still functioning, is the pace of technology/practice uptake continuing at the same or better pace than when there was institutional support? (1. Same pace; 2. Better pace; 3. Slowed down)			Slowed down	na	Better pace	na	The adoption pace is slowed down.
36.5 Give reasons for the response to 36.4			Some farmers perceive the technology to be labour intensive although they value the incremental benefits obtained from increased yields. The pace usually slowed down each good rain season and accelerates when there is drought.	na	The enterprise has enough capacity to manage itself and operation and maintenance costs are low for the farm enterprise.	na	Farmers in the Gwembe valley are poverty stricken and cannot afford the technology on their own. Since support ceased, the initial receipients receive extension support from Ministry of Agriculture and cooperatives.
37. Specific support provided[d]			Support from from SHEMP was through market linkages whereas Africare, PAM, ADRA, CARE International, World Vision and PAM through World Bank funding supported technology adoption through input provision, Food for Work and training.	na	Business and Marketing training	na	Training in water use, operation and maintenance of treadle pumps and business/marketing planning.
IV. FACTORS CONTRIBUTING TO PROFITABILITY & SUSTAINABILITY OF TECHNOLOGY (see Annex 3 for sample answers #40-45)							
38. Ease in implementation (Yes & No)			Yes	Yes	Yes	yes	Yes
39. Ease in O&M (Yes & No)			Yes	Yes	Yes	yes	Yes

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1.0 Detailed description of technology or practice (give technical description, refer to Annexes 1 & 2; attach an illustation/picture if technology is not in the lists)							
40. Suitability of technology/How adapted to local conditions (well, not so well, etc.)			well	well	well	well	Not so well
41. Cultural acceptability			Modreately acceptable	Highly acceptable	Highly acceptable	Acceptable	Acceptaable
42. Effectiveness			Highly effective	Highly effective	Highly effective	Highly effective	Highly effective
42. Environmental impact			Conserves soils moisture and reduces soil erosion	System harvests water for future use and ridges constructed across slopes protect the soil from eroding.	Environmentally neutral	The system does not induce any soil erosion.	The growing of some trees to fence the garden is helping to prevent erosion on fields along the river banks.Irrigation has helped life forms such as earth worms grow.
43. Other advantages (factors contributing to profitability & Suitability)			Labour for weeding and land preparation reduces in subsequent years as same planting stations are used.	Nutrient reserve pool from organic matter accumulating in the valley bottoms saves on inputs.Complimentary between livestock and gardens seen in the use of maure from livestock to fertilize gardens.	nil	The technology optimizes yields per unit water and land with water use efficiency in excess of 1000% for most crops.	Double cropping on the same piece of land has been possible because of dry season vegetable growing using treadle pumps. Larger areas than traditionally irrigated are cultivated because of use of the pump.
44. Other disadvantages (factors constraining profitability & sustainability-- e.g. lack of specific support services or supplies of specific inputs, etc.-- be very specific)			The lack of credit to purchase inputs by small-scale farmers reduces the potential to achieve high yields and poor market structures.	Excessive flooding and lack of drainage may cause crop failure. Competing use between gardening and livestock makes the system cumbersome by requirements to fence off gardens.	nil	Lack of supply points for technology. Low level of demonstration sites does not stimulate adoption.	No service provider is available in the area ZESCO has provided the technology so break-down time may affects yields as crops suffer stress before repairs are done.

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[a] 1: ultra poor - extremely poor or most vulnerable engaged in rainfed cereal production, no potential to diversify because of lack of land, no livestock, limited available labor, no off-farm incomes/remittances, or without access to land and resources at all 2: poor; 3: non-poor;
[b] 1: indigenous knowledge; 2: NGO (specify); 3: government agency/extension worker; 4: private enterprises; 5: other (specify)
[c] 1:government agency (extension agency/irrigation advisory services/University); 2: representative/authorized dealers of manufacturers; 3: private consultant; 4: farmers themselves; 5: other (specify)
[d] 1:introduction of technology; 2: facilitated access to inputs; 3: facilitated access to output markets; 4: provision of (or facilitated access to) credit; 5: capacity building such as training (specify what); 6: formation of association (specify: water user assoc., producers