Simple labour-saving ways to boost maize and rice harvests in southern Africa

RIU

Validated RNRRS Output.

Farmers in dry uplands in southern Africa mainly grow maize. In wetlands, where their fields flood in the rainy season, they intercrop maize with rice. But maize and rice are labour-intensive and harvests were poor. Now, farmers use simple labour-saving practices and work their oxen more effectively. New farmer groups in Masvingo, Zimuto, Mshagashe, Chatsworth and Chivito, Zimbabwe, are spreading the word that soaking seeds, planting on ridges to combat waterlogging, ridging fields to get rid of weeds, and conserving moisture in furrows and pits saves work and boosts harvests. The Universities of Zimbabwe and Gweru, and agricultural colleges also now teach these and other practices. Plus, seeing the benefits for themselves, farmers are quick to copy what obviously works.

Project Ref: **CPP48:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **Silsoe Research Institute, UK**
Source: **Crop Protection Programme**

Document Contents:

Description

Research into Use
NR International
Park House
Bradbourne Lane
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UK

Geographical regions included:

Zimbabwe,

Target Audiences for this content:

Crop farmers,

CPP48

A. Description of the research output(s)

1. Working title of output or cluster of outputs.

In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

Improving crop establishment and weed management in both dry upland and wetland cereal-based systems

Suggested title: Improving crop establishment and weed management in cereal-based systems

2. Name of relevant RNRRS Programme(s)

Also indicate other funding sources, if applicable.

The Crop Protection Programme funded the projects which validated the core outputs described in this dossier. Salaries and facilities for University and field staff of Zimbabwean partner institutions were funded by the University of Zimbabwe and Zimbabwe Government. Activities under R7198 in Botswana were co-funded by Government of Botswana.

Rice lines evaluated in Zimbabwe by R7474/R8191 were provided by the rice breeding programme at WARDA, The Africa Rice Centre.

3. Relevant R numbers, institutional partners and contacts

(and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

R5742	1992-1997	*Cynodon dactylon* management in animal draft systems
R6655	1996-1999	Conservation tillage and improved weed management.
R7473	1999-2002	Weed management options for seasonally inundated land (vleis) in semi-arid Zimbabwe.
R7198	1998-2001	On-farm seed priming to improve maize establishment and weed competitiveness.
R8191	2002-2005	Promoting improved crop establishment and weed management in semi-arid sub-Saharan Africa.

Institutional partners	**Contact person**

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AREX Weed Research Team
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Mazoe, Zimbabwe — Dr S. Mbasa

Department of Agricultural Engineering (then part of AREX) — Tiri Kosa

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Centre for Arid zone Studies
University of Wales
Bangor — Dr D Harris (R7198)

4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? (max. 400 words).

This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.

Participatory technology development with farmers in the **semi-arid** Masvingo Province, Zimbabwe (1992-2005) produced a series of outputs to improve crop yields by using labour-efficient practices within tillage systems based on **animal draught ploughing**:

R5742

1) Validated practices for management of the perennial grass weed ***Cynodon*** *dactlyon*. Research showed that under dryland cropping systems in Botswana and Zimbabwe suppression of the weed was achieved and maize yields increased by ploughing early in the spring and applying a herbicide to grass regrowth before planting;

R6655

2) Characterised farmers existing weed management practices: and identified that weeds are a constraint in seasonally flooded ***vleis*** (**wetlands** that are vital for food security in rainfed areas) due to access problems after rain;

3) Validation of innovative crop establishment and weed control options for uplands and *vleis*: Use of a low draught **ripper tine** for reduced tillage planting; use of the mouldboard plough for inter-row weeding, shown to reduce labour and improved timeliness of operations;

R7474

4) On-farm validation of modified **tillage** and **crop establishment** systems for *vlei* fields: Preparation of broad-beds and ridges with the mouldboard plough owned by the majority of farmers to raise maize roots out of standing water. The beds or ridges are cropped with maize and separating furrows are cropped with rice. This system reduces the impact of water-logging on maize and provides water harvesting for rice;

5) Improved weed management in maize and rice in *vleis*: i) Application of pre-emergence **herbicides** provides weed suppression during maize vegetative stage and reduces need for labour-demanding hand hoeing in saturated soils, ii) Use of the mouldboard plough for inter-row weeding in dryer *vleis*. This allows farmers to conserve soil moisture during drought spells and drain excess water in wet periods;

6) Participatory selection of high yielding **rice lines**: Farmer groups selected and multiplied lines selected from seed provided by WARDA. These were distributed on a local scale in the project area and subsequently have spread rapidly from farmer to farmer;

R7198

7) Use of **seed priming** in maize validated under farmer-management: Soaking of maize seed over night prior to planting improved maize establishment, reducing the need for gap filling and significantly increased yield (at 5% level);

R8191

8) Promotion and dissemination of findings. Field days, workshops, and papers, extension "**Best Practice Guidelines**" and posters for land, preparation, weed management and knapsack sprayer use were prepared on the basis of findings of previous projects (Annex 1)

9) Development of a participatory technology development (PTD) process for farmer testing of the alternative weed management practices. This involved farmers and farmer groups facilitated by Government agricultural extension staff;

10) Strengthened capability of participating organisations to use participatory approaches.

5. What is the type of output(s) being described here?

Please tick one or more of the following options.

Product	***Technology***	***Service***	***Process or Methodology***	***Policy***	***Other Please specify***
	X Management practices		**X PTD**		

6. What is the main commodity (ies) upon which the output(s) focussed?

Could this output be applied to other commodities, if so, please comment

These outputs focus on maize grown in both dry uplands and seasonally flooded land (*vleis*) in southern Africa where inter-cropping with rice is also common as a risk reducing strategy. Most of these outputs are specific to animal draught systems.

7. What production system(s) does/could the output(s) focus upon?

Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	High potential	Hillsides	Forest-Agriculture	Peri-urban	Land water	Tropical moist forest	Cross-cutting
X							

8. What farming system(s) does the output(s) focus upon?

Please tick one or more of the following options (see Annex B for definitions). Leave blank if not applicable

Smallholder rainfed humid	Irrigated	Wetland rice based	Smallholder rainfed highland	Smallholder rainfed dry/cold	Dualistic	Coastal artisanal fishing
X		X				

9. Clustering these outputs

*How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**). Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.*

Outputs from this cluster include:

- Validated options for weed control in maize and rice, including the integrated use of herbicides with hand or draft animal weeding and early winter ploughing;
- A participatory technology development approach for farmer testing and selection of methods appropriate to their resources.
- Extension and training material.

Maize production in southern Africa faces a number of constraints not investigated during the series of projects from which these outputs were drawn. Validated technologies to address these are available under the following topics:

Soil fertility management
R8215 and R8452 – recommendations for use of green manures in maize based systems developed in Tanzania.

Other legume based options have been evaluated on-farm in Zimbabwe by the CIMMYT mid-altitude maize programme based in Harare.

Maize Stalkborer control
R8215 and R8452 – use of field margin planting of napier grass and application of neem based botanical insecticide in Tanzania.

R8449, R8212 – use of *Desmodium* inter-crops and napier grass field margins in the “push-pull” system developed in Kenya.

Striga tolerant maize

R6291 and R8215/R8452 – selected sources of resistance in early maturing lines provided from CIMMYT and validated their performance under farmer management in Tanzania.

Animal draught tillage/weeding equipment and extension messages
R7352 – recommendations on how to improve draught animal performance validated in Zimbabwe.

Weed control in direct seeded rice
R8234 – herbicide options for DSR validated in Bangladesh

Validation

B. Validation of the research output(s)

*10. **How** were the output(s) validated and **who** validated them?*

*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation **(max. 500 words)**.*

The projects that contributed outputs described in this dossier used a *participatory technology development approach*. Workshops with a range of local stakeholders including farmers, government extension (AREX), NGO and research staff and subsequently farmer focus groups were used to develop an understanding of constraints and the opportunities for improving farm productivity. Stakeholders then agreed the selection of crop management practices to be evaluated and these were included in a series of on-farm trials that were managed by farmers. Research staff collected data on crop stand establishment, weed control; yield etc and sites were used as replicates for statistical analysis which generally employed REML methods for unbalanced designs. Farmers came together with the research teams to undertake mid season and harvest evaluations of trials. Generally each group of farmers visited trials in its area and participants used matrix ranking to assess the performance of maize crops, establishment or weed control practice according to a set of their own previously agreed criteria. The advantages and disadvantages of each practice evaluated were also assessed in group meetings for households with a range of resources as described in section 11. Where new practices were evaluated that required cash inputs, including ripper tines or herbicides, these were provided by the projects. Otherwise farmers took decisions on ploughing and planting dates and undertook field activities with their own labour and draught power.

Best bet options identified for upland maize production included i) over night soaking of seed in water (priming) prior to planting to improve crop establishment (significant yield increase at 5% level); ii) low-draught crop establishment by seeding into a rip line followed by reduced labour demand for weeding by using a plough; iii) control of the perennial grass *Cynodon dactylon* by application of the herbicide glyphosate after harvest or after an early ploughing and before planting (average of 40% yield increase compared to planting on a single ploughing). On wetland *vlei* fields farmers selected early maturing high yielding rice lines in place of the local land race and maize establishment by planting in rows onto broad beds or ridges created by a plough (significant 56 % increase in maize yields with similar rice yields). Farmers also found it more profitable to grow sole crop rice at a

high population density on portions of the wettest *vlei* where maize production carries a high risk. Labour non-availability remains the key concern and many farmers do lose their entire *vlei* crop due to weeds. Hand weeding of traditional row planted maize inter-cropped by broadcast rice required large amounts of labour and partial budget analysis showed higher net benefits on sole maize crops using herbicides. However in wetter years, when maize yields are very low due to early season water logging, rice yields are impressive, particularly where weeds were controlled with herbicides. Key again has been the non-availability of labour to control weeds. Where farmers were not able to control them 100% yield loss resulted.

Rice lines were assessed using "*Participatory Variety Selection (PVS)" approaches* within projects R7473 and R8191. At the same time a farmer was contracted to multiply seed of lines obtained from WARDA in West Africa and the national programme in Zimbabwe as well as providing land for replicated yield trials. Sufficient seed to plant two plots each of 5m x 3 rows of up to 12 lines was provided to experienced rice farmers selected by their communities. A total of 22 lines were distributed and trials were co-ordinated by the crop specialist at the Masvingo Provincial AREX office. Sets of seed were also evaluated by farmer groups participating with CARE Zimbabwe.

*11. **Where and when** have the output(s) been validated?*

*Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above **(max 300 words)**.*

All the outputs were derived from projects undertaken in semi-arid areas of Masvingo Province (450-650 mm annual rainfall), on granitic sandy soils, largely in the communal areas of Gutu and Zimutu. Focus group discussions between researchers and extension staff led to establishment of farmer study groups in four further areas for validation of *vlei* technologies under projects R7474/R8191. A total of 400 farmers in 20 study groups were involved in this validation work in Mukara and Zimutu communal areas, Chatsworth re-settlement area and Mshagashe small-scale commercial farming area. These were selected to represent major classes of land tenure and farmers of different resource categories. (Table 1) On-farm trials on *Cynodon* control were also implemented in Zvimba communal area (annual rainfall 750-1000 mm) and in SE Botswana. Project participants and those hosting trial were volunteers, rather than being purposively selected according to pre-determined criteria.

Table 1: Farmer resource or wealth groups

	Farmer category					
	Full DAP & implements; few labour constraints; outside income and regular farm sales		Partial DAP & plough only; labour constraints; variable outside income; farm sales in good years		Little or no DAP or implements; severe labour constraint; remittances/relief; farm sales rare	
Proportion	*5%*		*60%*		*35%*	
Hire/borrow DAP[1]	-		-		√	
Works on other farms	-		-		√	
Hires labour	√		-		-	
Management practices	Topland	*Vlei*	Topland	*Vlei*	Topland	*Vlei*
Use Manure	√	√	√	√		

Winter plough	√	√	√	√		√
Plant date	Nov/Dec	Aug/Oct	Nov/Dec	Aug/Nov	Dec/Jan	Aug/Nov
1st weed	Hoe Cultivator	Hoe Cultivator	Hoe	Hoe	Hoe	Hoe
2nd weed	Hoe Cultivator	Hoe Cultivator	Hoe	Hoe	Hoe	Hoe
Fertiliser use	√	√	√	√	-	-

[1]DAP=Draught animal power

Most households in the communities where outputs were generated would be categorised as “moderate poor” according to RIU criteria but a significant (and now increasing) proportion were “extreme vulnerable poor” who rely on working for others to afford to hire or borrow draught power for ploughing. Consequently this group plant smaller areas often later and tend to weed later than better resourced household.

Current Situation

C. Current situation

12. ***How and by whom*** *are the outputs currently being used?*
Please give a brief description ***(max. 250 words****).*

DFID-Harare held a three-day agricultural research and dissemination workshop and fair in Harare during September 2005. This brought together policy-makers, researchers and field practitioners from the private sector, donor community, and the natural resource sector to consider and discuss DFID RNNRS programme outputs as well DFID-Zimbabwe’s “Protracted Relief Programme”. UZ hosted a stand at the fair, where dissemination outputs of CPP funded research in Zimbabwe over the past ten years was displayed. A large demand for UZ-CPP and other RNNRS (R7473, R7474, R8191, R7362 and R7085) produced extension and training material could not be met during the workshop. As a result CPP funded the production of a CD covering this material, which was produced by the University of Zimbabwe, Department of Crop Science for distribution to development agencies.

As a result individual validated practices described in this dossier have been included in extension programmes of various NGOs implementing the DFID funded Poverty Reduction Programme or on a local scale through the activities of local extension officers. Also practices are continuing to spread from farmer to farmer in areas where validation was undertaken, but no adoption survey has been made. Priming is used for seed that will be planted in *vleis* before the rains, and farmers with ploughs but without cultivators routinely “ridge the crop” as a way to remove weeds and to create a furrow for moisture conservation in cereal crops. Although the improved rice lines selected by farmers during PVS trials were not formally released as cultivars, farmer to farmer spread from the focal point farmers that received seed for testing has been rapid.

13. Where *are the outputs currently being used?*
As with Question 11 please indicate place(s) and countries where the outputs are being used ***(max. 250 words).***

Within Zimbabwe outputs are being used in at least five districts of Masvingo province as listed in section 16. Teaching at the University of Zimbabwe and Gweru also incorporates knowledge generated by the projects. At UZ this includes a specific topic in the crop production degree on crop production in vleis and a section on wetland management in the Soil and Water Management course that is taught in the Soil Science Department using knowledge included in the dissemination CD. The Weed Management course in UZ's Crop Science Department draws on research experiences and use the extracts from the CD. The CD has also been distributed to agricultural colleges and other training institutions. It has also been used as a training tool by UZ staff leading courses in Mupamalanga and Limpopo province in South Africa and Mozambique. UZ has also received requests through their website for information on sprayer calibration, herbicide for perennial weed control in *vleis*, combining herbicides with tillage in *vleis*, herbicide dissipation in wetlands, planting densities of rice from South Africa, Mozambique, Burundi, Nigeria, Pakistan, Togo etc These requests show that people in various countries have accessed training materials on water and weed management in *vleis* (as well as cotton systems) that is available on the UZ website.

14. What is the scale of current use?

Indicating how quickly use was established and whether usage is still spreading ***(max 250 words).***

During the period of on-farm validation there was a steady increase in the number of farmers adopting the technologies for *vleis* in the Mshagashe small scale commercial farming area (Table 2):

Table 2: Farmers adopting technologies in Mshagashe (2002/3-2004/5)

Technology	Farmers in groups			Other adopters
	2002-03	2003-04	2004-05	2004-05
Sole rice in rows	12	25	25	15
Broad beds for maize and rice	17	13	13	10
Pre-plant ridges for maize and rice	16	15	15	13
Post-plant ridges for maize	5	12	10	11
Maize and rice planted in same row	23	11	19	35
Maize and rice alternate rows	6	23	6	23
Herbicides	0	3	1	2
Seed production of new rice varieties	6	5	6	-
Water conservation pits on contours	13	18	18	35

Source: Extension agent reports (Masvingo workshop 2005)

In addition CARE Zimbabwe reported that a number of technologies were being tested and promoted within their activities in five districts in Masvingo Province.

- Production of rice including new varieties with 12 groups involved.
- Seed priming with 10 lead farmers and farmer groups.
- Weeding with a light cultivator with 10 lead farmers and farmer groups.
- Tied ridges on topland fields with 10 lead farmers and farmer groups.

- The use of water conservation pits on contours was reported as being widespread

Beds and ridges are still very popular, with AREX reporting that new farmer groups are being formed in Masvingo, Zimuto, Mshagashe, Chatsworth and Chivi to promote their use to reduce the effects of waterlogging in wetland fields. Farmers with ploughs but without cultivators routinely "ridge the crop" as a way to remove weeds and to create a furrow for moisture conservation in upland maize crops. Estimates made by AREX staff suggest that one out of four farmers now use this technology in Zimuto, Chatsworth, and Gutu. The intensification of rice production through the use of higher plant densities and fertilizer, demonstrated by CPP projects, is said to be increasing in Chatsworth and Zimuto.

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? ***(max 350 words).***

Outputs were developed and promoted giving attention to both institutional and community issues. Of critical importance was involvement of stakeholders in a participatory process, where farmers were able to identify and prioritise the problems with which they were faced. They were then involved in the research process including identification of treatments, implementation, monitoring and evaluation. This process required commitment from both research and extension organisations involving greater emphasis on facilitation and less on teaching and recognition of the key role that farmers must play in the research process. The key partnerships for future promotion was that of farmers with extension agents (Government and NGO) whose staff participated and benefited from the training provided by the University of Zimbabwe and developed the capacity to continue to promote farmer testing and adoption of technologies. Anecdotal evidence suggests that in a number of villages where project activities were undertaken participating AREX extension officers continue to extend outputs despite little or no institutional support being available. The demonstration element of on-farm validation has also been critical to farmer learning and adoption decisions.

Other factors included

- Building institutional and community capacity in participatory approaches.
- Ensuring that institutional roles of stakeholders were well defined and agreed.
- Ensuring close integration of research and development activities.
- Ensuring feed back from research to local communities.
- Ensuring farmers participating in the process were representative with the capacity to lead and communicate with other farmers and promote farmer-to-farmer extension.
- Ensuring ready availability of training and extension material in a planned communication process.
- Ensuring farmers have access to the required farm inputs, when required.

Current Promotion

D. Current promotion/uptake pathways

*16. **Where** is promotion currently taking place?*

*Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion **(max 200 words).***

Apart from the ongoing promotion already described in sections 12-14, planting into ripper tine furrows or open plough furrows was promoted in the 2005-06 season by CIMMYT and a number of NGOs in Masvingo Province working with DFID's Poverty Reduction Programme [1] as part of efforts to promote conservation agriculture (Table 3).

Otherwise promotion is taking place on a sporadic and local level through the efforts of individual extension officers.

[1] DFID is providing £30 million over three years (2004-2007) for a relief programme to improve the food security of more than 1.5 million of the poorest and most vulnerable people in Zimbabwe by increasing their access to seeds and fertilisers, nutrition gardens and safe water.

Table 3: Current promotion of reduced tillage planting

District	NGO	Implementing partner	Number of demos established	Number of demos being closely monitored
Chivi	CAFOD	ZWP	180	90
Gutu	OXFAM GB	RUDO	43	44
Masvingo	CARE	CARE	100	100
Masvingo	OXFAM GB	RUDO	22	22
Zvishavane	OXFAM GB	OXFAM GB	54	44
TOTAL			**399**	**300**

17. What are the current barriers preventing or slowing the adoption of the output(s)?

*Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. **(max 200 words)**.*

In Zimbabwe, poverty is presently manifested by the inability of many households either to feed themselves and to procure essential goods and services for a productive and healthy life. Given the present political and economic situation many extension agencies, especially Government are inadequately resourced with insufficient transport and a shortage of funds for the promotion of outputs described in this dossier. NGO priorities are largely aimed at providing relief feeding to vulnerable households and individuals and working in support of programmes such as DFID-Zimbabwe's "Protracted Recovery Programme". This aims to stabilise food security and protect the livelihoods of vulnerable households. This includes both feeding schemes and assisting with nutrient or vegetable gardens and interventions aimed at stabilising food production through promoting crop diversification and resource efficient farming techniques. In the economic situation that has developed in Zimbabwe, extension programmes in the communal farming areas have largely survived with little or no funding from central government, and are largely sustained by the individual sacrifice and efforts of a cadre of extension workers that participated in the research and dissemination phase of the CPP projects. Lack of foreign exchange has restricted imports of pesticides including herbicides. Many herbicides registered in Zimbabwe are no longer

available, and those that are still imported are difficult to find beyond the outskirts of Harare. With inflation above 1000% per annum herbicides are not currently a viable option for smallholder farmers.

18. What changes are needed to remove/reduce these barriers to adoption?
This section could be used to identify perceived capacity related issues ***(max 200 words).***

Given the limited human resource capacity at local level it will be essential to harness the university and NGO sectors to increase the pace of promotion and to reach a larger number of communities. This can in part be achieved through i) maintaining and improving collaboration, networking and partnership between research, extension, ii) ensuring partners are adequately resourced, with clearly identifiable roles for which they are accountable and iii) most importantly ensuring that community level organisations are able to play an important role. It also requires that input and output markets are effectively working. Local level field staff can have greatest impact by working with farmer groups through lead farmers selected by each group to set up field demonstrations to provide the focus of field days and community learning. This in turn requires training in the use of the extension material through an on-going partnership for training between research and extension staff.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? ***(max 300 words).***

Processes and partnerships that result in the training of extension workers so they can facilitate farmer groups to undertake field demonstrations to stimulate farmer awareness of technology options and farmer learning in how to optimise best bet practices have been the key to farmer to farmer spread of outputs described in this dossier.

This requires planning of three phases all with realistic timescales:

- an orientation and action planning phase, where i) communities are facilitated by extension agents to have a common understanding of their problems, set priorities, agree action plans with targets for problem resolution and productivity increases, together with appropriate indicators, ii) a strategy for ensuring sustainability is developed by stakeholders that ensures resource availability for capacity building, communication, monitoring and evaluation, with role and cost sharing agreements within partnerships.

- An implementation phase where the capacity of local institutions is improved through training, collaboration, networking and alliances where institutional roles are defined and undertaken. During this stage it is crucial that priority community constraints are addressed using participatory extension approaches that test and demonstrate technology options appropriate for all poverty groupings. Local monitoring and evaluation (M&E) reinforced by appropriate awareness raising and training are essential components. In addition those institutions working at community level must be accountable to the communities with which they are working.

- A sustainability phase that ensures long term sustainability. This requires that communities agree from the outset a timeframe for achieving their goals. In this case local District administrations will need to commit resources to improving local organisational capacity, and the private sector to ensuring farmer access to input and output markets and providing technical support. Although these are essential for

ensuring sustainability, they must be established in the implementation phase.

- In addition, M&E and impact needs to be assessed using indicators developed at planning stage with mechanisms established to provide feedback on issues and problems as they arise to communities and district administrations.

Impacts On Poverty

E. Impacts on poverty to date

19. Where have impact studies on poverty in relation to this output or cluster of outputs taken place?

This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

No formal poverty impact study or poverty mapping work has been undertaken related to the outputs of this dossier. However a detailed cost benefit analysis was undertaken as part of the validation process and is reported in detail in FTR 7473. Examples of participatory budgets and gross margin analysis are provided in papers presented at the final workshop of project R7473 and the final technical report for project R8191:

Barton A and Ellis-Jones J. (Eds.) 2002. *Proceedings of the end of project workshop on vlei management.* Report No. IDG/03/02 Silsoe, Bedfordshire: Silsoe Research Institute.
Chivinge O. 2005. Promoting improved crop establishment and weed management in semi-arid areas of sub-Saharan Africa. Final Technical Report Project R 8191. Harare, Zimbabwe: University of Zimbabwe.

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) ***(max. 500 words):***

- *What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;*
- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;*
- *Indicate the number of people who have realised a positive impact on their livelihood;*
- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded*

Crop establishment and subsequent weed control costs largely depend on farmers' resources, with the availability of draft power and labour being key determinants of the methods used. Those without these resources, usually the poorest are reliant on others and are often late in planting and weeding and in wet years land is often abandoned due to weed problems. In this situation the cost of poor weed control is the total loss of crop as well as the production resources already invested. This inability to control weeds (especially in the wetland environment) declining labour availability, exacerbated by HIV/AIDS, declining draft animal availability, and the sheer drudgery of hand weeding suggested that integrated weed management combining crop establishment, subsequent tillage and herbicide use would become increasingly justified. Cost benefit analysis undertaken at the time confirmed this. However herbicides have become largely non available due to lack of foreign exchange in Zimbabwe with prices along with other inputs escalating beyond the reach of most farmers, while maize prices

have been controlled by Government. At the same time, availability of wetlands in an otherwise low potential semi-arid area play a critical role for food security in most years, especially dry ones. They also have potential for increasing household income from producing rice, a relatively high value crops.

In these circumstances promotion of low risk low cost technologies that can be implemented with existing household resources is critical. This includes:

- Seed priming (no cost with considerable potential benefit).
- Reduced tillage (rip and OPFP planting systems) as part of conservation agriculture initiatives.
- Promotion of improved rice varieties (no cost with large benefits).
- Alternative tillage and cropping systems that give farmers options depending on the resources they have available.

The economic cost-benefit analysis, reported in the final workshop of R7473 showed that highest productivity was achieved in *vleis* by planting maize on beds with rice sown in adjacent furrows, whether herbicides were used or not, providing a 60% increase in overall productivity and doubling the returns to labour over traditional method of planting maize and rice on the same row on the flat, even when these were clean weeded. Interestingly during the promotion project, farmers themselves devised a better method of making ridges than researchers. This included planting maize as the ridge was formed in still moist soil, to overcome germination problems associated with traditional pre-plant ridges. Later rice was planted in the furrow. These compared favourably with beds and required less draft power and labour. Next best was a flat system with maize and rice in alternate rows more especially in a wet season. The worst is a flat system with maize and rice in the same row, which has the highest labour requirement. It was concluded that the large variation in soil types, rainfall conditions and farmer resources complicated a formal cost benefit analysis approach but rather an approach was needed whereby farmers are facilitated to identify those options suitable for their conditions (Figure 1) and expand from here.

Figure 1: Crop systems and tillage options for *vlei* areas

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

The outputs of this dossier include an integrated crop establishment and weed management approach that incorporates many aspects of good land husbandry including improved soil and water management. These give emphasis to environmental protection. This is particularly important in the *vleis* where promotion programmes need to emphasise the maintenance of uncultivated areas adjacent to water courses. The construction of broad beds or ridge and furrow landforms, aligned along the contour, will reduce the risk of erosion and moisture loss during drought periods in the wetlands. Much of the erosion that has been seen in *vlei* land has resulted from overgrazing. Fencing is associated with the profitable cultivation of these areas and this will protect these fragile areas from grazing pressure.

22. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

Use of herbicides carries with it a degree of environmental risk. However used at recommended doses herbicides registered for use on maize have favourable environmental toxicity profiles. It is essential that users are made aware of the potential hazards, such as water contamination from inadvertent spills. The agro-chemical industry has a key role to play in disseminating information on safe use to the agriculture community. Training of pesticide dealers who interact with farmers should be an integral part of promotion of herbicides for weed management in maize and rice. Posters and other training materials produced by CPP projects in Zimbabwe can contribute to this increased level of understanding.

23. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

Farmers in the semi-arid maize growing areas of Zimbabwe are used to living with climatic variability, a situation that is predicted to worsen due to global climate change. Current climate models for a range of atmospheric CO_2 estimates suggest an increase in mean annual temperature of 1.9 to 6.2 ^{0}C in central Zimbabwe by 2080 with 5 to 18% less rainfall than the 1960-90 average [8] These effects are already reality for farmers. Overall there has been a 5% reduction in rainfall across the country since 1900 with 15% less rainfall than average during the period 1986-1995, almost certainly due to an El Nino event. With more variable and lower rainfall farmers need to manage land to conserve moisture more than ever before and closing the yield gap due to weeds will become an increasing priority to mitigate the effects of climate change. Herbicides provide a labour efficient opportunity for timely weed control to prevent competition for moisture while inter-row cultivation later in the season can reduce run-off from intense storms.

[8] Hulm and Sheard, 1999 *Climate change scenarios for Zimbabwe*. Climate Change Unit, University of East Anglia, UK.

Annex

Annex 1: Training and extension materials available in support of outputs described in this dossier

A Guide for farmers on Good Land Husbandry[1]

This included a series of 15 booklets concerning

i) Introduction to Good Land Husbandry.
ii) Soil and Water Management.
iii) Soil Fertility.
iv) Primary Tillage and Land Preparation.
v) What is Important for Good Crop Establishment.
vi) Planting Option 1 – Hand Planting.
vii) Planting Option 2 – Traditional Third Furrow Planting.
viii) Planting Option 3 – Open Plough Furrow Planting.
ix) Planting Option 4 – Ripper Planting.
x) Weed Management.
xi) Conservation Tillage Option 1 – No Till Tied Ridging.
xii) Conservation Tillage Option 2 – Low Input Tillage and Weeding.
xiii) Alternative Soil and water Conservation Ideas.
xiv) Draught Animal Harnessing.
xv) Tillage Implements.

"Best Practice Guidelines" on

- Sustainable Cultivation of *vleis*
- Sustainable Soil, Water and Weed Management in Cotton-Maize production Systems
- Use and maintenance of draught animal ploughs

Group Extension Training Guides using Pictures, and Visual Aids for Training Modules

- Land Preparation, Crop Establishment, Soil Conservation and Weed Management
- Crop, Soil, Water and Weed Management for maize and rice in *vleis*

Leaflets for farmers for each training module

These draw from material produced in the Guides

Five posters on the safe handling and use of pesticides

- Poisonous nature of pesticides
- Safeguards against pesticide poisoning
- Precautions when mixing and spraying pesticides
- First-aid measures in case of pesticide poisoning
- Disposal of pesticide waste and personal hygiene