

# Ploughs, hoes and cheap herbicides beat weeds in cotton

RIU

## Validated RNRRS Output.

Smallholder cotton growers in Zimbabwe now use low-cost techniques to control weeds. In the Zambezi Valley, the rainy season is short and hot. If farmers don't weed promptly and thoroughly, they can lose nearly all their crop. Previously, controlling weeds needed lots of labour for constant weeding. In the Lower Zambezi Valley and South East Lowveld of Zimbabwe, farmers now beat weeds by ploughing before planting, hand hoeing and applying low-cost herbicides—techniques within their means and that save labour. Extension services now routinely advise farmers that this is a good way to deal with weeds and universities teach this system in their courses. Plus, inquiries from South Africa, Mozambique, Tanzania, Uganda, Kenya, Pakistan, Slovenia, Togo and Brazil are pouring in.

Project Ref: **CPP67:**

Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**

Lead Organisation: **University of Zimbabwe, Zimbabwe**

Source: **Crop Protection Programme**

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## Document Contents:

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## Description

## Research into Use

NR International  
Park House  
Bradbourne Lane  
Aylesford  
Kent  
ME20 6SN  
UK

## Geographical regions included:

[Zimbabwe](#),

## Target Audiences for this content:

[Crop farmers](#),

**CPP67****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.*

Promoting weed management options for cotton-based systems in semi-arid areas of sub-Saharan Africa.

*Suggested title:* Improving weed management in cotton

**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, Zimbabwe Government and the Cotton Company of Zimbabwe.

**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.*

**R7474 and R 8191****Institutional partners**

University of Zimbabwe  
Faculty of Agriculture, Department of Crop Science. P O Box MP 167, Mount Pleasant, Zimbabwe

Department of Agricultural Engineering, (originally Tiri Koza part of AREX)

Cotton Company of Zimbabwe (COTTCO)

Agricura, Bindura

Zimbabwe Farmers' Union

Lower Muzarabani Rural District Council

**Contact person**

Ostin Chivinge  
AB Mashingaidze/Peter Jowah

Charles Kanyongo

Walter Dombojena

Local field representatives

Agricultural officer

Natural Resources Institute  
University of Greenwich, Chatham Maritime, Chatham,  
Kent, ME4 4TB

Charlie Riches

Silsoe Research Institute  
Agriculture-4-Development,  
Silsoe, MK45 4RU, UK

Jim Ellis-Jones

**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.*

**R7474** had three outputs

- 1) Improved understanding of the impact of weeds in cotton production systems. Research showed that under Zambezi valley conditions, a short hot rainy season, weed control must be initiated two weeks after emergence and continued for at least eight weeks. The method is unimportant, but is dictated by available household supplied or hired resources, in particular labour, draft power and cash. Many farmers plant larger areas than they have the capacity to effectively weed and so suffer considerable yield loss.
- 2) Validation of three innovative options for reducing the impact of weeds: i) using low cost **herbicides** either on their own, or ii) integrated with **hand hoeing, ox-drawn cultivator** or **plough** and, iii) **early winter ploughing**. Early winter ploughing was shown not only to reduce weeds but also to conserve moisture, promote earlier **crop establishment** and increase yields. An alternative option, of no tillage and use of herbicides, to control early weeds did not meet farmer expectations for either weed control or yield.

Hand hoeing and ox-cultivator were the lowest cost options, but are not feasible over large areas given labour and draft animal shortages. Option iii) remains low cost, but has practical limitations, in that it can only be used by those with access to draft power and only after a maize crop or fallow. Shortages of labour and draft power make the use of herbicides attractive. Although best suited to those with least labour and draft (the poorest resourced) it does require ready cash and skills for herbicide use to be feasible. It is therefore likely to be used only by those who can access and pay for their use. Integrating herbicides with hand hoe or draft animal weeding offers the best option for most farmers.

- 3) Promotion and dissemination of findings. In addition to field days, workshops, and papers, "**Best Practice Guidelines**" for land, preparation, weed management and knapsack sprayer use were prepared for subsequent use by R8191.

**R 8191** [1] outputs included:

- 1) Development of training and extension material with extension workers and farmers on R7474 and R8191 outputs (Annex 1).
- 2) 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 and COTTCO, a private sector input supply and marketing company

3) Strengthened capability of participating organisations to use of participatory approaches as well as improved research-extension-farmer-private sector linkages.

[1] R8191 had similar outputs relating to other CPP funded work promoting improved crop establishment and weeding in maize systems in Masvingo province, Zimbabwe. This is the subject of a separate dossier.

**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

The main commodity was cotton grown largely in cotton-maize 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						

**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 cotton, including the integrated use of herbicides with hand or draft animal weeding and early winter ploughing for early crop establishment.
- A participatory technology development approach for farmer testing and selection of methods appropriate to their resources.

- Extension and training material.

As such this source could be clustered with the following:

Title/cluster	R number	Lead organisation	Lead person
<u>CPP</u>			
Crop management in cereal based cropping systems <sup>1</sup>	R8191, R7473, R6655, R7198, R5742	University of Zimbabwe	Ostin Chivinge AB Mashingaidze
Draught animal power <sup>3</sup>	R7401	SAARI, Uganda (D Barton, UK Ltd)	J Obuo, Serere (D Barton)
IPM for cotton smallholder farms in Uganda <sup>2</sup>	R8403, R8197	NRI	Roy Hillocks
<u>LPP</u>			
Draught Power Performance and Production Management <sup>4</sup>	R7352	University of Zimbabwe (Silsoe Research Institute)	Aidan Senzanje (Dave O'Neill)
Draught animal toolbox <sup>4</sup>	Zc204	KENDAT	Pascal Kambutho

<sup>1</sup> Although concerned with cereal based systems this cluster includes a number of elements that will add value to this cotton dossier

<sup>2</sup> This work concerned use of draft animals in weeding in cotton in Uganda will add value.

<sup>3</sup> The need to consider an integrated approach to weeds and other pests in cotton make this a possible cluster partner.

<sup>4</sup> The important role of draft animals in crop establishment and weed control would ensure this element is not overlooked.

## 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**).

R7474 outputs were validated through

- 1) A number of community workshops reinforced later with a formal survey provided detailed information on farmers' livelihoods, knowledge and practices in cotton production. Most households derived an important part of their livelihoods from cotton with a major constraint to improving productivity being weed

management. Maize was also a key crop for food security. Weed species abundance was recorded over 12 sites and the effect of additional weeding on maize and cotton yield were assessed by farmers through paired plot experimentation. In addition a “critical time of weeding trial” was undertaken using a randomised complete block design with three replicates. To attain 90% of the maximum seed cotton yield farmers need to control weeds from three to eight weeks after crop emergence unless prolonged drought spells occur when weeding should last from two to 11 weeks. It was apparent that in many years, especially when rainfall is above average, weeds are an impossible burden and whole fields of both cotton and maize are abandoned with consequent loss of invested capital and labour. Productivity losses from late weeding could be as high as 95% in a wet year and 70% in a dry year.

2) A “mother-daughter” research trial approach ensured farmer involvement in the research process including problem identification, treatment selection, implementation, monitoring and evaluation. This was characterised by two levels of experimentation which included

- A researcher-managed mother trial with replicated plots undertaken on land owned by a local school.
- Daughter trials undertaken on-farm with participation of 18 farmers, nine of whom had draught power, and nine did not. This included both men and women from a range of age groups and a range of resource categories. This ensured involvement of both those with access to draught animals and those who did not.
- Mid-season evaluations were undertaken as a series of field days open to all farmers in the locations where they occurred. Alternative treatments were inspected and farmers’ views on the strengths and weaknesses of each noted ensuring farmers evaluation criteria were captured and utilised in the validation process.
- At the end of each season after harvest and results had been analysed by researchers, these were presented and assessed by all project partners at especially convened workshops.
- Sites provided replication for statistical analysis of on-farm trials. Analysis of treatment effects was carried out using ANOVA with farms nested in different locations as the blocking factor for the on-farm trials. Mean yields were compared by Fisher’s protected LSD test.
- Special consideration was given to social and economic issues such as input availability and ensuring technology options were available for the least resourced.

R 8191 outputs were validated through

3) A PREA process (Annex 2) involved some 400 farmers being members of 20 farmer groups. This was facilitated by 15 extension agents drawn from Government extension, NGO and the private sector in further testing the alternative weed management practices. A farmer field school approach was used where lead farmers from each group provided facilities and tested the new technologies, with others from the same group participating at key stages, learning and trying the technologies on their own farms. A range of technologies was tested including: soil and water management involving reduced tillage, improved use of ploughs and cultivators in crop establishment and weed control and use of herbicides for weed management in combination with hand and draught animal weeding equipment.

4) Project workshops, for discussing the overall approach, technologies tested, communication needs and dissemination materials were held with all partners including farmer representatives. Training and

extension material was finalised after input from both farmers and extension agents.

### 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).

Outputs were initially validated on the mother trial and 18 farmers' fields in the Lower Muzarabani District of the Zambezi valley, Zimbabwe, over two seasons, 2000/01 and 2001/2. A further period of validation including promotion activities took place more widely in the Zambezi valley in the Mshumbi Pools, Muhuwe, Muzarabani, Machaya and Hoya villages over two seasons 2002/3 and 2003/4. This region, Zone 19 on Zimbabwe's livelihoods' map, bordering Mozambique supports extensive cotton production with some income from groundnuts and sorghum, supplemented by local, seasonal employment and some goat sales (Zimbabwe vulnerability assessment committee, 2005).

All the work was undertaken under semi-arid smallholder rainfed conditions, this area of the Zambezi valley being characterised by a short extremely hot rainfall period where weed growth is particularly rapid and aggressive.

The targeted social group was that described as moderate poor, in the definition used by RIU, in that all farmers had some access to land with the potential to improve their livelihoods through increasing cotton productivity. However within this broad category five sub-groups were identified during early workshops with the community. Access to resources varied considerably, in particular to the area farmed, to draught animals and draught animal equipment as well as to savings or credit. Better resourced and comparatively wealthier farmers were not constrained by draught power resources and often had access to inputs on credit through COTTCO. Poorly resourced farmers were constrained primarily by access to draught power and labour with no access to credit or savings. The weed management options relating to resource availability indicates a limited range for poorly resourced farmers (Table 1).

**Table 1: Land preparation, crop establishment and weed management options available for different farmer resource categories**

	Farmer resource category				
	RG1	RG2	RG2/3	RG2/3	RG4
<b>Resource availability</b>					
Labour	Unlimited	Limited	Limited	Unlimited	Limited
DAP	Unlimited	Unlimited	Limited	Limited	Limited
<b>Implements</b>					
Hand hoe	X	X	X	X	X
Ox plough	X	X	X	X	
Ox cultivator	X	X			
<b>Land preparation and crop establishment options</b>					
EWP	X	X	(X)		
LWP	X	X	(X)		
SP	X	X	X		
OPFP	X	X	X	X	X

RIP	X	X				
<b>Weed control options</b>						
HH	X		X	X		
Ox plough	X	X				
Ox cultivator	X	X				
Herbicide	X	X	X	X	X	X
Reduce area	X	X	X	X	X	X

RG=Resource groups identified locally (RG1=well resourced, RG2=average resources, RG3=poorly resourced, RG4=very poorly resourced)

EWP=early winter ploughing, LWP=late winter ploughing, SP=spring ploughing

OPFP=Open plough furrow planting, RIP=rip planting. HH=hand hoe

The project showed the superiority of an integrated approach to weed management (using a combination of ploughs with and without mouldboard, correctly adjusted equipment, hand hoeing and low cost herbicides) to achieve timely weed control when compared to using a single method of weed control. Farmers cannot rely on weed removal only when they appear, but need to consider timing and method of land preparation as part of an overall weed management strategy.

## 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 were 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, produced by the University of Zimbabwe, Department of Crop Science (Annex 1) for use in training and resource material for extension staff and farmers.

UZ have now distributed copies to Govt extension (AREX) and NGOs in an effort to ensure that farmers outside the research areas are able to benefit from the technologies and management practices developed. In addition dissemination material has been made available to farmers, extension NGO and extension personnel that come for short courses (so far the total is 50) and some are using the materials for training and extension within their organizations. In addition UZ and Bindura Universities now use the results from the research in their teaching activities for both under and post graduates and as part of their Outreach programme to farmers.



**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).*

Further enquiries on project outputs have been posted on the UZ's Faculty of Agriculture website from a number of countries (including South Africa, Mozambique, Tanzania, Uganda, Kenya, Pakistan, Slovenia, Togo, Brazil and others). These relate to herbicide use in cotton for smallholder farmers, farmer training and technology transfer, integrating herbicide and mechanical/hoe weeding techniques for weed management in cotton, as well as calibration and pesticide application for knapsack sprayers. There is evidence from the queries that the material posted on the internet is being used for teaching by other Universities and colleges of agriculture and for farmer training and extension by NGOs and government extension agencies as well as individuals carrying out further research.

Key extension messages formulated from project outputs are now part of the extension packages routinely used by AREX, COTTCO, and Agricura (input supplier) in their work in promoting the production of cotton in the Lower Zambezi Valley and South East Lowveld parts of Zimbabwe, where similar conditions exist. This includes:

- The value of early weeding of cotton because of its extreme vulnerability to weed competition in the first 2-4 weeks after planting
- The need for more rigorous weeding in difficult seasons.
- Adjustments to plough and cultivator settings, which can have a huge impact on efficacy of this equipment in controlling weeds and operational efficiency.

Such messages are now used in many cotton growing areas in Zimbabwe. In addition dossier outputs popularised the notion that recommendations to maximize productivity had to be tailored according to the resource endowments and other characteristics of the household. Current recommendations by the above organizations reflect this with extension and research programmes ensuring that technology options are considered for adoption by different groups according to their resource profiles (primarily labour, draft power, off farm-incomes and technical competence).

**14. What is the scale of current use?**

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

During the promotion stage of the project, use by participating farmers was quickly established and we expect farmer-to-farmer extension has continued to promote the technologies, with the exception of herbicides. Rapid price increases and non-availability due to foreign currency shortages have placed herbicides beyond the reach of most farmers. However, since ploughs and cultivators are readily available in most cotton growing areas, their use and integration with crop management to control weeds is being encouraged by extension agents. A lack of resources has however precluded us from quantifying the spread.

**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 promoted giving attention to both institutional and community issues. This included the involvement

of stakeholders in a participatory process, where farmers were able to identify and prioritise the problems with which they were faced. The “mother-daughter” research approach ensured farmer involvement in the research process from the start and included diagnosis of the problem, 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, NGO and the private sector) whose staff participated and benefited from the training provided and developed the capacity to continue to promote farmer testing and adoption of technologies.

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 ready 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).*

We are unaware of the detail of promotion activities outside Zimbabwe, other than those mentioned under Q13. However use of the UZ website has ensured that material is available and we are encouraged by the number of enquiries from outside Zimbabwe.

In Zimbabwe, pilot scaling-out of the outputs was initially supported by CPP as part of the validation process in the Zambezi valley. This area is fairly typical of many other cotton growing areas of Zimbabwe, where the human and financial capacity of local institutions working with cotton to promote agricultural change is limited [2]. Notwithstanding extension messages in these in cotton growing areas have been promoted by UZ's Crop Science Department within the context of its outreach programme. This has involved farmers, NGO and extension personnel that attended a variety of short training courses not specifically in cotton production [3].

It was hoped that the Cotton Training Centre at Kadoma would also be an important promotion pathway, but as with other institutions in Zimbabwe their capacity has been severely reduced over the past five years. However it still remains potentially an important pathway.

[2] These are detailed in Zimbabwe's vulnerability assessments livelihoods maps (2005).

[3] Africa 2000, Africare, Biotechnology Trust of Zimbabwe, CAB International. Care International, Care-Mozambique, Care-Zimbabwe, CIMMYT, Department of Food, Family and Nutrition Sciences, FAO, FCTZ, Goal-Zimbabwe, NLWCCDP. Pelum Association, Safire, Seke Rural HBC, Zimbabwe Red Cross, Zvishavane Water Project

### **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 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 AREX 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, 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, assisting with nutrient or vegetable gardens and interventions aimed at stabilising food production through promoting crop diversification and resource efficient farming techniques. This places emphasis on drought tolerant food crops, conservation farming (no tillage, micro-dosing of fertiliser etc), as well as micro irrigation with drip kits, sweet potatoes and cassava promotion and use of forestry products for domestic use. With resources being limited cotton production has not been a priority.

Notwithstanding cotton still remains an important export crop, much of which has been historically produced by the smallholder farming sector, and for many households in drought prone areas is an important source of income and food security. However cotton production depends on ready access to inputs and easy marketing. Input availability has declined markedly in recent seasons. This will have limited the pace of adoption. As a result promotion of the technologies beyond what was achieved in the dissemination phase of the projects remains sporadic and ad-hoc. The need to promote the low cost technologies and the dissemination materials is strong but funding for this is currently not available. Given the other priorities of NGOs, the role of the private sector (for instance COTTCO and Agricura) is particularly important.

### **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 resource capacity at local level, it will be essential to harness the private sector to increase the pace of promotion and reach a larger number of communities. This can in part be achieved through i) improving collaboration, networking and partnership between research, extension and the private sector, 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. This will require support and facilitation so that an ongoing process of innovation can be initiated and continued. 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. This in turn requires facilitation and training in the use of the extension material through an on-going partnership.

Given the present limited resources of AREX and the other priorities of the NGO sector, it is likely that the private sector can make the largest contribution. Companies like COTTCO and Agricura are already making a significant contribution to input supply, credit and marketing of cotton and could be encouraged to broaden their training and

extension activities.

**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).**

Scaling up the benefits of project outputs needs to be considered in at least three phases (Ellis-Jones et al., 2005, Hagmann et al, 1998, Middleton et al., 2004, Gundel et al, 2003).

- 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. At the same time realistic time horizons for establishing support mechanisms at community level need to be established.
- 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. This includes demonstrations, field days, posters and information supplied through private sector input suppliers. In addition those institutions working at community level must be accountable to the communities with which they are working.
- A 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.

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## Impacts On Poverty

### **E. Impacts on poverty to date**

**20. 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 detailed cost benefit analysis was undertaken as part of the validation process and participatory budgeting exercises were carried out with farmer groups during the pilot promotion stage.

**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*

The economic cost-benefit analysis, based on results from farmer trials and reported in the R7474 FTR, showed that the cost of poor weeding to be far in excess of even the highest cost of weeding. Weeding late or missing a weeding incurs yield penalties of up to 95% in a wet year and 70% in a dry year. Even failing to weed for four weeks, a common practice can incur a yield loss of up to 60% of potential yield as the crop competes for moisture and nutrients with weeds. The lowest cost weeding options are an overall herbicide with hand hoeing for those without draft power and a banded herbicide used in conjunction with an ox-cultivator for those with draft power.

Participatory budgets indicated both an improvement in quality of the cotton, meaning that higher prices were received, and large savings in labour were possible. Increases in productivity of 70-80% were achieved by farmers.

## 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 weed management approach that incorporates many aspects of good land husbandry including improved soil and water management. These give emphasis to environmental protection.

The result of improper and dangerous use of pesticides in cotton have been well documented (FAO, 2006), and include dangers for people, animals and the environment. Consequently the outputs in this dossier have included training and extension material on the safe handling and use of all pesticides, not just herbicides. We believe that these can make an important contribution to reducing the adverse effects of pesticides.

**25. 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 cotton are much less toxic than many insecticides and 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 cotton and posters and other training materials produced by CPP projects in Zimbabwe can contribute to this increased level of understanding.

**26. 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)**

This answer is included in that for Q22

Farmers in cotton 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<sub>2</sub> estimates suggest an increase in mean annual temperature of 1.9-6.2°C in central Zimbabwe by 2080 with 5-18% less rainfall than the 1960-90 average (Hulm and Sheard, 1999). These effects are already reality for farmers, since 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. An integrated weed management approach provides 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. For the wider community enhancing cotton yields through adoption of these and other improved production practices can contribute harvest labour opportunities, particularly important for poor households in years when maize yields are low.

## Annex

### References

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

### **A Guide for farmers on Good Land Husbandry**

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

## Annex 2: Zambezi Valley PREA programme of activities for 2003-2004 seasons

Activity	J	J	A	S	O	N	D	J	F	M	A	M	J	Responsibility
<b>SHARING EXPERIENCES-2003</b>														
End of season participatory evaluations														
Visit plot, ensure LF explains detail to group	X													Group/LF/EA
Facilitate discussions on ad- and dis-advantages	X													EA/LF
Facilitate partial budgets	X													EA/LF
<b>SOCIAL MOBILISATION-2004</b>														
Ensure farmer groups are aware of activities	X			X										EA/LF
Facilitate LF reports to farmer groups	X	X	X	X										EA/LF
Discuss alternative technologies				X										EA/LF/Group
Facilitate training of LFs	X	X	X	X										EA/AREX/UZ
Distribute extension leaflets to LFs				X	X									EA
<b>JOINT (PARTICIPATORY) ACTION PLANNING</b>														
Agree on trials/demos to be established		X	X											Group/LF/EA
Farmers to confirm plots to be used				X	X									Group/LF/EA
Plan resource requirements		X	X											Group/LF/EA
Access resource needs				X	X									Group/LF/EA/UZ
<b>IMPLEMENTATION</b>														
Obtain inputs				X	X									EA/UZ
Mark pots				X	X									EA/LF
Plant trials/demos					X	X								EA/LF
Harvest trials/demos								X	X	X				EA/LF
Use existing LF plots for training other farmers						X	X	X	X	X	X	X	X	EA/LF
Encourage LFs to visit/assist others						X	X	X	X	X	X	X	X	LF
<b>SHARING EXPERIENCES-2004</b>														
Mid season evaluations by each community							X	X						EA/LF
End of season evaluations, participatory budgets												X		Groups/LF/EA
<b>Submit reports (quarterly)</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	

EA=Extension Agents (AREX, COTTCO, Farmers World, ZFU)