Easy-to-use software provides the poor with access to information

RIU

Validated RNRRS Output.

Interactive learning software has been created to give users in Kenya and Bolivia access to information. The Daktari and Promotor programs are suitable for use even by the illiterate, and can give poor households who aren't reached by the extension services access to vital information. Poor users' access the software through kiosks placed in their community. And, despite the fact that only a small number of these kiosks are available, these programs have already been used by more than 6000 households. The programs are also complemented by digital forums. These can be accessed by policy makers and planners who want to gain better insights into the needs of the poor by finding out what information they are requesting.

Project Ref: **LPP30:**
Topic: **7. Spreading the Word: Knowledge Management & Dissemination**
Lead Organisation: **University of Reading, UK**
Source: **Livestock Production Programme**

Document Contents:

Description

LPP30

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

Geographical regions included:

Bolivia, China, India, Kenya,

Target Audiences for this content:

Livestock farmers,

A. Description of the research output(s)

1. Working title of output or cluster of outputs. Knowledge Dissemination:

El Promotor and Daktari wa Mifugo: Demand-led interactive learning software for poor livestock keepers in Bolivia and Kenya.

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable

Livestock Production Programme

3. Provide relevant R numbers (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.

ZC026

Principle Investigator: Claire Heffernan, Livestock Development Group, School of Agriculture, Policy and Development, University of Reading, Reading, RG6 6AL
Collaborating Partners in Bolivia:

a. Lic. Victor Lemdeza, Executive Director, SEMTA

SEMTA (Servicios Multiples De Technologias Apropiades). SEMTA is an NGO, based in La Paz, who works primarily with rural and per-urban communities in the Altiplano and Valles of Bolivia. The NGO has a strong training program in livestock husbandry and health and has utilised the software to enhance community-level awareness raising and knowledge transfer.

b. Lic. Antonio Guyo, Director, PDLA

FEDELPAZ/PDLA (Programa de Desarrollo Lechero del Altiplano). The PDLA is a Danida-funded project to support peri-urban dairy producers on the Altiplano. PDLA is affiliated with FEDELPAZ, the federation of milk producers. The project has a strong training component and was involved in the base-line, impact and uptake portions of the study as described below.

c. Lic. Eduardo Alvarro, Director, FDTA

FDTA, Altiplano (Fundación para el Desarrollo Tecnológico Agropecuario). The Foundation is a non-profit institution funded by public monies and has been created under the aegis of the government system for agricultural technology (SIBTA). Geographic coverage includes La Paz, Oruro and Potosi departments.

Pre-Dissemination Partners in Kenya:

Dr James Wabach, Department of Medicine, University of Nairobi Faculty of Veterinary Medicine, Kabete, Nairobi.

The University of Nairobi, Faculty of Veterinary Medicine has agreed to identify 10 communities for the siting of kiosks and dissemination of the Daktari software programme. The communities will range from those with high levels of exposure to extension messages and material to those with low to no exposure.

4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced?

RNRRS Cluster: Global Public Good

Project Date: April 2002-April 2006

The Problem: Poor households are often marginalised from traditional extension services. And for those households who can access services large biases exist. First, information is often provided in a blanket fashion, with little account for the differing needs of users. Second, research has demonstrated that even participatory communication pathways often favour the more educated and elite (LDG, 2003). Nevertheless, it is not only the poor, who are marginalised from information. Livestock development policy makers and planners rarely gain direct access to the needs and demands of their clients. Therefore, it became apparent to the research team that a neutral mechanism, which can deliver appropriate and relevant information and transfer demands for information between stakeholders was urgently required.

To address these issues, the research created and disseminated the El Promotor/Daktari software program, an interactive, multi-media, learning platform for poor livestock keepers in India and Bolivia. By creating a multi-lingual programme tailored to the individual user, many of the disadvantages that the illiterate face in traditional learning environments were addressed. Further, by developing a digital forum to detail user preferences and priorities, the programme enables policy makers and planners to obtain specific and timely information regarding the information and knowledge needs of the poor.

Figure 1: El Promotor in Quime, Bolivia

(courtesy of SEMTA)

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

Product	***Technology***	***Service***	***Process or Methodology***	***Policy***	***Other Please specify***
x	*x*		*x*	*x*	

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

At present, the programme is focused on livestock production, husbandry and animal health. The software can easily be adapted for content for other agricultural products and furthermore, human health. In this manner, the software can link with the outputs of other RNNRS projects from other sectors.

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

In Bolivia, the software has been developed for poor indigenous farmers of the Altiplano. In Kenya, the software addresses the needs of peri-urban and urban livestock keepers.

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

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

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

9. 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)?

The software program has a number of unique aspects that enable the demands of the poor for knowledge to be measured and the findings subsequently transferred to decision-makers. In this regard, further value can be added via synergies with convergent technologies such as wireless networking, solar technologies (to increase dissemination in rural areas) and mobile phone technologies (such as diagnostic and surveillance technologies).

Equally, additional components can be added to the software for human health and agricultural production.

In relation to RNRRS, clusters of relevant outputs include those relating to participatory, decision-support tools, knowledge management and dissemination and marketing support and policy influence. Across the RNRRS portfolio of projects, potential synergies are as follows:

Crop Post-Harvest Programme: Pest Management Tools and Strategies (R6311, R6684, R7686, R8265); Market Information Tools (R7494, R8250, R8422); Farmer Access to Markets (R8275; R8274; R8498); Knowledge Management (ZB0308).

Natural Resources Systems Programme: Community-led Improved NRM (R8362), Strategies for Scaling up Processes (R6525), Scaling up through communication (R8363) and Participatory Technology Development (R7412).

Animal Health: TB/Brucellosis (R7229, R7357); Diagnostic and Decision-Support Tools (R7596, R7597), Influencing Animal Health Policy.

Livestock Production: Small Holder Dairying Toolbox (ZC0261), Talking Pictures (R7431, R7855), Draught Animal Power Toolbox (ZC0204), Practical Decision-Support Tool to Improve the Feed Management of Ruminant Work Animals (R7376, ZC0257), Smallstock Toolbox (ZC0243), Participatory Livestock Research (ZC0289), Wambui (R7425).

Validation

B. Validation of the research output(s)

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

The validation strategy for the software was undertaken in three stages by the following partners:

Stage I: Assessing User Demand (LDG, SEMTA, FEDELPAZ)
Stage II: User Perceptions and Learning Assessment (LDG)
Stage III: Impact/Uptake (SEMTA, FEDELPAZ, FDTA)

In Kenya, validation stages I and II have been performed by the LDG in collaboration with in-country partners.

Core methods are as follows:

Stage I: User Demand

To ensure the content for the programme was based upon user demand, a baseline survey was carried out with 732 livestock keepers in the Altiplano and Valles of Bolivia. Within the context of a semi-structured interview, key livestock management/husbandry issues were described and ranked. Equally, perceptions regarding the animal health and priority livestock diseases were detailed. In total, 64% of the study set were women. Conversely, in Kenya, the demands of 432 poor livestock keepers informed the software.

Stage II: User Perceptions and Learning Assessment

a. Validating the Interface: Prior to building the programme, a range of pictorial styles were initially tested among a sub-group of the overall sample group above. In total, 40 households participated in the visual testing. Tools from visual semiotics were utilised to explore the denotative and connotative meanings of specific illustrations. The visual testing also highlighted key aspects of the Andean ‘cosmo-vision’ which supported learning and could subsequently be incorporated into the final program. Characters were also tested for ‘trustworthiness’ and suitability. The figures below represent the final ‘trusted’ visuals for the main characters: El Promotor and the Daktari.

b. Learning Assessment: A repeated measures study design was utilised to assess changes in knowledge that could be attributed to program use. As such, 210 individuals in 13 communities were tested both pre- and post exposure to the software. In total, 114 women and 96 men participated in this portion of the study. Responses were scored utilising an adaptation of Jonassen and Grabowski's (1993) framework to assess differences in the quality and quantity of knowledge uptake. The results of this portion of the analysis were also utilised to compare learning with two alternate methods of knowledge transfer for development: learning videos and written pamphlets. During this portion of validation, specific issues relating to the speed and duration of both instructive and interactive content were also assessed. Conversely, in Kenya, 95 households participated in validating the Daktari.

Stage III: Impact/Uptake

Partner organisations measured the impact/uptake of the software programme during three different assessment exercises over the course of a one year period from July 2005-July 2006. Key methods for assessment included workshops/stakeholder meetings and individual-level interviews.

Indeed, FEDELPAZ/PDLA performed over 100 workshops in 7 provinces across two departments. The software was utilised as part of their training program among the 3,500 smallholder dairy producers that are members in the federation. In total, 786 individuals directly utilised the program during the workshops. Alternatively, SEMTA enhanced awareness of the benefits of the software in the Municipality of Quime, via local radio announcements. User groups for this NGO ranged from guinea pig and sheep herders to small-scale dairy producers. Finally, the FDTA has cited a kiosk in a local milk collection unit in Oruro. In total, 1,062 individuals participated in the impact/ uptake assessment at the community level. The assessment focused on user perceptions and the demand for particular topics.

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

As noted above, the core target population was poor indigenous livestock keepers of the Bolivian Altiplano. The production system is formally classified as 'small holder high altitude mixed crop/livestock'. As the official government discourse on poverty in Bolivia disaggregates the poor by age, gender and ethnicity (see GoB, 2002) the research largely followed these divisions in the targeting of user groups.

Table 1. El Promoter Validation

Collaborator	Province	Department		Total
		La Paz	Oruru	
LDG	Aroma	92		92
	Cercado		190	
	El Alto	18		18
	Ingavi	100		100
	Inquisivi	20		20
	Los Andes	33		33
	Murillo	70		70
	Omasuyos	42		42

		390	*190*	*580*
Fedelpaz/PDLA	Aroma	449		449
	Avaroa		87	87
	Cercado		32	32
	Ingavi	80		80
	Los Andes	18		18
	Murillo	12		12
	Omasuyos	88		88
	Pacajes	2		2
		649	*119*	*768*
SEMTA	Cercado		129	129
	Inquisivi	91		91
	Pantaleon Dalence		45	45
		91	*174*	*265*
FDTA	Cercado		29	29
			29	*29*
Grand Total		***1130***	***512***	***1642***

Overall, 56% of the study group were women. The average age across study participants was 38 years with a range between 14-80 years. Education levels were low with the average education of women 4.8 years and men 5.1 years, whereas 13% of the study population had no exposure to formal education. Participants were from Aymara and Quechua ethnic groups.

Current Situation

C. Current situation

12. How and by whom are the outputs currently being used?

As detailed above, the software programme in Bolivia is being disseminated by project partners among indigenous communities on the Altiplano. Two language versions have been created with instructional content in Aymara and Quechua. Partners have utilised the programme in both stationary and mobile kiosks across the broad range of clients detailed above. The software has largely supported existing training programmes among FEDELPAZ and SEMTA with a stand-alone application for the FDTA. All of the project collaborators have requested increased involvement in the project in response to community demand. Indeed, FEDELPAZ and SEMTA have requested further kiosks for scaling-up activities to meet the present and emerging needs of their clients.

Conversely, in Kenya, partners have requested the Daktari to be initially implemented among 10 identified communities in peri-urban and urban Nairobi.

13. *Where are the outputs currently being used?*

At present, the software program is being utilised in two countries: Bolivia and India, with plans to scale-up activities in Kenya and China. More specifically, the Livestock Guru programme has been distributed in three states in India: Pondicherry, Tamil Nadu and Orissa Further requests for a software programme have been initiated by a number of nations and groups ranging from the State Government of Kwa Zulu Natal in South Africa to North-West Sci-Tech University in China to a development projects in Nigeria and Zanzibar.

14. What is the scale of current use?

To date, more than 6,000 households have utilised the program across the three countries: Bolivia, India and Kenya. However, the number of kiosks in use is comparatively small (8 kiosks in Bolivia and 9 kiosks in India). Thus, scaling-up activities are likely to have a large impact on the lives and livelihoods of the poor. The demand for kiosks and partnerships among a wide variety of organisations who have read or heard about the software is also high. Nevertheless, to date, the key constraint to scaling-up has been funding.

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?

On a global level, over the past five years there has been an explosion of interest in ICTs in development. Organisations implementing projects range from donors to small NGOs and CBOs. These actors are involved in a wide range of projects from supplying marketing information to mobile phone dissemination projects to enhancing internet access for the poor. Thus, the infrastructure investment in ICT projects is currently high. Nevertheless, historically less interest has been shown by the development community in developing ICT applications for learning. While this is beginning to change, particularly for children, there are presently very few programmes targeting adult learners. The Livestock Guru project, however, has demonstrated an overwhelming demand of the poor for knowledge and information, among adults, particularly those marginalised from formal education. In this manner, ICTs may have their greatest role in forging new opportunities for the ‘knowledge disabled’ poor. Indeed, adult learning software is perhaps one of the most cost-effective ways of strengthening human capital and empowering the poor to challenge existing social strictures. Therefore, ultimately such tools can support the economic and social mobility of both the ‘extreme vulnerable poor’ and moderately poor.

On a national level, in Bolivia, the success of the El Promotor can be related to two factors. First, the significant levels of visual and oral validation and the inclusion of local referents and knowledge frames has created a programme with high levels of resonance for the user. Indeed, the research team has received high numbers of requests from communities themselves for kiosks and to return for follow-up activities with the programme. Second, the in-country partners have widely embraced the technology and have been keen to augment existing training programmes utilising the software.

Current Promotion

D. Current promotion/uptake pathways

16. Where is promotion currently taking place?

El Promotor: The majority of machines in Bolivia are being moved into communities on a temporary basis in order to enhance coverage. All the partners have requested further machines to enable wider access by the communities involved. As detailed above, FEDELPAZ holds on average two workshops a week across their client population and have requested machines for static placement at milk co-operatives and collecting stations. Conversely, SEMTA has requested kiosks for their training centres and additional kiosks for use by fieldworkers. With 20 additional machines, it is estimated that the software can enhance knowledge among a potential user population of 10,000 households.

The Daktari: Planned promotional activities are as follows: 10 communities have been identified by in-country collaborators which range in exposure and access to formal veterinary and extension services. In this manner, in addition to disseminating the programme, action research will be undertaken which explores the impact and uptake of the software in differing knowledge and learning contexts. It is estimated in the first year, the Daktari may reach an estimated 5,000 households.

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

Amongst practitioners, perceptions frequently offered in relation to the uptake and adoption of ICTs may be synthesized as follows:

1. ICTs in the South are for the elite and are less appropriate for the poor.
2. Projects are expensive and programs are difficult to update.
3. Southern country conditions i.e. poor electricity, excessive heat or cold makes access in other than urban areas difficult.

However, during the development stage, El Promotor was designed to accommodate these issues. First, as detailed above, to address social exclusion, the software has been developed on a multi-media platform that does not rely on literacy. Second, the software was designed to be demand responsive and to engage a variety of stakeholders from the poor to decision-makers. Third, by sourcing the machines locally, maintenance of the kiosks has not been a problem. Figure 1 illustrates the kiosks being created by a local manufacturer.

Figure 2: Building the Kiosks, La Paz, Bolivia (July, 2005)

Equally, the kiosks have been equipped with voltage stabilisers and the team is presently experimenting with solar power.

Therefore, at present, the primary barrier slowing the adoption of the outputs is funding.

18. *What changes are needed to remove/reduce these barriers to adoption?*

    As noted above, the arguments against ICTs as a key means of poverty alleviation relate to issues of access, acceptability and cost. Indeed, programs are often perceived to be high cost with little impact and a short-duration of sustainability. However, the experience in Bolivia with El Promotor has demonstrated when ICTs accommodate the demands of the poor in relation to both topic and learning style, the communities themselves will ensure project sustainability.

    El Promotor has been distributed on a cost-sharing basis with project partners. Indeed, partners are responsible for all in-country transport, labour, training and awareness-raising and any maintenance costs. Indeed, FEDELPAZ has dedicated an employee for dissemination activities. Nevertheless, to scale up the outputs, further inputs are required to engage other in-country partners and institutions.

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

The LDG has identified two issues fundamental to the adoption of ICTs in Southern countries:

1. The software must be driven by the demands of the poor. As such the content must be relevant and the visuals appropriate. If these conditions are satisfied, the poor themselves will generate and sustain the demand for the software.
2. Collaborator organisations must be responsive to the demands of their clients and dedicated to poverty alleviation goals.

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?

The aim of the project was to explore the impact of ICTs on knowledge transfer. As such, the study was not explicitly designed to measure changes in poverty levels. Equally, given that project terminated in April 2006, an assessment of short-term poverty impacts would only be feasible during October, 2006 (at least six months ex-post). However, the collaborators have expressed interest in discerning the explicit poverty impacts in addition to exploring the influences of the learning program on farmer behaviour.

Nevertheless, this is not to say that changes in poverty levels have not taken place. Rather, collaborator reports suggest that the software is particularly useful in training the most vulnerable farmers with the least experience in livestock keeping. Thus, the software has been noted to directly support the livelihoods of the most marginalised groups of livestock keepers. Further, by geo-referencing report points, decision-makers are able to identify the knowledge needs and demands of particular user groups. In this manner, the software reduces risk and enhances the benefits of livestock keepers for the most vulnerable and finally, creates a new communication pathway between decision-makers and the poor.

Core publications on learning impacts are as follows:

Heffernan, C. and Nielsen, L. (2006) *The Livestock Guru: Demand-led knowledge transfer for poverty alleviation.* Conference Proceedings International Conference on ICTs and Development, May 14-16, 2006, University of California, Berkeley.

Nielsen, L. and Heffernan, C. (2006). New Tools to Connect People and Places: The impact of ICTs on learning among resource poor farmers in Bolivia. *Journal of International Development* 18(6): 889-900.

Heffernan, C. and Nielsen, L. (2005). *The Livestock Guru: Transmitting demand-led information between decision-makers and the poor*. Conference Proceedings International Workshop on Improving the Well-being of Resource Poor Farmers. September 12-16th, 2005 Howick, South Africa.

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)

Rather than changes in livelihoods, the research explored changes in knowledge regarding livestock-based livelihoods. Indeed, the study was based upon the assumption that livelihood impacts require an initial change in the knowledge outlook of the individual involved.

Across the study set, three disease modules formed the core of the analysis: Mastitis, Liver fluke and Foot and Mouth Disease. Participants were asked to describe the symptoms, cause, treatment and prevention of the disease, in four open-ended questions. Responses were then scored utilising a system based on Jonassen and Grabowski's (1993) distinction between the amount and type of knowledge. Scores ranged from +2 to -2 in each category, where +2 was given to a correct answer, +1 was applied to a correct answer which lacked specificity to a particular disease. Conversely, on the other side of the scale, -1 was applied to incorrect answers, and -2 to incorrect answers which could lead to detrimental behaviour towards the animal. Finally, a neutral category of 0 was given to cases where there were no responses.

Each participant was given a single summed score on each assessment category (symptoms, causes, treatment and prevention) before and after training, using the following formulae:

$$Assessment\ Score = \Sigma((AC*2)+(GE*1)-(ER*1)-(ED*2)$$

The data was normalised and scores in each category were divided by the total number of scores possible in the category deriving a score between 0 and 1.

By comparing knowledge scores prior to and after training, any learning which had occurred could be ascertained and compared. The learning score was therefore derived using the following formulae:

$$Learning\ Score = Post\text{-}assessment\ Score - Pre\text{-}assessment\ Score$$

Findings were as follows:

Table 2. Knowledge Assessment and Learning Scores by Module: El Promotor

	Mastitis (n=16)	Liver fluke (n=53)	FMD (n=26)
Mean Prior Knowledge Score	0.09	0.08	0.18
Mean Present Knowledge Score	0.45	0.41	0.48
Mean Change in Knowledge Score	0.37	0.33	0.31

Table 3. Learning Scores disaggregated by Topic: El Promotor

Learning Scores by Topic	Mastitis (n=16)	Liver fluke (n=53)	FMD (n=26)
Cause	0.24	0.44	0.46
Symptom	0.41	0.26	0.30
Treatment	0.31	0.28	0.23
Prevention	0.51	0.32	0.25

Table 4. Correlation Coefficients between Prior Knowledge Scores and Learning

Topic of Disease Module	Mastitis (n=16)	Liver fluke (n=53)	FMD (n=26)
Cause	-0.55	-0.59	-0.56
Symptom	-0.54	-0.64	-0.71
Treatment	-0.15	-0.87	-0.67
Prevention	-0.32	-0.60	-0.66

Not surprisingly, the distribution of scores suggests that those participants with lower pre-assessment scores tended to achieve higher learning scores, and vice versa. However, when the responses were examined in more detail, a number of interesting findings were apparent. Study participants with a significant amount of prior knowledge or the 'high scorers', tended to offer less detailed responses. Nevertheless, rather than provide previously known information, after exposure to the programme, these individual's responses tended to focus on the new material. Therefore, those individuals with a high level of previous knowledge appeared to be prioritising information derived from the program. Interestingly, women tended to have larger learning scores than men, although the majority of women had lower education levels than their male counterparts. Hence, the software appears to be particularly effective among the most educationally marginalised groups.

Further, as detailed in Question 10 above, the research also compared the learning outcomes of the software across media types such as videos and written pamphlets.

Table 5. Learning Scores disaggregated by Media

Media groups	Mastitis (n=101)	Liver Fluke (n=85)
El promoter	0.367	0.326
Video	0.295	0.279
Pamphlets		0.334

The results suggest that all of the media groups had a positive impact on learning. Indeed, there was a significant effect of media on learning scores associated with liver fluke (P = 0.042). With regard to mastitis, however, a significant interaction (P = 0.004) was found between media and topic (cause, symptoms, treatment and prevention) over time (pre- and post-assessment), as shown in the Figures 3. Similar findings occurred in relation to Liver Fluke.

Figure 3: The Interaction Effect of Topic and Media (Mastitis)

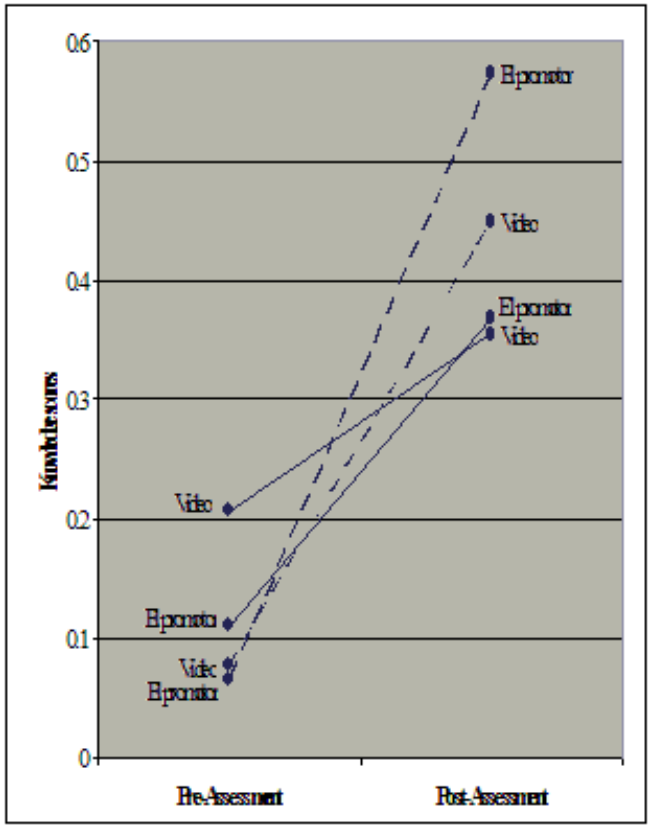
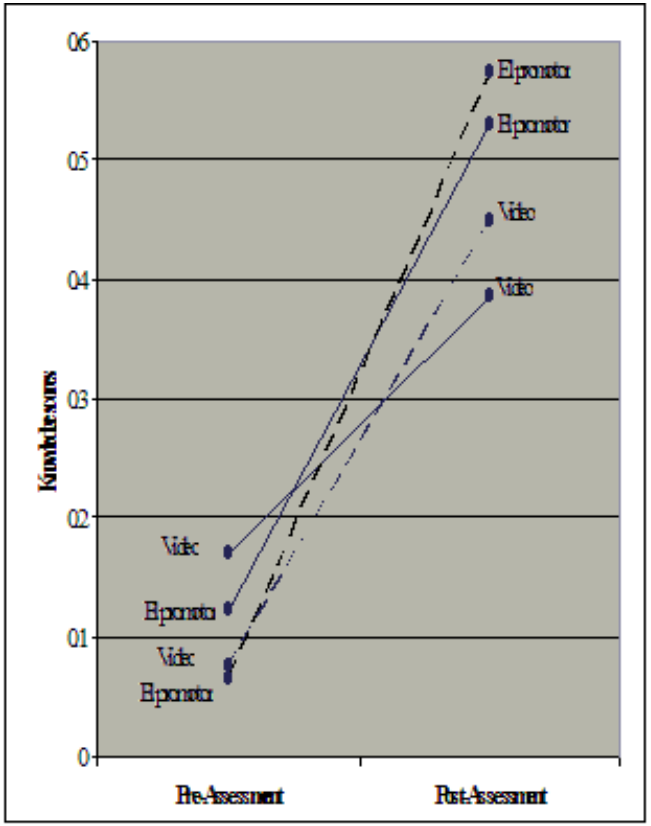


Figure 4: The Interaction Effect of Topic and Media (Liver Fluke)



-------- Symptons - - - Prevention

As the Figures illustrate, there was a clear advantage of training with El Promoter with regard to disease symptoms and prevention. For the other topics i.e. treatment and cause, the training videos were as effective as El Promoter. Thus, the study concluded that multi-media tools had greater impact and uptake levels for more 'instructional' content.

Environmental Impact

H. Environmental impact

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

Enhancing the sustainability of livestock enterprises among the poor will obviously support benefits to the environment in relation to crop/livestock interactions. However, the software, at present, only explicitly tackles environmental issues in relation to animal health. For example, the component on taeniasis/cysticercosis explores faecal contamination of household environs.

However, project partners in Bolivia have requested a further environmental component to aid farmers in understanding the impacts of different crop/livestock production strategies. As such, positive impacts on local environments are likely to be accrued with the addition of an environmental component to the software.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? The software has no negative environmental impacts.

At present, the software is geared to solving animal health and production issues. Therefore, it principally deals with issues relating to livestock husbandry and management and the treatment, prevention and diagnosis of epidemic and endemic livestock diseases. A component on Highly Pathogenic Avian influenza is being added in each of the countries involved. In this manner, the software can help ameliorate the negative impacts of an emerging disaster for smallholder farmers in southern countries.
