

Project Title Code: 1.8	Enhancing capacity in rodent management in the Mekong delta region using non chemical methods
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Australian Institution	CSIRO Wildlife and Ecology
Vietnam Institution	IAS, PPD and CLRRI
Project Duration	July 2000 to June 2002

Project Description

In Vietnam rodents are one of the three most important problems identified by the agricultural sector. The damage caused by rodents in agricultural systems is an important impediment to rural development in the Mekong Delta region. This proposal capitalises on the research findings and on the measurement of farmers' belief and practises associated with rodent control in the Mekong Delta. Three research activities were determined to be of high priority: to determine farmers' knowledge, attitude and practise (KAP) in rat management; the economics of using a trap-barrier system (TBS) for managing rat populations; the sociological framework for implementing community TBS (c-TBS). This project will develop Vietnam's capacity to develop extension and research capacity for rodent management.

Objectives

This project will develop Vietnam's capacity to:

- a) Develop extension and research capacity for rodent management,
- b) Assess the effectiveness of control programs (assessing changes in beliefs of farmers, their control practices, etc; assessing economic benefits through increased rice production)
- c) Develop tools for establishing provincial wide implementation planning.

Outputs and Performance indicators

Outputs	Performance Indicators
◆ Enhanced ability of Vietnamese counterparts to address key research and sociological issues associated with non-chemical methods of rodent control	i) Completed by January 2001

◆ Tested the capacity developed (above) at demonstrated sites within a province	i) Completed by Feb 2001 to March 2002
◆ Assessed the sociological framework for implementation and benefit cost of village-level rodent management	i) Reviewed and developed, in consultation with PPDs and farmers, a provincial-wide process for implementing and assessing effective rodent management (April to June 2002).

PROJECT COMPLETE REPORT

Executive Summary

The project was finalised in mid-October 2002 with all components completed to schedule and to high standard. The project objectives and design proved highly appropriate, especially through the close integration of the ecological, agronomic, and sociological components of the project.

Each of the four primary project objectives was met. We believe that the first objective (enhancing ability of Vietnamese scientists) was met to the highest level of achievement, due in great measure to their outstanding application and contribution to this project. The remaining objectives were also met to fully satisfactory standard.

All key tasks were implemented to high standard and within the project time frame and budget. Minor implementation problems were encountered due to the late onset of the wet season in 2002. However, these problems highlighted important practical issues that led to an improved understanding of the proposed rodent control methodology. Several additional tasks were undertaken as a result of new issues surfacing during the course of the project. These included i) an analysis of historical records of rodent damage; ii) An anthropological study of farmer adoption of the main rodent management technology being tested, this was achieved through increased collaboration with the International Rice Research Institute, Philippines, iii) trials of alternative trap designs; iv) development of new methods of damage assessment; v) a market study of the live rat-meat trade; and vi) a pilot study of potential human health risks associated with the live rat-meat trade.

The Vietnamese project participants have performed strongly in all scientific and management areas. Their efforts, together with the enthusiastic response from farmers in each of the participating villages, have jointly underpinned the success of this project at all levels. The overall success of the project is indicated by firstly the strong promotion of the major outputs of the project at a wrap-up meeting in My Tho. Approximately 110 extension personnel from 21 provinces (20 in the south, one in the north), 35 farmers from 3 provinces, 10 Vietnamese scientists from 4 institutes (3 in the south, one in the north) and 5 high ranking politicians, attended the final meeting. The national and provincial television and print media covered this event. Secondly, the announcement at the meeting of a strong commitment on the part of the GOV to provide significant funds

to establish demonstration sites for non-chemical rodent management in 8 provinces in North, Central and South Vietnam.

1. Project Description

1.1 Background and preparation

More than 90% of the world's rice is produced and eaten in Asia, with rice providing 35-60% of the total food energy for the three billion people living in the region. In Vietnam, the rodent problem has escalated in the past 5-10 years. For example, the area of crops with high rat damage increased from approximately 50,000 ha in 1993 to more than 310,000 ha (mainly rice) in 1997. In June 1997, the Vietnamese Ministry for Agriculture and Rural Development classified rodents as one of the three most important problems faced by the agricultural sector.

Initial research on this problem was conducted under ACIAR project AS1/9679 - "Management of Rodent Pests in Vietnam". Key outputs from this project, which was conducted in the Mekong and Red River deltas, were:

- Development of a cost effective method of physical rodent control – the community Trap Barrier System (CTBS): a lure-crop is set inside a plastic fence with live capture traps, the lure crop planted three weeks earlier than the surrounding crop;
- Rice levee banks wider than 400 mm and higher than 400 mm were identified as the primary breeding requirement for the major pest species (the Ricefield Rat); and
- Identification of the optimal timing, location and scale of rodent management actions that were consistent with goals of sustainable agriculture, minimal environmental impact and humaneness.

A pilot study of farmers' attitudes and beliefs on rodent control in the Mekong Delta of Vietnam was conducted by staff from the International Rice Research Institute (IRRI), Vietnamese Plant Protection Department (PPD), Cuu Long Rice Research Institute (CLRRI) and South Regional Plant Protection Centre (SRPPC).

The CARD project capitalised on the research results and extension linkages developed during each of these precursor activities. The project team was assembled to include representatives of all of the key research and extension agencies in south Vietnam, and to provide expert support for each of the key areas of rodent ecology and sociology. CSIRO staff contributed expertise in rodent ecology. IRRI staff provided expertise on integrated pest management (IPM), and sociological issues associated with pest management programs. Anthropological expertise was also provided by IRRI, additional to what was agreed at the beginning of the project. This proved to be an excellent addition, leading to an insightful appraisal of the factors that are likely to influence the future adoption of ecologically-based management of rodent pests in the Mekong delta.

1.2 Context and rationale

The following series of successful workshops maintained the necessary contact between the project participants and provided timely opportunities for discussion and critical reappraisal of the project objectives and design as it progressed:

- Initial planning workshop in Ho Chi Minh City (HCMC) on 21-22 September 2000;
- Planning workshop for core project team in HCMC on 26 Feb 2001;
- Training workshop for provincial participants at My Tho on 27 Feb-2 Mar 2001;
- Review workshop for core project team in Hanoi on 21-22 Sept 2001 (held in conjunction with an annual review meeting for ACIAR project AS1/98/36);
- Review workshop for core project team in My Tho on 4-5 March 2002; and
- Final review workshop for project participants in My Tho on 7-9 August 2002.

The Training workshop in 2001 was attended by delegates from 14 provincial sub-PPDs. As a consequence, CTBS trials were established outside of the core project in two additional provinces (Bac Lieu and Tra Vinh).

During the life of the CARD project, another related project was carried out in Bac Binh district in Bin Thuan Province, funded under a joint ACIAR-World Vision Vietnam initiative. The aim of this project was to introduce CTBS and other methods of non-chemical control to this badly rodent-affected region to the east of the Mekong Delta. This ongoing project has benefited greatly from, and contributed significantly to, the overall success of the CARD project.

Another important spin-off activity from the CARD project was a study of the Mekong rat-meat market by SRPPC and An Giang University; CSIRO and the Queensland State Health Services (QSHS) also assessed potential human health risks associated with the rat-meat trade. This important avenue of investigation will be pursued by PPD, CSIRO, IRRI and QSHS.

The Final Review Workshop in August 2002 was attended by representatives from Bac Lieu and Binh Thuan Provinces, and from An Giang University.

1.3 Project objectives and scope at design

The primary objectives of this project were:

- i) to develop the research and implementation capacity of Vietnamese agricultural researchers in the area of ecologically-based (non-chemical) rodent management; and
- ii) to assist with the development of a regional plan for implementation and monitoring of effective rodent management.

This broader objective is consistent with the current directions and priorities of the Government of Vietnam (GOV) for pest management in agricultural systems.

Ultimate benefits for Vietnam would be a reduction in crop losses to rodents and a likely reduction in chemical use through integrating a range of alternative control actions and ensuring each is affordable and ecologically sustainable.

1.4 Implementation arrangements

CSIRO was responsible for overall project management and provided expertise in rodent taxonomy and ecology. IRRI provided expertise in sociology and anthropology. Within Vietnam, the rodent ecology field program was implemented by staff from the Institute of Agricultural Science (IAS), agronomic fieldwork was performed by staff of IAS, SRPPC and CLRRI, sociological data were gathered by staff of PPD and CLRRI.

2. Appropriateness of Project Design and Objectives

2.1 Appropriateness of Objectives

The project objectives were all found to be highly appropriate, as indicated in the following table:

Objective No./Ref.	Objective Description	Appropriateness Rating
(1)	Enhance ability of Vietnamese counterparts to address key research and sociological issues associated with non-chemical methods of rodent control	The close integration of biological, sociological and IPM expertise was highly appropriate. <i>Rating 5</i>
(2)	Tested the capacity developed in (1) at demonstration sites	The testing of methods and hypotheses developed from (1) at appropriate scale (village) resulted in significant new insights. <i>Rating 5</i>
(3)	Assess the sociological framework for implementation and benefit-cost of village-level rodent management	Essential to measure impact and to gain insights into opportunities and barriers to broad-scale adoption <i>Rating 5</i>
(4)	Review and develop, in consultation with PPD, sub-PPDs and farmers, a provincial-wide process for implementing and assessing effective rodent management	Essential to consider how methods can be applied at broader scale and across a range of ecological and socio-economic contexts. <i>Rating 5</i>

5: Best Practice; 4: Fully Satisfactory; 3: Satisfactory Overall; 2: Marginally Satisfactory; 1: Weak.

2.2 Appropriateness of Design

The project design proved highly appropriate, especially so the close integration of the ecological and sociological components of the project. By working closely together at the various planning and review workshops and at the field sites, biologists and social scientists both gained a new level of understanding of the complex ecological and social issues that, in combination, would influence the effectiveness and acceptability of the recommended rodent management strategies.

This mutual learning process was further enhanced by the involvement of sub-PPD staff and participating farmers in each of the major workshops. Although this brought some difficulties in terms of the need for constant language translation, the result was some critical insights and identification of issues that otherwise might not have surfaced.

Description of Design Features	Appropriateness Rating
(1) Farmer surveys on knowledge, application and practices on rat management; planning workshop, stake-holder meetings, needs assessment; technical training of provincial staff for CTBS; establish village study on common property decisions;	<i>Rating 5</i>
(2) Establish village-level rodent management using CTBS; monitor farmer actions; undertake village study on common property actions;	<i>Rating 5</i>
(3) Collect data on crop damage by rodents and costs of management actions; conduct study on CTBS adoption	<i>Rating 4</i>
(4) Final review workshop; recommendations of principles for rodent management in the Mekong delta	<i>Rating 5</i>

5: Best Practice; 4: Fully Satisfactory; 3: Satisfactory Overall; 2: Marginally Satisfactory; 1: Weak.

3. Implementation Performance

3.1 Project Components and Outputs

All key tasks were implemented to high standard and within the project time frame and budget.

Major project outputs are listed below:

1. Project planning workshop in HCMC 21-22 September 2000 (agenda, list of participants and report attached – items 1a, 1b, 1c)
2. Report “The performance of TBS in control rice field rat in the Mekong Delta’ by Mr La Pham Lan (IAS). (Presented to planning workshop; copy attached – item 2).

3. Technical Training Workshop for provincial sub-PPD staff in Tien Giang 27 February-2 March; (agenda, list of participants, report attached – items 3a, 3b, 3c).
4. Review workshop for core project team in Hanoi on 21-22 Sept 2001 (held in conjunction with an annual review meeting for ACIAR project AS1/98/36); (agenda, list of participants, report attached – items 4a, 4b, 4c).
5. Review workshop for core project team in My Tho on 4-5 March 2002; (agenda, list of participants, report attached – items 5a, 5b, 5c).
6. Final review workshop for project participants in My Tho on 7-8 August 2002; (agenda, list of participants, report attached – items 6a, 6b, 6c).
7. Public ceremony in My Tho on 9 August 2002 to celebrate completion of project and announce new initiatives by GOV; (agenda – item 7)
8. Nine papers (6 spoken; 3 posters) submitted for 2nd International Conference on Rodent Biology and Management, to be held in Bogor, Indonesia 28 Oct – 1 Nov 2002 (the proceedings are refereed and will be pre-published in mid October 2002 as ACIAR Monograph No.98 with all 9 as full papers). Authorship and titles as follows:
 - (a) Cuong, L.Q., Chien, H.V., Han, L.V., Duc, V.H., and Singleton, G.R. “Relationship between rodent damage and yield loss in rice in Mekong Delta” (item 8a)
 - (b) Palis, F.G., Morin, S., Chien, H.V. and Chi, T.N. “Socio-cultural and economic assessment of CTBS adoption in South Vietnam.” (item 8b)
 - (c) Morin, S.R., Palis, F.G., Chien, H. V., Chi, T.N., Magsumbol, M. and Papag, A. 2002. “A sociological perspective on community based trap barrier system”. (item 8c).
 - (d) Lan, L.P., Aplin, K.P., Hung, N.M., Quoc¹, Chien, H.V., Sang, N.D., and Singleton, G.R. “Rodent communities and historical trends in rodent damage in the Mekong Delta of Vietnam: establishing an ecological basis for effective management” (item 8d)
 - (e) Khiem, N.T., Cuong, L.Q., and Chien, H.V. “Market Study of meat from field rats in the Mekong Delta”. (item 8e)
 - (f) Singleton, G.R., Smythe, L., Smith, G., Spratt, D.A., Aplin, K. and Smith, A.L. “Rodent diseases in southeast Asia and Australia: inventory of recent surveys”. (item 8f)
 - (g) Sang, P.M., Huan, N.H., Escalada, M.M. and Heong, K.L. “Farmers’ beliefs and practices in rat management in the Mekong Delta, Vietnam” (Item 8g)
 - (h) Aplin, K.P., Chesser, T. and ten Have, J. “The evolutionary biology of *Rattus*: profile of an archetypal rodent pest”

- (i) Aplin, K.P., Frost, A., Tuan, N.P., Lan, L.P. and Hung, N.M.
 “Notes on the identification of Bandicota species in Southeast Asia”

9. Decision made at final review workshop (7-8 August 2002) to seek urgent funding support from FAO TCP scheme to support monitoring of uptake of CTBS and other aspects of recommended technology across Vietnam (see workshop report – item 6c). If there is a future round of CARD, Vietnam, then a project could be developed to link with this initiative through developing and implementing a national campaign for ecologically-based management of rats. Colleagues at the International Rice Research Institute are keen to be involved in this next phase of capacity building because of the success of the current CARD project.

The performance against each component using the scale is given below.

Component No.	Component Description	Outputs	Performance Indicators*	Performance rating
1.1	Complete farmer surveys on their knowledge, application and practices (KAP) on rat management in Mekong Delta	8g		4
1.2	Continue study on sociology of implementing CTBS	8c		4
1.3	Conduct planning workshop, site visits, stake-holder meetings, needs assessment	1		4
1.4	Conduct technical training of PPD/Provincial Government staff for implementation of CTBS; more extensive training to participants from 14 provinces was also provided in February 2001	3		5
1.5	Baseline data collection on CTBS adoption in pilot provinces	8b		4
1.6	Establish village level study on common property decisions in	8b		4

	community actions			
2.1	Establish village-level rodent management using CTBS			4
2.2	Monitor farmer actions			4
2.3	Repeat for dry season crop			4
2.4	Continue village level study on common property actions	8b, 8c		4
3.1	Collect data on crop damage by rodents and costs of management actions	8a,8b		4
3.2	Analysis of data for review workshop	8a		4
3.3	Repeat for dry season crop			4
3.4	Conduct study on CTBS adoption in pilot provinces	8b		4
4.1	Wrap-up workshop	6		5
4.2	Recommendations of principles (sociological, training, research) for rodent management in the Mekong delta	7,9		4

5: Exceeding time and quality targets, 4: Achieving time and quality targets and on budget; 3: Moderate progress towards targets, some issues about quality, budgets or costs but these are being adequately addressed; 2: Some progress towards targets, but slippage in schedule and cost overruns; & 1: Significant problems in achieving targets, quality outputs unlikely to be achieved and substantial cost increases affecting overall budget.

* *Note: Specific performance indicators were not specified in the project design*

Several additional tasks were undertaken as a result of new issues surfacing during the course of the project. The most important of these were:

- Taxonomic analysis of the major pest rodents in the Mekong Delta (Outputs 8h,8i)
- Analysis of historical records of rodent damage to crops across all of the Mekong Delta provinces; (Output 8d)
- Development of a framework for understanding CTBS by redefining it as a common property resource (CPR) and thus subject to many of the same constraints and opportunities as other CPRs. This approach documented

challenges to CTBS adoption, principal among these are the free rider, issues of transparency and equity, and the use of existing institutional structures for resource management. This study indicated a positive future for ecologically-based management of rats built around the CTBS concept and concluded with a set of testable hypotheses. (Output 8c)

- Trials of several alternative trap designs, with the dual purpose of i) improving capture rates; and ii) exploring cheaper options;
- Systematic recording of habitat structure around each of the CTBS units, after it was observed that capture rates could vary considerably between TBS units, even within a single hamlet;
- Development of a more comprehensive system of damage assessment around the TBS units, designed to more fully identify the 'halo' of crop protection around each unit;
- Detailed market study (with MSc student) of Mekong rat-meat business headed by Dr Khiem of An Giang University; (Output 8e)
- Analysis of rats from rat-meat processing plants for zoonoses (leptospirosis and hantaviruses) to investigate potential human health risks; analysis performed by Queensland Health Scientific Services (QHSS). (Output 8f)

In most cases these additional activities were initiated and successfully implemented by staff of the Institute of Agricultural Science (IAS), SRPPC, PPD, and the Cuu Long Rice Research Institute, with some assistance from CSIRO and IRRI staff.

3.2 Project Outcomes

The project has produced the following key outcomes:

- Research and implementation capacity has been significantly enhanced within all participating Vietnamese agencies;
- CTBS, as a key component of ecologically-based rodent management, has been demonstrated to be an effective means for controlling rodents in rice fields.
- The sociological parameters that are likely to influence the outcome of village-level rodent management have been established; and
- The necessary skills, resources and commitment have been fostered within key Vietnamese agencies (IAS, PPD, SRPPC, sub-PPDs) to enable regional implementation and monitoring of effective non-chemical rodent management.

Further details are provide under 4.1

3.3 Sectoral Impact

The proposed rodent control methods can be implemented by any landowner and is not gender specific. The methods are less demanding on hard physical labour than some of the traditional practices (eg digging of burrows) and are thus more accessible to women and people with physical disability. The methods are also much safer than the recently

increased practice of poison use that poses a special threat to women who are either pregnant or nursing.

3.4 Costs and Financing

Cost estimates at design proved to be very close to actual costs incurred, both for the in-country and external partner organisations. A full acquittal cannot be provided until the end of October after all funds are expended. However, a summary of expenditure during the 2001-2002 financial year is attached. All budget items are on track for completion within budget.

3.5 Monitoring of project

The reporting schedule and requirements of CARD have been appropriate and a useful component of the project internal review process as it has stimulated a regular stocktake of activities and outputs. Email contact among the partner institutions has been vital to the success of the project, and should be considered as a vital component of future projects of this kind, with funding support for improved email facilities where necessary.

3.6 Technical Assistance, Training and Capacity Building

The project was designed to develop Vietnam's capacity in three main areas of research and extension capacity for rodent management.

- (i) Research capacity in the area of rodent ecology and chemical-free rodent management (with assistance from CSIRO);
- (ii) Research and implementation capacity in sociological aspects of rodent management, primarily through assessment of changes in the knowledge, attitudes and practices (KAP) of farmers; and assessment of economic benefits to costs of rodent management (with assistance from IRRI); and
- (iii) Implementation and extension capacity in the development of effective region-wide promotion, support and monitoring of new rodent management strategies.

The research and implementation capacity of our Vietnamese counterparts has been significantly enhanced as a consequence of the close working relationships established between staff of IAS, PPD, SRPPC and CLRRI and staff of CSIRO and IRRI.

Core project activities were conducted within two provinces (Tien Giang and Soc Trang). However, training activities often involved participants from other provinces within the Mekong Delta and this led several provinces to independently commence rodent management trials within the time frame of the project. These additional activities provided some extremely valuable insights into the likely adoption rate of the new technology and strategies.

The following successful workshops were held for project participants:

- Initial planning workshop in Ho Chi Minh City (HCMC) on 21-22 September 2000;
- Planning workshop for core project team in HCMC on 26 Feb 2001;
- Training workshop for provincial participants at My Tho on 27 Feb-2 Mar 2001;
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The Training workshop in 2001 was attended by delegates from 14 provincial sub-PPDs. As a consequence, CTBS trials were established outside of the core project in two additional provinces: Bac Lieu and Tra Vinh.

The Review workshops in March 2002 and the Final workshop in August 2002 were both attended by representatives from Bac Lieu and Binh Thuan Provinces. Bac Binh district in Bin Thuan Province is the location of another related project, a joint ACIAR-World Vision Vietnam initiative to introduce the CTBS and other methods of non-chemical control into this badly rodent-affected cropping environment.

3.7 Management of Constraints, Issues, Risks and Change

The project suffered some initial delays relating to finalisation of the contract and disbursement of project funds. However, efficient work on the part of all partners through the first 6 months brought the project back onto schedule.

Some problems were encountered with establishment of CTBS at specific sites due to the late onset of the wet season in 2002. This problem was overcome by changing the location of some CTBS units, with care taken to select closely similar contexts.

Several important constraints to the wider adoption of non-chemical rodent management were identified during the course of the project. These related to three main areas:

1. Ecological issues relating to the question of what regulates seasonal or inter-annual changes in rodent abundance in different parts of the Mekong Delta (hydrological regimes vs farming systems);
2. Practical issues relating to access to critical resources (particularly water, threshing machines); and
3. Sociological issues relating to the formation and maintenance of community groups and networks in order to ensure a coordinated approach to rodent control.

Identification of these issues is in itself a significant outcome of this project, as it is now possible to frame specific hypotheses related to the adoption of recommended rodent control strategies, and to design appropriate trials and monitoring regimes. The development of a sociological framework for understanding CTBS by redefining it as a common property resource provided specific recommendations that will guide capacity building for ecologically-based management of rodent pests at the regional level.

3.8 Project Management

The strong management performance of IAS, PPD and sub-PPD staff, and the enthusiastic response from farmers in each of the participating villages, have jointly underpinned the success of this project at all levels.

The project managers in the respective Vietnamese institutions have been highly responsive throughout the project for requests for information from CSIRO and IRRI staff. Furthermore, they implemented in a timely manner the recommendations that arose from the workshops held in HCMC in February 2001 and in Hanoi in September 2001. (*Ranking 5*)

5: Best Practice; 4: Fully Satisfactory; 3: Satisfactory Overall; 2: Marginally Satisfactory; 1: Weak.

4. Performance and Outcomes

4.1 Assessment of Performance Against Objectives and Design

The project has been highly successful in respect of all major objectives:

- Research and implementation capacity has been significantly enhanced within all participating agencies;
- This capacity has been tested and demonstrated through the completion of successful field trials and sociological studies in two provinces, involving integrated action by IAS, PPD, SRPPC and sub-PPDs;
- The sociological parameters that will influence the outcome of village-level rodent management have been established through KAP surveys and benefit-cost analyses; and
- The necessary skills, resources and commitment have been fostered within key Vietnamese agencies (IAS, PPD, SRPPC, sub-PPDs) to enable regional implementation and monitoring of effective non-chemical rodent management.

CTBS, as a key component of ecologically-based rodent management, was demonstrated to be an effective means for controlling rodents in rice fields. It showed a high rate of return on investment and individual labour costs remain relatively low. The sociological and anthropological findings indicate that it is sustainable in both the short and long-term.

Farmers appreciated the ingenuity and complexity of the system and have suggested effective alternatives to the system to fit their local conditions.

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1. Ecological issues relating to the question of what regulates seasonal or inter-annual changes in rodent abundance in different parts of the Mekong Delta (hydrological regimes vs farming systems);
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Like many technologies CTBS will work best where farmers understand the technology and have the social and institutional background to effectively apply it. The multi-disciplinary mix of biologists, sociologists and agronomists in the project provided a breadth of capacity building for Vietnam scientists and extension staff. It also highlighted to our Vietnamese colleagues (scientists, extension staff, policy makers AND farmers) the strong benefits of collaborating across disciplines when addressing challenging agricultural issues such as rodent management.

The overall success of the project is indicated by the commitment on the part of the GOV of significant funds to establish demonstration sites for non-chemical rodent management in 8 provinces in North, Central and South Vietnam.

Two spin-off activities also represent significant outcomes of the CARD project:

- The study of the Mekong rat-meat market by SRPPC and An Giang University and of associated potential human health risks by CSIRO and QSHS; this important avenue of investigation will be pursued by PPD, CSIRO, IRRI and QSHS.
- The ongoing ACIAR-World Vision Vietnam project in Bin Thuan Province; this project has benefited greatly from, and contributed significantly to, the overall success of the CARD project.

4.2 Sustainability

The project was carefully designed to maximise issues relating to technical (including curricula), environmental, social/community and gender sustainability.

The high level of expertise and professionalism displayed by IAS biologists and PPD and CLRRI sociologists suggests that the research capacity built during this project is highly sustainable. (*Ranking 5*)

The decision on the part of the GOV to provide significant funding for further CTBS trials and demonstrations in selected provinces *throughout Vietnam* suggests that technology and strategy transfer is moderately to highly sustainable (*Ranking 4 or 5*).

The enthusiastic response of sub-PPD staff and farmers to the recommended rodent management methods suggests that the future uptake rate will be satisfactory to excellent (*Ranking 3-5*). However, further monitoring of support and uptake levels will be needed over several years to fully judge sustainability in both of these areas.

Overall, we consider that the project has achieved *Best Practice* in regard to Sustainability, at least in the short to medium time frame of 2-5 years. (*Ranking 5*)

5: Best Practice; 4: Fully Satisfactory; 3: Satisfactory Overall; 2: Marginally Satisfactory; 1: Weak.

4.3 Development Impact

The project has had strong and very likely lasting impact in two main areas:

- The improved research and implementation capacity of our Vietnamese counterparts
- The establishment of close and mutually beneficial relationships between Vietnamese agencies and between the agencies and the two external partners (CSIRO with IAS, SRPPC and PPD; IRRI with PPD, CLRRI and An Giang University).

All partners have benefited from the close integration within the project of biology, agronomy and sociology. This genuinely multi- and cross-disciplinary approach has been critical to the identification of key issues and constraints, and has greatly enhanced the learning experience for all project participants.

The lasting success of the project is indicated by the commitment on the part of the GOV of significant funds to establish demonstration sites for non-chemical rodent management in 8 provinces in North, Central and South Vietnam.

5. Conclusions

5.1 Overall Assessment

The project has provided a solid foundation for the implementation of ecologically-based, non-chemical methods of rodent management in the Mekong Delta (and potentially elsewhere in Vietnam). In large part, the success of the project can be attributed to the close integration of rodent biology, agronomy and sociology at all stages in planning, training and project implementation. This genuinely multi- and cross-disciplinary

approach has been critical to the identification of key issues and constraints, and has also greatly enhanced the learning experience for all project participants.

The research and implementation capacity of our Vietnamese counterparts has been significantly enhanced as a consequence of the close working relationships established between staff of IAS, PPD, SRPPC and CLRRI and staff of CSIRO and IRRI.

Non-chemical methods of rodent management were trialed at appropriate (village-level) scale and found to be successful in reducing crop damage, in reducing the level of chemical usage, and in fostering a community-approach to rodent management. The key sociological parameters that will influence the outcome of village-level rodent management have been established and appropriate methods developed to assess benefit-cost ratios under differing conditions.

CTBS, as a key component of ecologically-based rodent management, was demonstrated to be an effective means for controlling rodents in rice fields. It showed a high rate of return on investment and individual labour costs remain relatively low. The sociological and anthropological findings indicate that it is sustainable in both the short and long-term. Farmers appreciated the ingenuity and complexity of the system and have suggested effective alternatives to the system to fit their local conditions.

Like many technologies CTBS will work best where farmers understand the technology and have the social and institutional background to effectively apply it. The multi-disciplinary mix of biologists, sociologists and agronomists in the project provided a breadth of capacity building for Vietnam scientists and extension staff. It also highlighted to our Vietnamese colleagues (scientists, extension staff, policy makers AND farmers) the strong benefits of collaborating across disciplines when addressing challenging agricultural issues such as rodent management.

The Government of Vietnam has demonstrated its commitment to the future of non-chemical methods of rodent control through the announcement of significant ongoing funding the establish field trial / demonstration sites in 8 provinces in North, Central and South Vietnam.

Several spin-off projects have developed during the life of the CARD project, including one that relates to significant human health issues in the Mekong Delta region.

5.2 Lessons Learned

In large part, the success of the project can be attributed to the close integration of rodent biology, agronomy and sociology at all stages in planning, training and project implementation. This genuinely multi- and cross-disciplinary approach has been critical to the identification of key issues and constraints, and has also greatly enhanced the learning experience for all project participants.