From knowing it all to learning to engage – Experiences from Australian interventions in agricultural research and development in Vietnam

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Abstract: *The Australian Assistance in Development organisation (AusAID) funded three projects over the last ten years as part of the Collaboration for Agriculture and Rural Development Program (CARD) with the initial objective to introduce Integrated Pest Management (IPM) based on mineral spray oil into citrus production in Vietnam. This objective later evolved from IPM to a broader Integrated Crop Management (ICM) approach and eventually to the introduction of procedures for Good Agricultural Practice (GAP). In this paper we discuss the evolution of the collaborative approaches in the consecutive projects, departing from making Vietnamese researchers introduce a preconceived, externally developed concept in their local socio-economic and natural environments, to gradually facilitating the local partners to review potential innovations, test and adapt them, and develop management systems that suit the local conditions. This process resulted in linkages and interactions amongst local and international experts across disciplinary boundaries and between local stakeholders themselves. The final outcome of 15 years of collaborative work extended far beyond IPM, ICM and GAP resulting in the improved capacity of all stakeholders including farmers, extension and technical personnel from government organisations, non-government organisations and private industry, scientists from research institutes and universities and representatives of local governments to respond to the local specific needs of farmers and the policy requirements of agricultural and rural development in Vietnam. The major outcome for Australian researchers was the realisation that humans (farmers) with their culture, habits and behaviours are a crucial part of the system in which our knowledge and technologies are to be utilised.*

Keywords: *farmer field school, technology focused research, stakeholder focused research*

Introduction

This paper describes the evolution of a series of Australian research and development interventions in Vietnam from 1996 to 2010 in the citrus industry. It analyses the change in approaches applied to research and extension that occurred over time including:

- the change from technology focused to stakeholder focused;
- from wanting to change farmers to adapting technologies to suit farmers' conditions and abilities;
- from wanting farmers to directly adopt technologies to enabling them to test, adapt and internalise innovations;
- and from transplanting foreign concepts to moving beyond technology, identifying and meeting farmers' and other stakeholders' needs.

The change in approaches was triggered by immediate experiences in the field, through which the Australian experts learned from and with local experts and farmers what did and did not work under Vietnamese conditions. These experiences initiated a personal change for the first two authors of this paper in the way they go about research and development. As this paper critically analyses the Australian team members experiences and perceptions of the learning and changing processes it is not co-authored by our Vietnamese colleagues. We highly appreciate the fact that our Vietnamese partners had a significant impact on our projects, careers and lives.

The paper is structured as a theatrical event in the hope to clearly and chronologically capture the flow of activities, range of stakeholders and significance of the evolution that happened over a 15-

year period and across five projects. Firstly, we introduce all stakeholders (Actors and Audience), then we described our interventions (The Play), and finally we analysed the play.

The Actors

Australian actors

The Centre for Horticulture and Plant Sciences (CHAPS) of the University of Western Sydney (UWS)-Hawkesbury was formed in 1998 with major research focus on plant protection, post-harvest, and to a lesser extent, plant physiology. In 1999 CHAPS was listed as one of the top 50 Australian research facilities in a survey commissioned by the Federal Department of Industry, Science & Resources. Most researchers associated with the centre were scientists who believed in the power of reductionist science and their research was aimed at developing new technologies that could be used in agricultural production. At the same time the Centre for Farming Systems (CFS), also within UWS, was mainly comprised of scientists believing in a farming system approach that followed the internationally recognised Hawkesbury model (Bawden, 2005). In a sense, "hard science" was a key feature of the CHAPS differentiation from CFS and a very important paradigm. At the time CHAPS was very successful in applied research closely cooperating with private industry and attracting funds from industry R&D bodies. CHAPS is today called the Centre for Plants and the Environment, with a shifted focus from applied to more basic research. CFS disappeared together with the Hawkesbury teaching model at UWS in early 2000s.

ACIAR, established in June 1982, is an Australian Government statutory authority that operates as part of Australia's Aid Program within the portfolio of the Department of Foreign Affairs and Trade. It contributes to the aid program objectives of advancing Australia's national interests through poverty reduction and sustainable development by funding agricultural research and development projects, which are jointly carried out by scientists from Australia and partner countries (ACIAR, 2010). ACIAR commissions research that will foster agricultural development in partner countries and enhance the capacity of these countries to undertake agricultural research. The projects that ACIAR funded in the 1990s and early 2000s had a major focus on developing the research capacity of partner country research institutions. Outputs from ACIAR projects could be defined as scientific knowledge, research capacity and technology (Davis et al., 2008). Adoption of results by final users was expected but usually not a great deal was done within the projects to enable and facilitate adoption.

The Australian Assistance in Development organisation (AusAID) established a program called Collaboration for Agriculture and Rural Development (CARD) in the late 1990s with the first round of projects awarded and commenced in 2000. CARD's mission is to support agriculture and rural development in Vietnam through the application and adaptation of research, technology, skills and management practices with a focus on smallholders (CARD, 2010). Another important CARD activity has been to build capacity of the Vietnamese Ministry of Agriculture and Rural Development to organise tenders for research projects, evaluate applications, monitor project implementation and evaluate project impacts after completion. At the end of 2010 the CARD program will be completed and ACIAR will broaden its role by increasingly making adoption and development of scaling-up models an integrated part of their projects.

Caltex Australia is an Australian petroleum company that produces the mineral spray oil product, Caltex D-C-Tron Plus, and it was an industry partner in two ACIAR projects in China and one project in Thailand, Malaysia and Vietnam. Caltex Australia developed the product used in research and development interventions and made significant intellectual investements in the projects by developing logistics and marketing strategies for oil sales. They also made substantial financial investments with funds covering salaries of some CHAPS staff involved in projects. By the end of the second ACIAR project Caltex withdrew its support to our group, ceased investments in Asian markets and a few years after completion of the projects, D-C-Tron was not readily available in Asia. At the time of Caltex's withdrawal SK Energy (Republic of Korea) emerged on the scene and invested in registration of their high quality mineral spray oil EnSpray99 in China, Vietnam, Thailand and the

Philippines. They became industry partners in the second and third CARD projects described in this paper through their Vietnamese partner Saigon Pesticide Company (SPC).

Vietnamese actors

Ministry of Agriculture and Rural Development (MARD) govern and administer the majority of agricultural research and extension in Vietnam. In Northern and Central Vietnam research is conducted by seven institutes that are members of the Vietnamese Academy of Agricultural Science (VAAS) and in the South there are 2 major institutes that operate under MARD but independent of VAAS: Institute of Agricultural Sciences for Southern Vietnam and Southern Fruit Research Institute (SOFRI). In our projects we cooperated with the Plant Protection Research Institute (member of VAAS) from Hanoi and with SOFRI from Mekong delta. Other important contributors to agricultural research independent of MARD are universities and we cooperated with Can Tho University

The structure of the extension system in Vietnam is rather complex being governed by MARD on the national but by the Department of Agriculture and Rural Development (DARD) on the provincial level. Provincial DARD is controlled by Provincial People's Committee and MARD. On the commune level, extension officers are administered by their district extension/plant protection station and the commune people's committee (Nguyen *et al.*, 2005). The very close connection between local government and extension services had the consequence of local government officials being actively involved in all CARD projects. The last link in the extension chain are the "mass organisations" The Vietnamese use the term mass organisation to collectively include Farmers Union, Womens Union and Youth Union that are involved in organisation of most extension activities. Alongside the "mass organisations" are farmers groups, clubs and cooperatives, which are more common in the South of Vietnam than in the North. These more or less informal farmer organisations actively seek and experiment with new technologies and are not just passive receivers of extension products.

Complimentary to the government extension system is the extension provided by farmers associations and input providers including pesticide, fertiliser and seed companies. There is a high level of cooperation and integration between the government and non-government extension systems so that government employed extension officers are at the same time working as part of the input providers extension and marketing system.

The largest Vietnamese gardening association- VACVINA is a local NGO established in 1986 by a group of eminent scholars, agronomists and outstanding farmers. It is a technical, economic and professional voluntary mass organization that promotes sustainable agriculture and a small scale bio-intensive farming system where gardening, fish rearing and animal husbandry are closely integrated (VAC ecosystem). VACVINA endeavours to establish and promote strong relations with local and international organizations that have the goal of humane and sustainable development.

The Saigon Pesticide Company (SPC) from Ho Chi Minh City is one of the largest Vietnamese pesticide companies. Their products are primarily off-licence older generation pesticides formulated by SPC from cheap active ingredients acquired mainly in China. The mineral spray oil EnSpray99 is a high quality mineral spray oil with a higher price than many lower quality oils on the market and as such does not fit with the rest of the SPC portfolio. EnSpray99 requires more sophisticated marketing strategies and a higher level of technical support for the users than other pesticides formulated by SPC. Consequently, SPC received financial and technical support from SK Energy and technical support from our group to launch and market mineral spray oils in Vietnam.

The Audience

Farmers have been major stakeholders in all our projects even though it took us some time to realise that. However we will not call them actors in this paper since at the beginning of our journey it would be fair to say they were just audience. As we started to change with the progression of projects, we started to hear the farmers' voices and by the end of the projects we were acting together in the

same play. But still we cannot call them actors since we are the ones that come and go as any other troupe, while the farmers are staying bearing the consequences of the decisions they made based on our play.

In Vietnam there are nearly sixty million farmers who account for 75% of the entire Vietnamese population. The total land area under cultivation is about six million hectares, which makes on average only about 1000 m^2 of land available per person dependent on income from agricultural production (FAO, 2004). Our own data show that the average size of citrus orchards in the Mekong Delta is around 0.5 ha and in Northern parts of Vietnam around 1 ha. However, income from citrus in the Mekong Delta is higher so income per household does not differ much between the Northern parts and Mekong delta. Most citrus producers rely on citrus as their main source of income. They also produce rice and keep animals (poultry and pigs) mainly for their own consumption. There is a high degree of specialisation in the varieties of citrus grown within provinces in Vietnam, with farmers in Dong Thap almost exclusively growing mandarins and farmers in Nhge An provinces almost exclusively growing oranges. Pomelo is grown in a majority of provinces and the area planted has increased in the last decade. Different varieties of citrus provide very different returns to farmers. While the mean net profit averaged over citrus species and provinces was VND 78,620,000/ha (1 € = 22,000 VND) farmers growing mandarins had the highest average net return of VND 100,000,000/ha followed by pomelo growers with VND 93,330,000 while farmers growing oranges only had an average profit of VND 37,880,000. Not surprisingly, the highest profits of over 100,000,000 VND/ha were recorded in Tien Giang and Dong Thap provinces where mandarins are predominantly grown. Compared with rice, the net return from citrus is 3 to 6 times higher. The above data also shows that citrus farmers have enough disposable income to attract the attention of input providers.

Farmers involved in our projects live in households that usually consist of 5-7 members comprised of a husband, wife and 2-4 children. Older generation family members (grand parents) generally live with one of their children. The level of education is relatively high with the majority of farmers having completed primary education (7-8 years) and most of their children completing secondary school (12 years). Most citrus farmers own a house made of bricks and cement with a tile roof. In the Mekong delta the majority of decisions and activities in the field are performed by men while in Northern Vietnam they are equally shared by both sexes. This situation is well illustrated by the level of participation of female farmers in FFS; in the Mekong delta only 8% of participants were women while in Northern provinces approximately 45% were women.

The Play

Prologue: Mineral Spray Oil

Mineral oil is an organic liquid produced by distillation of crude oil and consists of carbon and hydrogen atoms that form three major types of compounds: iso-paraffins, naphthenes and aromatics. Mineral oils used in agriculture should contain at least 60% of iso-paraffins to be effective against pests and not more than 8% aromatics to avoid phytotoxicity (Agnelo, 2003). The mineral spray oils we used in the projects were superior products on the market far above the minimum standard with D-C-Tron having an iso-paraffin content of about 70% and aromatics below 6% and EnSpray99 an iso-paraffin content of about 74% and aromatics below 1%. Furthermore EnSpray99 is so well refined that it is food grade mineral oil and it was awarded a certificate for use in organic farming. The superiority of the oils we used in our research gave us a high level of confidence in our technology centred research approach.

Mineral oils can control pests in 2 major ways: by killing them through suffocation or by changing their behaviour so pests do not lay eggs or do not feed on the sprayed plant surfaces. Well timed oil sprays can effectively control citrus leaf miner, red mites and scale. They can also suppress Asiatic citrus psyllid, rust and broad mites, and spiny and citrus whitefly. In order to suffocate pests like scale, very high volumes of spray (3000 L/ha and above) using nozzles with a large droplet size should be used. When leaves have to be covered with oil to prevent pests like citrus leaf miner from laying

eggs, lower volumes (1500 L/ha and above) can be used if sprays are applied with nozzles that produce a smaller droplet size (Nicetic et al. 2008).

Mineral oils have great advantages over conventional pesticides: virtually no toxicity to vertebrate animals and humans; low harmful impact on beneficial insects and mites; and pests cannot develop resistance to mineral oils. However oils have disadvantages that affect their adoption by farmers: higher risk in comparison to most other pesticides to cause phytotoxicity; they have to be sprayed at higher volume than most conventional pesticides to be effective which increases labour costs; an increased time required to spray; the availability of large volumes of water; and overall in the short term a mineral oil based IPM program is more expensive than a conventional program while in the longer term it could have economic benefits.

Act One: We have the technology and we will conquer the world (ACIAR projects)

From 1993 to 2000 our group at UWS was the lead organisation in two ACIAR projects on the use of mineral spray oil as the foundation of IPM in citrus. The first project was based in China where large scale experiments were conducted in 2 locations in Guangdong province, alongside smaller scale experiments on specific insect pests. The large scale experiments involved comparing a number of different season-long spray schedules based almost entirely on mineral oil sprays with the normal farmer practice. The results showed that of the mineral oil spray programs delivering the same total concentration of oil, the most effective were those with a higher number of lower concentration sprays and these were as effective as the farmer pest management practises that included frequent use of broad spectrum pesticide. These experiments were continued for a three year period and over time it was shown that the level of natural enemies in the mineral oil treatments increased. The positive results, many of which were published as scientific papers, high levels of researcher enthusiasm and a very favourable ACIAR review resulted in the development of a second more extensive project that involved rolling out the optimal mineral oil spray schedules established in the first project in 5 different provinces in Southern China as well as at locations in Vietnam, Thailand and Eastern Malaysia. With so many locations involved, the team from UWS allowed themselves to overlook the less than favourable results that were being obtained from some sites. Most of these negative results involved phytotoxicity and low effectiveness of oil in control of pests due to less than adequate volume sprayed. In retrospect a pattern was emerging that citrus trees were far more sensitive to phytotoxicity in the lower latitude sites, but these signs were passed off as aberrations or the result of experiments not being conducted with optimal precision. These results were written up accurately in the final report, but the Project Leader's overview focused on the favourable findings in relation to mineral oil, while not truly reflecting the emerging problems. Other stakeholders, including local experts, clearly became more aware of the problems reflected by the very limited farmer adoption. Limited adoption by farmers led to very slow sales of oil and after years of investment without returns on that investment, the commercial partner, Caltex Australia withdrew from the project.

Act Two: Technology cannot be wrong we just have to change the farmers (First CARD project)

Caltex's withdrawal of financial support to the UWS team and the consequent team reduction forced the remaining members of the team to reflect on what had happened. It was concluded that adoption by farmers was very limited. According to our assessment at the time, the reasons for limited adoption were the farmers' low technical knowledge, failure of extension services in the partner countries to understand technology and effectively transfer it to the farmers and bad marketing by Caltex. All factors were put down as being beyond our control. Our project results were still considered excellent as they had by this stage given us more than 20 publications in refereed conference proceedings and journals. An independent review of the second ACIAR project was also positive so we still believed in our concept of oil based IPM. Soon after the completion of the second ACIAR project, AusAID commenced the CARD program in Vietnam to provide a vehicle for the extension and application of research results from ACIAR projects. The CARD program seemed to be

ideally suited to allow us to continue our work in Vietnam, and our application for funds to continue our work was successful.

The concept of the first CARD project (2001-2004) was simply that we would teach Vietnamese experts and farmers how to use mineral spray oil and then how to implement mineral spray oil based IPM. To achieve that concept we planned to write three books, bring a large group of Vietnamese scientists and extension officers to Australia for training and develop a curriculum for a citrus IPM farmer field school (FFS). The top-down approach "we know – Vietnamese need to learn" is well illustrated by the language used in the project document describing how the books would be written (CARD, 2000):

1. *Compile English text for booklet from existing ACIAR and other Australian results and decide on necessary photographs and diagrams*
2. *Translate into Vietnamese*
3. *Take relevant photographs in Vietnam*
4. *Have relevant diagrams produced by a graphic artist*
5. *Final editing and layout*
6. *Printing*

Training in Australia was well organised with well prepared and delivered presentations and with a lot of practical activities but all activities used scientific laboratory equipment and field pesticide application technology that was not available in Vietnam. Vietnamese experts gained knowledge about the potential of mineral spray oil to control a variety of pests and diseases and how it was used in Australia but not how it could be used under the prevailing conditions in Vietnam.

The Farmer Field School model was a new concept for the Australian team but it was well known to our Vietnamese partners from PPD who had participated in FAO organised FFS programs since the early 1990s. The Australian team saw FFS as a vehicle to teach farmers about mineral spray oil just as in any other school. However, our colleagues from PPD were confident in their knowledge and skills in organisation and facilitation of FFSs so they took the initiative to design and run a full season curriculum based on experiential learning principles, which is the foundation of FFS model (van de Fliert *et al.*, 2007). As a result, a FFS developed citrus IPM program emerged that was relevant for the Vietnamese situation, because it was much more comprehensive than just use of spray oil. Equally important for implementation of this project and development of the following projects was the realisation by some of the Australian researchers of the power and effectiveness of the participatory approach. After the first two books were written by a member of the Australian team and translated into Vietnamese, the third book was initiated and written by Vietnamese experts with only minor inputs from Australian team members. The third book was also on integrated management of citrus but with a different perspective on citrus management and it was specific for the environment of the Mekong delta. That was a turning point in the relationship between the Australian and Vietnamese partners, which caused a split in the Australian team between researchers who wanted to continue with the top down approach and those who wanted to adopt the participatory approach to research and learning. Final adoption of participatory approaches in the second and third CARD projects was the result of a change in team leadership and composition. UWS management made these changes after pressure from the industry partner, who blamed very low spray oil sales on the strategy of oil use developed by the team leader at the time.

Act Three: Learning from and with local experts and farmers (Second and Third CARD projects)

The second CARD project (2005-2007) started with a different UWS team composition and a new lead Vietnamese partner: PPD's Southern regional Plant Protection Centre in Tien Giang province. The scientific institutions SOFRI and Can Tho University were also important partners in the project but the leading institution was an extension agency reflecting the change in project focus from technology to farmers. The NGO VACVINA and an industry partner, Saigon Pesticide Company (SPC) became official project partners.

The change of focus from technology towards farmers and their needs adopted after the first CARD project confronted us with the true complexity of a sub-tropical citrus production system and just a few months into the project we realised that the focus on just IPM, as it was written in the original project, could not improve citrus production or even just address pest and disease management. We learned that a deficit of organic material in the soil and phytophthora were the major limitations to production. After the first cycle of FFS were completed and farmers needs were better understood, a more comprehensive integrated crop management (ICM) approach that also included soil health and plant nutrition was adopted. Certain aspects of farm financial planning and budgeting were also incorporated in the FFS curriculum.

The most exciting parts of the project at this stage were the interactions between all the actors involved in FFSs. The FFSs were no longer just an extension event but rather it served as a platform for adaptive research and experiential learning addressing production problems in a complex citrus agro-ecosystem and an equally complex social and economic environment.

The interactions between scientists, extension officers, farmers and the marketing and R&D team of SPC resulted in the production of marketing material (a brochure) that was based on scientific facts and in line with the ICM program. The brochure became effective resource material for extension officers and since it was based on results obtained by farmer researchers, all recommendations were understandable and easy for farmers to apply. Similarly, interactions between farmers, extension officers and scientists resulted in the publication of two field guides for pests, diseases and nutrient deficiencies of citrus and a series of twelve educational posters for farmers. These publications were not envisaged in the project proposal but they were written to address specific needs of farmers in FFS. While books written by Australians in the first project were still sitting in the basements of research institutes, the publications written by Vietnamese partners with limited input from Australian researchers were distributed and used by thousands of farmers. Local government involvement in the project provided an opportunity for farmers and extension officers to lobby for additional financial support to increase the number of FFSs in the region. The provincial governments responded by financing about 25 additional FFSs so that total number of farmers participating in FFSs reached approximately 5000.

The major changes in practices recorded in interviews with 60 farmers from 6 different provinces in the Mekong delta and Central Coast regions of Vietnam, conducted a year after FFS completion were: increased use of compost and manure (increase of compost use was such that the price of compost in Mekong delta was increased); a slight decrease in the number of pesticide sprays used; and a significant change from use of broad spectrum pesticides (primarily synthetic pyrethroids) to less disruptive pesticides like mineral spray oils and Imidacloprid. Reduced input costs was declared by 47% of interviewed farmers and 38 % farmers declared increased yields that contributed to significant economic impact. contributed to significant economic impact. Environmental impacts observed included increased numbers of beneficial arthropods and an increased abundance of fish in canals.

Participation in FFS raised the confidence of farmers in their ability to manage the citrus agro ecosystem. It improved relationships amongst farmers who participated in FFS and increased their influence in the community. It increased activities in growers' clubs that ultimately resulted in the formation of several cooperatives. The emergence of organised groups of advanced farmers (including both farmers who had participated in FFS and those who had not) that could produce significant volumes of high quality citrus fruits were pivotal in the formulation of the third CARD project which focused on implementation of Good Agricultural Practice (GAP) in the citrus industry.

The major objective of the third CARD project (2007-2010) has been continuation of farmers' training for implementation of citrus ICM in citrus production areas in 7 provinces of North Vietnam that were not included in the second project. In addition to farmer training in the North, more advanced production areas in the Mekong delta, identified in the previous project, were selected for implementation of elements of GAP using FFS. Of the 25 FFSs conducted in 5 provinces, two farmer groups implemented GAP to the level that satisfied all requirements and they received GAP certification. Implementation of GAP was facilitated by researchers from SOFRI, through

development of a GAP manual for citrus production based on GlobalGAP requirements and on-farm record keeping systems appropriate for Vietnamese farmers and compatible with GAP certification requirements (for full detail on implementation of GAP in Mekong delta refer to paper Nicetic et al. "Good Agricultural Practice (GAP) as a vehicle for transformation to sustainable citrus production in the Mekong Delta" in section 4.4 of this proceedings).

To conclude this play we will present the example of Vinh Long province (outlined below). While this example illustrates some of the impacts of the second and third CARD projects, it does not represent the average impact, but rather what can be achieved when projects are implemented in a context where farmers were organised and supported by local government and had strong productive relationships with the extension services.

In Vinh Long province a total of 12 FFSs were conducted of which 9 were financed by CARD and 3 by the provincial government. At these FFSs, 350 farmers were trained of whom 342 were male and 8 were female. As a result ICM is practiced on 140 ha out of a total area of 240 ha of citrus grown in the province. One of these FFSs was conducted for 26 members of My Hoa cooperative in Binh Minh district. The total area of pomelo grown by these farmers is 22 ha. The cooperative secured financial support to implement GlobalGAP from the German supermarket chain Metro in 2007 and in September 2008 they were granted GlobalGAP certification by SGS Vietnam. The total production of pomelo for the 12 month period from May 2007 to June 2008 was 970T. The Cooperative exported 120 T of pomelo mainly to the Netherlands, Metro bought 50 T and about 800 T was sold on the domestic market.

Analysis of the play

In the first act of the play there was very limited communication among actors (Fig 1). Australian researchers were feeding technological data, research agendas and protocols to the Vietnamese partners who were supposed to implement them. Hardly any feedback was sought from Vietnamese partners and even if some feedback was given by the Vietnamese that was not favourable to mineral spray oil based IPM strategies, it would be dismissed by Australian researchers. Extension officers and farmers were not directly included in the process but they were indirectly linked through the marketing and sales department of the industry partner (Caltex). Communication between the government funding agency (ACIAR) and the Australian researchers mainly consisted of the reporting of research results. The same results were reported to Caltex but Caltex was also getting feedback through its own network. The first signals that the oil technology and IPM approach may not be working and something had to be changed came *de facto* from the farmers through Caltex. Farmers' very limited adoption of the technology was reflected through low sales of mineral oil that then triggered withdrawal of the industry partner due to unacceptably low return on their investment. Limited adoption of the technology by farmers did not trigger a response with the government funding agency, mainly because of different impact indicators and the longer time period permitted between intervention and impact.

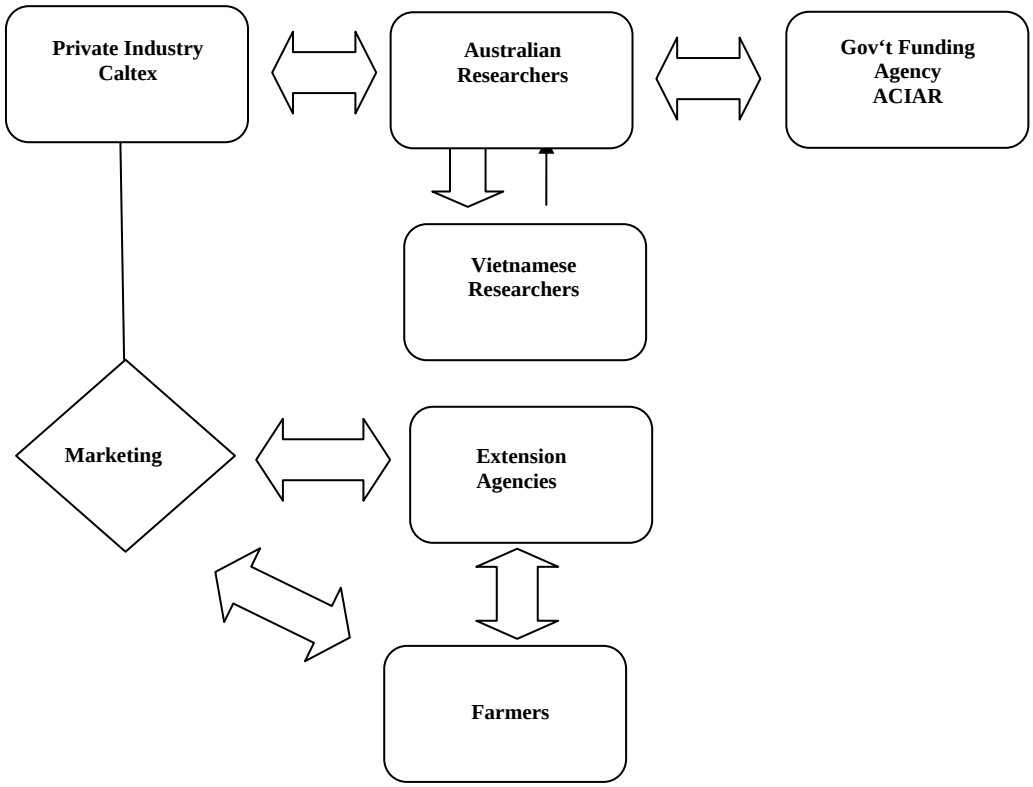

Figure 1: Communication flows between stakeholders in technology centred research approach.

In the second act, some communication among actors began to emerge (Fig 2). Communication between Vietnamese partners, which by this time included researchers, extension officers and, to a very limited extent, farmers was much more balanced and flowing equally between partners. Communication between the Australian and Vietnamese partners, however, still mainly flowed in one direction, with the Australians being the senders and the Vietnamese the receivers. Feedback by the Vietnamese partners, who began to question the mineral spray oil based IPM strategy, became stronger, especially towards the end of Act Two after the IPM strategy was tested by farmers in a FFS. Again, the fastest and most powerful response to limited adoption of oil by farmers came from the industrial partner and this response triggered a complete change in project approach and communication between partners.

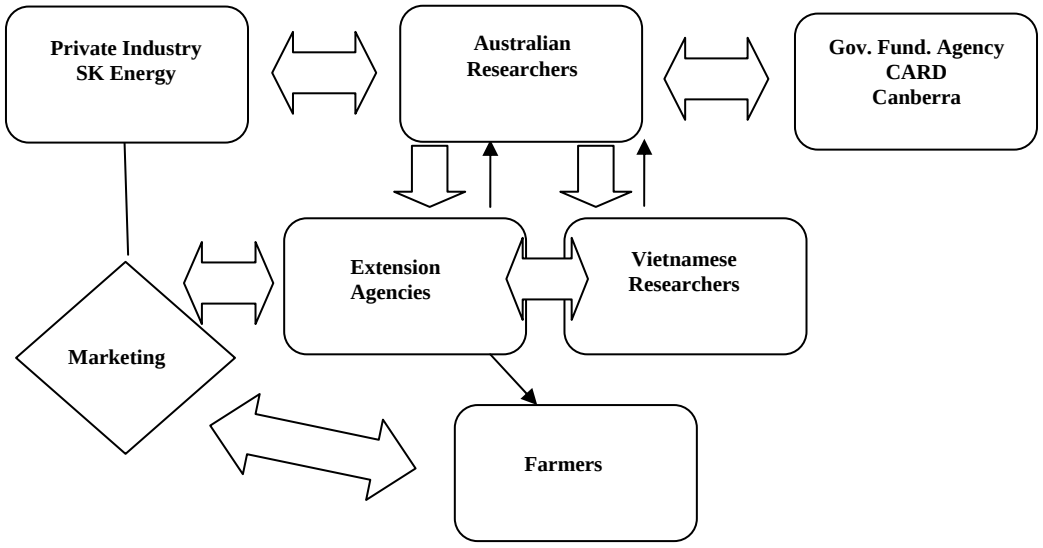

Figure 2: Communication flows between stakeholders in technology focused research and extension approach (Act 2).

In the third act, the FFS model was not applied just as an extension tool as in the second act but it was used as a platform for experiential learning, research and communication amongst all partners (Fig 3). The flow of information between all actors (which now included not just researchers and extension officers but also farmers, their organisations and local government agencies) influenced the research agenda within the project. Mineral spray oil was still a component of the ICM strategy but was no longer a central focus of the study. The project grew beyond the transfer of predetermined technology, and instead responded to the wide array of needs of citrus farmers and all other actors involved. Equal status in communication was pivotal for all actors to negotiate their stakes in the project and agree on a course of action that resulted in satisfactory outcomes for all actors. This can be illustrated by the adoption of mineral spray oil. Mid way through the second CARD project it became clear that adoption of mineral spray oil would be much lower than anticipated by the oil producer. Sales by the end of the second CARD project only reached 100 tonnes when it was anticipated they would have increased to 200-400 T. However through a process of exposure to farmers realities (no adequate spray equipment, limited availability of labour, high dependence on income from citrus making even the smallest risk of phytotoxicity unacceptable) SK Energy perceived lower sales and lower profits as acceptable and continued their presence in Vietnam. Farmer who now use spray oil to the extend they comfortable with have benefits of reduced pesticide use.

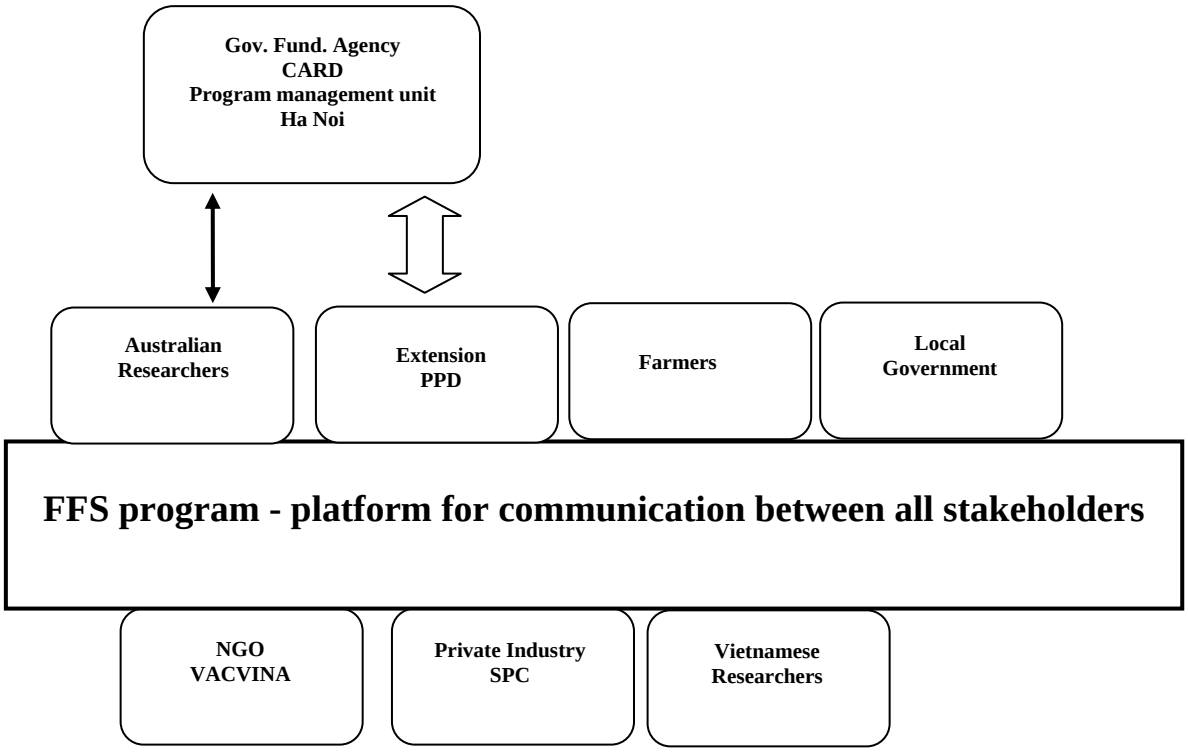

Figure 3: Communication flows between stakeholders in stakeholder focused research and extension approach using FFS model (Act 3).

It should also be noted that there was a change in the reporting requirements between the two Australian government funding agencies (ACIAR versus CARD). Report submission for CARD is the responsibility of the Vietnamese rather than the Australian leading partner institution and reports are submitted in both Vietnamese and English. Appraisal of the reports is done by both Vietnamese and Australian experts. This strategy for collaboration and communication put into effect by the funding body empowered Vietnamese partners and facilitated a more equal partnership between the Australian and Vietnamese partners' institutions, in which they learned from each other and widened their knowledge together.

Performance indicators determined by CARD were based on adaptation of research, technology, skills and management practices by smallholders. Project teams had to provide a baseline of smallholders' agricultural practices and economic and social conditions at the beginning of the

project and then impact assessment at the end of the project. This farmer centred approach taken by this funding body favours participatory research and experiential learning.

However, major actors involved also had to fulfil the indicators set by the organisations they belonged to. For the Australian researchers, performance indicators were set by their University and this involved achieving a successful research profile determined by the number of publications in scientific journals and the amount of research funds brought into the University. Changes in farmer practices and improvements in their livelihood are of no concern for University administrators and do not contribute to the researchers' promotion within the University system. Vietnamese researchers have their performance indicators determined by the Australian project partners who evaluate their performance in terms of project milestone delivery. They also have a number of indicators set by their own institutions and government that are not the same as the indicators set by Australians. As was the case for the Australian partners, positive achievements at the farmer level do not necessarily contribute to the performance evaluation of the Vietnamese researchers. However, they generally do obtain a significant financial reward from participation in international collaborative projects. Therefore, it would be fair to assume that they may be reluctant to provide negative feedback on project achievements towards the Australian partners.

The performance evaluation of extension personnel is more directly related to changes in farmers' practices. The extension officers' reputation with and influence on farmers is their most valuable asset because the respected and influential extension officers are more likely to generate additional income by participating in international projects and cooperating with input suppliers. So even if improvements in farmers' livelihood are not fully recognised in the extension officers' review they are compensated with income outside their institution.

The predominant performance indicator for the private industry (input supplier) is their sales volume, which is a direct function of farmers' decisions to use or not to use a product (in our case, the mineral spray oil). As was demonstrated in our play, when research is funded by private industry, feedback from farmers flows much faster and more powerfully to the researchers than through the government funding agency. However sales volume is only acceptable as an indicator of technology adoption, not as an indicator of improvement in farmers' livelihood.

It is; in fact, very difficult to determine what should or can be measured to estimate the impact of a stakeholder focused FFS model that involved so many beneficiaries, as was the case in the second and third CARD projects. Economic indicators are commonly used but to identify and precisely quantify all costs in the Vietnamese context is barely possible. Moreover, environmental and social indicators are often limited due to difficulties in capturing change and the cost involved in rigorous evaluation (Bartlett 2005; Fleischer et al. 2004).

Making the change from a hard science, technology focused approach to a stakeholder and process focused approach without institutional support implied some very difficult personal decisions for the researchers involved. It posed a dilemma between farmers' benefits and the individual researcher's personal benefit within their institution. The differences in performance indicators that apply for different partner organisations and stakeholders participating in research and development projects should be openly acknowledged within teams and efforts should be made to harmonise them.

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