

COMMUNITY MANAGEMENT OF BIOSECURITY: OVERVIEW OF SOME INDONESIAN STUDIES

Professor Ian Falk
Charles Darwin University, Australia

Dr Sang Putu Kaler Surata
Universitas Mahasaraswati, Bali, Indonesia

Mr Wayan Mudita
Universitas Nusa Cendana, Kupang, West Timor, Indonesia

Ms Eka Martiningsih
Universitas Mahasaraswati, Bali, Indonesia

Dr Bronwyn Myers
Charles Darwin University, Australia

Abstract

[‘Plant Biosecurity](#) is a set of measures designed to protect a crop, crops or a sub-group of crops from emergency plant pests at national, regional and individual farm levels’ ([Plant Health Australia](#), 2005). This research asks what ‘set of measures’ can communities adopt that will assist in the identification and management of the plant pests and diseases that affect their food supplies and livelihoods? How can these measures, or strategies, be described and how can communities engage with the issues and knowledge about plant biosecurity in sustainable ways? Rephrased, the question for this research is: *How do communities acquire new knowledge and develop new strategies for identifying and managing the plant pests and diseases that affect their food supplies and livelihoods?* Literature scans and preliminary discussions between Indonesian and Australian institutions and communities about biosecurity established an urgent need to understand its intricacies and applicability, especially in relation to community management of biosecurity. The term ‘biosecurity’ is relatively new in Indonesia. In order to increase knowledge of ways communities can engage and manage plant biosecurity effectively, a mixed methods quantitative and qualitative study was conducted in three diverse sites involving a total of 185 respondents. Quantitative analyses at a coastal village in West Timor (Site C) showed that Biosecurity awareness, knowledge, and actions are related to social capital. Social capital variables involved in the relations are unique for each of these biosecurity aspects. The results of qualitative analyses showed that local (and Indigenous) knowledge is a vital factor in the way communities view biosecurity, and indeed the ways they can engage with new knowledge and practices associated with managing pests and diseases. However, local knowledge is only one part of the story. The actual structure of a community – its organizations and network connections – and the processes the leadership engages across those structures – make a lie of the apparent similarities in community governance structures, such as the Desa (village) and Banjar (sub-administrative body) with their respective Heads. This has potentially dramatic impacts on engagement and management of new knowledge and strategies. The study shows that there is a clear need for additional research into the relationships between the

processes and structures of communities and the ways new knowledge and outside knowledge are acted upon. This is shown to be especially important in relation to how policy on plant biosecurity can be implemented effectively.

Introduction

There is high potential for incursions of Emergency Plant Pests (EPPs) and diseases between Indonesia and Australia because of their proximity. Successful eradication of an incursion depends rapid identification of the initial incursion and rapid subsequent effective eradication procedures. Both identification and eradication, in Indonesia and northern Australia, present opportunities for proactive cooperation between local communities, government agencies and NGOs to develop risk mitigation strategies. An opportunity exists to engage local communities to manage both the source and pathway for plant threats. In response, the Australian Cooperative Research Centre for National Plant Biosecurity (CRC NPB) has commissioned project work to model the role of local communities in the identification and management of such threats.

Preliminary literature reviews and collaborative work between Indonesian and Australian institutions and communities exploring issues, strategies and models of community management of biosecurity indicates that there is an urgent need for research to understand the intricacies and applicability of this concept, and the research of which this paper provides an overview is a start to that process. The term *biosecurity* is relatively new in Indonesia¹, implying a virtual non-existence of the concept in current policy documents, educational curricula or research endeavours. A concerted research effort exploring, in an integrated and holistic way, the wide range of aspects involved in managing national and cross-country plant biosecurity, would help to establish the knowledge base and models needed to develop and contribute to suitable policies, strategies, support systems and community-based practices in areas of interest for both Indonesia and Australia. These efforts should benefit Indonesia and Australia equally, both in the short and the long term.

This paper provides a report on the first stage of the research funded by the Cooperative Research Centre for National Plant Biosecurity (CRC NPB) based in Australia. It was conducted over 2006-7 and involved three diverse sites, two in Bali, one in West Timor outside the city of Kupang. The researchers employed a mixed methodology and a representative subset of the data is presented in this overview.

Literature review²

The central question being addressed is: *How do communities acquire new knowledge and develop new strategies for identifying and managing the plant pests and diseases that affect their food supplies and livelihoods?* The focus is on ‘community’, the ‘acquisition of new knowledge’, ‘developing new strategies’, ‘identification’ and ‘management’. While it is important to bear in mind that the object of these foci is in the cause of enhanced biosecurity outcomes, the science of biosecurity is not the main concern here. Rather, the concern is with *how* communities identify new and often scientific knowledge that is relevant to their situations, the role of leadership in that process and *how* they

¹ The Indonesian term “ketahanan hayati” (introduced during the CRC NPBS Summit in Bali on 24-26 May 2007) does not return any relevant results in a Google search, whereas “biosekuriti” is only referred to in combination with Avian influenza.

² The paper draws on a literature review conducted by Dr Bronwyn Myers which is reported more fully in another paper in this volume.

manage the change processes necessary for them to deal with problems as they arise. It is therefore an applied and very practical topic, but one that, as it turns out, is subject to being caught in the crossfire of relevant disciplinary bases, and this matter is reflected in the literature review that follows here. More detail is given in other papers, including the literature analysis authored by Bronwyn Myers, in this volume.

Emergency plant pests (EPPs) are defined as known exotic plant pests with potential to have adverse economic impacts (<http://www.crcplantbiosecurity.com.au>). The focus is on biosecurity as found in farming systems, both for income generation and subsistence, with direct economic impacts on livelihoods. However, the unit of analysis is the 'community', with resultant involvement of economics, community development and regional development, the latter especially relevant for the diverse geographic, socio-cultural regions where biosecurity is likely to be an issue. The policy environment is therefore complex but vital and highly implicated in this research. Key stakeholders clearly also include farmers (broad acre and subsistence), scientists, nature conservation managers, urban dwellers (gardeners, travelers) and policy makers. Many if not all of these stakeholder groups are also members of their own communities, and the term community can be applied to various groupings.

Community

Broadly, 'Community' refers to a group of people who share a common identity or a special interest (Kenny, 1994; Langone & Rohs, 1995). 'Community participation' can be defined as a process of active involvement of local individuals and groups in assessment of needs, planning solutions, creating structures for and implementing solutions and assessing outcomes (Shiffman, 2002; Zakus & Lysack, 1998). It is sometimes assumed that a community is any single network of people who carry out activities around a common purpose, such as an internet interest group. However, this is insufficient when we look at the communities of place which are our unit of analysis in this research. We therefore define communities as being located in a particular shared place, and consisting of networks of networks. In other words, a community of place is more complex than a single network, it has members with multiple identities, roles and aspirations, who belong to a number of networks within their own community and others.

Community capacity, resources and capitals

Sustainable development at the community level utilizes the capacity that already lies in a community. It is dependent on the community identifying and investing in six forms of resources, or capitals: natural, cultural, human, social, built and financial (Flora, 2004, Garnett *et al* 2007). Flora (e.g., 2004) provides a useful framework for understanding these various components of a community that might be drawn on in the way a community might engage with and act on information about plant pests and diseases.

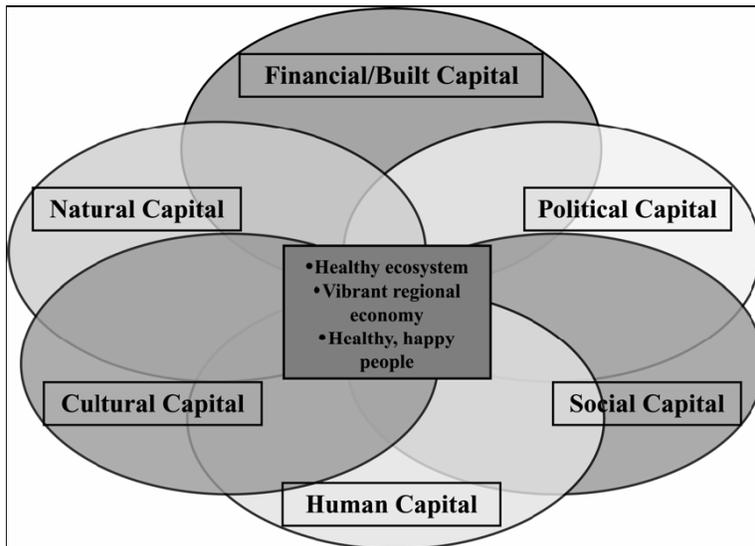


Figure 1: Intersections of forms of community capitals (Flora, 2004, p. 9)

Natural capital includes environmental health (*e.g.* soil conservation) and landscape diversity, and promotes sustainable land productivity. Cultural capital is a human construction that includes perceptions and knowledge systems, and affects the definition of problems. Human capital is driven by demographic trends, and the skills and capacity of the population. Natural, cultural and human capitals make up the “base” of the community in terms of resolving environmental issues (Flora, 2004). For a community to develop in a sustainable way these forms of capital are transformed into high levels of social, built and financial capital (Flora, 2004).

The transformation of these six forms of capital into sustainable and productive outcomes occurs through community cooperation. Plant pests and diseases have direct impacts on natural capital, often causing reduced crop yield, reduced biodiversity and adversely altering fire regimes. In addition, management practices can have good or bad effects on the sustainability of the economic life of the community and its members, and of course on the environment. The processes, dynamics and organizational structures of a community are therefore central to understanding how new information and knowledge is received, understood and acted on by members of any community. ‘Community development’ is a term used to embrace the multitude of ways in which community resources can be put towards achieving collectively beneficial outcomes. That form of community capital referred to above as ‘social capital’ underpins effective community development, along with its networks and interactive processes, now summarised.

Resources are made available for use in achieving a community’s socio-economic outcomes through the interactive processes involved in the production of social capital. Far from being just one of the capitals available for use in a community, the process of social capital formation is in fact the mill that grinds the social and economic order into place each and every moment of each and every day (Falk & Harrison, 1998; Falk & Kilpatrick, 2000). Each time and place (site) of interactivity has its own purpose and because the achievement of different purposes requires different inputs, the features of the interactive ‘ties’ will differ. That is, different resources in different configurations are required at different times and different places to achieve particular purposes.

Local and traditional knowledge and management practices

Christie (this volume) points to the importance of traditional knowledge in effective and sustainable management of pests and diseases. “In Aboriginal philosophy, language, place and identity are always strongly linked” (p. 49 this volume). Identity is a crucial aspect of people’s knowledge of the world and the natural environment around them. “Knowledge comes from place and relates people to place in their everyday lives” (ibid, p. 50). Karetji (this volume) calls this a ‘bounded rationality’. This knowledge, at least in the context of Australian Indigenous people who are the subject of Christie’s work, is distinctive in a number of ways: “Traditional laws and acceptable practices that govern knowledge use are local and need to be understood and negotiated at the local level” (p. 50). As has been noted earlier, there have been occasions in history, such as the Green Revolution, where sound indigenous knowledge practices were over-ridden in the interests of ‘superior’ outside Western science and economics. Sometimes this proved to be beneficial, but at other times it proved disastrous. Lansing (2006) documents the Balinese example where indigenous knowledge practices in water management systems of the rice paddies were replaced by western science, economics and technology. The heavy use of fertilizers and pesticides, coupled with changes to the irrigation system resulted in widespread environmental damage as well as crop failure, large scale pest plagues and resulting food shortages and severe poverty. In the face of this failure, the indigenous knowledge practices were surreptitiously reestablished and the situation soon improved.

Myers (this volume) provides additional information. She cites Wellhausen (1970) who estimates that 40% of agricultural land is cultivated by farmers using “traditional” techniques. Most of these farmers have failed to benefit from technological advances in farming practice because of lack of knowledge of, or access to, these technologies, resistance to adoption, or because of negative social consequences of their adoption (Trutmann *et al.* 1996). Farmers’ perceptions of plant disease generally differ markedly from those of scientists, evidence of different knowledge practices or cultural capital. For example, the poor adoption of Integrated Pest Management (IPM) by rice farmers in south Tamil Nadu, India, is partly attributable to the social values that include acceptance of crop pests and diseases as inevitable (Muthuraman & Mangal Sain 2004).

Christie (this volume) takes the discussion a step further by pointing to a significant role for indigenous knowledge in biosecurity processes. He argues that,

[t]he way ahead begins with a more formal recognition of the value of having Aboriginal people on their country, looking after it and keeping it healthy. The potential cost of a biosecurity disaster should motivate governments to provide financial and infrastructure support to people on country, especially in high risk areas. (Christie, this volume, p. 53).

While making a point about the value of indigenous knowledge, this quotation is important for approaches to management, a discussion about which now follows.

Management approaches

In Australia, to take one example, there is a growing recognition of the role of indigenous knowledge as a tool for managing biosecurity issues, as evidenced by Christie’s (this volume) quote which concluded the previous section. Looking back a few years allows a broader view of successful approaches to pest and disease management. These can only be mentioned here but are dealt with more fully in Myers (this volume). By and large,

successful approaches are not those that are mandated, but based on engagement and participation between the farmer, policy and scientist stakeholders. However, it is reasonable to assume that a mix of mandated and voluntary approaches may also work, as often policy precedes action. Integrated Pest Control (IPC), according to the United Nations Food and Agricultural Organization (FAO) definition (FAO, 1968), implies that economic thresholds are established to determine the need for control measures, and natural mortality factors are recognized and enhanced (Brader, 1979).

Integrated Pest Management (IPM) more accurately describes most responses to pests and diseases in an agricultural setting, as management rather than control is a more realistic aim. The promotion of IPM by the Indonesian government in 1986 was a major departure from the earlier approaches associated with the Green Revolution since the 1960's. IPM was a breakthrough in national policy because of its referral to natural processes (including conserving natural enemies) and because it aimed to educate and empower farmers (Winarto, 1995). Farmer Field Schools (FFS) have been successful in empowering farmers to develop biocontrol practices since the early 1980's (Williamson 1998, Nelson *et al*, 2001). Following from FFS, the Community Integrated Pest Management (CIPM) Programme in Asia has the aim of 'making farmers experts' and decision makers (Winarto, 2004). FFS and CIPM programs have resulted in a gradual change in farming practices in several countries in Southeast Asia, with increases in farmers' technical understandings and enhancement of their creativity, dignity and self-confidence (Winarto, 2004).

It is emerging that, for any management strategy to be effective, it must be both collaboratively executed and have a strong knowledge base supported by appropriate legislation. The knowledge, as we have seen already, should take account of the local, traditional or indigenous knowledge that prevails in a community concerning biosecurity. This is not to deny the large amounts of knowledge available through science. The trick, if we may call it that, is in finding the best solution to the local pest and disease identification *for that community*. Of necessity, this must involve a process that allows a valuing of both the local and the 'outsider' knowledge.

Once again, Christie's work (this volume) provides us with the link:

The second step the government agencies must take after deciding to invest in the engagement of Indigenous knowledge work in biosecurity, is to begin negotiations in each place to find the best most sustainable but most flexible structures for collaboration, which engage and support the traditional governance structures which are still in place, while at the same time fulfilling the information needs of the government... (Christie, this volume, p. 53)

Of course, this process of engagement means that the first stop must be to consult the community leadership so as to work with them in understanding how the local governance structures might be brought to bear on the problem at hand.

Leadership and governance

Instrumental in any transformation or change are various kinds of leadership, and five kinds can be discerned in the literature. *Trait theories* distinguish between the characteristics of leaders from non-leaders. The focus of this group of theories is on the leader rather than the organisation or contextual influences at the site of the leaders' activities or the leadership intervention (Gardner, 1988). *Leadership as behaviours*

highlights the functions, tasks or behaviours of the leader and assumes that if these functions are carried out competently, and members behaved rationally, the organisation will prosper (Fairholm, 1998; Leithwood & Duke, 1999; Sergiovanni, 1996). The notion of *leadership style* runs through this. The four best known so-called leader styles are *directive/autocratic*, *participative/democratic*, *abdicative/laissez-faire* and *supportive/human relations* (Schermerhorn, 1996, p. 325).

The third set of literature on leadership is *Contingent leadership* which focuses on leader behaviour and situational attributes concerning how leaders respond to the unique circumstances or problems they face (Bolman & Deal, 1991). Here, there is a greater allowance for the significance of context, but the relationship is still one of a single leader and their context. The fourth group of leadership theories is a catch-all for some established strands of theory and research. There is *transactional leadership* (Bass, 1985) that sees leaders as helping their followers to achieve outcomes through adjusting tasks, rewards and structures. *Charismatic leaders* (e.g., Conger 1991) are those who inspire followers by engaging in special leader–follower relationships. *Transformational leadership* (e.g., Gardner 1988) is leadership which inspires people to do more in reaching performance goals and includes features outlined by Schermerhorn (1996, p. 332) as vision, charisma, symbolism, empowerment, intellectual stimulation and integrity.

Fifth and finally, there is *Enabling leadership*. Enabling leadership (Falk, 2003; Falk & Mulford, 2001) has emerged as a contemporary leadership theory and construct. Enabling leadership puts the focus on the leadership processes themselves as implicated in a specific event related to strategic change. Leadership here is seen not to be the exclusive domain of one person but is rather constructed as a jointly owned, or collective, approach to managing a specific set of events identified by a common purpose. Its unit of analysis is therefore on the specific leadership event, or intervention sharing a common purpose, and its associated shared envisioning activities rather than on any single individual's vision. The notion of enabling leadership provides the most appropriate basis for the research reported here, which concerns interventions in community life with people who then become engaged in those interventions. It is the most appropriate because leadership is seen as a collective set of attributes dependent upon the purposes and outcomes of the intervention in hand.

Governance and leadership are closely interlinked in communities, as it is often those who are regarded as leaders in a community who control the local government, semi-government and private organisations and other clubs and associations which together make up the 'governance structure'. For example, political reforms in Indonesia since 1998 establishing 'regional autonomy' as a policy force have increased the autonomy of local-level institutions and representative councils have been elected in all Indonesian villages so that the village head is no longer the sole authority in the community (Antlov 2003). An examination of the World Bank-supported Urban Poverty Project (Fritzen 2005) found that the more democratic procedures for selecting local leaders to manage project funds resulted in slightly lower domination by local elite, but more importantly, to a greater degree of commitment to serving the poor and greater participation by the poor in the project. Beard and Dasgupta (2006) examined participation in a poverty alleviation project in Indonesia and described two distinct forms of collective action: the first based on community cohesion, stable social relationships and adherence to social hierarchy and the second based on a shared desire for social change. Both forms were important for

positive project impacts for beneficiaries but only the second had potential for social transformation.

From the overview of some of the relevant literature above, we now move to summarise the methodology for the research.

Methods

As established in Falk and Guenther (2007), a ‘mixed methods’ approach serves many functions in research. First, it ‘fill in the gaps’ of one method or the other, but has far greater benefits. Methods can be combined in a variety of ways: a) through the ‘quantitization’ (Tashakkori & Teddlie, 1998) of qualitative data (for example collating and counting recurrent themes in the qualitative data) in order to add ‘legitimacy to the researchers’ conclusions’ (Onwuegbuzie & Teddlie, 2003, p. 356); b) by accessing complementary quantitative data from within the same sample (for example through use of quantitative survey instruments complementing interview data) in what could be described as a ‘concurrent triangulation strategy’ (Creswell, 2003) and may incorporate ‘multilevel mixed sampling’ (Kemper et al. 2003, p. 287) and c) by drawing on data that comes from outside the purposive sample frame (for example using national or large sample surveys on related topics) to compare the ‘accessible population’ with a ‘target population’ possibly for the purpose of ‘identifying the population to which a finding can and cannot be made’ (Johnson & Christensen 2004, p. 244-245). This approach uses what is sometimes referred to as ‘sequential mixed methods sampling’ (Teddlie & Yu, 2007). The literature describes several other ways of looking at different mixed methods approaches (e.g. Tashakkori & Teddlie, 1998; Miller, 2003; Tashakkori & Creswell, 2007), all of which allow researchers to on the one hand make deductions from empirical data (most often the quantitative data) while at the same time testing these deductions with the inferences that emerge (most often from the qualitative data)—and vice versa—to both test hypothesis and build theory (Erzberger & Kelle, 2003). This combination effectively validates the findings of both data sources, a strategy which was employed in the research reported here.

Three sites were identified according to a set of criteria related to diversity of economy, location and relevance to biosecurity issues. For example a site was chosen in the heart of the tourist zone of Bali, partially to capture information about the passage and knowledge of tourists (2.5 hours flying time to Darwin, Australia) and partially because of the response to these issues by the local community. Another site was identified from a remote, rural region of Bali whose core activities revolved around agriculture and the ways agricultural produce found its way to markets locally and nationally. The third site was in the savannah region of eastern Indonesia outside Kupang, West Timor. It was selected because of similarity to environments of northern Australia, close proximity to Australia with links by air and shipping and so high potential for transmission of environmental pests. It also represents diversity in farming and cropping activities and subsequent market access responses.

Data was gathered from 185 interviews (Site A: 85, Site B: 47, Site C: 53) using many of the mixed methods noted above, including formal interviews, informal open-ended interviews, closed questionnaires and observation. These were tailored for the different audiences of community leaders, farmers, tourists, policy personnel and women. Interview data were transcribed first in Balinese and Indonesian (according to the

language of the original interview). The resulting quantifiable data were analysed in a variety of different ways, including the use of standard statistical packages and techniques. The qualitative components from interviews conducted face-to-face as well as from the open-ended sections of questionnaires were analysed using thematic analyses (e.g., Boyatzis, 1998; Silverman, 2001) with guidance from Onwuegbuzie and Teddlie's (2003) idea of a "intrarespondent thematic matrix to determine the relationship among the meta-themes (p. 359)".

Frameworks such as Flora's (Flora, this volume and as cited above) 'capitals' framework were applied to selected passages of conversation to elicit deeper levels of possible meanings, and certain linguistic techniques related to the kind of conversation analysis based on ethnomethodology (e.g. Boden, 1994) were used in the same exploratory and confirmatory fashion. Finally, it is noted that the data were analysed on a site-by-site basis, then the data was subjected to a cross-site analysis as well (often called a cross-cutting analysis), and this is the structure in which they will be reported in the next section of this paper.

About the sites

Balinese communities

The governance and leadership of Balinese communities is based around the 'Banjar', which is the smallest unit of local government management. A Banjar is also an open area building used for meetings, performances and storage of costumes and musical instruments – remembering arts and music and their performances play a central role at all levels of Balinese society and culture. The leaders are called Heads of Village (Kepala Desa) and Heads of Traditional Customs and Law (or as named below, 'community') (Kepala Adat) respectively. The structures of the two communities in question can be pictured as follows:

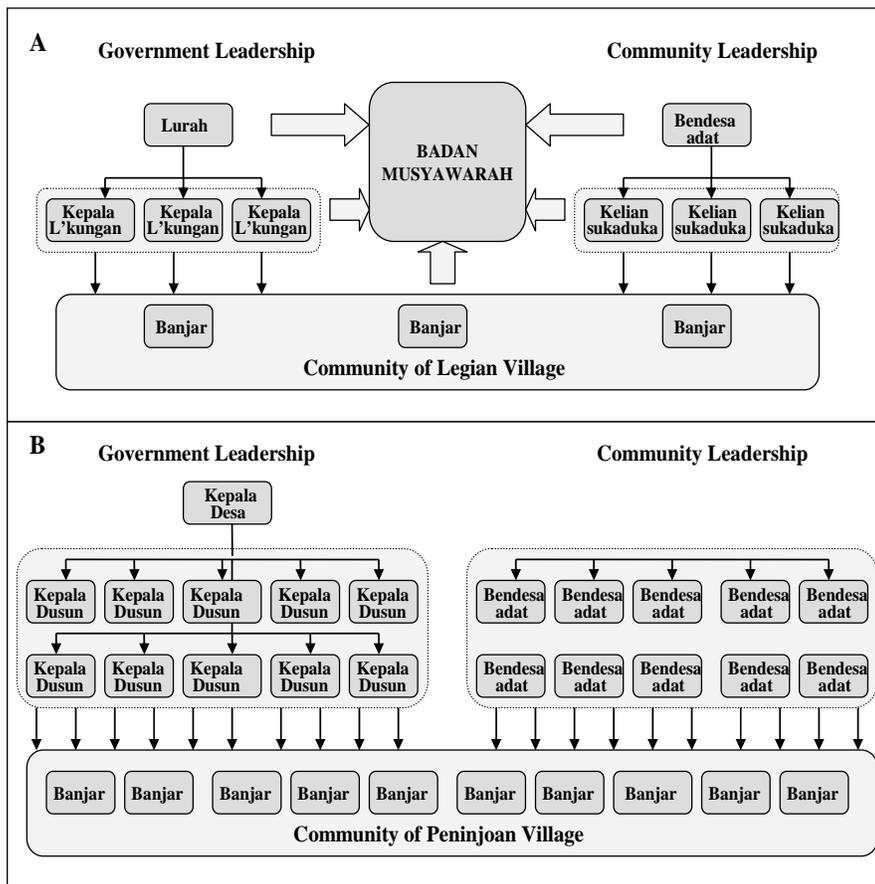


Figure 2: Comparing governance structures of Site A and Site B

Site A: Tourist strip in Bali

This community is among the top three beach destinations for tourists in Bali. Figures here are taken from the Indonesian central bureau of statistics referred to as BPS here. Site A has an area of 305 hectares varying between two and 10 metres above sea level. The more-or-less permanent population is 3331 of which more than half (57.4%) work in the retail sector, selling goods such as wood carvings, clothing, artwork, place mats and decorations of various kinds to tourists (BPS, Badung, 2006). The tourist population itself has fluctuated in the last few years since the bombings at Kuta and Jimboran. BPS (2005-6) notes that the total tourist numbers for Bali in 2005 were 1,388,984 and in 2006 1,262,537, but figures for this site are not available.

In Site A, two distinct clusters of respondents were interviewed: the people from the community itself – community leaders, women, youth and others,

The community

Interviews were conducted with two community leaders, two government leaders, two from the youth leadership group, two from the women's leadership group, 33 community members and five outsiders.

The tourists

Thirty nine (39) tourists were interviewed. As noted in the Methods section of this paper, the interview schedule for the tourists was tailored for this group and differed in several respects from the schedules for the communities. The tourists were drawn from a wide

range of nationalities and age range as follows:

- Europe four, Japan one, Malaysia three, Australia 12, Thailand four, USA two, Taiwan one, Russia two.
- Ages were as follows: 17-25 yrs 17, 26-35 yrs 6, 35 yrs and over 16. The results of the interviews are reported in the results and findings section of this paper.

Site B: Remote, rural and agricultural: Bali

Site B is, for Bali, a remote and rural area with a strong agricultural base. It is located close to the central mountains about two hours drive from the Provincial capital of Denpasar and has an area of 1,200 hectares. The population is 7,829 of which approximately two thirds (64.9%) who work in the agricultural sector (BPS, Bangli, 2006). Here, agriculture is a majority wetlands rice, but with a good representation of other mixed crops such as coffee, cocoa, corn and livestock such as chickens and cattle.

Interviews were conducted here with two community leaders, one government leaders, three from the youth leadership group, three from the women's leadership group and 38 community members.

Site C: West Timor: Kupang

The research conducted at this site is also reported more fully elsewhere in this volume. The following is a summary of that report.

Site C is a coastal village about 16 km to the East from the town of Kupang along the main road of Kupang-Atambua-Dili. Kupang is the largest city in West Timor and the capital of East Nusa Tenggara Province. To the North of the village is Kupang Bay, to the East is Tanah Merah Village, to the South is Oelmasi Village, and to the West is Mata Air Village. Site C is easily accessible from Kupang by means of rural transportation service or between towns using provincial buses. The inter-town bus terminal, where buses from district capital throughout West Timor are pooled, is located in the village.

For the purpose of this study, three villages were initially proposed as candidate sites, one West Kupang District, one in the Central Kupang District, and one in Sulamu District. Kupang is the largest city in Timor island and the capital of East Nusa Tenggara Province. A visit to each village was arranged in early April 2007 to meet village leaders and to carry out rapid appraisals on village structure, cropping systems, and potential pests and diseases threatening crops cultivated in each village. Based on the diversity of ethnic and social structure, cropping systems and the diversity of pests and diseases, Site C village was selected as the study site. A more detailed study was then carried out during April-May, 2007. The results of this study, in the form of preliminary findings, were discussed in an International Summit on Plant Biosecurity in Sanur, Bali, in late May 2007.

The selected site is in the Oesao-Pariti Plain, the second most important coastal plain for rice production in West Timor after the Besikama Plain in the Southern coast of Belu District. Being located in a coastal plain, the area of the village of 94.79 km² is mostly flat. Going south toward the inland, the topography becomes undulating and hilly. The village receives moderate 1,481 mm annual rainfalls and 120 annual rain days. Water for raice field irrigation is provided by the Dendeng Dam and since 2003 from a much larger Tilong Dam located in Oelmasi Village. Rice field is the most dominant land use in the village (44.6 km²), followed by dryland mixed perennial and annual crops (25.0 km²),

and dryland annual crops (24.8 km²). The remaining area consists of settlement, shrub lands, and mangrove forest along the coast.

The village (Site C) was established around 1816-1820 when the Dutch Colonial Government set up Rotinese settlements to protect Kupang from attack by the Meto people. The population of the village in 2006 was 6,389 persons within 1,321 households. Considering the village area of 94.79 km², the geographical population density was 361 persons/km² or 75 households/km². No data are available on ethnic composition of the population but, according to the Village Head, the major ethnic group is the Meto, followed by the Rotinese, then the Savunese. There are also minor ethnic groups, among which the most prominent are the ex-refugees from East Timor, the Florinese, and the Javanese.

The research in Site C employed both primary and secondary data. For the purpose of primary data collection, two visits occurred in March and April 2007, one to introduce the study team members to and have discussion with village leaders concerning the methodology and schedule for primary data collection. Based on this discussion, a survey protocol was developed. The primary data included surveys of a stratified random sample and interviews of a purposefully selected group of respondents. Secondary data included village documents which were obtained from the Village Office and sub-district, and district statistics which were obtained from Kupang District Office of the Central Agency of Statistics.

Pest and disease identification was mainly based on symptoms of damage and signs of pest organisms and pathogens found on a particular crop. Laboratory assessment was carried out only when direct field identification was doubtful. When a laboratory assessment was required, voucher specimens were assessed in the Laboratory of Crop Pests and the Laboratory of Crop Diseases in the Faculty of Agriculture, Nusa Cendana University, Kupang.

Interviews were carried out with the aid of questionnaires. Separate questionnaires were designed for each category of respondents (i.e. farmers, non-farmers, village leaders, and village institution leaders). The questionnaire was designed according to an integrated questionnaire structure for measuring social capital as used by Grootaert *et al.* (2004). It is assumed that awareness of community members about biosecurity issues, like other social issues, depends on knowledge and mutual understanding and collective action among community members (Schuller *et al.* 2004).

Based on the work of Grootaert *et al.* (2004) and Schuller *et al.* (2004) above, three social capital variables were selected for measurement: Awareness, Knowledge and Actions. These are explained more fully in the paper by Mudita (this volume). Data resulting from interviews were coded and along with the secondary data were then tabulated with help of spreadsheet software. Data analyses were carried out by means of cross tabulation and descriptive analysis. A more detailed inferential statistical analysis for the primary data resulting from farmer interviews was also performed to find out any relationship that might exist between various social capital variables of Awareness, Knowledge and Actions and characteristics of the community with awareness of, knowledge on, and action taken upon plant biosecurity issues. The results of such analysis is summarized in the results section of this paper along with the regression equations for each variable, but reported more fully in Mudita's paper in this edition of the journal.

From the above overview of the methodology, data, techniques and sites the paper now moves to a report of the results of the analyses, first by site and second by cross-cutting analyses. The section ends with a synthesis of these findings.

Results and discussion

Introduction and overview

The results from all three sites show the levels of knowledge and awareness of identification and management of plant pests and diseases at three sites. The analyses disclose the underpinnings of how communities acquire and assimilate new knowledge and the strategies used. All of these analyses are aimed at furthering understanding of how strategies can be deliberately developed collaboratively with communities to assist with identification and management of plant pests and diseases, and so positively impact on their food supplies and wider socio-economy.

Bali

Site A: Tourist strip, Bali

The community

It was found that the majority of the community members are not yet aware that pests and diseases are able to spread through various means such as wind, water, food and via human agency. In addition, community members by and large do not know that pests and diseases can come from outside their region and, conversely, that they can also disseminate to other regions. One respondent said that he has never heard anyone become sick after eating imported fruits, while another reported never having seen insects or caterpillars inside imported fruits. Several respondents assured the interviewee that fruit imports have been given preservative before sent. Another respondent expressed the belief that pests and diseases in imported fruits are 'insulated' before sent to other countries. However yet another respondent noted the possibility of pests and diseases coming from outside as well as disseminating regionally from where they were grown. According him, grasshoppers are readily dispersed within the region because they are present in estafette and so not easily observed.

A second result concerned leadership. The real leadership in communities comes from the Bendesa Adat and Kelian Adat community leadership, because they were chosen by the community, and they operate on bottom up approach. There is BAMUS which has a role for bridging between government leadership and community leadership so there is a balance between top down and bottom up approaches. Its existence ensures that the majority of local community members are involved in many collective activities such as cleaning the river and the environment, and participating in various traditional customs. Both the youth organization at village level (namely Karang Taruna) and Banjar level (namely Sekaa Teruna) are organizations that are seen to exert a strong influence on the community because they conduct regular meetings and carry out activities at regular times.

The various opportunities to find work in Site A result in many people from outside the community coming to live there. This generates a measure of social crises in the areas of housing, health, theft, deception and other criminal activities. One of the negative impacts

from rapid and sometimes unorganised settlement has been the spreading of dengue fever. In the year 2007 this Site A and two other villages in Subdistrict Kuta were specified as the area with the highest dengue fever infection level in Bali. The migration flow has, however, generated an interest on the part of the local community to take more interest in caring for their places, especially because they feel 'outsiders' are increasingly competing with them for employment opportunities. This matter has seen a push from the local community to make various regulations to limit the participation of 'outsiders' in policy and decision making. This is evident in the data through the tendency of local community members not to involve outsiders in social structures and processes.

Finally, mostly local community members are involved actively in many collective activities such as cleaning the river and the environment, and participating in various traditional customs. Both youth organization at village level (namely Karang Taruna) and banjar level (name Sekaa Teruna) are organizations that are seen to exert a strong influence on the community because they conduct regular meetings and carry out activities at regular times.

The tourists

The tourist interviews were analysed and the results are reported, against the respective interview questions 1-7, in the table below. The questions are listed first to assist the reader:

1. Are you interested in the issue of pest and diseases that can be brought through travel across countries?
2. Do you realize that one who travels from one place to another place is at risk to spread out diseases?
3. Are you quite familiar with the term Emergency Plant Pest (EPP) incursion?
4. What kind of souvenirs that you like best to bring to your country after holiday in Bali? Exotic plants, or pets (animals) or artificial souvenirs you can buy in art shop?
5. Have you experienced a serious diseases infected yourself or one of your family members?
6. Do you bring any products such as food, electronic, medicine, or other from your country?
7. Do you think that awareness to the quality of food that we eat is important? Whether the foods are safe enough to be consumed?

Age range	Nationality & No.	Answers								
		Q1	Q2	Q3	Q4	Q5	Q6	Q7		
17 - 25	Dutch 2	Not very interested.	Ye	From 5, 2 of them had heard it. (Internet, news).	Jewellery: mostly silver. Artwork: made from bamboo, wood, rock. Bags, hats, shoes.	No.	They bring surfboard, sunglasses, medicine (vitamin) and cigarette.	Yes.		
	Australian 6	Interested	Ye	Never heard.	Jewellery: made from silver, rock, cockle shells. Artwork: made from bamboo, rattan, wood, rock. Hats, bags, wallets, shoes, clothes.	No.	Instant food, cigarette.	Yes.		
	Japanese 1	Not very Interested	Ye	Yes. Internet, news.	As above	No.	Cosmetics.	Yes.		
	Malaysian 2	Interested.	Ye	Never heard.	As above.	No.	Vitamin, cosmetics.	Yes.		
	Indonesian 4	Interested.	Ye	Never heard.	As above.	No.	Cosmetics.	Yes.		
	Thailand 2	Interested.	Ye	Yes. Internet, news.	As above.	No.	Instant food, cosmetics.	Yes.		
26 - 35	California 1	Interested	Ye	No.	Art work. Made from wood, bamboo, rattan.	No.	Electronics.	Yes.		

	Japanese 2	Interested	Ye	Yes. Internet.	Art works: mall statue, knitted material, clothes, made from wood, rock.	No.		Medicines	Yes.
	Australia 2	Interested	Ye	Yes. Internet.	Art work: item. Jewellery.	Yes.	Autism, diabetes. Problem solving: therapist, hospital.	Electronics. Snacks. Cigarette.	Yes.
	Thailand 1	Interested	Ye	No.	Art work. Jewellery.	No.		Sauce.	Yes.
Up to35	Australia 4	Interested	Ye	No.	Art work. Jewellery.	Diabetes. Therapist.		Medicine, milk powder, vitamin.	Yes.
	France 2	Interested	Ye	No	Art work. Jewellery.	No		Electronics, snacks.	Yes
	Thailand 1	Interested	Ye	Yes. Internet.	Art works: small statue, knitted material, clothes, made from wood, rock.	No.		Sauce	Yes

Table 1: Tourist interviews: Summary of responses to questions

Most respondents expressed an interest in biosecurity issues. All report an awareness that people can carry host materials with them as they travel. Approximately half report an awareness of the term 'Emergency Plant Pest (EPP)' and as having that awareness from the internet. As can be seen from answers to the remaining questions, a wide variety of the materials from which the souvenirs are made of plant materials such as wood (including bamboo and rattan which often contain borers), knitted fabrics and grasses (handbags and string). High on the list of things they bring into the country and which therefore have the potential to import risks are plant products in the form of food stuffs such as snacks, instant (and often fresh) food. Given that there are no restrictions on the carriage of plant materials within Indonesia itself, the issue of domestic tourism is an important possibility to explore further in terms of transmission of pests and diseases around different regions.

Site B: Remote, rural and agricultural: Bali

Analyses of the interviews from the rural and agricultural site produced these results: As is the case for Site A, the majority of community members in Site B are not yet aware that pests and diseases are able to be spread by various means such as wind, water, food and human. Most of them do not know that pests and diseases can come from outside their region and, conversely, can also disseminate to other regions. But here we asked farmers several special questions. Interestingly, most respondents related that they solved this problem by conducting ritual ceremonies in many temples, with prayers for God to help bring back a balance to the proportion of pests and diseases. Meanwhile a few of them try to control pests and diseases in different ways: by using chemicals; by drying out rice fields; spreading salt or kitchen ash and destroying dead crops. While they expressed the belief that these ways were enough, and effective in controlling pests and crop diseases of paddies, unfortunately, they have not as yet succeeded in controlling the pests and diseases of dryland crops: banana and cacao trees have been attacked by pests and diseases which are not yet controllable. The disease of bananas cause the symptom which is known as 'mati daha' because the banana palm wilts and dies before bearing fruit, while in cacao it causes the fruit ossify and its seed to be destroyed.

The government leadership in site B is shown to be somewhat weaker because most policy and decision making that is done is not obeyed by community members, for example in providing rice and cattle for community members. On the other hand, community leadership in site B is very strong, because these members were chosen by the community and work based on a bottom up approach. The Village Advisor Institution (Badan Penasehat Desa or BPD) that is expected to be the link between governmental leadership and community leadership does not function. As a result there is no institution to act as a bridge between both forms of leadership (governmental and community).

The accumulated effect of the above results in low community participation in activities led by government leadership. On the other hand, community participation is high if the agenda comes from the community leadership organisation. The Head of the Village (Kepala Desa) is also seeking to become a member of a political party, resulting in an assessment by community members that policy generated by him was more oriented towards private and party-political interests rather than for public interest. There is no

youth organization at the village level, and the youth organization at Banjar level is relatively weak: meetings are scarce, as is any other form of collective activity.

Site C: West Timor: Kupang

The research conducted at this site is reported more fully elsewhere in this volume. The following is a summary of the results and findings.

Leadership

Regarding leadership, it was found that the leadership in the village consists of formal and informal leadership. The formal leadership consists of two bodies, namely the executive body and the legislative body. The executive body is headed by the Village Head who is elected directly by the village community members on a five-year term. The Village Head is assisted by the Village Office Secretariat headed by the Village Secretary and consisting of division of Government Affairs, Development Affairs, and General Affairs. Under the village office, there are sub-village officers and neighbourhood officers dealing with the day-to-day affairs of the community members. The legislative body, called the Village Council, is headed by the Council Head. Members of the Village Council are also elected on a five-year term from among village non-formal leaders, i.e. among traditional, religious, community leaders, women leaders and youth leaders among others. Both formal and non-formal leaderships are intertwined when it comes to the consultation that has to be carried out in decision making.

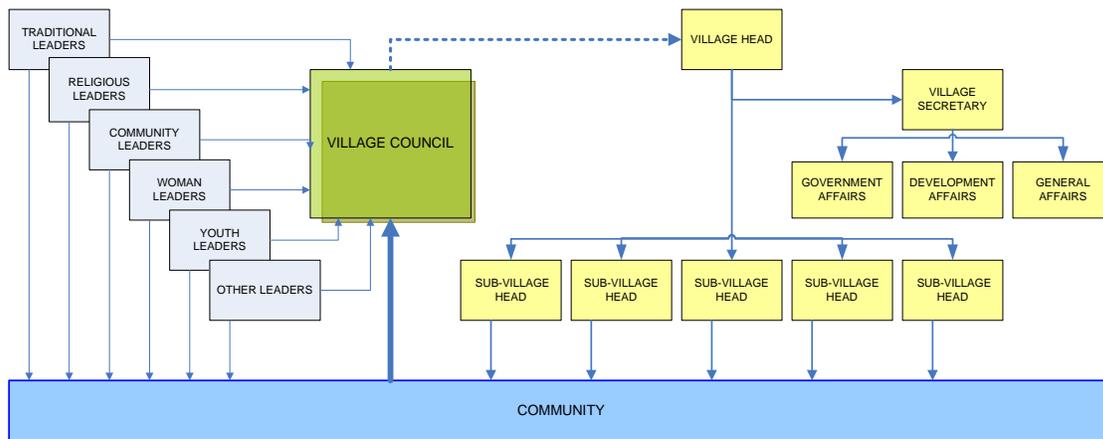


Figure 3: Site C Village leadership structure

Biosecurity and social capital

As explained in the section at the section about of Site C methodology, biosecurity **awareness, knowledge, and actions** in Site C Village are related to social capital. Social capital variables involved in the relations are unique for each of these biosecurity aspects. The following are the summary statements and regression equations for each variable, and the reader is reminded that the detail around these is explained in greater depth in Mudita (this volume):

1. **Awareness** of the presence of crop pests and diseases was greater if community members had:

- (a) More collective actions,
- (b) Greater communication engaged in by members of the community and
- (c) More information sources were accessed by them.

Regression equation for Awareness: $AWARE = 0.37520 + 0.04506*ACTS + 0.06027*COMS + 0.03946*SINFO$, $r^2 = 0.97$ and $C(p) = 6.67$, where AWARE=index of awareness to the presence of crop pests and diseases, ACTS=number of collective actions and cooperation involving members of the community, COMS=number of communications made by members of the community, and SINFO=number of information sources accessed by members of the community.

- 2. Knowledge** regarding crop pests and diseases was greater with:
- (a) Greater number of groups joined by a person in the community,
 - (b) More collective actions and cooperation involving members of the community,
 - (c) More institutions contacted to obtain particular information and
 - (d) Less time required to arrive at the sources of required information.

Regression equations for Knowledge: $KNOW = 0.25517 + 0.02843*GRPS + 0.05790*NETS + 0.04377*ACTS - 0.01118*TINFO$, $r^2 = 0.97$ and $C(p) = 1.86$, where KNOW=index of knowledge regarding crop pests and diseases, GRPS=number of groups joined by a person in the community, NETS=number of institutions contacted to obtain a particular information, ACTS=number of collective actions and cooperation involving members of the community, and TINFO=time required to arrive at the sources of required information.

- 3. Actions** taken to manage crop pests and diseases were greater when:
- (a) More groups were joined by a person in the community,
 - (b) More communications were made by members of the community and
 - (c) Less time was required to arrive at the sources of required information.

Regression equation for Actions: $ACTION = 0.38007 + 0.05547*GRPS + 0.05210*COMS - 0.0412*TINFO + 0.12043*FINFO$, $r^2 = 0.92$ and $C(p) = 1.66$, where ACTION=index of actions taken to manage crop pests and diseases, GRPS=number of groups joined by a person in the community, COMS=number of communications made by members of the community, and TINFO= time required to arrive at the sources of required information.

Other results from Site C

(1) Extension officers and other farmers in the farmer group are important sources of information regarding plant biosecurity for people in Site C village. The most important process of learning involved in the transfer of knowledge regarding crop pests and diseases are direct observation and putting the results of this observation directly into practice. Group discussion is also an important source, but this is usually done only when a serious threat has been posed by a particular plant pest or disease.

(2) Chemical insecticides and fungicides are currently used excessively to control pests and disease in Site C village. Some farmers are aware of other more environmentally

friendly techniques, but do not use these because the consumers prefer pest and disease free products rather than those free of pesticides Excessive use of chemical pesticides may hinder biosecurity efforts by promoting resistant strains of pests and pathogens, and by suppressing populations of natural predators. Reduced use of chemical pesticides may be encouraged by demonstrations of the effectiveness of alternative practices and through greater awareness among farmers and consumers of the dangers of excessive pesticide use.

(3) Some farmers submerge the bark of the albizia tree *Albizia chinensis* (called 'Nangkai' in local dialect) and citrus leaves in the rice fields to control armyworm, but further investigations are required to prove how effective these indigenous practices are in controlling the target pest and other pests.

Cross-site

Quantitative

A cross-site quantitative analysis has not been possible to date. It is, however, scheduled to take place in the following months and be incorporated in subsequent publications.

Qualitative

A. An analysis using Flora's 'community capitals' framework

Readers are reminded that Flora (see this volume) has provided a model of community capitals. In this section of the data, we report how this has been used as an analytic technique to portray the ways in which social capital has potential as a community capacity (effectiveness in community problem solving or change management) in the detection and management of plant pests and diseases. A selection of the results of the interviews and analyses that focus on the structure and dimensions of social capital interactivity from the two Balinese sites are reported. Through the first analysis, we show how social capital is central to getting a job done, solving a problem, disseminating new knowledge and so on. This is followed up by an analysis of the social capital structures and processes in the two communities.

Social capital and other capitals at work in interactive productivity

The two pieces of data analysed in this section show different events where the role of social capital is exposed. The events came from two different questionnaire items and were gathered from face-to-face interviews.

Analysis of sustainable activities

The first data sample is in response to the question in italics at the top of the table, with the answer in the left column and the notation regarding the forms of capital drawn on in the interactive productivity in the right column.

<i>Question: What institution/organizations (private or public) have continuously implemented a particular program here?</i>	
Transcript answer	Commentary
For the last three years, we have carried out collaborative work with several hotels here to conserve the local river and do some tree planting. Besides that, we have cleaned up our environment . . .	IS THIS ORGANISATIONAL CAPITAL? SOCIAL CAPITAL BUILT CAPITAL, FINANCIAL CAPITAL NATURAL CAPITAL NATURAL CAPITAL NATURAL CAPITAL
The hotels with their staff work with the community.	BUILT CAPITAL HUMAN CAPITAL SOCIAL CAPITAL
Sometimes the hotels assist the village and give money to buy. seed for the trees and for other things.	BUILT CAPITAL SOCIAL CAPITAL FINANCIAL CAPITAL NATURAL CAPITAL
needed to help clean up the environment.	NATURAL CAPITAL

Table 2: Transcript segment 1 with capitals commentary

There are 15 occurrences of capitals here, spread across 6 types. Only political capital is missing, and it could be argued that this is implicit in the precursor to the description, in that one could anticipate a high level of political persuasion and engagement might be necessary in order to establish this initiative. At least the influence of the political component cannot be ruled out. The above passage illustrates the role of social capital in the collaboration that is involved in the local river project. The project is a partnership between the community on the one hand, and business and industry on the other hand. The analysis using the framework of Flora’s capitals identifies conceptual categories as they are referred to in the narration of the event. The agency for interactive productivity (getting things done) is social capital. Social capital events are where the human capital of ‘staff’ can be utilised. The collaborative events (social capital) are where the resources

of the hotels (built and financial capital) can be harnessed by the community. The common purpose is quite a complex one – the restoration and sustaining of a river’s ecosystem, yet it is only through building in opportunities (events) where social capital (getting together) is harnessed that these other resources (financial, human, built and natural capital) can be released for the community’s benefit.

Analysis of unexpected difficulties with activities

In this second piece of text analysed against Flora’s ‘capitals’ framework, we ask a different question about what and why a particular event did not work out how it was intended. In asking a question such as this we can learn about the ways interactivity about a common purpose can be impeded, as well as the influences on its effectiveness and impact.

Question: Could you tell me about one example of an activity or project which you at first hoped would succeed but it did not turn out how you expected. Why did this happen and what do you see as the solution?

Transcript answer	Commentary
An example is when the community was informed	SOCIAL CAPITAL
about a meeting regarding information-sharing	SOCIAL CAPITAL
about diabetes disease.	HUMAN CAPITAL
This is an important meeting,	SOCIAL CAPITAL
containing valuable knowledge	HUMAN CAPITAL
so that people can keep healthy	HUMAN CAPITAL
On the intended day, there is a death and the meeting is	
postponed because people are engaged	SOCIAL CAPITAL
with the cremation ceremony.	CULTURAL CAPITAL
It was moved to another day. But, unfortunately though the information is important, only 11 came out of 30 participants expected. The main problems are the community owns their business and activities	
Using this example to guide us, we need a higher level of	FINANCIAL CAPITAL
organisation	ORGANISATIONAL CAPITAL
and ways of getting the people together	SOCIAL CAPITAL
in order for there to be a greater awareness of diabetes. .	HUMAN CAPITAL

Table 3: Transcript segment 2 with capitals commentary

There are 12 items of capital in this sample, spread across five different types out of a possible eight (assuming we count organisational capital as another form of capital). In planning for the non-successful event, only two kinds of capital are noted – human and social, though others cannot be ruled out. In the events that caused the lack of success (a death in the community) there are three types of capitals noted. This very different ‘take’ on a common purpose shows how, when social capital events are less productive (poor meeting attendance) the community fails to gain new knowledge. The meeting would have provided an event where a collection of people could network about a common purpose of diabetes. The lack of a well-attended meeting means that the human capital (knowledge about diabetes) cannot be put into action. The cremation ceremony (Cultural capital) and the pressures of business (Financial capital) are parallel activities which provide alternative means of social capital building and use, although in this case they detract from the meeting (social capital) event that allows the diabetes information to be circulated more effectively. Moreover, the data here show how these capitals are drawn on during the act of interaction, but also that their nature is defined by the particular purpose: Not *all* the resources are useful – seeds obviously are, so is money. The type of human capital for the purpose of the restoration and sustaining of the river in the form of ‘staff’ and ‘knowledge’ is also formed from the purpose in hand. That is, social capital provides the mechanism through which the work in a community (or anywhere else) is accomplished.

The problem that triggered the selection of these pieces of text for analysis was our perception that it is usually inadequate to look for a single thing as a cause or solution to a problem. The real situation is inevitably complex: interconnected and single ‘things’ are inseparable in the act of social interaction. Social interaction at the level of data (answers to interview questions) is seen here to be as important as the interactions these micro-examples build into – large scale social and community activities involving interactions such as partnerships, meetings, collaborations and relationships between people of a less formal kind. Finding a ‘simple’ way to portray and then manage this complexity in terms of a strategy or model for change management is part of the task of this research.

B. The Structure/Process analyses across two sites

The paper in this volume by Surata reports more fully on this aspect of the two Balinese sites and readers are referred there for further information.

C. The role of women in the community management of biosecurity

The paper in this volume by Martiningsih on the role of women in the community management of biosecurity provides detail on interviews conducted with women in the two Balinese sites (A and B) on this topic.

Synthesis

The most significant themes that have emerged as a result of cross-site and within-site analyses are presented here and other information is presented in other papers in this volume.

The following section focuses on the acquisition of new knowledge, and the capacity to develop management strategies.

The four key themes to emerge are:

1. *Leadership and governance*
2. *Interaction between local and 'outside' knowledge*
3. *Nature of networks*
4. *Policy: top-down, bottom-up*

1. *Leadership and governance*

In the communities studied, leadership is certainly an issue in how new knowledge is received, understood and acted upon. However, it is not just a question of 'strong' leadership or 'democratic' leadership that produces the results, it is the way the leadership is embedded in and interacts with the governance structures of each community. That is, to develop a model of community approaches to biosecurity, we must take account of the governance structures in the community, analyse the leadership capacity, then see how these qualities interact – leadership and governance structures. The 'process' and structures' described in the current research will provide a basis for future activities based on a participatory research model to allow reflection and input into information gathering studies. Conventional understandings of leadership and governance do not explain these processes and structures.

2. *Interaction between local and 'outside' (including scientific) knowledge*

In all cases and sites, local and traditional knowledge was shown to have an important role in existing, effective pest and disease management. The results indicated that interaction of the local knowledge with the outside or new knowledge (including 'scientific' knowledge) is a vital factor in how community members take on board new information and act upon it. If the knowledge from outside is seen as top down and intrusive, it will be counterproductive, and it can be seen how this aspect of the findings supports the role of leadership/governance in achieving biosecurity outcomes. On the flip side of this situation is the way the outsider knowledge can be more effectively applied by understanding local knowledge and conditions. Indeed, there are a number of documented examples of how local knowledge assisted in or informed the outsider knowledge, and for example traditional herbs and medicines.

3. *Nature of networks*

Networks are the conduits through which knowledge and information can flow. Networks are the only means by which new knowledge or information is acquired (learned) and acted upon. Moreover, there are data showing how the bridging networks that link community members with resources via connections with, for example, politicians, are conduits for resources both ways, and conduits for information that both top-down and

bottom-up people can use. In the coastal village in West Timor (Site C), a greater involvement of community members in pest and disease identification directly in the field is found to be important as the basis for improving their awareness and knowledge of plant biosecurity and at the same time developing better strategies for the necessary actions required in dealing with the possibility of threats resulting from the arrival of new pests and pathogens and the outbreaks of the currently existing ones. As can be seen from this example, the qualities of the local networks are what will determine whether new knowledge will be ‘noticed’ or regarded with sufficient importance to be fitted into daily life and incorporated into a daily routine. This aspect of network functioning – the way identities of local people influence effective engagement with and the transmission of knowledge and its uptake into daily practice, is a vital area for further research.

4. Policy: Top down, bottom up?

Running through all the above, but established as a theme in its own right, is the importance of interactions between all levels of stakeholders in the particular process. The theme sees the importance of looking beyond the easy typification of a top-down, bottom-up dichotomy. The data show that, when policy personnel at all levels have genuine concern for a particular issue, and when ‘grassroots’ people provide circumstances where opportunities for mutual understandings and advancement can occur, there will be improvements to the way new information and knowledge is received and acted on, and needs of these stakeholders are more likely to be met.

Summary, conclusions and implications:

The paper has provided an overview of a year-long introductory study in Indonesia and Northern Australia whose purpose was to identify the ways in which communities learned about, and learned how to manage, the plant pests and diseases affecting their food supplies and so the wider community socio-economic well-being. This overview is complemented by other papers in this volume which provide more detail on various sections and analyses of the overall research.

The research found that the first step in the development of a strategy or model of community approaches to biosecurity is to take account of both the governance structures in the community and the processes that facilitate action between community members. Then the precise nature of the leadership capacity for any particular intervention can be established. Knowledge is at the core of any community intervention related to managing plant biosecurity. Local, traditional and indigenous knowledge should be valued, as they have a history of taking account of unique local environmental and geographic factors. Locally held knowledge, including traditional knowledge, will interact with new knowledge as deemed relevant to the particular intervention to achieve change.

However, knowledge is only one aspect of what is required to bring about sustainable change. Learning the required knowledge is the other. Learning always occurs through networks. Networks are both the means through which local and outside knowledge engage with each other, and the practical means by which change and development occurs. Both knowledge and identities are involved in network transactions for change. Change, however, requires people to alter the way they see themselves: if existing roles,

responsibilities and linkages are to be changed sustainably, then people must adjust their self-perceptions (and their perceptions of others with whom they interact) in order to incorporate the ‘new them’ into their world picture, otherwise new behaviours will not become entrenched, and ‘old ways’ will re-emerge. The difficulties associated with the phenomenon of ‘transfer of learning’ are well-known, but have not so far been articulated in terms of identity change. The importance of identity in learning and change found in this research points to a gap that needs filling. Finally, many interactive complexities associated with ‘getting things done’ through policy at a community level are fuelled by the powerful dichotomy of ‘top-down/bottom-up’. The research indicates that when policy mixes with knowledge brokers (local people and scientists, for example) along with ‘grassroots’ community people in exchanges with a common purpose, change and learning occurs for all parties.

In summary the findings of the research include:

1. A model of community management of biosecurity occurs through:
 - a) Assessing community capacity in terms of its structure & process.
 - b) Building capacity in identified gaps.
 - c) Identifying common purpose of change process.
 - d) Working with a balance between *structures* and *processes* in engaging with communities from grassroots to policy.
2. An urgent need for new models of leadership, local knowledge and governance to achieve effective policy outcomes.
3. Effective outcomes for biosecurity will rely on how leadership allows new knowledge to be received, understood and acted upon through knowledge transfer.
4. Biosecurity research capacity in eastern Indonesia needs identifying, supporting and developing to be fully effective.

Implications for further research stemming from our discussions are phrased as questions:

1. What are models of leadership and governance that effectively mediate Western and local knowledge systems?
2. What is it about effective interactions between (a) Western and (b) local/indigenous/traditional knowledge systems that can improve the impact of scientific knowledge?
3. We know knowledge is transmitted through networks, so what are ‘good’ (effective and efficient) networks, how can they be identified, and how can existing ‘good’ networks be used *more* effectively?
4. What models best describe the policy and community level interactions that result in effective pest and disease management in communities in eastern Indonesia?

We stress, finally, the importance of ‘interaction’. It is not a single factor, such as leadership or governance *per se*, that makes a difference, but their respective qualities and the ways they interact with each other. Local (including traditional) knowledge can interact with ‘outside’ knowledge to produce productive change. Networks are formed from interactions and finally, the success of any initiative, strategy, model or research outcome depends not simply on good science or good policy, but on ensuring each of these interacts with each other productively. Productive interactivity, its nature and structure, must therefore form a significant theme underlying the future research set out.

References

- Antlov, H 2003, Village government and rural development in Indonesia: The new democratic framework. *Bulletin of Indonesian Economic Studies*, 39, pp. 193-214.
- Bass, B 1985, *Leadership and Performance Beyond Expectations*, Free Press, New York.
- Beard, VA & Dasgupta, A 2006, Collective action and community-driven development in rural and urban Indonesia. *Urban Studies* 43, pp. 1451-1468.
- Boden D 1994, *The Business of Talk: Organizations in Action*. Cambridge, UK: Polity Press.
- Bolman, L & Deal, T 1991, *Reframing Organizations*, Jossey-Bass, San Francisco.
- Boyatzis, R 1998, *Transforming Qualitative Information: Thematic Analysis and Code Development* Sage, Thousand Oaks.
- BPS (Badau Pusat Statistik) 2005-2006, *Statistik wisatawan mancanegara ke Bali*. Bali: Katalog BPS Provinsi
- BPS (Badau Pusat Statistik) 2006a, *Kabu pateu Badung 2006: Kecamatan Kuta dalam Angka 2006*. Badung: Kantor Statistik Kas.
- BPS (Badau Pusat Statistik) 2006b, *Kabu pateu Bangli 2006: Kabupaten Bangli dalam Angka 2006*. Bangli: Kantor Statistik Kas.
- Brader, L 1979, Integrated pest control in the developing world. *Ann. Rev. Entomol.* 24, pp. 225-254.
- Christie, M 2007, Traditional Aboriginal Knowledge Practices and North Australian Biosecurity. *Biosecurity Bilingual Monograph, Learning Communities: International Journal of Learning in Social Contexts (Australia)*, & Kritis: *Journal of interdisciplinary development studies (Indonesia)*. pp. 47-54.
- Conger, R 1991, Inspiring others: The language of leadership. *Academy of Management Executive*, Vol.5, pp. 31-45.
- Creswell, J 2003, *Research design: Qualitative, Quantitative and Mixed Methods Approaches*, Sage, Thousand Oaks.
- Erzberger, C & Kelle, U 2003, Making inferences in mixed methods: the rules of integration. *Handbook of Mixed Methods in Social and Behavioral Research*. C. Tashakkori A and Teddlie, Sage, Thousands Oaks: pp. 457-488.
- Fairholm, G 1998, *Perspectives on Leadership*. Quoroks, London.
- FAO 1968, *Report of the first session of the FAO panel of experts on integrated pest control*, Rome. 18-22 Sept 1967, PL/1967/M/7. Rome: FAO. 19 pp.
- Falk, I 2003, The design of effective leadership interventions: A case study of vocational education and training. *The Leadership and Organization Development Journal*, 24(4), pp. 193-203.
- Falk, I & Guenther, J 2007, Generalising from Qualitative Research: Case studies from VET in Contexts, evolution, revolution or status quo? *The new context for VET, AVETRA 2007 - 10th Annual Conference*. Victoria University, Footscray Park, Australian Vocational Education and Training Research Association.
- Falk, I & Harrison, L 1998, Community learning and social capital: "Just having a little chat", *Journal of Vocational Education and Training*, vol. 50(4), pp. 609-627.
- Falk, I & Kilpatrick, S 2000, What is social capital? A study of a rural community. *Sociologia Ruralis*, 1(40), pp. 87-110.

- Falk, I & Mulford, B 2001, Enabling leadership: A new community leadership model, in Falk, I (Ed.), *Learning to manage change: Developing rural communities for a local–global millennium*, NCVER, South Australia.
- Flora, CB 2007, Social Capital and Community Problem Solving: Combining Local and Scientific Knowledge to Fight Invasive Species. *Biosecurity Bilingual Monograph, Learning Communities: International Journal of Learning in Social Contexts (Australia)*, & *Kritis: Journal of interdisciplinary development studies (Indonesia)*. pp. 30-39.
- Flora, CB 2004, Social Aspects of Small Water Systems. *Journal of Contemporary Water Research and Education* 128, pp. 6-12.
<http://www.ncrcrd.iastate.edu/pubs/flora/watersystems.htm>
- Fritzen, S 2005, *Local democracy matters: Leadership, accountability and community development in Indonesia*. National University of Singapore, Singapore.
- Gardner, J 1988, The Context and Attributes of Leadership, *New Management*, Vol.5, pp.18–22.
- Garnett, ST, Sayer, J & du Toit, J 2007, Improving the effectiveness of interventions to balance conservation and development: a conceptual framework. *Ecology and Society* 12(2), [URL:http://www.ecologyandsociety.org/vol12/iss1/art2/](http://www.ecologyandsociety.org/vol12/iss1/art2/)
- Grootaert, C, Oh, G & Swamy, A. 2004, Social Capital, Household Welfare and Poverty in Burkina Faso. *The Journal of Environment Development*, 13(4), pp. 371 – 399.
- Johnson, B & Christensen, L 2004, *Educational Research: Quantitative, Qualitative, and Mixed Approaches, Research Edition, Second Edition*, Pearson Education Inc., Boston.
- Karetji, P 2007, Linking Biosecurity to community Development in Indonesia. *Biosecurity Bilingual Monograph, Learning Communities: International Journal of Learning in Social Contexts (Australia)*, & *Kritis: Journal of interdisciplinary development studies (Indonesia)*. pp. 118-137.
- Kemper, E, Stringfield, S & Teddlie, C 2003, Mixed methods sampling strategies in social science research. *Handbook of Mixed Methods in Social and Behavioral Research*. A. Tashakkori and C. Teddlie, Sage, Thousand Oaks, CA.
- Kenny, S 1994, *Developing communities for the future*. Nelson, Melbourne.
- Langone, C & Rohs, R 1995, Community leadership development: Process and practice, *Journal of the Community Development Society*, 26(2), pp. 252–267.
- Lansing, JS 2006, *Perfect Order: Recognizing Complexity in Bali*. Princeton, NJ, Princeton University Press.
- Leithwood, K & Duke, D 1999, A Century’s Quest to Understand School Leadership, in Murphy, J and Louis, K (Eds), *Handbook of Research on Educational Administration*, AERA, Washington, DC.
- Martiningsih, E 2007, The role of women in the community management of biosecurity. *Biosecurity Bilingual Monograph, Learning Communities: International Journal of Learning in Social Contexts (Australia)*, & *Kritis: Journal of interdisciplinary development studies (Indonesia)*. pp. 86-99.
- Muthuraman, P. & Mangal Sain 2002, *Sociology of integrated pest management in rice. Resources management in plant protection during twenty first century*, Hyderabad, India, 14-15 November 2002. Volume II.
- Myers, B 2007, Community processes in development and implementation of practices for the management of plant pests and diseases – a discussion paper. *Biosecurity Bilingual*

- Monograph, Learning Communities: International Journal of Learning in Social Contexts (Australia), & Kritis: Journal of interdisciplinary development studies (Indonesia)*. pp. 100-117.
- Nelson, R, Mundt, C, Orrego, R, Ortiz, O, Fredrix, M, Tenorio, J & Vien, NV 2001, Working with resource-poor farmers to manage plant diseases. *Plant Disease*, 85, pp. 684-695.
- Onwuegbuzie, A & Teddlie, C 2003, A framework for analyzing data in mixed methods research. *Handbook of Mixed Methods in Social and Behavioral Research*. C. Tashakkori A and Teddlie, Sage, Thousands Oaks.
- Plant Health Australia 2005, *Emergency plant pest response deed*.
http://www.planthealthaustralia.com.au/project_documents/display_document.asp?category=15&ID=211. Last accessed 29 September 2007.
- Schermerhorn, J 1996, *Management*, 5th Edn, Wiley, New Jersey.
- Shiffman, J 2002, The construction of community participation: Village family planning groups and the Indonesian state. *Social Science and Medicine* 54(8), pp. 1199-1214.
- Schuller, T 2004, *The Benefits of Learning*, Routledge Falmer, London.
- Sergiovanni, T 1996, *Leadership for the Schoolhouse*, Jossey Bass, San Francisco.
- Silverman, D 2001, *Interpreting Qualitative Data: Methods for Analysing Talk, Text and Interaction*, Sage, London.
- Surata, K 2007, Structure and process in facilitating community action in Bali. *Biosecurity Bilingual Monograph, Learning Communities: International Journal of Learning in Social Contexts (Australia), & Kritis: Journal of interdisciplinary development studies (Indonesia)*. pp. 55-66.
- Tashakkori, A & Teddlie, C 1998, *Mixed Methodology: Combining Qualitative and Quantitative Approaches*, Sage, Thousand Oaks, CA.
- Trutmann, P, Voss, J & Fairhead, J 1996, Local knowledge and farmer perceptions of bean diseases in the central African highlands. *Agriculture and Human Values*, 13, pp. 64-70.
- Wellhausen, EJ 1970, The urgency of accelerating production on small farms. In *Strategies for increasing agricultural production on small holdings*. (ed) D.T. Myren. Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico. pp. 5-9.
- Williamson, S 1998, Understanding natural enemies; a review of training and information in the practical use of biological control. *Biocontrol News and Information* 19, 117-126.
- Winarto, YT 1995, State intervention and farmer creativity: Integrated pest management among rice farmers in Subang, West Java. *Agriculture and Human Values*, 12, 47-57.
- Winarto, YT 2004, The evolutionary changes in rice-crop farming: integrated pest management in Indonesia, Cambodia, and Vietnam. *Southeast Asian Studies*, 42, pp. 241-272.
- Zakus, JDL & Lysack, CL 1998, Revisiting community participation. *Health and policy and planning* 13, pp. 1-12.