Local and Indigenous Ecological Knowledge as an Emergent Property of a Complex System: A Case Study in the Solomon Islands

Ellen Woodley, PhD
Liana Environmental Consulting
Ontario, Canada

Abstract

Despite unprecedented interest in local and indigenous ecological knowledge (IEK) over the last twenty years, there is still a lack of awareness of the implicit complexity in IEK and the epistemological barriers to its effective use for ecosystem management. Development professionals and project participants often minimize the importance of social structures and biophysical features of the ecosystem that support the system of knowledge and how the process of change impacts that system. For researchers and development practitioners, both local and non-local, to have access to and to understand situated, embedded knowledge that is undergoing change and adaptation, a new conceptual approach is required.

This paper describes research that attempts to expand and refine the understanding of indigenous ecological knowledge as dynamic and place-based in order to better inform contemporary ecosystem management. This research positions local ecological knowledge as an emergent property of a complex of *context*, *practice* and *belief* (CPB). The CPB complex represents the conditions that structure knowing. In this approach, knowledge is understood as process, or 'how' people know, not 'what' they know. IEK is, therefore, emergent from and a representation of complexity. The approach diverges from the widely applied development practice of participatory consultation designed to extract knowledge, and instead examines local epistemology and the process of change to understand the basis of human-ecosystem interaction. The paper describes the CPB complex in the communities of Uzamba and Valapata in the Solomon Islands, and shows that understanding how people are engaged within their surroundings, instead of documenting knowledge that can be articulated, can assist in bridging differences in worldviews.

1.0 Introduction

The appeal for an 'alternative collective wisdom' (Berkes, 1993: 7), based on local ecological knowledge has, over the last two decades, become more defined and is now becoming more influential in policy documents, research agendas and participatory methodologies. However, despite the best intentions behind development policies that attempt to reflect local needs and use local knowledge, there is still dissatisfaction with many of these efforts – expressed by those working in the field, including local and indigenous peoples themselves.

Indigenous populations living subsistence lifestyles and relying on traditional practices have, to varying degrees, changed from being relatively autonomous societies to societies interdependent within complex global relationships (Feit, 1988). Attempts by development professionals and project participants to incorporate traditional and local knowledge of small subsistence-based communities into development and research projects usually make little, if any, effort to understand changing social structures and biophysical features of the ecosystem, which support the system of knowledge and livelihood practices. Instead, the tendency is to reify ecological knowledge as something abstract rather than something that is lived day to day. The assumption is made that finding and tapping into a base of abstract knowledge will help provide sustainable solutions for resource use today, a way of thinking that is evident in many conceptualizations of small subsistence and indigenous societies.

The central purpose of this paper is to present ideas for discussion as to how to better represent IEK in its own right for the benefit of ecosystems management. A conceptual framework is presented, that was developed while living and working in the villages of Uzamba and Valapata in the Solomon Islands (Figure 1). The conceptual framework incorporates the concepts of structural and organizational features of human-ecosystem interaction and concepts of space and time in the understanding of IEK as an emergent property of a complex system. There is also discussion of IEK in terms of resilience and of reflexivity. The paper focuses on the *ecological* issue and political issues such as intellectual property rights and issues of self-determination, while critical and demand attention, are beyond the scope of the discussion.

1.1 Clash between worldviews

There appears to be a significant gap in comprehension between different worldviews. Some indigenous researchers feel that Eurocentric thought 'cannot attempt to capture an incommensurable knowledge system in its web of purposes' (Battiste and Henderson, 2000: 38). Often, the factual aspects of indigenous knowledge are emphasized over the spiritual foundations, worldviews and values of indigenous peoples, and this has not served indigenous peoples nor the environment well - documenting and integrating local knowledge over the last ten years has done little to protect the land from environmental destruction (Simpson, 2001; Lambrou, 1998). Understanding the complexity of indigenous ecological knowledge (IEK) goes far beyond documenting species names, classification systems, the local uses of plants, changing weather and animal migration patterns, *etc.*, conducted via consultation with local community members. This kind of 'directed' consultation usually results in one worldview being

brought under the auspices of another, and in the process the local knowledge is de-contextualized as facts are taken out of context and extracted in a piecemeal fashion.

Essentializing local ecological knowledge presumes that knowledge held collectively in communities can be documented without consideration of how knowledge is a dynamic interplay of a complexity of variables. Essentializing indigenous knowledge systems may be a 'fallacy of misplaced abstraction: the making of intellectual mysteries out of situations and activities whose practical import is obvious to all but the observer' (Richards, 1993, as cited in Hobart, 1993:19).

Another assumption in development ideology is that there will be epistemological compatibility between project participants. Presupposing knowledge compatibility does not acknowledge the complexity of local beliefs, practice and context operative in communities and how this shapes local epistemology, which differs from academic or more abstract ways of engaging with the world. It remains a challenge to develop a 'conceptual symbiosis' (Hornborg, 1994) between all players in a development initiative, be they indigenous community members or western trained academic scholars who have never lived in a small village. There is a need for a new and more complete understanding of local ecological knowledge in its specific context of use. A conceptual framework is needed within which to view local and indigenous ecological knowledge – one that goes beyond the imposition of one worldview upon another and which, instead, transcends ontological and epistemological differences.

1.2 Merging Academic and Indigenous Knowledge

The legacy of Enlightenment is the belief that we can know, understand and make wise choices about how we live on this planet – this 'self confidence' has risen with the exponential growth of scientific knowledge (Wilson, 1998). IEK that is sought after is often compared to standards of academic science so that is becomes something that may be criticized on the basis of its claim to a universal truth (Satterthwaite, 1996). Interpreting IEK as a mode of engagement based on monist ontology and not as knowledge of an objectified 'other', is one way of viewing IEK in its own right, and not as knowledge that requires validation by the standards of western science. Understanding the epistemological basis of IEK is more about knowing *how* rather than knowing *what and why*, the latter, which tends to be the emphasis in western science. The monist approach is the most solid premise for a contextualist position (that which denies the capacity of abstract, totalizing systems - such as academic science and the market - to solve basic problems of survival), and recognizes that local and implicit meanings are the essential components of sustainable livelihoods (Hornborg, 1996). Luhman (cited by Lee, 2000) proposes that nothing exists outside of context, which undermines the conventional subject-object view of reality and no single context can give universal meaning. This relates to different ontologies and epistemologies involved in management, and emphasizes the need for pluralism that promotes the awareness of the legitimacy of the other's perception. With complementarity, there is diversity - each stakeholder is aware that his or her own projection is partial.

Different epistemologies may converge at a similar function, such as sustainable resource use. For example, local community members may practice restraints on resource use for entirely different reasons than academic science might - the violation of religious or social sanctions may be the mechanism for restraint. Recognizing the

difference is critical so that the western system of acquiring scientific knowledge and constructing a version of management is not assumed as a universal epistemology (Funtowicz and Ravetz, 1990).

1.3 Consideration of scale of IEK

Consideration of the spatial and temporal scales of IEK is essential for bridging worldviews. Scale elaborates on contextual features of place as well as the influence of change. Mendoza (2001) skillfully uses Gidden's theory of time-space distanciation to discuss how globalization influences IEK. Mendoza uses the concept of the embedded character of indigenous knowledge as a starting point for examining the condition and study of indigenous knowledge using time-space analysis as developed in Giddens' structuration theory. For example, since the essence of structuration theory is concerned with relating the minute and the large-scale, the short-term and the long-term, presence and absence, it can be applied to local/indigenous knowledge in a global world.

Gidden's theory of time-space distanciation (Giddens, 1984; 1991; 2000), lends insight into the impacts of globalization on small indigenous communities where social activities, once defined by time and place, change and become organized at a level no longer confined to one place and time. The personal conception of place changes from local community to national, to global as people conceive themselves more as part of a global system and less connected to their immediate geographical place. As Mendoza (2000) points out, knowledge is coming from places with different and often incompatible histories. Certain driving mechanisms (which act as 'disembedding' mechanisms) such as introduced practices or the market economy have decreased the total dependence on local resources for subsistence, so the driving force to maintain resource stability is gone. The positive effects of close proximity to resources and the functional knowledge of resources and social cohesiveness, all of which in the past helped in the development of knowledge and institutions eventually become weakened. An example is harvesting the traditional staple crop for custom celebrations at certain times of the year. The change to harvesting an introduced crop throughout the year for a market located at a distant location shows how local knowledge becomes disembedded from place and time. There are several examples, such as this one, where the coordination of social activities and livelihoods becomes displaced from the contextual features of locale, so the associated knowledge becomes more difficult to place in a locality. The consequence is that, in the process of becoming less contextual, knowledge becomes more universal and less relevant to the local ecosystem. This of course has implications for using knowledge in its local context for sustainable ecosystem management. Changes often reflect or cause disruptions so that people's actions and their social systems become detached from the particular condition of ecosystems - in essence, peoples' perception of and relationship to elements in the ecosystem change. This can lead to over-exploitation of resources and contribute to erosion of IEK.

Links to concepts and events outside the local ecosystem become more prominent in people's lives. Some people claim that with these rapid and major changes, local communities were left without sufficient lead-time to amend their age-old coping strategies or to evolve new ones. The resilience of the system is weakened. This process is and has always been ongoing, but it is argued here, that a rapid pace of change, which removes local knowledge from context of place, may mean that traditional knowledge is

disregarded and lost without the chance for useful evolution of knowledge to reflect and be used under new conditions.

1.4 Knowledge as engagement

There are several references in the literature that suggest that knowledge should be considered a form of active engagement, rather than something abstract. Ingold (1992:44), states that humans, as other animals, do not live in a 'permanently suspended condition of contemplative detachment' but are in a mode of *engagement*, rather than a mode of construction. The concept of cognition also recognizes knowledge as action. Cognition, or the 'process of living' (Maturana and Varela, 1987), represents effective action within the ecosystem. Cognition is derived from embodied experience (Preston, 2000) and accounts of knowing must reveal human engagement in a physical environment (Johnson, 1987 cited in Preston, 2000). Human-ecosystem interactions play a role in shaping cognitive activity that in turn shapes knowledge. Understanding knowing and knowledge in these terms then undermines the ascendancy of abstract or universal reason (Ingold, 2000).

Knowledge resides not in the mind, but in the world, and its significance is in its relational context (Ingold, 2000; Borofsky, 1994). People are situated knowers both in relation to our particular biology and in relation to the specifics of the social and cultural context. Feyerabend (1987) distinguishes between two traditions of thought: the *abstract* tradition, corresponding to western scientific epistemology and the *historical* tradition, characteristic of traditional and indigenous societies. The latter epistemology is based on the observer's personal experience with the object: it is concrete rather than abstract and the knowledge is often encoded in the cultural practices of everyday life.

2.0 A conceptual framework for representing IEK

In the conceptual framework, shown in Figure 2, indigenous ecological knowledge is represented as emergent from a complex system which is structured into three subsystems: context, practice and belief (CPB). *Context* portrays the confines of learning due to history (settlement patterns), demographic factors as well as biophysical features of place. Knowledge as *practice* portrays meaningful action[1], through physical interaction and experiential learning. Knowledge as *belief* portrays the influence that spirituality and values have on how people act within their ecosystem. The CPB framework is a heuristic used to represent structure and organization in the complex ecosystem and it represents knowledge as engagement rather than as abstract understanding. The use of the CPB complex as a structure for the epistemology of the local knowledge system is intended to give some order to the myriad of ecosystem variables that influence IEK. It is a complex systems concept that, by understanding the whole, properties emerge that are not evident in the component parts. Indigenous ecological knowledge (shown in the diagram as the blue triangle 'above' the three CPB components) is considered the 'property' that emerges from the interaction of multiple component parts. Structure, (the CPB variables in the socio-ecological complex) and

[1] meaningful actions have relations of meaning to one another, in terms of a cultural system, and one must learn what the action means in order to function and be accepted by a community of practice (Lemke, 1997).

organization (cognitive process by which engagement brings forth reality) are reciprocally inter-related. Changes in structure may influence changes in cognition – changes in cognition also influence changes in structure.

Within a complex systems context, IEK constitutes a metaphorical 'cognized model', which represents context based conceptions of the surrounding environment and provides the basis for praxis in daily life. Cognized models are not designed to conform to the reality of the outsider, but are meant to represent and engagement of people within the ecosystems they participate (Rappaport, 1979).

The conceptual framework also incorporates elements of scale. The spatial dimension of IEK is the holistic, embedded or 'place-based' aspect of knowledge, signifying the situatedness (at any one point in time) within the social, cultural, historical and biophysical aspects of locale or 'place'. The temporal scale of IEK is the change that may occur in any of the CPB variables and the influence this has on emergent IEK. The time scale is also shown in the diagram as the cycle of knowledge acquisition and transfer (shown as the cycle in the centre of the triangle). Both factual (explicit) knowledge and tacit (implicit) knowledge constitute the cognized model.

As the CPB complex changes, in time and space, IEK also changes which, in turn, influences CPB (Figure 2b). The emergent knowledge is shown as displaced from the local ecosystem due to the influence of several driving forces. For example, a component of the belief subsystem is use of specific 'magical' practices to cultivate the traditional crop. This has changed over both time and in space: i.e. there were several practices that were specifically linked to particular times in the year or a person's life, that changed to practices determined by external drivers. The change in the spatial dimension is from practicing traditional forms of cultivation that included worshiping deceased ancestors who resided over gardens, to an introduced belief system that existed outside of locality. The change in both time and space of this component has accelerated the loss of the local knowledge that is associated with traditional forms of spirituality. Traditional beliefs are strongly associated with the relationship to the land and resource base. As local knowledge becomes 'lifted' from local context, it becomes less tacit and experiential and more explicit and factual, influenced more by factors outside the local ecosystem.

The process of reflexivity[2] shown in Figure 2b emerges and influences the knowledge production cycle. Reflexivity, while displacing IEK further towards the explicit or abstract end of the knowledge continuum, is referred to as the 'formalization' of knowledge. It is a process that may become an important, if not critical, process enabling knowledge holders to transcend time and reclaim 'traditional' knowledge that was once used in a specific context and apply it within a new context. Reflexivity may also be considered part of the resilience and adaptive capacity[3] of a community. The concept of reflexivity as introspection may be a means to locate both traditional and contemporary IEK in the current context of ecosystems management.

Re-articulating traditional practices, institutions and associated knowledge so that is has application within a new context is partially the 'process of knowing how we

[2] reflexivity is the use of knowledge of traditional indigenous practices and beliefs used as a constitutive element in the application of knowledge to present circumstances

[3] Adaptive capacity, a vital component of the overall resource base of a society, is the mobilization of an increased level of social resources in response to natural resource scarcities (Ohlsson, 1998; 1999 as cited in Turton, 1999).

know. It is an act of turning back upon ourselves' (Maturana and Varela, 1987:24). The process of being reflexive bridges different contexts (spatial and temporal scales) and allows for a set of beliefs or practices that are embedded in a particular context to be applied in changing contexts.

3.0 Food Insecurity and IEK

In order to illustrate an example of how IEK can be represented and operationalized in a more specific context, a series of interacting variables within the CPB complex are shown in Figure 3. A critical issue and recent phenomenon in both communities of Uzamba and Valapata is food insecurity. The introduced crop (sweet potato) has been widely adopted and has displaced the traditional staple crop (taro), which is now showing decreased productivity. The purpose of the diagram is to visually track reasons for the decline by showing changes in the system as well as impacts to the relations between components within the system. Specific variables are shown that have specific relevance to the issue of food insecurity. The IEK specific to the issue emerges from these variables. Representing IEK surrounding food insecurity in this way both expands upon and compliments the reasons that community members give for the current food crisis. Reasons given for crop decline of the traditional staple are: 1) increased disease (stated by younger community members); and 2) loss of traditions (stated by older community members).

The drivers of this system are roughly divided into three main elements: one is the changed belief system, shown here as introduced religion; the second is the context of changing population demographics, and the third is the recent practice of the adoption of an introduced crop. Looking at the first 'driver', it is evident that introduced religion has had the multiple effects of changing traditional spirituality, changing the traditional education system, encouraging the market economy and increasing the development of plantations. The next driver, population increase, influences the intensification of land, land shortage, the time spent gardening and biophysical constraints. The third driver, the adoption of an introduced crop, influences the decline of the traditional staple, the size of gardens, soil fertility and land intensification. Each of these factors then, in turn, affect other factors, as shown by the myriad of interconnections in the system.

In response to changing socio-ecological conditions (the drivers mentioned above), the system 'moves away' from the original stable operating point, which was the use of the traditional staple crop that supported Vella communities for hundreds of years. In systems terms, a bifurcation point was reached, where a significant change in the original system occurred (decline in traditional staple) before the system began an alternate path and reorganized towards a new self-organizing and resilient operating point (the introduced crop).

In order to describe the system that created conditions for the shift and the characteristics of the system before and after, the diagram should be viewed from the broader context, which illustrates a number of influences acting concurrently. These interactions are explained as follows. Foreign missions and new forms of national governance that encouraged plantation development and formal education, changed the local economy, prohibited custom and thus changed traditional methods of gardening. These factors also created changes in practice, which were an increased demand for

plantation work, resulting in less time spent in the subsistence garden and more time spent earning income. There was also more time spent in church-related activities. Swidden cycles changed to shorter fallows, resulting in intensification of land use and nutrient poor soils. Increasing population along with marginal biophysical conditions that constrain land availability also occurred. At the same time that the productivity of the traditional staple crop was being undermined by increasingly infertile soils, less attention to tending the crop, the disuse of traditional practices, which all resulted in the increase of disease and pests, there was a changing value system from traditional foods to a preference (by the younger generations) for an introduced crop as well as imported foods.

Cultivation of the introduced crop became the norm. There are two positive feedback loops, which maintain this system as dependent on the introduced crop. The first feedback loop is that the introduced crop has lower soil fertility requirements and so shorter fallow periods become the norm so that the cycle of cultivation is increased. The resulting nutrient poor soils (which the traditional staple cannot grow in), can only support the more tolerant introduced crop, thus the cycle is maintained. The second positive feedback loop is where the adoption of the introduced crop accelerates the disuse of traditional cultivation practices, which were necessary to ensure productivity of the traditional crop. If traditional techniques are not used to control disease, then disease incidence increases, which, in turn, has a negative influence on the traditional crop leading to a greater dependence on the introduced crop.

From this diagram it is clear that there is no simple linear cause and effect that links food insecurity solely to disease or loss of traditions. While both of these factors play a significant role in the change process, the relationships are more complex. The approach of looking at multiple variables and their interactions also transcends the conventions of analyzing problems and finding solutions from the separate disciplinary perspectives of sociology, economics and ecology. IEK as emergent from the complex web of interactions highlights knowledge as engagement. It is the unarticulated local knowledge surrounding this resource issue. The conceptualization of local knowledge as emergent from a set of CPB variables replaces the set of issue driven facts that are often sought after by resource managers intent on using local expertise to find direct solutions to problems.

This example also shows that the drivers are relatively new (over the last 100 years) and that a number of significant factors all influence the conditions of engagement so that knowledge is constructed differently than it was in the past. What if the cycle of knowledge acquisition, construction and transmission was not interrupted by globalizing forces operative in these small communities and the traditional knowledge of the staple crop production was maintained and provided more options for agriculture? Here, it is suggested that traditional IEK may have provided resilience to the system (Berkes and Folke, 1998). Disembedding mechanisms (in this case, the influence of the new belief system and the market economy) strengthen links to concepts and events that occur 'outside' the local ecosystem. Thus, for example, the collective ecological memory of older community residents that contributes to resilience within the agricultural system is not utilized and is no longer considered relevant to the current situation. In addition, with rapid and major changes, local communities were left without enough time to change their traditional adaptive strategies or to evolve new ones. Therefore, knowledge systems

influenced more by the traditional systems of practice and belief as well as the historical context (i.e. low population and relative abundance of land) become less relevant, less effective within changing socio-ecological conditions and thus, less useful, especially to younger generations. The result is that the livelihood practices have radically changed, and traditional knowledge is not transmitted through practice as it once was. The traditional knowledge system that might have contributed to a sustainable agricultural system is not being drawn upon.

A more positive outcome of disengagement, however, is the process of reflexivity, the shift from outward action to inward-directed thought (Ingold, 1992). This process of self-referencing is considered here as a pre-condition for knowledge to be more resilient. This has implications for the commensurability of western based, ecosystem management with local/indigenous management. A consistent criticism of attempts to merge western and local/indigenous science is that conceptual and methodological pluralism is too difficult to attain because of epistemological differences. Reflexivity creates the space to step outside the boundaries of the tacit to broaden the realm of knowledge to encompass the abstract. Reflexivity is also a manifestation of the realization of epistemological contingency leading to an understanding of how we may come to know by examining what influences us as knowers.

A new and remodeled ecosystem management paradigm requires that learning over time be a major part of understanding human relationships within ecosystems, much like the adaptive management paradigm. It requires that humans collaborate across political, ecological, and cultural boundaries to reflect the different relationships to ecosystems and different ways that the emergent ecological knowledge systems occur. It requires that western-trained resource managers also be reflexive in examining their own epistemology and how they apply knowledge. Reflexivity requires that epistemological biases are understood and transparent and that there is a critical awareness of the factors influencing their particular ways of engagement. Similarly, for the local/indigenous participant, reflexivity requires that practices and beliefs are interpreted by 'stepping back and looking within' to reformulate situated or traditional tacit practices into the abstract. Knowledge as experience is personal and shaped by a complex of factors, and that which is transferable is created by the listener (Maturana, 1980). That knowledge which is transferable is not first between speaker and listener, but instead occurs first within the speaker her/himself. In the process, knowledge is transformed from tacit-implicit to explicit. Subsequently, through collective discourse, the knowledge becomes part of the system arising from a different set of components of the CBP complex.

4.0 Discussion

The concept of local/indigenous ecological knowledge as a system and deconstructing that system to understand how knowledge is known, influenced and constructed establishes common ground for bridging the epistemological gap that occurs when people with different worldviews are working together on a common issue. 'Sharing knowledge turns out to be astonishingly difficult' (Kaplan and Kaplan, 1982), but challenging dichotomies assists in breaking down the barriers. The perceived dichotomy between 'local' or 'indigenous scientific' and 'western scientific' exists because knowledge of indigenous peoples has been essentialized as a cultural commodity and western science is

grounded in the mistaken belief of universal truth. If the concept of knowledge in all societies is understood by how we know through the mode of engagement within the ecosystem, and not as an objective truth, then there is some common ground to enable multiple perspectives to contribute to ecosystems management, whether on a local, regional, national or even global scale. The dichotomy of absolute vs. culturally constructed knowledge is broken down by the understanding of knowledge as effective action in a world that is constituted by engagement within the ecosystem. This approach based on an awareness of the complexity and variability of epistemology places all knowledge systems within a common conceptual framework for understanding. The recognition that western science may also be constructed based on particulars of context, practice and belief may be a start to more effective integration of both local/indigenous ecological knowledge and 'western science'. Understanding epistemology - how we come to know in our lifelong engagement within our local and global ecosystems - is the basis for a conceptual framework (CPB) that provides a means to seek commensurability among different worldviews and perspectives and bring a more thorough understanding of human-ecosystem interactions.

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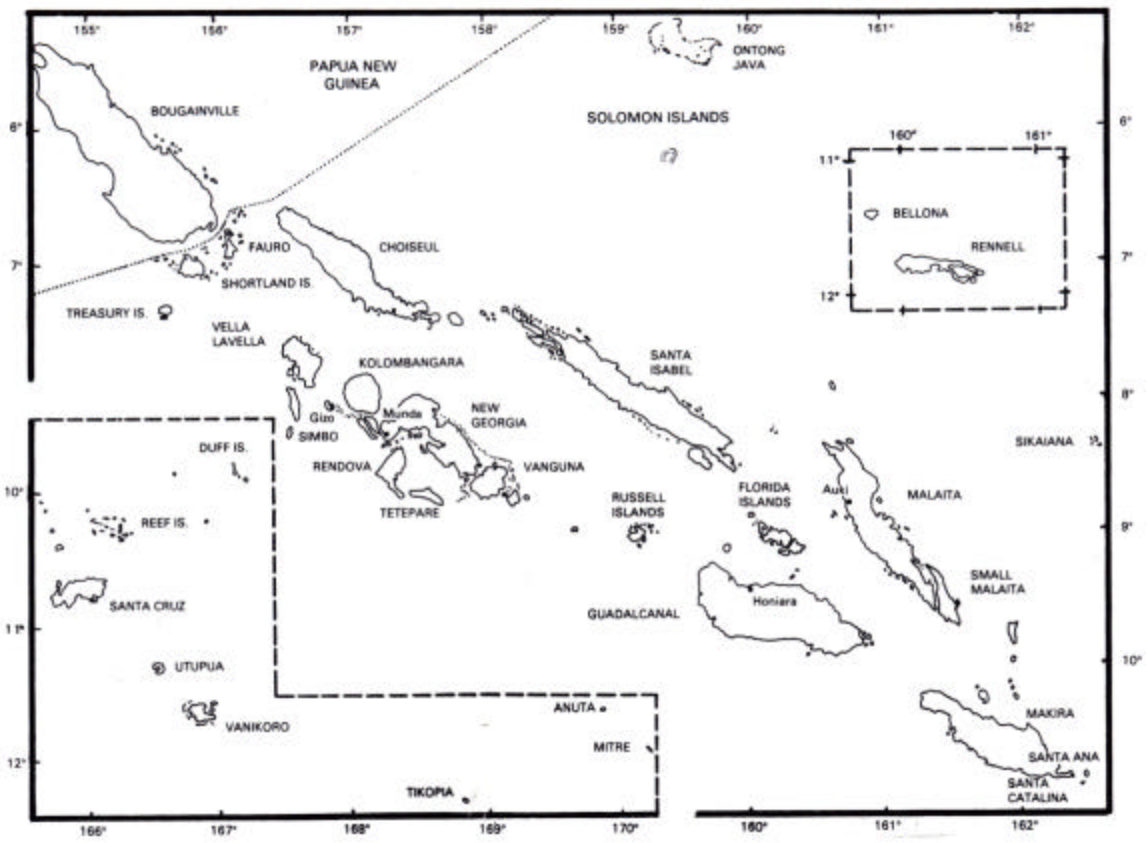
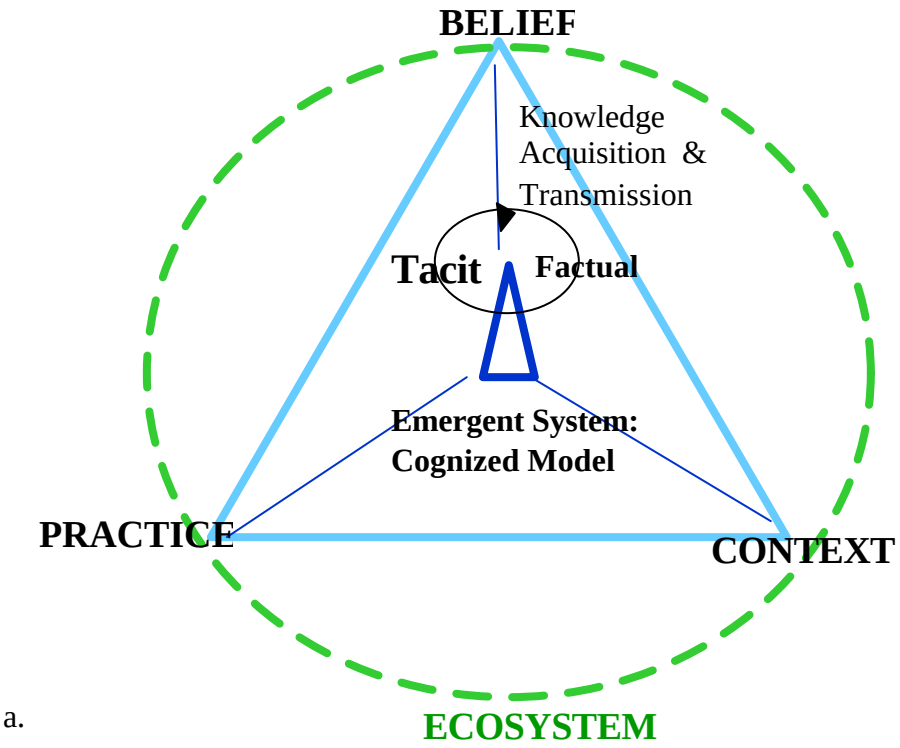
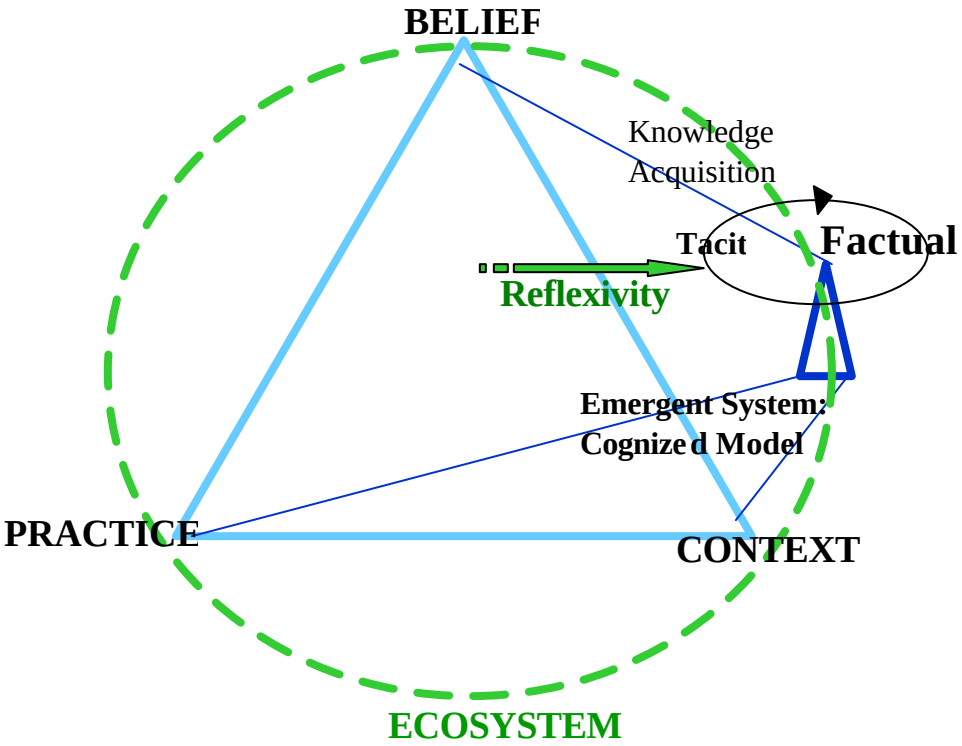


Figure 1. Map of the Solomon Islands. Vella Lavella is located in the Western end of the archipelago.



a.



b.

Figure 2. Conceptual framework showing the emergence of IEK from a traditional system where knowledge is acquired within the local ecosystem (a) shifting to disembedded IEK as knowledge is acquired outside of local ecosystem (b).

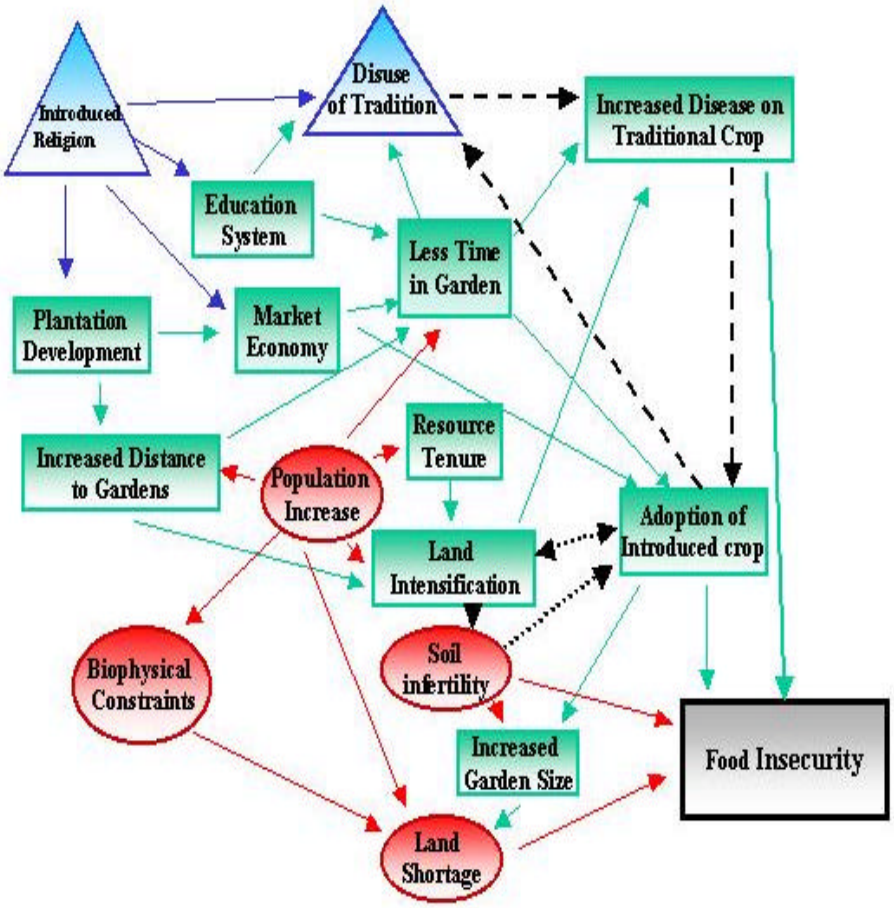


Figure 3. Structural components of the CPB that influence emergent IEK related to food insecurity. (note: red colour indicates components of 'Context"; green is "Practice" and blue is "Belief". Black dashed line show two positive feedback loops).