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Session 7 - A Comparative geographic analysis of the impact of scale on hazards and vulnerability in industrialized continental lands and small pacific islands

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A Comparative Geographic Analysis of the Impact of Scale on Hazards and Vulnerability in Industrialized Continental Lands and Small Pacific Islands

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Abstract

Geography, specifically scale, has significant impacts in terms of hazards and vulnerability. Small islands, such as those found in the Pacific, experience the impacts of their relatively unique geography and scale in terms of hazards and vulnerability in at least five ways: 1) Perception and communication; 2) Impact and escape from impact; 3) Technology; 4) Recovery; and 5) Socio-environmental justice. Comparative analysis in these five areas between the Pacific's small islands and industrialized continental regions illuminates differences regarding the way hazards and vulnerability should be conceptualized in the under-treated small islands of the world. Lessons from this analysis will aid in conceptualization of small island scenarios, as well as lend guidance to those seeking direct intervention regarding technological and natural hazards.

1. Introduction

Heathcote notes the place of drought, a "natural" hazard, in the historical psyche and record of many nations (1969). He states:

> *The first heroic legend, the Epic of Gilgamesh, which dates from the second millenium before Christ, tells how King Gilgamesh of Uruk in Mesopotamia fought with, and defeated, drought in the form of the Bull of Heaven. Written records of drought in China go back at least to 206 B.C., and in Australia there is abundant evidence of droughts both before and after the First Fleet arrived in 1788 (175)* [1].

Traditional categories of natural hazards such as drought, fire, flood, and those of tectonic origin, as well as what are arguably technological hazards in the form of sea level rise linked to climate change, and impacts brought about by invasive species, all produce severe impacts on human and biophysical systems across the globe. Given recent turns in the climate change debate, the traditional lines separating "natural" and technological hazards have become increasingly blurred. For example, drought has existed, depending on definition, widely over history, yet, it is now increasingly linked to climate change. The "blurring" continues, as drought can be defined in terms of precipitation, or a combination of direct measurements, perhaps in combination with other information, resulting in an index score [2]. Or, drought can be declared in terms of impacts on a given locale, which, are to a great extent, determined by the character of the human systems developed there.

There is great discussion being generated in areas such as the climate debate regarding the natural VS. technological nature of hazards such as drought, flooding, sea level rise, etc. However, I argue here that while "on the ground," the discourse revolving around the nexus of hazards-technology-economy-justice-science are not unimportant, or even lost on "victims," they are just not as important as how to adapt. For example, less-wealthy countries such as India might be blamed for high emissions of green house gases, and they might, in return, point to the Northern countries high *per capita* emissions and the unjust nature of consuming such a large portion of the atmospheric commons per person.

"Winning" the argument is important, but can't ease the concerns about sea level rise which worry those in the Maldives (small atolls with a maximum natural height of 2.3 m, or 7½ ft, S.W. of India, where over the last century sea levels have risen 20 cm, or 8 in). What potentially has greater value on the ground are contextualized policies to address hazards utilizing *multi-scale* knowledge of human and biophysical systems. To do such analysis it is helpful to consider some broad impacts of geography, especially scale, on mitigation and adaptation. Here I remain with the small island model, which I contrast to continental scenarios, but I change location to the Federated States of Micronesia (FSM), where I have worked since 2002 [Figure 1].

2. Perception and communication

As Cutter (2004) points out, how we as societies perceive and evaluate risks is a subjective process – and therein lies the contested nature of coping with hazards [3].

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Geography impacts perception and communication regarding hazards in small islands in FSM in ways that, say, a typical hazard relief worker in the U.S., might not anticipate.

FSM represents a typical Pacific small island scenario, as the exclusive economic zone is about 1,000,000 miles, but the land mass is less than the state of Delaware! (One can find other more well-known examples in S.E. Asia, where the Philippines encompasses over 7,000 islands with the approximate land mass of Arizona.) In the U.S., a major concern is the translation of science to hazard policy. In FSM and similar places, the main concerns are whether there is *any* communication that a hazard may be occurring, unscientific perceptions regarding a given hazard's geographic and temporal scope of impact, how to find funds, and how to communicate effectively in multiple languages.

Undoubtedly, continental areas face some of the same barriers to hazard mitigation and adaptation, but they are magnified in the small island world. This is because in a fragmented island environment, working across many small islands, with few appropriate boats and planes, at too great a distance for an effective signal, often without electricity, never mind the Internet, people can remain oblivious to a hazard's potential impact. This impacts both emergency response, as well as setting up programs for adaptation. Small islands often simply do not have the resources to reach out to communities on a village scale in a geographically disconnected nation.

In addition, governance in such settings as FSM is often only effective if driven by village scale, or traditional, leaders [4]. Working with so many leaders at that scale is difficult, especially under time constrains, and particularly for outsiders who are hazards experts from "the mainland," as is said in FSM when referring to the U.S. (or "the states," as is said in the Philippines). Collaboration must take the place of the hammer of federal level (scale) of authority, and it takes significant time to nurture collaboration. At times, national scale laws are not respected in such settings.

When focusing on collaboration for adaptation, the problem might very well be that a grant demands "outputs" from early stages. However, real progress, the kind that sustains after outsiders leave, only is possible once real relationships have been built, and outsiders learn about diverse island cultures, and what technologies can sustain in that fragmented physical, economic and political environment. Sometimes persons might believe that if they recognize or "connect" to some pieces of a given culture that *appears* the same as back home, such as Catholic worship and English being spoken in the Philippines, then they can work effectively in that culture. However, this reflects a naïve view of the role of science across cultures, vested interest, as well as politics. A practical example is a Westerner misreading signals in the Philippines, where a "yes" is not always a "yes," as it can merely be a way avoid rudely say 'no.' You may walk away feeling the mission was accomplished, only to be shocked upon return to see nothing has changed because persons either did not really understand you, did not agree with you, had different priorities, or poor communication precluded the sense of urgency you felt was inherent. These aforementioned examples underscore that communication is different in character and effective scale (i.e. village) in many such settings. This may be seen as supporting a role for regional and cultural specialists in what are normally technical endeavors for "scientists."

3. Impact and escape from impact

There are perhaps fewer nuances to the next point, but it is also essential to understand in terms of seeking mitigation and adaptation. Simply put, there is physically less room for mistakes on small islands, less room and diversity of topography, climate, and biogeography to escape to, and far further and more expensive to go to seek assistance in dealing with hazards. (Remoteness may also result in lack of essential data.)

In small islands of less than, say, a square mile, there is literally nowhere to relocate to if a place becomes inhabitable. Persons must continue to live in the hazardous moment, not retreat to let the experts in. Consider the case of Hurricane Katrina and its attending floods in the U.S., where, despite many botched attempts to plan for, and then cope with, the crisis, many persons were able to evacuate to Houston and other cities by car. In contrast, most people in small islands can often do is to seek higher ground or wetter or drier parts of a given island, and this is not much of an option in low islands. Going back to the example of the Maldives, a group of low islands, tsunami impacts in 2004 pushed the ocean on top of many islands, physically remaking them. Thus, in seeking mitigation and adaptation, the barrier of moving across long distances by boat, perhaps by air with aid, likely in the throws of a given hazard with the population unable to move away, represents significant barriers not normally faced in continental settings.

4. Technology

Much hazard mitigation may require implementation of technology. These technologies may simplified for the purposes of this discussion by dividing them into long and short-term technological interventions. Of course, the discussion is truncated in this case. I focus here mainly on technologies that seek to provide long-term contributions to coping with hazards and helping populations to adapt.

Long-term technologies are those which must sustain (often self-sustain)in the physical, economic, and political climate of a given region for significant time. An example from my own research is the effort to mitigate waterborne disease. In many wealthier continental settings centralized water purification systems are able to stretch across significant space to provide safe drinking water. Such systems may be more or less expensive depending on factors such as economies of scale and the nature of the distribution network, ground water (less treatment may be needed) VS. surface water, local and federal treatment standards, etc. Effective treatment of water, as well as establishment of an effective sewage network can support environmental health and prevent disease outbreaks.

However, in small island settings, the fragmented geographic setting precludes centralized approaches [Figure 2]. In addition, while the islands may be small, the population density may be intense for historical reasons. In fact, it may be more dense than statistics convey, as per square mile measurements, for example, do not mean much when the island is less than a sq. mi. and the inhabitants squeeze along the coast against steep slopes [Table 1]. How does one stretch distribution pipes from a centralized water system across the water? The question is practically rhetorical. However, some attempts have been tried, and failed, such as in the Philippines [5]. And, if only some islands can get the expensive centralized system, then which one(s) should get it?! My experience is that the place where government officials and/or tourists stay is likely to receive the potential benefit.

Small island economies also play a role in determining what is possible. For instance, consider FSM, where unemployment rates vary significantly (though the usefulness of the term "employment" where a "subsistence" lifestyle is prevalent is dubious), from 4.1 percent in Yap, to 12.3 in Pohnpei and 16.5 in Kosrae, to 34.2 percent for Chuuk. Of nearly 29,000 employed persons in 2000, 52 percent were engaged in agricultural, fishery, or "related" activities. Some 30 percent were engaged in market-oriented agricultural, fishing, or related activities, with the rest existing in a subsistence lifestyle [6 & 7] [Figures 3].

These factors, in combination with the aforementioned dominance of village and family-scale governance on an island-by-island basis, form a gestalt, so that centralized technologies and mandates assumed to trickle down from the federal scale are effectively neutered. I argue that what is called for are long-term relationships between multiple scales of governance and outside hazards specialists, ones not created with a national government when crisis occurs. Additionally, small, decentralized technologies, especially those using native products such as local sand, may be best suited in collaborating with locals to find physically, economically and politically sustainable technologies. Small may not only be "beautiful," but may also be more affordable, easier to run and fix, and distributed in a more geographically equitable fashion [8 & 9]!

5. Recovery

The last three places settled on earth were likely Micronesia, Polynesia and New Zealand [10, 11, 12 & 13]. This speaks to the remoteness of Pacific small islands. This also provides perspective regarding the challenge to outside experts and governments to assist with recovery efforts after populations have been impacted by hazards.

While networks such as the Pacific Tsunami Warning Center [14] have great scientific value, provide important warnings to countries all around the Pacific (including the U.S. state of Hawai`i, where it is based), there is real doubt whether the lives saved by it outside the wealthier world are sufficient. For example, just recently the Solomon Islands lost many lives due to a Tsunami. The scientific data may have been collected, and important warning information might have been mapped on the Internet, but many people lost their lives just the same. This is in part because the message did not arrive where it was needed most, and in part because immediate response and recovery efforts are difficult in a far-flung group of islands such as the Solomons.

Contrast this 2007 Solomons disaster to the 9-11 experience in the U.S., where, in just moments after a major incident, jet planes were in the air, Internet, radio and television were providing coverage of events in real time, and fire, police and other services were mobilized. Warnings aside, the response from local and adjoining areas was rapid and extensive, and was underlain by transportation technologies, relative location, and economic strength. In the U.S., even single lost boater can trigger massive Coast Guard search and rescue missions.

6. Socio-environmental justice

The nexus of hazards, class, and geography widely manifests inequities in terms of vulnerability. This is observed in the continental U.S., where, for example, Bullard's salient work [15] produced evidence of racism in hazard management. For small islands, a new issue has emerged as a core concern, with strong elements of justice to consider. Small islands, which produce little green house gas, nevertheless, are most vulnerable to sea level rise, drought, and increased storm intensity being linked to global warming. These three hazards can lead to salinization of soil and degradation of very shallow freshwater lenses, as well as the physical destruction of countries. Of course, this contrast of continental and small island conditions is a generalization, and so exceptions, such as the vulnerable coastal regions of Bangladesh, are worth noting.

Nevertheless, if one is willing to accept that *at least*, global warming is being enhanced by modern industrial practices, then it follows that a systematic enhancement of small island vulnerability is underway that is driven as much by the political economy paradigm of the wealthy, as by nature and geography. This forms a sort of hydrologic extension to the concept of "Third World dumping." [16]

When small island geography, natural threats, and this new political economy of climate change converge to form a sort of "perfect storm," the synergistic effects result in an enhanced difference in vulnerability between industrialized continental and small island nations. Perhaps a bit of a stretch to use the term "unpacking," to refer to the pulling apart of differences in vulnerability to recognize the equally important roles of political economy, science, technology, and culture. Nevertheless, I argue that once one unpacks the condition of vulnerability on small islands today, it becomes apparent that there are as many salient questions pertaining to social and environmental justice, as there are regarding "appropriate technologies," science, island geography and hazard policy. An examination of official documents from the Small Island Developing States Network Web site offers a plethora of case studies and policy frameworks that underscore this point. [17 & 18]

7. Conclusion

Geography, both physical and cultural, provides a backdrop to any useful examination of small island hazards and vulnerability. Scale, more predictably in terms of biophysical systems, and perhaps less intuitively in terms of village VS. macro governmental systems, represents a core set of issues to consider in attempting to translate lessons learned in hazard and vulnerability mitigation in wealthy continental areas to small island worlds. Those outside the small island community wishing to engage in hazard mitigation in the small island environment must do more than understand "cutting-edge" science and technology to succeed. Rather, such persons must come to grips with the unique geography of small islands, so that they can put their knowledge in the proper multi-scale context and forge sustainable collaborations.

8. Acknowledgements

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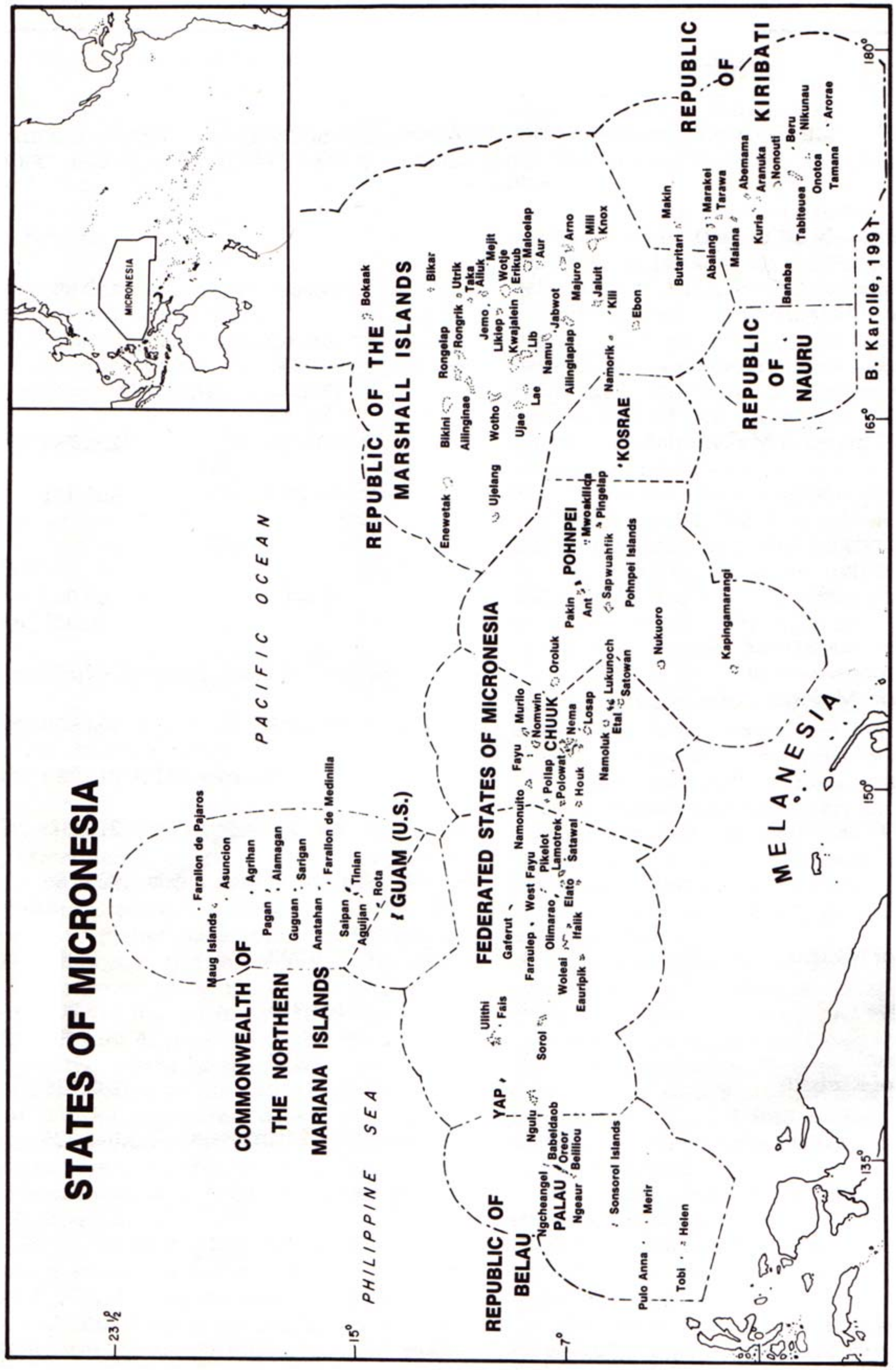
Table 1. Population density for FSM: 1994 and 2000 (*Source*: Calculated from data from the Division of Statistics, FSM 2002).

1994						2000				
Attributes	Total	Yap	Chuuk	Pohnpei	Kosrae	Total	Yap	Chuuk	Pohnpei	Kosrae
Population	105,506	11,178	53,319	33,692	7,317	107,008	11,241	53,595	34,486	7,686
Land area (in sq. km)	702	119	127	342	111	--	--	--	--	--
Land area (in sq. mi)	271	46	49	132	43	--	--	--	--	--
Density (per sq. km)	150	94	420	99	66	152	94	422	101	69
Denisty (per sq. mi)	389	243	1,088	255	170	395	244	1,094	261	179



STATES OF MICRONESIA
COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS
GUAM (U.S.)
FEDERATED STATES OF MICRONESIA
REPUBLIC OF BELAU
REPUBLIC OF THE MARSHALL ISLANDS
REPUBLIC OF KIRIBATI
REPUBLIC OF NAURU
YAP
CHUUK
POHNPEI
KOSRAE
PALAU
PACIFIC OCEAN
PHILIPPINE SEA
MELANESIA
MICRONESIA
B. Karolle, 1991

Figure 1.

Micronesian EEZ. (Karolle 1993.)

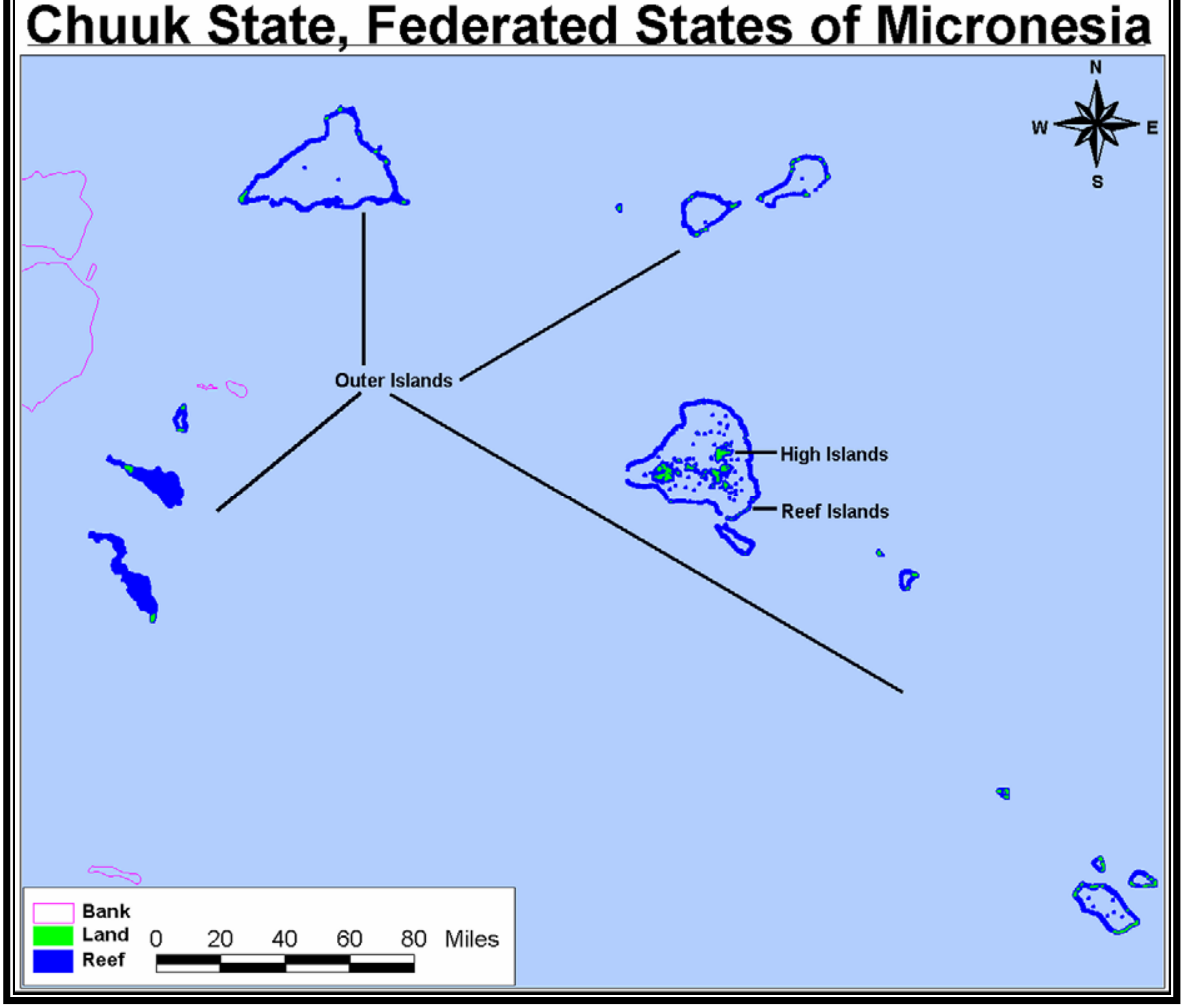


Figure 2. Chuuk State (80 mi = 129 km).

Figure 3. Fefan, Chuuk, FSM. Upper left a northeast view of Fefan from Southern Weno. Upper right northwest coast including study area of the Island of Fefan. Lower left study basin including villages of Onongoch, Fein & Fogen. Lower right a study basin home.