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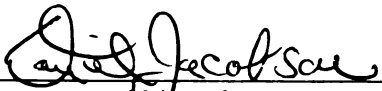
Incorporation of High-Protein, Endemic Cultigens in the
Economic Formal Sector of Ecuador

presented by

Sandra Hernandez

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INCORPORATION OF HIGH-PROTEIN, ENDEMIC CULTIGENS IN
THE ECONOMIC FORMAL SECTOR OF ECUADOR

By

Sandra Hernandez

A DISSERTATION

Submitted to
Michigan State University
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DOCTOR OF PHILOSOPHY

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1987

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ABSTRACT

INCORPORATION OF HIGH-PROTEIN, ENDEMIC CULTIGENS IN THE ECONOMIC FORMAL SECTOR OF ECUADOR

By

Sandra Hernandez

The incorporation of high-protein endemic cultigens within the economic formal sector of Ecuador requires the use of several types of knowledge by persons in both the formal and informal sectors of the nation. The international scientific research community provides much of the knowledge used by developing nations to enhance their research. Both the international and national research communities recognize the need to expand production and increase utilization of food crops that are able to provide guaranteed yields in a variety of environmental conditions ranging from favorable to harsh. There is, however, a considerable lag from the time that the international research community becomes aware of endemic food crops that grow well in harsh environments and the incorporation of high protein endemic cultigens by the economic formal sector.

It is hypothesized that increased knowledge of and research by the international scientific community on high protein endemic cultigens will lead to greater national research, higher production

and marketing of these food sources, in the formal sector of Ecuador, in the future. In order to test this hypothesis, research for this dissertation uses the Delphi method, which is a forecasting technique, participant observation and library/archival research. A procedure for measurement and analysis is applied, aided by quantitative data as well as qualitative information.

The results indicate that the greater the knowledge of high-protein endemic cultigens by the international scientific research community the greater is the likelihood that national research, production and marketing of high protein endemic cultigens may increase in developing countries. This is consistent with the results obtained for Ecuador. Concomitant developments indicate these crops are increasingly being incorporated by the economic formal sector, particularly the crop under study, known as quinoa. These observations and results support the stated hypothesis.

As a result, key recommendations to facilitate national planning policy for the incorporation high protein endemic cultigens into the economic formal sector in Ecuador are: the development of a quinoa board; a mass media campaign directed at the highland population, both indigenous and creole; and a persuasive communications campaign directed at national and international institutional elites.

To Mohamed Bedair Al-Eraky
With All My Love

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To my committee Dr. Daniel Jacobson of Geography, Dr. Kim A. Wilson of the Institute of International Agriculture, Dr. Carl Goldschmidt, Director of the Multidisciplinary Program, and Dr. Gonzalo Soruco of Communications, who all came to share in the quinoa madness. A special note of thanks to Dr. Allan Rahn of Animal Science who showed me how to apply a linear programming computer routine to quinoa valuation in corn-soy based feeds.

To my Mother for her understanding.

To the Quichua of highland Ecuador who first showed me Quinoa.

It is the essence
of genius to make
use of the
simplest ideas.

Charles Pierre Peguy

Table of Contents

	Page
List of Tables.....	x
List of Figures.....	xii
 CHAPTER	
I. Introduction.....	1
Geography and Demography of Ecuador.....	1
The Informal Sector.....	4
Background of the Problem.....	6
Statement of the Problem.....	7
Purpose of the Study.....	8
Questions Investigated.....	9
Scope and Limitations of the Study.....	10
Summary.....	11
Research Related to HPEC's.....	14
Problem-Solving Research.....	17
Types of Knowledge.....	22
Research Philosophy.....	25
Colonial Period.....	26
Overview of the Study.....	28
II Literature Review.....	30
Nutritional Value of Quinoa.....	33
Natural Environment: The Highlands.....	39
Endemic Disease, Epidemics, & Migration.....	41
National Plan for Ecuador 1980-1984.....	45
Urbanism.....	49
Summary.....	51
III Research Methods.....	52
A. Introduction.....	52
B. 1. The Delphi Technique: Overview.....	56
2. The Empirical Model.....	60

3. Hypotheses.....	61
4. The Model.....	62
5. The Sample Design.....	62
6. The Data Collection Instrument: The Questionnaire.....	63
7. The Statistical Analysis.....	67
a. Data Analysis Approach.....	67
b. Regression by OLS Method.....	67
C. 1. Participant Observation: Overview.....	69
2. The Sample.....	70
3. Participant Observation: Another Information Technique.....	71
D. Library/Archival Research.....	72
E. Summary.....	72
IV Results and Discussion.....	73
A. Introduction.....	73
B. The Delphi Technique: The Questionnaire.....	73
1. Biodata Profile.....	73
2. Grain Preference.....	73
3. General Knowledge of HPEC's.....	74
C. Participant Observation.....	87
D. Library and Archival Research.....	96
E. Discussion.....	103
V Summary, conclusions, and suggestions for further research.....	111
Summary.....	111
Planning and Power: Prescriptive Recommendations.....	112
Market Potential: Agro-Chemical and Agro-Industrial.....	117
Conclusions.....	121
Communications and Planning.....	122
Suggestions for Further Studies.....	125
Appendices	
A. Quinoa: Agronomic and Chemical Characteristics.....	127
B. Review of the Colonial Period.....	138
C. Questionnaire.....	155
D. Data Tables.....	161
E. Quinoa Valuation.....	171
Bibliography.....	172

List of Tables

Table	Page
2.1 Nutritional Analysis Comparisons (%).....	35
2.2 Essential Amino Acid Pattern (g/16g N) of Quinoa Compared to Wheat, Soy, and FAD Reference Pattern for Evaluating Proteins.....	35
2.3 Comparative Mineral Values of Selected Cereals Per 100 Grams of Weight.....	36
2.4 Average Daily Caloric Intake: Highland Population.....	38
4.1 Profile of the Delphi Respondents.....	75
4.2 The Association Between Grain Preference and Knowledge Indices (Correlation Coefficient).....	77
4.3 Estimates of Multiple Regression (ECI) Equation.....	79
4.4 Estimates of Multiple Regression (QKI) Equation.....	81
4.5 Estimates of Multiple Regression (QRI) Equation.....	82
4.6 Estimates of Multiple Regression (QEI) Equation.....	84
4.7 Summary of Probabilities-Tables 4.3-4.6.....	86
4.8 Visits to Formal Agencies-Ecuador.....	91
4.9 Site Observations-Sierra.....	92
4.10 Visits to the Highland Markets of Ecuador.....	93

Table	Page
4.11 Exchange Rates in Ecuador 1981-1987.....	95
4.12 Price of Quinoa in US Dollars 1981-1986.....	96
A.1 1983 Crop Losses in Bolivia and Peru due to drought (As of June 30, with 1982-1983 season completed.).....	135
D.1 Estimates of Environmental Knowledge.....	161
D.2 Estimates of Quinoa Knowledge.....	162
D.3 Estimates of Personal Preference and QKI.....	163
D.4 Estimates of Personal Preference and QRI.....	165
D.5 Estimates of Personal Preference and ECI.....	167
D.6 Estimates of Personal Preference and QEI.....	169
E.1 Quinoa Valuation in Corn-Soy Based Layer Feeds.....	171

List of Figures

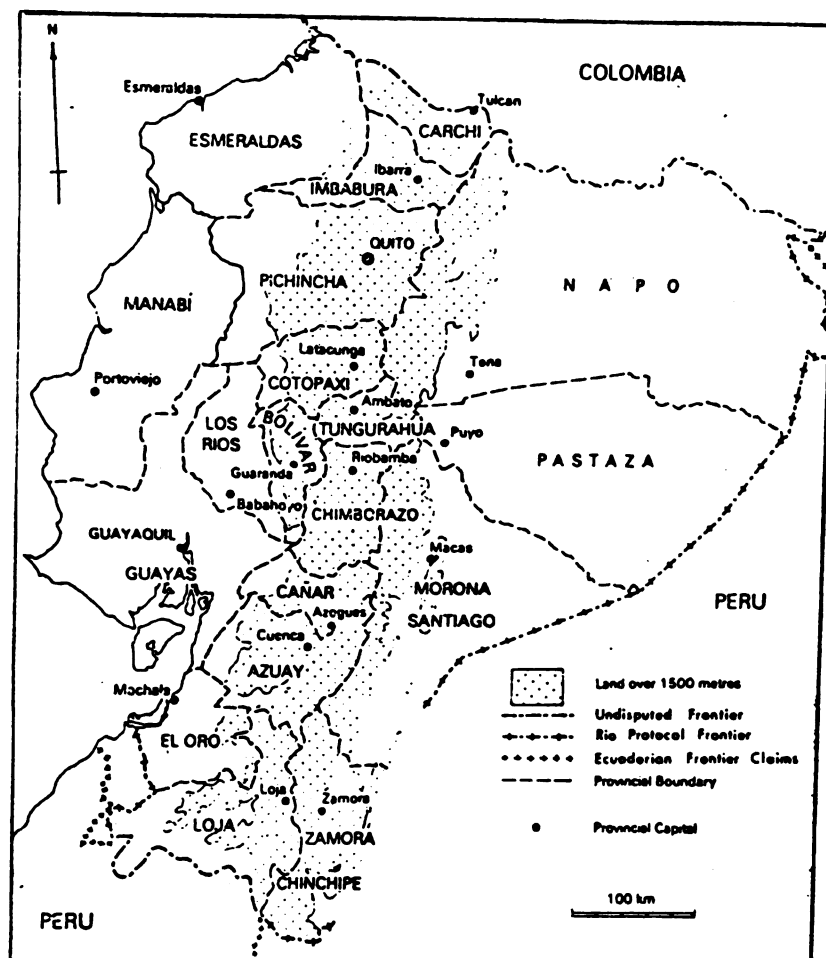
Figure	Page
1.1 Ecuador's Mainland Provinces and Provincial Capitals.....	2
1.2 Indian Population: Highlands.....	13
2.1 Ecuador in the Inca Empire.....	32
2.2 Agro-administrative Centers: Ecuadorian Highlands.....	44
3.1 Quinoa in the Informal Sector: Ecuadorian Highlands.....	53
A.1 Quinoa in Flower.....	128
A.2 Vilcanota, Peru.....	131

CHAPTER I

Introduction

Geography and Demography of Ecuador

Ecuador is a small Latin American country on the west coast of South America and lies on the equator (Figure 1.1). At 1 S, the Andes mountains have been compressed to a width of no more than 81 miles (130 kilometers), and at their broadest point, they are only 137 miles (220 kilometers), wide in Ecuador (Basile, 1974:5). In 1950, the majority of the population of 3,100,000 inhabitants (60 percent) of the population, lived in the Sierra, the central region of the country. By 1972, when Ecuador's population was 6,600,000, 49.2 percent were in the Coastal areas and 48.4 percent in the Sierra (Basile, 1974:32). The population in 1975 was 7,090,000. No estimates were given for the Sierra or Coastal regions (Berelson, Parker, and Segal, 1980:94). The population was growing at 2.4 percent per annum. Comparable national figures obtained from the World Bank in 1980 gave a 3.3 percent annual population growth rate. In 1984 the United States Department of State indicated that the 1983 population of Ecuador was 8.7 million with an annual growth rate of 2.9 percent.



ECUADOR'S MAINLAND PROVINCES AND PROVINCIAL CAPITALS

Figure 1.1

The indigenous population of Ecuador once was part of the northernmost extension of the Inca Empire. During the sixteenth (1528) century Ecuador was conquered by Francisco Pizarro for Spain, thus becoming part of the Spanish colonial empire. Benalcazar founded Quito in 1534. Ecuador obtained independence from Spain in the nineteenth century. Appendix B contains more material on the colonial history of Ecuador.

Bias against the indigenous population is also an important factor that should be examined in the communications discussion and strategy. Bias is a systematic tendency to deviate from the "true" value in one direction (Simon, J.L., 1969:83-84;274). In 1830, the first constitution of Ecuador called the Indians "una raza abyecta y miserable" (an abject and miserable race), and though the words are no longer official, the sentiment remains. Vast segments of the population devoutly believe that Indians are inferior (Dorfman, A., 1984:12).

The current racial composition of Ecuador is complex. Estimates of the percentage of the indigenous population range from 25 percent (U.S. Department of State, 1984) to 70 percent. In crude genetic terms, the Ecuadorian population is probably about 70 percent Indian, 25 percent Caucasian, and 5 percent Negro (Browley, R.J., 1978:36). However, the estimation of the indigenous population is not solely determined by genetics. This is one of the reasons for the variation in the estimation of the indigenous population. It is necessary to establish the number of autochthonous inhabitants for several reasons. First, the determination of the native population affects the interpretation of data and concomitant policy decisions of the the national government. Despite governmental pronouncements directed at

improving conditions in the rural sector, these are at best hypocritical statements. Given the variation that exists in the population data, it is difficult to determine how the government defines terms such as rural, peasant, or indigenous. Second, a related issue is the shift in terminology between Indian and peasant. A peasant is usually a person of mixed blood, both Indian and European. The term mestizo is often used interchangeably with peasant. The term peasant, however, does not appear to have the same negative connotation that Indian does. Therefore, by using the term peasant, the indigenous issue is avoided. It is difficult to establish the intent for alternate uses of vocabulary, as it would appear to be a minor point. Differences, by researchers, in definition of population subgroups render subsequent research difficult.

The Informal Sector

In the highlands of Ecuador, the geographical focus of this study, the primary participants in the informal sector are those of the indigenous population. The informal sector is so named because it does not have formal relationships with government, with banking systems, or with large commercial and industrial enterprises. The sector is characterized by ease of entry, reliance on indigenous resources, family ownership, small-scale operation, labor-intensive and adapted technology, skills acquired outside the formal school system, and unregulated competitive markets (I.L.O., 1972; Sinclair, S.W., 1978 in Rhoda, R., 1982:122).

The wide use of the concept of the "informal sector" in the recent development literature has resulted in great confusion as to

what is actually meant by "informal" employment and earnings opportunities. For instance, the concept has, at different times, been regarded as synonymous with the urban poor, with people living in slums and squatter settlements, or with people engaged in socially disapproved informal activities whose marginal productivity is low (Editorial: The informal sector and marginal groups, 1973 in Abdel-Fadil, 1983:1). The literature also highlights a tendency to identify the informal sector with the migrant population in the cities, since there is a high correlation with between migrants on the one hand and urban poverty, underemployment, slum areas, etc., on the other (Sethuraman, S.V., 1976 in Abdel-Fadil, 1983:1). A major feature of the informal sector is that it also consists of those commodities for which inadequate or no official government data exist. HPEC's are characteristic commodities of for which data are usually totally absent. Therefore, data from this sector are often not included in national or international statistical reporting (Bor, W., 1982:29; FAO Agricultural Year Book; Hernandez, S., Field notes, 1977, 1982; World Bank Report, 1979; Rhoda, R., 1982:122).

Although conceptualizations of the informal sector vary widely, all place emphasis on socio-economic dualism in the urban economy, thus joining a long line of theories which recognize duality of economic structure in the growing cities of developing countries (Moser, C., 1978 in Abdel-Fadil, 1983:2). As a result of a division between the informal and the formal sector of the national economy, a division also exists between a formal and an informal agricultural economy. The informal agricultural economy has the same characteristics as the informal sector. The informal agricultural

economy forms a subsector of the informal sector. The literature also refers to the Ecuadorian dual economy. The informal sector, however, as characterized here is more specific with regard to its participants and their agricultural production, the informal agricultural sector.

Background of the Problem

Worldwide concern to ensure a reliable source of high quality non-animal protein, has created a renewed interest in high protein endemic cultigens (hereafter referred to as HPEC's) by the international scientific community. "Malnutrition, hunger, starvation, and famine are concerns of many today. Academics, political leaders, administrators, and other professionals have been paying more attention to these problems in recent years than they did in the past. For individual governments and the world community at large, the magnitude of these problems, hunger, starvation and famine has become a matter of embarrassment" (Alsudery, A., 1985:71).

Many crops are important commercially only because of the efforts of "crop champions", people who dedicate their talents, energies, and emotions to advancing them. With underdeveloped crops, such as HPEC's, huge advances can be made by such individuals (Vietmeyer, N.D., 1986:1381). For example, research is currently being conducted in a variety of agronomic areas on quinoa, amaranth, and lupines, which are food crops of the High Andes (3,000-4,500m) that received only intermittent attention in the past 50 years. High protein endemic cultigens are crops primarily grown and consumed within the informal sector of the Andean economy.

A major implication of this renewed research activity (Daley, 1982;1984) by the international scientific community, is its potential

stimulus for the national and local planners to recognize the importance of including data on HPEC's in the agricultural projections which form part of the national plan. In order to respond to the implications of concurrent research in agronomy, national planners should therefore include primary data on HPEC's in the formulation and projection of national development plans. Policy and planning problems have plagued the food and formal agricultural sector at national, regional, and international levels. The food sector has been neglected in public sector resource allocation (Alsudery, A., 1985:75; World Bank, 1979). To increase awareness of the need for government officials to collect and use these data, requires promotional activities directed at both public and private sector decision-makers.

Statement of the Problem

The research problem in this study is how to focus attention on quinoa and other high protein endemic cultigens (HPEC's), and to relate knowledge about these crops, to incorporate them into the formal agricultural sector. General lack of knowledge and information about its own traditional agricultural potential for expansion is keeping Ecuador increasingly dependent on other nations to provide it with food. Traditional knowledge has been viewed in several ways: as part of a romantic past, as the major obstacle to development, as a non-issue, as a necessary starting point, and as a critical component of a cultural component of a cultural alternative to modernization. Only very rarely, however, is traditional knowledge treated as knowledge per se in the mainstream of the agricultural development literature, as knowledge that contributes to our understanding of

agricultural production and the maintenance and use of environmental systems. "The discounting of the practical value of traditional knowledge is rather astounding given its performance over the long sweep of human evolution" (Norgaard, R.B., 1984:874). To reiterate, an important aspect of this study is to evaluate if recognition of the utility of HPEC's, by the power brokers in the formal economic sector of Ecuador and the international scientific community, can set the base for long-term job generation in the emerging technological and industrial sector of Ecuador.

Continued disregard due to a lack of awareness of HPEC's by the participants of the Ecuadorian formal economy and the international research community will create greater dependence on food and grain imports which will reduce the portion of the national budget available for other needs. Incorporation of HPEC's into the economic formal sector of Ecuador would contribute to and expand national agricultural production. In the long run, dependency on imported agricultural commodities should gradually decrease. If these crops are not incorporated there will be increased national expenditure for imported agricultural commodities.

The development of a persuasive strategy directed at the power behind the formal sector will be recommended to facilitate the incorporation of HPEC's into the formal economic sector of Ecuador.

Purpose of the Study

In order to determine what effect the perspective of the international scientific community may have on the research and planning of third world nations, a survey was conducted using the Delphi technique. It is assumed that the perspective of experts in

the international scientific community may influence both research and planning in developing nations. This in turn may directly affect agricultural policy and, by extension, the use of HPEC's as a commodity in the economic formal sector of Ecuador.

Questions Investigated

As a result of the Delphi survey in conjunction with participant observation field work in Ecuador, the following questions are addressed:

1. Do the perspectives of the international scientific community influence research and agricultural policy in Ecuador?
2. Does lack of knowledge of HPEC's by the international scientific community negatively influence national research initiative directed to HPEC's?
3. Will awareness of HPEC's by the international scientific community stimulate further research on these commodities in Ecuador?
4. What are the salient characteristics of HPEC's according to the international research community?
5. Will consensus among the international research community eventually contribute to an increase in use of quinoa and other HPEC's in the world market?

In the past, there has not been an attempt to identify how the perspectives of the international scientific community may affect agricultural research and planning in a developing nation with present-day, nonexport crops. Such research has been conducted on export crops such as wheat and rice.

Scope and Limitations of the Study

The purpose of planning is to rationalize the activities on which planning is imposed, to make subject to calculation that which was previously left to chance, and to replace spontaneous adjustment by deliberate control. Within the area of social services, planning has emerged as a tool of policy determination in countries which differ widely, not only in stages of economic development but also in particular economic and social systems (Navarro, 1970:386-394).

The value of this study is that it will identify how the perspectives of an international elite (the scientific community) may affect future research and planning in developing nations, with special reference to Ecuador. The study will recommend workable projects and agencies that may be more effective in incorporating HPEC's in Ecuador. Many nations with faltering and radical fluctuation in agricultural production also have agricultural commodities that are not incorporated into their formal economies. A study of this type examines the use of local endemic cultigens within the specific context, internal and international, of the nation. This allows for the determination of the specific agricultural demand of the country to be addressed based on national needs.

A limitation of this study is the data base extant on Ecuador. Data collection, processing and distribution by the public sector in Ecuador is to considerable degree an uncoordinated and spontaneous activity. There is little exchange of information among entities and even technical data or reports are often arbitrarily classified as restricted, which prevents the institution itself from fully utilizing the information. There are no consistent criteria for classifying data among administrative entities or, in some cases, within entities.

The Ministry of Agriculture is a prime example of some deficiencies in the information system of public entities. The information on production of 50 crops by the Ministry's Department of Agricultural Estimates are based on subjective estimates made by extension agents. At the same time other dependencies have their own statistics: the National Rice and Corn Program collects data on those two crops; the National Grain Program does sample surveys of wheat production; the National Banana and Tropical Fruit Program collects information on bananas, etc. As a result data on production, cultivated area, and so on, often differ and government authorities must operate without reliable information on this crucial sector (World Bank, 1979:295).

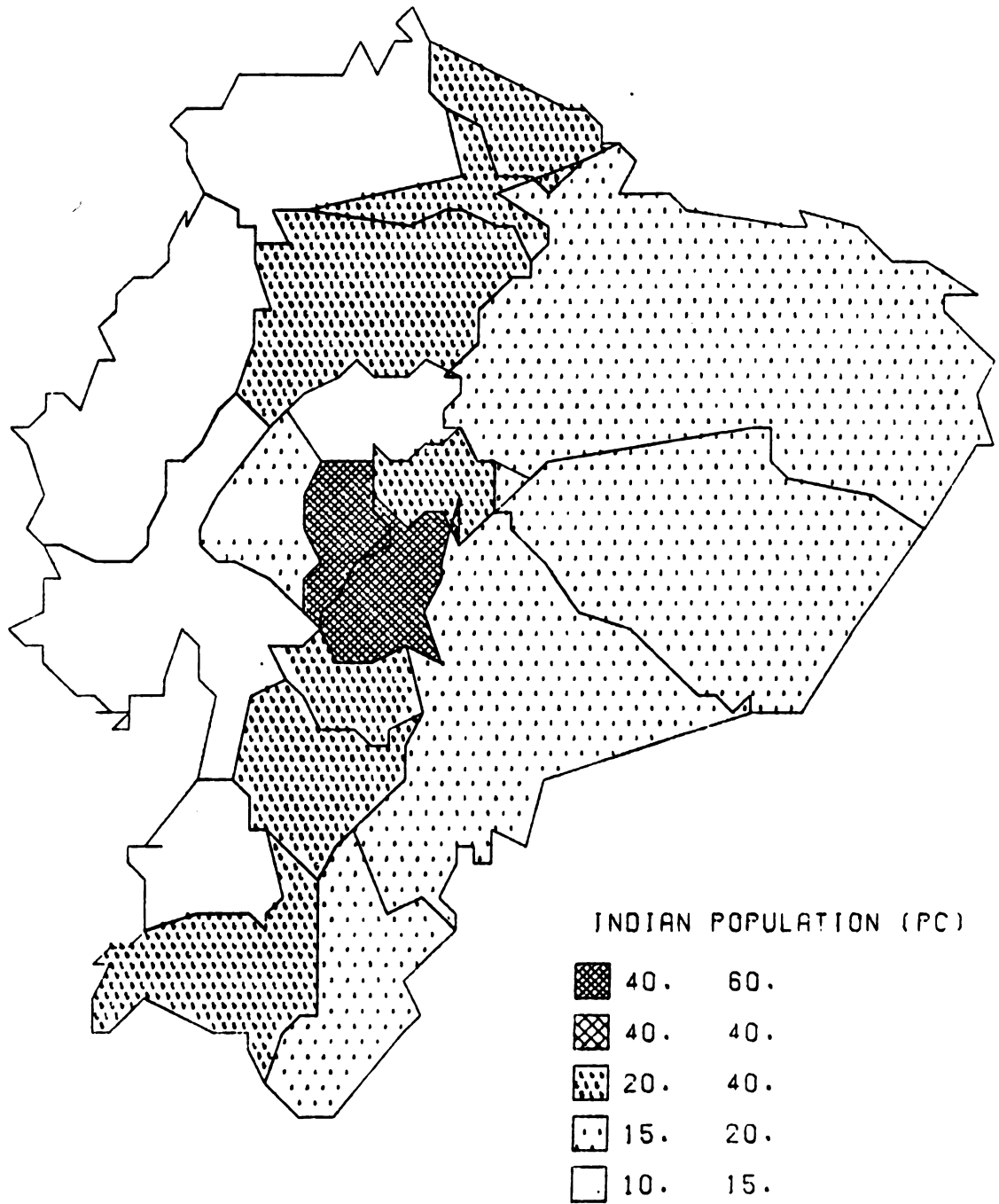
The formulation of a communications strategy aimed at key decision makers, national and international, will be recommended. This is based on the assumption that policy makers, national and international, are insufficiently aware of the importance of HPEC's and their relationship to the immediate and future agricultural needs of the country.

Summary

The purpose of this study is to develop and recommend a structural communication strategy that will acknowledge and incorporate information (knowledge of HPEC's) derived from the informal sector (economy) of the highland Indian population into the national development plan, the formal sector. Additionally, a set of decision rules for such an incorporation will be prescribed.

Successful articulation and implementation of a communication strategy requires providing national planners with technological

expertise and an intimate knowledge of the availability, accessibility, agronomic value and belief systems associated with endemic cultigens among the target populations. The principal target populations are: the Indian (Quechua), (Fig. 1.2) and the Mestizo highland population. The concentrations of Indians in Ecuador are in the higher-altitude rural areas of the provinces of Imbabura, Cotopaxi, Tungurahua, Bolivar, Chimborazo, and Canar. The Indian population is a potentially valuable human resource which at present is almost wasted, playing only a small part in the Ecuadorian economy and often having little real concept of nationality (Bromley, R.J., 1977:37).



Indian Population: Highlands

Figure 1.1

Research Related to HPEC's

The story is told that from the heights of the universe there fell blood onto a place called Huichicancha; it fell onto the fields where the quinua grew, and there, in those places, the peoples were formed, from Allauca to Cunisancha, from Satpasca to Yurinaya, from Sullpacha to Chuparacu, from Uacataca to Pomasa, from Musica to Chaucachimpita, from Cacasica to the already named Huarcancha and Llilicancha, of the Yancas.

Collected, circa 1598
Francisco de Avila

Recent conferences, March 1982 and July 1985, of the Society for International Development North-South Roundtable held in Rome identified the need for the study of a food crop such as Chenopodium quinoa and other endemic cultigens. Development planning should actively seek out non-traditional sources, especially from the informal sector, for its long-term projections. In order to approach any problem from the consumption side, researchers must be aware of the mechanisms that "poor" people have developed over the centuries in order to sustain their survival. The poor are all those individuals who do not have equitable access to the goods and services afforded to the population in power.

The culture of the indigenous Andean population fostered the domestication of a wide variety of crops that were in turn introduced to Europe, Africa, and Asia. Potatoes, for example, were eventually incorporated into the national formal economies and diets in those regions. In the Andean nations HPEC's have often shifted into the informal sector. The variety and wealth of agricultural commodities in the informal sector remains an untapped national resource.

Nations bemoan the misery of famine, yet there remains a virtually untapped source of knowledge of the informal sector that has not been used by the formal sector. The economic assault on the

indigenous American state was initiated by the Spanish state. The argument that the indigenous knowledge base is non-objective and non-scientific, from the Western perspective, is not easily dismissed, for the indigenous American state. The Inca state, at the time of the Spanish conquest had an extensive corpus of knowledge, which contained much on agriculture, was used and disseminated by the Spanish state to Europe, Africa, and Asia. The knowledge base of the American state was housed in the memory of official rememberers, as well as in codices and colonial documents written by both priests and learned Indians.

The missing link is the lack of knowledge on the part of the decision makers in the formal sector, regarding the potential of HPEC's. The development of a strategy that can bring this knowledge to individuals of power in the formal sector is an issue to be addressed. "The problem must be approached from the consumption side, that is, with the perspective of the malnourished people. It also means moving the international community beyond its preoccupation with technology and production towards a fundamental recognition that the focus of the fight against hunger must shift to the food-deficit countries and new strategies be derived from their particular political, social, economic and cultural circumstances" (SID Rome Symposium, 1982:33).

Chenopodium quinoa and other HPEC's represent an example of food crops in the informal sector of the Andean region which have received little and intermittent attention from the international scientific community (Cusack, D.F., 1984; Vietmeyer, N., 1975;1986). Amartya Sen, Uma Lele, Nevin Schrimshaw, Soedjatnoko, and Susan George,

conferees at the SID Rome Symposium, concurred that aspects relating to food production and consumption must be viewed in terms of the populations directly affected, i.e. the consumption side.

Uma Lele suggests four alternative policy directions: 1) The promotion of drought-resistant food crops to achieve self-sufficiency at the household or local level; 2) The provision of a market for surpluses of such crops; 3) Explicit recognition and promotion of the private cash market for foodgrains in rural areas (to bring the informal market price down to the official level); 4) Research and extension on improved methods of farm level storage, in which losses may amount to between 15 and 20 per cent of the harvest.

The need to devise schema, for the incorporation of knowledge from the informal to the formal sector, is clearly implied by the literature from experts in the fields of agriculture, anthropology, economics, agricultural economics, and planning. Researchers have encouraged national leaders to address the food problem from a "controversial perspective, rather than from a few non-controversial areas"; if the latter is continued it will amount to "a little more of the same" (SID, Rome Symposium, 1982). Chenopodium quinoa and other HPEC's compose a group of commodities that has received only sporadic research attention. The results of those research efforts, however, provide some data that can be examined within the context of both normative and positive knowledge and thus add to the data base of HPEC's.

Problem-Solving Research

The type of research addressed in this dissertation is that of problem-solving. Problem-solving research is generally multi-disciplinary and is considered one of the most difficult forms of research (Johnson, G.L., 1982;1986). The research philosophy in this dissertation is eclectic pragmatism; the information obtained will be considered as an interaction between positive and normative knowledge. Briefly, normative knowledge consists of that which takes into consideration the values of a given society. Positive knowledge considers that which is readily observable and quantifiable; it stresses what is rather than what ought to be. Positive knowledge generally deals with issues in the real world and at times of unknown immediate use. "The real world consists not of numbers but of shapes and sizes. It is topological rather than quantifiable. Quantification for the most part is a prosthetic device of the human mind, though a very useful one. Anyone who thinks that numbers constitute the real world, however, is under an illusion, and this is an illusion by no means uncommon" (Boulding, K.E., 1980:833). There may arise instances during the course of this or any type of research in which the normative and the positive should be considered independent of each other. This is determined by the workability of the prescriptions recommended. "If you think that perfectly real tough problems can be made to go away by a process of logical incantation, you will necessarily be disappointed, particularly if your logical incantations pay more attention to internal consistency than relevance to reality" (Stopler, 1969:2).

A considerable amount of positive research has been conducted on the agronomic characteristics of Andean HPEC's. Normative information

concerning the non-monetary value placed on Andean endemic food crops has not been systematically obtained from the general highland population: Indian, Mestizo, and White, nor has extensive use been made of the documentation of the early chroniclers to help current researchers understand the fluctuations in the use of these crops. The link between Chenopodium quinoa, a high altitude grain that grows on the upper reaches on the slopes of the Andes, and the people of the highlands who cultivate, consume, and sell it is explicit from several myths that have been collected during the colonial period as well as from contemporary Indian groups. By their own testimony, the people were a part of the mountain slopes they inhabited, born of the same lands that gave them the food they ate. Chaupinamaca was the fertility deity worshiped at harvest time and consulted by people throughout the region in cases of personal trouble. Her worship probably coincided with the solstice. After the Spanish conquest, her festival was hidden by associating it with the Corpus Christi feast in June (Spalding, K., 1984:98). Quinoa still retains its importance as both a ceremonial and a food crop. It continues to be the only crop that still plays an important part in the feast of Corpus Christi (Hernandez, S., 1977; 1982; Field notes; Gade, D.W., 1975).

It is those crops such as quinoa, amaranth, and lupines that are still solely within the province of Quechua speaking Indians of the Andes that are considered in this problem. While the nutritional value of HPEC's has been long established, [See Appendix A], the cultural bias against these crops by Andean researchers and key decision makers has hampered the successful implementation of a project that relates directly to Andean endemic cultigens in Andean

countries. Work in these areas has generally received stimulation from researchers outside of the Andean realm. The crops are not corn, beans, and potatoes.

Acknowledgment of the relationship between man and the environment continues to provide clues to this unending relationship in the Andes between two indigenous populations: man and domesticated food crops. The minifundistas in Latacunga, Ecuador still compose songs to sing to their quinua plants, and thus insure a bountiful harvest (Hernandez, S., 1983, Field notes; Spalding, K., 1984:9).

Knowledge obtained by pragmatic methods, one of which is participant observation, allows the researcher to experience the socio-cultural environment in which his recommendations will be implemented. Only by using a series of methods that assure that the power and position of the key decision makers is not openly threatened will there be a successful implementation of recommendations. Along with the positive knowledge that exists on the biological and genetic characteristics of HPEC's, it is imperative to balance these data with normative information. "A different analysis of economic theory is normative, taking a definite moral position on what should be done (Nicholson, W., 1985:11).

Prescriptive knowledge is knowledge about what ought or ought not to have been done or ought or ought not to be done. Prescriptive knowledge can be regarded as a function of positive and normative knowledge and, as such, is a logical consequence of them (Johnson, G.L., 1983:class notes).

To capture the marketable properties of HPEC's, their utility must be evident to the power structure (formal sector) and the planning agencies that develop and establish national priorities. One

way to do this is to show the economic advantage, and the international and national marketability of the chemical by-products such as saponins of HPEC's, especially Chenopodium quinoa. The cost-effective aspect of producing HPEC's must be presented to the Quechua speaking farmers and to the private sector that is to make the greatest money investments, before any action can be taken. Both groups will take risks.

In a semi-subsistence agriculture farmers produce partly for their own consumption and partly for the market. The amount of the marketed portion of total output may either be planned or unplanned. If it is planned, the farmer may grow one or more cash crops specifically for market; if it is unplanned it is likely to consist of food which is surplus to the farm household's subsistence needs. Unplanned food surpluses may be confined to the years when the harvest is unusually good. Pure subsistence farmers, and semi-subsistence farmers of both types described, may coexist in the same locality. Whereas a purely subsistence farmer is not necessarily fully self-sufficient, a purely self-sufficient farmer may also produce a marketable surplus. However, if no market exists, or if the farmer does not desire a cash income, the surplus may be absorbed by the farm family which consequently increases its consumption to match the large-sized crop - Engel's Law does not apply to a subsistence economy.

The specification of the peasant farmer's objective function has been the subject of much debate among economists. Whereas some have held that his primary concern is to maximize profit (like the modern sector farmer) others have argued that, above all, he seeks economic

or the minimization of risk. The pure subsistence farmer is concerned only with managing a household, not a business, so it is to be expected that his primary motivation will be food security for himself and his family. The semi-subsistence farmer is both a household manager and a businessman, so that he may be motivated by the goal of profit maximization, but subject to the constraint of withholding sufficient resources from cash crop production to provide for the subsistence of the farm household. But since his cash income is typically very low, it would not be surprising if risk-aversion took precedence over profit maximization in deciding which crops to grow and how to grow them. However, allocating resources in a way which trades a marginal profit for a marginal gain in security does not signify economic irrationality, since such behavior is fully consistent with utility maximization. Moreover, the results of empirical studies show that peasant farmers who do produce for the market are not unresponsive to changes in the relative prices of production alternatives (Ghatak & Ingersent, 1984:6).

The outcome of such an effort is to establish HPEC's as a viable national resource. There must be a constant cross-fertilization of the desirability and advantage for individuals in both the formal and informal economic sector of the population. Both sectors intersect throughout the agricultural and market cycle of HPEC's. If there is absolute relative advantage to both populations, then the incorporation of these crops into the national plan is possible. "Planning must take place where power and authority reside. But that center of power will find itself in deep trouble if it does not relate in more than a superficial way to the 'grass roots' of its national society" (Cochrane, W.W., 1974:74).

Non-monetary value of HPEC's has played a greater role in the persistence of these crops than the monetary value. The singlemost compelling reason for the incorporation of HPEC's in the national development plan is the endurance of endemic cultigens in both the physical and cultural environment of the Andean highlands. The existence of a viable and sometimes profitable form of agrarian capitalism has existed in highland Ecuador since the establishment of Jesuit colleges in the country in 1586 (Cushner, N., 1982:176).

Types of Knowledge

Value knowledge and value free knowledge are needed to convert decision rules into prescriptions by decision makers. Value knowledge is knowledge about the goodness and badness of conditions, situations and things (including acts). The values may be either monetary or nonmonetary in nature. They may also be intrinsic or extrinsic, the latter including the exchange value we define as price. Value free knowledge is knowledge about characteristics of conditions, situations and things (including acts) other than their goodness or badness. Value-free knowledge has to do with weight, number, color, size or volume, density and the like. Prescriptive knowledge is knowledge about what ought or ought not to be done. Solutions to problems are prescriptive in nature (Johnson, G.L., 1986:16). Other values, i.e., is something that is intrinsically desirable from an individual point of view, that may contribute to the lack of curiosity for these crops are the underlying unstated negative attitudes, a disposition that is primarily grounded in affect and emotion and is expressive of opinions rather than belief, toward the informal (indigenous) sector by the participants in the formal economic sector. Public and private

decision makers are crucially concerned with the generation of prescriptive knowledge to solve problems. In order to generate prescriptive knowledge, they need both value-free and value knowledge (Johnson, G.L., 1986:18).

Specific forms of knowledge are needed in order to communicate to the target populations, in both the formal and the informal sectors, comprehensive data and information on HPEC's. Positive knowledge is synthetic knowledge which deals with the characteristics of conditions, situations or things in the real world other than with their goodness or badness or rightness or wrongness. Availability, accessibility, and agronomic characteristics of HPEC's constitutes positive knowledge. Normative knowledge is knowledge having to do with the goodness or badness of conditions, situations and things in the real world (Johnson, G.L., 1983: class notes).

In order to formulate a problem statement, the underlying assumptions of what constitutes bias on the part of the researcher and the groups under study should be stated prior to the elaboration of the problem statement. This is done in order to understand the bias one is working with, and therefrom clarify the bias of the problem statement. In order to avoid the difficulty involved in problem solving research, a pragmatic orientation to research is suggested, as is a recognition that baseline data in both the normative and positive areas for HPEC's is limited. The usefulness of a pragmatic orientation is that productivity is largely in reaching solutions to practical problems under the presupposition that the truth of a concept is determined by its consequences. When concepts are used to solve problems, the solutions are consequences (Johnson, G., 1983:

class notes).

A pragmatic orientation to problem solving requires prescriptive knowledge. Prescriptive knowledge is knowledge about what ought to be or ought not to be done. Prescriptive knowledge is a function of positive and normative knowledge and is a logical consequence of them. The decision rules which convert positive and normative knowledge into prescriptions must be resolved on the basis of more or less arbitrary distributions of power (Johnson, G.L., 1983:class notes).

Although research into the nature of HPEC's has been primarily descriptive (e.g. the physical properties of quinoa, amaranth, and lupines), research that addresses the function of HPEC's in their Andean environment is lacking. Environment includes not only physical and cultural factors that originally contributed to the domestication of the crops, but also the current cultural scenarios that need to be understood. Success in addressing the pressing issue of continually increasing dependence on food imports rests upon a holistic understanding of the physical and cultural environment. If HPEC's are to be incorporated into the formal economic sector we must know how these crops function in the informal economic sector. In order to do this we must know the factors that have created an aura of social resistance to a group of agricultural commodities that have been known for at least the past 50 years to possess characteristics that, today, are considered to be highly desirable for regions historically plagued by periodic drought and famine. In short, we must be able to work with knowledge related to HPEC's.

The problem statement in this study is strongly associated with the research philosophy, eclectic pragmatism. This philosophy acknowledges the existence, and the need to recognize the power, of

all those individuals who believe they influence decisions.

Research Philosophy

The research philosophy followed in this dissertation is that of eclectic pragmatism. Eclectic pragmatism rejects a single unitary and exclusive interpretation, doctrine or method; the truth of a proposition is tested by the practical consequences of belief. Major strengths of pragmatism are that it addresses real world problems and their solution; it breaks down the barriers among the traditional academic disciplines and tends to force them to pool their knowledge in problem solving efforts; and, it provides a scientific methodology for working with both the positive and the normative sides of particular problems. The greatest weakness of pragmatic methods is their complexity (Johnson, G.L., 1983;class notes).

The international scientific research community is rediscovering plants from the past. Contemporary knowledge on HPEC's has been accumulating since the 1930's. This has been primarily positive knowledge based on the results of experiments carried out in agricultural research stations. These data relate primarily to the agronomic characteristics of the plants.

Documents from the Spanish colonial period stressed the economic, cultural, and to a limited extent, the nutritional importance of HPEC's. These data were understood and interpreted by the Spanish viceregal government within the context of American urban centers. Certainly, the recognition of the importance of sound agricultural production as a base for urbanism in the Americas is explicit from the pre-Columbian and Columbian inhabitants of Andean America. Given that urbanism in the Americas, since the colonial period was a planned

enterprise, it is reasonable to devise a scheme for the dissemination and use of endemic cultigens within the legitimacy of the national development plan.

Moreover, above subsistence should be maintained and improved by the highland Indian population. A general assumption is made by economists: import substitution of agricultural commodities is not a desirable goal for developing countries (Mellor, J., 1982: presentation Michigan State University-Agricultural Economics). Preservation of the indigenous knowledge base in regard to endemic cultigens is advantageous for the refinement of a national development plan, which by necessity must include sound agricultural development planning (Cochrane, W.W., 1982).

Colonial Period

Evidence based on Spanish colonial documentation shows that the non-monetary value of HPEC's was largely ignored. Crops were considered in terms of their monetary exchange value. Endemic crops were selected for their environmental adaptability. Our current knowledge of rural life in colonial Latin America is severely limited (Cushner, N.P., 1982:3). Despite our limited knowledge, we should recognize the early knowledge base of the Inca state was incorporated into the agricultural-urban plans of early colonial America. Past and current planners committed a similar error when they separated the monetary and non-monetary value of endemic crops. In doing this they created an aura of low status (non-monetary value) to all of those crops which remained primarily within Inca culture. This eventually led to a fluctuation in the monetary value of endemic cultigens, and in the case of Chenopodium quinoa, is not attributable solely to the

usual agronomic, economic, and environmental causes such as low yield, low prices, poor weather, disease, and inadequate demand. The fluctuation of the non-monetary value of HPEC's is documented later. It will be argued that the negative non-monetary value placed on HPEC's by current leaders in the formal economy has played a greater role in their demise than their monetary value. Social factors, not capricious climate, are usually the crucial forces behind success or failure in the production and delivery of food (Garcia, R.V., 1981). Government policies, often dictated by interests of a powerful local elite, determine how land is used and where agricultural inputs are applied. More supportive policies may contribute greatly to the goal of food "self-sufficiency" and to the amount of food available for local consumption. The dualistic agricultural economy in many African nations is an instructive example of how politics influences policy making. As a rule, export crops receive government credits and supports, and benefit from irrigation schemes, water rights and scientific extension services. On the other hand, local food crops, often tilled with tools little advanced beyond the Iron Age, receive few of these benefits (Slater, L.E., 1983:42).

The consequences due to neglect of these crops were serious effects on the lowest socio-economic strata of the Ecuadorian highlands. This population consists primarily of Quechua speaking Indians, characterized by increased rural unemployment, increased seasonal rural-urban migration, increasingly poor nutrition of the rural population. These are some of the issues that are not yet addressed in the research literature. (Further information on the colonial period is found in appendix B).

Lack of desire to deal with the actual national context has led in the past to the augmented impoverishment of the indigenous population of Ecuador. Laws were extant (Laws of Burgos 1512-1513) to protect the indigent, however, these laws were often not enforced. This situation is reflected by the gradual exclusion of native crops from the formal economic sector. It may serve to show how the national reality was and continues to be selectively represented by the elite in power to serve their needs.

Ariel Dorfman captures the essence of the elite's perception of the poor in Latin America. He uses the example of the Dominican Republic:

What is fascinating about these experiments...is that they run contrary to some of the most deep seated prejudices in Latin America (and elsewhere)...about the poor and on how to deal with poverty. The cultural strategy values what the dispossessed already own: the rich complex traditions that have been stored and expanded during generations; the fact that they are whole and healthy human beings, that they are--what a surprise--adults. Poor people tend to be treated as if they were incomplete and sick, needing to be brought up-to-date, elevated, illustrated, cured of the plague of ignorance that handicaps them. Almost as if they were children. If they would only "grow up" and acquire the knowledge "normal" for their age, then development and well-being would automatically follow (Dorfman, A., 1984:12).

Knowledge, recognition and use of knowledge becomes a critical factor in the complex process of planning.

Overview of the Study

An introductory discussion on the background of the problem, HPEC's and research philosophy was presented in Chapter I. A contextual scenario will be presented in Chapter II, the Literature Review. Some of the areas covered are: the nutritional value of quinoa, the natural environment, the national plan and urbanism. The presentation of the research methods, the Delphi technique and

participant observation are presented in Chapter III. Research Findings are in Chapter IV and Recommendations are in Chapter V. Five appendices are provided. These contain specific material on quinoa and the colonial period. The third appendix contains the questionnaire, the cover letter, charts that refer to market visits in Ecuador and the results of informal conversations held in Ecuadorian markets and research institutes.

Chapter II

Literature Review

Urban problems become virtually insoluble without a proper agricultural policy (Stopler, 1969:28).

The literature review is divided into six parts. Each reflects the areas in which research has added to knowledge and understanding of the contribution that HPEC's have made on the past and current populations of Andean America. The areas are: the nutritional value of quinoa; the natural environment; endemic disease, epidemics, and migration; the national plan; urbanism; and a summary.

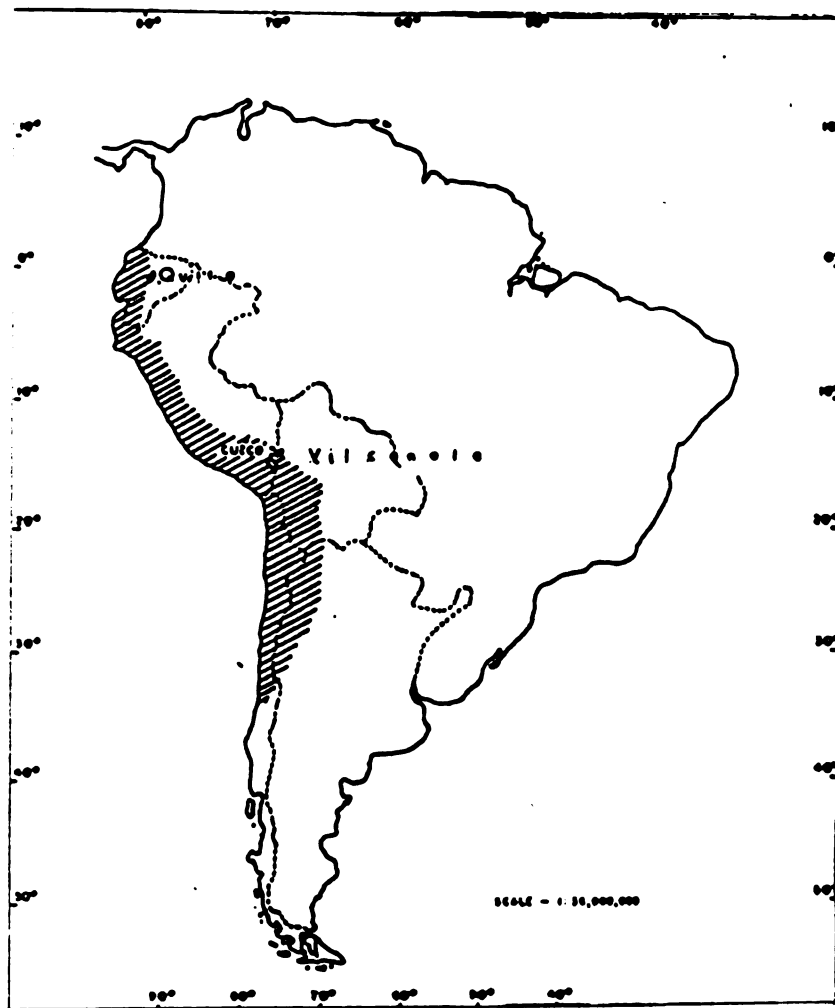
Most of the publications available in the United States on quinoa and its contribution to the native diet are sketchy. Most of the material that is obtainable was published in the 50's and 60's. The data that can be gleaned from the literature of the 70's and 80's invariably use the data base of the 50's and 60's. As a result, there is very little current and reliable information on quinoa or saponins; saponins are glycosides obtained from many varieties of plants. This situation holds true for most material concerning Ecuador. This is particularly true of the informal economy and the informal rural agricultural sector. Statements based on astute observations, by

to quantify. However, such material, despite its limitations, does provide sufficient substance to present a scenario of the rural and the informal economy of Ecuador.

Any attempt to understand the current situation in respect to agrarian reform must have a glimpse at Ecuador's past. This includes the country's pre-Columbian and Spanish colonial heritage. At the time of the advent of the Spanish conquest of the Americas, the Incan empire had barely established itself in what is today known as Ecuador (Figure 2.1). Benalcazar conquered Ecuador in 1534. The country gained its independence from Spain in 1830. During these periods, the majority of the population was concentrated in the highlands, at elevations of 8,200 to 11,480 feet (2,500 - 3,500 meters) (Basile, 1974:43).

Economically subordinate, politically powerless and culturally isolated from the national decision-making centers, the native population of Latin America has become a marginalized underclass of rural proletarians, exiles in their own countries, discriminated against by the dominant Spanish-speaking population, even in such countries as Guatemala, Bolivia, Peru, and Ecuador where they represent at least half of the total population (Stavenhagen, R., 1984:31).

It took the organized labor of many people to free specialists to mine silver or gold, to turn mercury ores into pigments, or to perform any of the other tasks that meant the difference between living poorly on what the immediate surroundings provided and living comfortably with access (at least for some members of the society) to all of the



Ecuador in the Inca Empire

Figure 2.1

goods defined as desirable. The small, fragmented villages of the Andes today are poor--both in European terms and in terms of their own values and needs. Their poverty is at least in part a problem of scale: they no longer have access to the agencies and sources of power as they are defined today (Spalding, K., 1984:21).

Nutritional Value of Quinoa

Most researchers that have explored the nutritional value of quinoa uniformly comment on the high quality of its protein and its amino acid balance. Quinoa is high in lysine, which is the one amino acid that grains generally lack, which presents a serious deficiency in the diets of both humans and livestock. This is most true of corn. Most quinoa varieties are also unusually high in the essential sulfur-bearing amino acids, methionine and cystine, which are particularly important for vegetarian diets as well as correcting deficiencies in legume diets (Cardozo, A. & Bateman J.V., 1961; Cusack, D.F., 1984; White, Alvistur, Dias, Vinas, White, & Collazos, 1955; Tyndal, K., 1987:56). As early as 1931 Jose T. del Granado noted that quinoa could replace corn and wheat in Bolivia due to its medicinal and nutritional properties (author's translation, 1931; 1986). Dr. Granado based his conclusions on an analysis done in Europe by Dr. Walker. Garcilaso de la Vega noted in 1609 that quinoa was second to corn (sara) as most important crop, the first was corn (sara). The Indians eat the tender leaves in cooked dishes, for they are tasty and nourishing. They eat the grains in pottages prepared in many different ways. The Indians also brew a drink from the quinoa, as they do from maize (sara), but it is only produced in regions where maize does not grow. The Indians used flour made of quinoa to treat

various illnesses (Garcilaso de la Vega, 1609 & 1617/1966).

The protein quality of quinoa and its amino acid balance depends on both the variety and upon the altitude where it is cultivated. Protein range for quinoa is between 10%-24% for dry grain (Mahoney, A.W., Lopez, J. G., & Hendricks, D.G., 1974; Mazess & Baker, 1964; Mintzer, M.J., cited in Leon, 1964; Quiros-Perez, F. & Elvehjem, C.A., 1956; White et al, 1955). In all experiments quinoa was superior as a food to both corn and wheat. The quality of quinoa protein means that a higher percentage of it is absorbed by the human body and its high quality means that more of its essential ingredients are supplied to the human diet. "If we take into account that quinoa has a larger percentage of protein,... We can see that quinoa offers a larger quantity of the essential amino acids than any of the four most important cereals in the world (wheat, barley, oats, and corn)" (Cardozo & Tapia, 1979 in Cusack, D.F., 1984:23). Quinoa is frost resistant and able to thrive on poor soils with an annual rainfall as low as 300-400mm, its protein content averages about 17%, lysine content 6% and methionine 2.2%. This makes it superior to most cereal grains in food value. In addition, it contains vitamin C and the B complex of thiamine, riboflavin and niacin (Weber, E.J., 1978).

Researchers in the Andean nations, Canada, Europe, the United States and to a lesser extent India, where some varieties of Chenopodaceae are also a staple, concur that the Chenopodaceae are a superior food grain to wheat, barley, oats, soybeans, and corn. This is due not only because of its high protein quality, but due to its low cost and its availability in the higher altitudes. Table 2.1 compares the nutritional quality of quinoa and other grains. Table 2.2 compares essential amino acid balance of quinoa and other grains.

Table 2.1 Nutritional Analysis Comparisons (%)

	Water	Protein	Fat	Carbo- hydrate	Fiber	Ash
Barley	11.1	8.2	1.0	78.8	0.5	0.9
Buckwheat	11.0	11.7	2.4	72.9	9.9	2.0
Corn	72.7	3.5	1.0	22.1	0.7	0.7
Millet	11.8	9.9	2.9	72.9	3.2	2.5
Oats	12.5	13.0	5.4	66.1	10.6	3.0
Quinoa	11.4	16.2	6.9	63.9	3.5	3.3
Rice	12.0	7.5	1.9	77.4	0.9	1.2
Rye	11.0	9.4	1.0	77.9	0.4	0.7
Wheat	13.0	14.0	2.2	69.1	2.3	1.7

Source: After "Fact Sheet" by Stephen L. Gorad quoting U.S. Department of Agriculture figures compared to average figures for quinoa (Boulder, Colorado, 1975). Unpublished.

Table 2.2 Essential Amino Acid Pattern (g/16g N) of Quinoa Compared to Wheat, Soy, and FAO Reference Pattern for Evaluating Proteins

	Quinoa	Wheat	Soy	FAO†
Isoleucine	4.0	3.8	4.7	4.0
Leucine	6.8	6.6	7.0	7.0
Lysine	5.1	2.5	6.3	5.5
Phenylalanine	4.6)	4.5)	4.6)	
	8.4	7.5	8.2	16.0
Tyrosine	3.8)	3.0)	3.6)	
Cystine	2.4)	2.2)	1.4)	
	4.6	3.9	2.8	13.5
Methionine	2.2)	1.7)	1.4)	
Threonine	3.7	2.9	3.9	4.0
Tryptophan	1.2	1.3	1.2	1.0
Valine	4.8	4.7	4.9	5.0

†(1973)

Source: Johnson and Aguilera, Processing Varieties of Oilseeds (Lupine and Quinoa), Table 6 (Report to Natural Fibers and Foods Commission of Texas, 1979-80).

Quinoa is also very high in phosphorus, calcium, and iron in comparison to wheat and other cereals (Table 2.3). It is also high in Vitamin E and several of the B-complex vitamins.

Table 2.3 Comparative Mineral Values of Selected Cereals Per 100 Grams of Weight.

	Quinoa	Wheat	Yellow Corn	White Rice
Calcium, mgr.	141.0	36.0	6.0	8.0
Phosphorus, mgr.	449.0	224.0	207.0	143.0
Iron, mgr.	6.6	4.6	3.7	--

Source: Recetas a Base de Quinoa. 2nd ed., Ministerio de Agricultura, Servicio Cooperativo Inter-Americano de Produccion de Alimentos, October 1953.

David F. Cusack in 1984 published a synthesis on material related to quinoa and other Andean endemic cultigens. This material is highly valuable because it presents data that is generally difficult to ascertain from empirical work. It also clearly states that there are many varieties of quinoa, each with its own econiche adaptation. These classifications are based on the work of Mario Tapia (1982) and Humberto Gandarillas (1979). The main four varieties of quinoa are: valley, altiplano, saltflat, sea level and a possible fifth, subtropical. The value of these classifications is that it is clear that quinoa has a broader altitude and latitude range than previously assumed and that the foremost characteristic of the crop is that it does well under harsh environmental conditions.

The role of saponins, which cover the seed coat of most chenopods is not well understood by researchers. Saponins are not a problem when they are examined within a human diet. Animal experiments have shown highly divergent results. Saponins either prevent weight gain or they do not affect weight gain. Human populations always wash their quinoa before it is eaten, therefore, saponins are not a problem. In animal experiments, when the quinoa was washed, weight gain was equal to or superior to animals raised on commercial feeds.

The cost of quinoa based feeds is also lower than commercial feeds. This is also true as a food for human consumption. The use of heat treated soybeans, as a poultry feed, requires the addition of methionine in order to improve the nutritional value of the soybean meal for chicks. Since this was discovered in 1937, and with the isolation of methionine in 1923 by J.H. Muller, the market for synthetic methionine has steadily increased with a marked growth explosion in the 1960's. Lysine, compared to methionine, the other amino acid in commercial use, is a relative newcomer to the feed ingredient list. Its use did not take on any significance volume-wise until about 1970 (Romoser, G.L., 1985; 1986). Another advantage of quinoa is that it does not respond to world price fluctuations, as do wheat, corn, and soybeans in the international commodities market (Allred, L., Mahoney, A.W., Hendricks, D.G., 1976; Mahoney, A.W., Lopez, J.G., Hendricks, D.G., 1974; Mazess, R.B. & Baker, P.T., 1964; McDowell, L.R., Conrad, J.H., Thomas, J.E., Harris, L.E., 1974; Quiros-Perez, F., Elvehjem, C.A., 1956; Tkachuk, R. & Mellish, V.J., 1977; White et al, 1955; Weber, E.J., 1978; World Development Letter, 1981; Zambrano, F., 1982).

Table 2.4 shows a comparison of indigenous dietary caloric intake and national intake in Bolivia, Ecuador and Peru.

Table 2.4

Average Daily Caloric Intake

<u>Population</u>	<u>Year</u>	<u>Average Daily Caloric Intake</u>
Highland	1964	3170 ₁
	1978	2428 ₂

National	1961	1820 ₃
	1968	1750 ₄
	1970	2040 ₅
	1974	2000 ₆
	1978	2183 ₇

 Sources: (2,7) Antunez de Mayolo R., 1978; (3,5) Handleman, H. 1980;
 (4,6) Instituto Nacional de Nutricion, 1978; (1) Mazess &
 Baker, 1964; (5,6) World Bank, 1979.

In all of the above cases the majority of the total calories came from chenopodia and tubers, all endemic to the highlands. A study done by Picon-Reategui in 1976 showed that in less than five years Mazess & Baker (1964) and Gursky (1969) tubers were practically displaced by cereals and chenopods from the daily diet of the district of Nunoa, Peru. Both surveys were carried out at the same time of year and only one or two months after the potato harvest. As a justification for the discrepancy between the results of these surveys, Gursky (1969) points out that the harvest of potatoes which preceded this survey was unusually small.

In communities where altitude limits or prevents cultivation and where 100% of the economy is derived from herding, vegetal products are still the most important part of the native diet. The survey on food consumption carried out by Gursky (1969) showed that food of vegetal origin provided 82.2% of the bulk of the food consumed in the herding community of Chillihua and 93.1% in the agricultural community of Sincata. This last figure agrees with that reported by Mazess & Baker (1964) for food consumed in the district of Nunoa. All of these places are in Peru.

According to Mazess & Baker's survey (1964) mean protein consumption was about 69g/person/day- i.e., somewhat more than 1.0g/kg of body weight for the standard adult of Nunoa. About 21% of the total protein ingested was of animal origin, 49.7% came from tubers, 10.9% from cereals, and 17.0% from chenopodias.

Animal food products, chenopodias, and tubers are the main sources of fat in the native diet. Calcium is obtained from chuno negro (Andean dehydrated potatoes) chenopodias, catahui lahua (clay) and llipta (lime). Approximately 44.1% of iron is supplied by chenopodias. In all chenopodias provided a major portion of caloric intake of the highland indigenous population. All authors note that the decrease in the availability and consumption of chenopodias are not being replaced by foods of comparable quality and environmental adaptiveness.

Natural Environment: The Highlands

The Andes represent a highly varied, basically unpredictable climatic and soil environment. The native population of the highlands developed hundreds of varieties of plants, in order to successfully

deal with irregular environmental stressors such as intense frosts and droughts that create predictable fluctuations in productivity from year to year. Precipitation on soils that are characterized as immature on a steep topography which is no longer terraced, can result in as much as 60 percent runoff (R. Brooke Thomas, 1979:148).

Puna, paramo, altiplano, and sierra, refer to high mountain lands generally above 3,000 meters in altitude. None of these areas represents uniform soil or vegetation. In pre-Columbian times the intermediate slopes and the upper slopes, also known as the paramo (3,500-4,500 meters), were terraced, extensive irrigation networks existed, and fertilizers and insecticides were used prior to the Spanish conquest (Antunez de Mayolo R., 1978:280).

The intermediate slopes (2,300-3,500 meters) receive an annual rainfall of 30-40 inches (Basile, 1974:118). Wheat and barley, both introduced into the lower contours of this region, by the Spanish, displaced many of the local cultigens. The upper slopes are today the "largest least productive and least utilized of any of the land use regions" in the Andes (Basile, 1974:131).

Only the hardiest of all crops will grow in the paramo region. The real world of developing tropical countries--the world of inequitable economies, lack of infrastructure, colonial agricultural carry-over, long enduring cultural constraints--suggests the answer must come from another direction. It most probably must come through a new science of tropical agriculture which achieves optimal productivity with strategies and technologies appropriate to the economics, culture, and natural environment of each developing country (Slater, L.E., 1983:37-38). All of the crops that grow at this altitude and have a guaranteed yield are the endemic varieties. Four

of the more important varieties are: (Solanum spp.): ocas (Oxalis tuberosa), mellocos (Ullucus tuberosus); and quinoa (Chenopodium quinoa). These plants all provided the native diet with a substantial amount of protein and calories, given the unique characteristics of quinoa, high protein, drought and frost resistance, qualities which were singled out by Uma Lele and others at the 1982 SID conference.

Endemic Disease, Epidemics, and Migration

Another critical aspect which argues for the incorporation of underutilized highland areas for agricultural production is the presence of endemic tropical lowland diseases. The Incas were aware of the existence of disease entities in the lowlands, as a result, they did not have permanent colonies in the tropical lowlands. The present government, as did the Spanish colonial government, ignores the wisdom of the native highland inhabitants. Leishmaniasis is increasing in the tropical lowlands, as a result of human intrusion into insect habitats. This human expansion into the lowlands is for the purpose of developing new lands for agricultural production and for raising cattle. A consequence of the intimate familiarity with their surroundings was the deliberate avoidance of the lowlands; instead, seasonal camps were established in the lowlands by the Incas in order to harvest plantation crops such as coca (Erythroxylon coca). Similar temporal migratory patterns, for crops other than coca, still exist in highland Ecuador.

Seasonal migratory patterns can also be interpreted as a response to seasonal unemployment in the highlands. The limited sojourn to the lowlands should not be interpreted from a single perspective. There is a combination of factors that contribute to any single action.

Gade (1975; 1979) presents data to elucidate the rationale for aboriginal evasion of the tropical lowlands. According to Gade one of the principal reasons for the transitory nature of lowland settlements was the fear of certain diseases.

A variety of viral, bacterial, protozoal, and metazoal pathogens occur in the jungle that do not exist in the highlands (Gade, D.W. 1979:268). Leishmaniasis is a disfiguring disease that attacks the nasal mucosa, the nose, palate, and upper lip, which may become ulcerated; the underlying cartilage may also be destroyed. If the larynx becomes infected, the vocal chords may fail, and necrosis of the trachea can limit food intake, ultimately, the disease may result in death through gangrene, broncho-pneumonia or starvation (Gade, D.W., 1979:269). This disease was known and feared by the Incas; as a consequence, they made no attempt at long term or permanent settlement of the jungle region where this disease was and is endemic. The Spanish, during the colonial period knew of the disease, described it, but discounted the fear that the Incas had for long term habitation of the yungas (tropical lowlands).

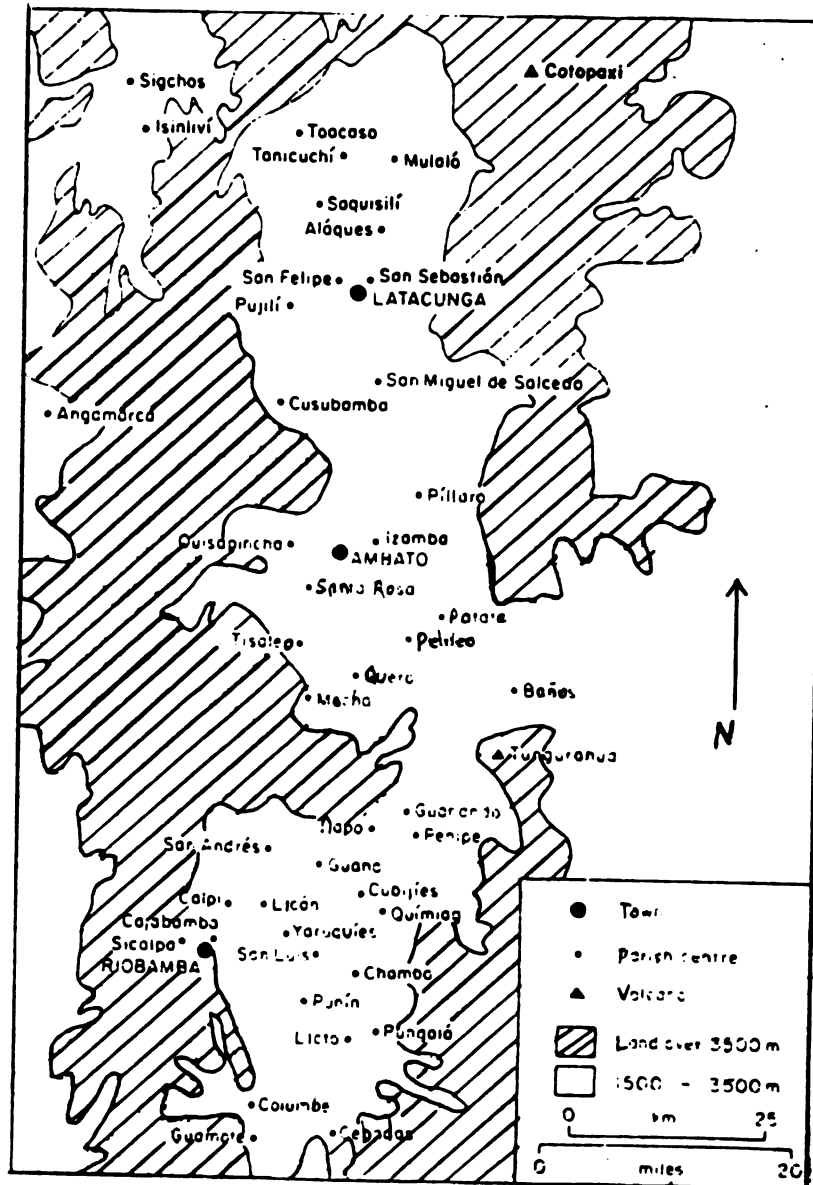
Leishmaniasis is not a contagion; only by actual presence in the yungas can it be contracted. At the same time, however, the disease remains activated long after the native has left the zone (Gade, D.W., 1979:274). The disease is not endemic above 2,500 meters.

While leishmaniasis is endemic, smallpox and measles were introduced by the Spanish into the Americas. Old world diseases, measles and smallpox, overwork, and flight had continued to decimate the population, until remnants of Indian families were left scattered over what was once uniformly and densely settled land. Uprooting and

reconcentrating the families in a few larger settlements, the viceroy reasoned would facilitate religious indoctrination and acculturation, and help maintain the segregation of Indians from the mistreatment and corrupting influences of the Spaniards. A less publicized but nonetheless significant reason was administrative expediency-facilitating tax collection and control. From the Indian perspective, Poma de Ayala, the move to the new towns was to the detriment of the native population. The move, according to Poma de Ayala, was to land that was humid, subject to disease-carrying, stinking winds that came from the sea (Poma de Ayala, 1615; Ramirez, S.E., 1986:76).

Ramirez notes, as have other authors, that the Spanish were aware of the health hazards of permanent habitation in the lowlands, but they elected to ignore the many negative aspects associated, with regard to both health and agriculture, associated with permanent habitation in the lowlands. Although Ramirez' document relates to coastal Peru, her concerns can be generalized to coastal Ecuador and the Amazonian lowlands in both Ecuador and Peru. Indeed the rapid decline in the indigenous population may have been affected more by diseases than by out-right decline in population due to armed conflict.

During the period from 1750-1920, the Ecuadorian sierra had a series of measles and smallpox epidemics from which it has never recovered although today measles is controlled; smallpox nonexistent. In the colonial period three main urban centers served as agro-administrative centers for their corresponding rural population. In 1974 Ambato was a city of 77,955 inhabitants, Riobamba had 58,087 inhabitants, and Latacunga only 21,921 (Bromley, R.D.F., 1979:1980). (Figure 2.2). Today, these towns still serve as such centers.



Agro-administrative Centers:
Ecuadorian Highlands

Figure 2.2

The epidemiological profile of the indigenous population is dominated by infectious disease and problems of nutrition. Nevertheless, it seems important to emphasize that the causes of this pathology in social terms are partially different than in the case of subsistence agriculture. The nutritional problems are less dependent on a deficient control over nature than on the low wage level and the rupture of cultural food patterns (Laurell, A.C., 1981:17).

A population that is ill-fed cannot sustain disease infestation, nor can it work to capacity; with these considerations in mind, the implementation of a national development programs could provide a strong basis for the utilization of local endemic plant resources for national improvement. However, before this can be done, the government must acknowledge the existence and value of endemic cultigens as a national resource.

The interrelationship among endemic diseases, epidemics, and migratory patterns is further evidence for the development and reincorporation of underutilized highland areas for national agricultural production. As stated earlier, the variety of endemic cultigens, especially quinoa, are ideally suited to the harsh climate of the highlands.

National Plan for Ecuador 1980-1984

Bromley notes in his analysis of Ecuadorian development plans and planning, that they are disjointed, and that dependency is a common element of both. Dependency is seen not only in the nature of development and planning but also in the values and interests of the elite. Hence, development in Ecuador is really a case of changing relationships (Bromley, R., 1977:III). Under the best of

circumstances, Ecuador would be a difficult place to develop due to interregional rivalry, wide social and ethnic divisions, and economic instability.

Several general problems plague Ecuadorian development schemes. Initially, they were concerned with import substitution, but this action has not proved effective for the general good of Ecuador (Bromley, R., 1977:15). An overwhelming problem is the overemphasis on technical details and diagnostic statements and insufficient attention to social and political realities (Bromley, R., 1977:68). Another problem is lack of coordination among different levels of government, or worse between planning agencies and those responsible for implementation (Bromley, R., 1977:68). Development planning demands a high degree of economic expertise, bureaucratic coordination, and political support that most third world countries find difficult to achieve. This is certainly true of Ecuador. Planners in various countries in Latin America are technically competent with regard to western techniques. Many trained in the United States (Bottomly, A., 1972). However, technical perfection gives little guarantee of success. One of the more difficult problems in planning is controlling the private economic sector where the decision processes normally lie outside the domain of government. Finally, these plans show no real commitment to change or allowance for popular participation in the planning process, either at the national or the urban level (Bromley, R., 1977). Ecuador's development policies were spelled out in the 1973-1977 Plan Integral de Transformacion y Desarrollo. The objectives of the Plan were (1) to foster national integration; (2) to improve the living standards of the Ecuadorian population and, in particular, those of the poorest;

and (3) to expand production in order to provide productive employment to absorb new additions to the labor force. The basic instruments to achieve these aims were agrarian reform, the tax reform (sic), and the reform of public administration (The World Bank, 1979:45). The rhetoric and accompanying lack of achievement suggest that these plans often have more political than economic significance.

The failure of development plans in Ecuador is partly due to the "metropolitan attitudes and technocratic approach of the planners" (Bromley, R., 1977:72). An analysis of the details of some of the plans reveals one reason why they fail. The execution of the plan or project is left to the discretion of the private sector, which controls the technical skill to develop local programs by which the national scheme is implemented. This results in a de facto exclusion of all those individuals who are affected by the desires of the private sector and the elites of the region.

Ray Bromley presents a series of critiques on Ecuadorian development planning. One of his first syntheses, presented in his 1982 text, does not show a significant departure from his earlier work either in research or in any actual change in development planning in Ecuador.

In an economy such as Ecuador, distortions are the main price relations that generate costs, that although great, cannot be observed easily until they reach critical proportions. The mechanisms of adjustment are not usually directly connected to distorted price relations. There is reason to believe, for instance, that in Ecuador the main adjustment mechanism aside from distorted factor prices is the size and growth of the informal sector. But this is often

perceived by the authorities as the consequence of demographic and social factors outside the realm of macroeconomic policy decisions. Thus, policies to deal with problems of unemployment or under-employment have been centered on mitigating the worst consequences of the growth of the informal sector. Consequently, solutions have been of the marginal type. They have not faced the issues at stake. The existence of a double market for labor is incompatible with the objective of better income distribution and at best, grossly inefficient. A more definitive approach towards the elimination of unemployment is through slowing down the further growth of the informal sector by changing the relative prices of labor and capital. Measures in this direction will also help to increase integration of the informal sector into the market economy and may allow a more intensive use of Ecuadorian natural resources, such as land and raw materials for industry (The World Bank, 1979:41)

Lack of participation of the local residents that are affected by development becomes more complex when you include the regional differences of division of labor due to seasonal migratory patterns to the coast for work on plantations. This leaves women and children as the agriculturalists in any given region during these temporary but predictable population fluctuations (Whyte, W.F., 1978; Midstrand, C., 1976).

The situation is naturally compounded when the authors of any project proposal set to prove the validity of their own pet theory, rather than incorporating the needs of a specific region, and forcing a region into an artificial predetermined framework (Streeten, P., 1976). The all-encompassing aspect that permeates the inability of the formal power structure to use the knowledge of the informal sector

is that it appears to have been thwarted by the dependence of modern bureaucracy on our epistemological beliefs about objective knowledge. An understanding of, respect for, and development based on traditional knowledge would have to be rooted in an evolutionary epistemology, in a world view that directly clashes with the epistemology of modern science and of modernization as we have known it. Taking advantage of both objective and traditional knowledge would entail maintaining institutions based on conflicting epistemologies. While academics can conceive of multiple forms of knowledge and supporting belief systems, pluralism may be a luxury of contemplative minds in a protected social niche. Given the argument relating social organization to epistemological beliefs, one concludes that pluralism baffles bureaucracy (Norgaard, R.B., 1984:877).

Urbanism

The notion of urbanism refers to a state without regard to the time element; urbanism is structural and synchronic and refers to what it means to be urban. There is no adequate "theory" of urbanization or urbanism that can explain the Latin American, or any other case, nor is there likely to be one for some time (Butterworth, D., and Chance, J. K., 1981:ix).

The Indians generally live away from the non-Indian population and form Ecuador's lowest social and economic stratum. The principal concentrations of Indians in Ecuador are in the higher-altitude rural areas of the provinces of Imbabura, Cotopaxi, Tungurahua, Bolivar, Chimborazo, and Canar (Bromley, R.J., 1977:37).

Bromley and other authors have made much of the fact that the Indian population is forced to live outside of the urban centers.

They usually attribute this as an imposition of the Spanish colonial government; however, according to Inca traditions, no poor lived in the capital. Priests, important members of the elite and the royal lineages, and the women housed in the aqllawasi who wove, prepared chicha, and served in the feasts and ceremonies made up the majority of the population. Spaulding continues her argument by noting that the dominance of the Europeans in the Andes was a surface phenomenon, not penetrating deeply into Andean culture or social relationships for decades. The Spanish invaders were at first content to ride the surface of Andean society, supported by the local communities whom they permitted--in fact encouraged--to maintain the social relationships of production and political structures evolved over centuries. The Spaniards did not even, in most cases, seek to interfere much with the administrative structures established by the Inca rulers. They used those structures and profited by them, absorbing the flow of labor and the products of that labor that had once gone to the Inca state (Spaulding, K., 1984:96,108).

The European picture of a community as a nucleated group, generally a village, occupying a defined territory or geographical area, cannot be applied to the Andes. An Andean "community" did not look like that at all. The ideal described as "verticality", that is access to multiple ecological zones, each exploited or cultivated for particular goods or crops did not produce a nucleated village pattern. The village, a colonial creation, was a fixed territorial unit on the European model whose population might include members of different groups. Residents of a village did not usually constitute a land holding unit (Spaulding, K., 1984:43,46).

Butterworth and Chance (1981) present a similar example. Their research showed that the majority of the Indian population did not live in the city center; this was reserved for the Indian elites.

Summary

The pervasive element throughout the body of the literature review suggests that available knowledge concerning HPEC's is not well served if it does not acknowledge the socio-political environment and physical limitations in which that knowledge is to be used. Academic philosophical disputes with regard to objective and subjective reality do not recognize the impact that individual subjective values have on policy decisions. This is argued in the critique presented by Bromley on the Ecuadorian national development plan. Separation between the formal and the informal sectors, in the case of Ecuador, and many developing countries, is the result of subjective decisions. Illustrative of this are the objective data on Chenopodaceae that do not command the same interest as comparable data on wheat, corn, and soybeans. The Chenopodaceae are agricultural commodities that are not traded on the floor of the Chicago Board of Trade or the New York Commodity Exchange.

Chapter III

Research Methods

A. Introduction

The purpose of this chapter is to describe the three research methods employed in this study: the Delphi technique, participant observation, and library/archival research. Each research method is described in detail. Library research, and to a limited extent, archival research, was used to provide data on the colonial-urban historical context of this study. The chapter includes sections on: the Delphi technique, the empirical model, hypotheses, the sample design, the data collection instrument, and the statistical analyses.

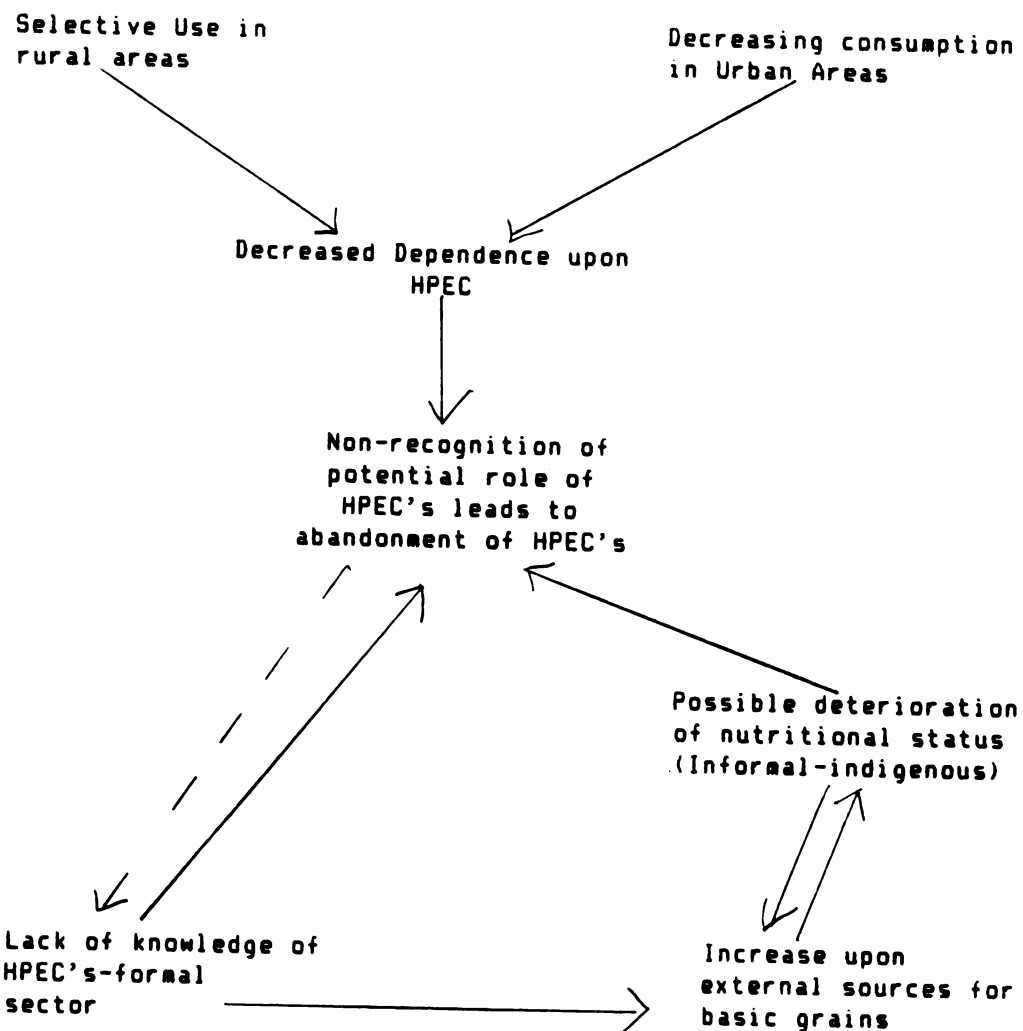
Before proceeding with the methods section, some terms that will be used throughout the text are defined:

knowledge: acquaintance with facts; range of information, awareness or understanding.

information: knowledge acquired in any manner.

data: facts from which conclusions can be inferred.

The diagram in Fig. 3.1 is a model representing the parts which constitute the whole of the problem. The problem, as stated in



Quinoa in the Informal Sector
Ecuadorian Highlands

Figure 3.1

Chapter I, is how to focus attention on quinoa and other HPEC's and how to communicate knowledge about non-traditional cultigens, to incorporate this knowledge into the formal agricultural sector planning process of Ecuador.

The primary tool used here is that of systems science as described by C. West Churchman 1968;1979 and Manetsch and Park 1982. Briefly, the systems approach is defined as a "problem solving methodology which begins with a tentatively identified set of needs and has as its result an operating system for efficiently satisfying a, perhaps redefined, set of needs which are acceptable or 'good' in light of trade-offs among needs and the resource limitations that are accepted as constraints in the given setting. There are two prominent attributes to this approach: 1) it overtly seeks to include all factors which are important in arriving at a 'good' solution to the given problem and 2) it makes use of quantitative models and often computer simulation of those models to assist in making rational decisions".

This consists of the notion that a problem should be conceptualized within the framework of the totality of those factors which affect the problem. This entails the use of both value and value free knowledge and information. The planner's first interest is to obtain information. Specifically, the presence of Chenopodium quinoa in the socio-cultural environment of the Ecuadorian Andes is vital information for gaining an understanding of the context in which events occur. The information should be used by planners to deliberately incorporate decision rules (prescriptive knowledge) for the use of these plants and others of the informal economy into the formal agricultural economic section of the national plan.

A word on measurement is appropriate here. Many developing countries lack a sufficiently large or sophisticated data base that can serve as the basis for making sound predictions of change through time. Therefore, in order to conduct pragmatic research, it is often necessary to employ non-quantitative research methods. Given these limitations, the researcher will employ the strategy of "limiting factors intervention". The strategy takes advantage of the principle that it is not necessary to eliminate all limiting factors before starting an action program. Overcoming obstacles builds momentum so that the field of forces, the components of the system, at later stages may be markedly changed from when the research was initiated. Success with this strategy depends on its flexibility and creativity, and the ability to build structure into unstructured situations (Foote Whyte, W., 1978), and information concerning factors that cannot be controlled.

The use and production of HPEC's have received intermittent attention in the past. With continuing and current massive crop failures due to drought in Ecuador induced by the El Nino current and lack of rainfall in Sahelian countries of Africa, renewed interest in HPEC's has begun to surface. Research on HPEC's in the past primarily has been disciplinary, however, sources of criticism have stated that research in this area needs to be problem-solving, and multi-disciplinary in nature. The work that relates directly to Ecuador and HPEC's is limited. Most studies relate to other Andean nations and to the varieties of HPEC's that are cultivated in those nations. Chapter II highlights those studies that have a close association with the highland environments in Ecuador.

In order to determine the extent to which these attitudes (values defined in Chapter I) are still extant in the formal sector, the author conducted short open-ended conversations by telephone, in 1983 and 1986, with individuals who are in positions to set the tone for monetary allocations for research and development in international agencies. If permission was granted to record the sessions, then a content analysis of the responses was incorporated into a dynamic model of the informal sector.

The major purpose of the three research methods used in this study is to identify the extent to which knowledge of HPEC's by the international scientific community may influence economic policy decisions in developing nations that involve this group of non-traditional crops.

B. 1. The Delphi Technique: Overview

Techniques for technological forecasting are auxiliary aids to decision-making, which normally have to be based on broader information than can be provided by these techniques.

The title "Delphi" comes from the ancient Greek Oracle at Delphi, which gave out forecasts of future events based on the analysis of bird entrails and other such devices. The forecasts, however, were such that they could be interpreted in several different, and even contradictory ways. The founders of the Delphi method at the Rand Corporation obviously had not intended to give all the resultant connotations to their technique, meaning it to be strictly a clever name for a forecasting technique.

Delphi is not only a forecasting technique; it is an intuitive technique. Such a technique permits random access at all levels. The Delphi technique is used for the unbiased selection of social and

other high-level goals, possibly aided by scenario-writing or operational models in the economic, political, and social areas (Jantsch, E., 1972:157,169).

The broadcasting of broad social goals and ethical patterns of the future is not a completely hopeless undertaking. Schemes to improve intuitive thinking to this end, for example the "Delphi" technique, and to stimulate systematic anticipation and evaluation of future goals for the sake of present as well as future action.

The Delphi procedure is characterized by three features which distinguish it from the usual methods of committee interaction: (1) anonymity, (2) iteration with controlled feedback, and (3) statistical response. The Delphi method usually consists of four rounds:

- round 1: the questionnaire is completely unstructured and open-ended.
- round 2: the panelists are presented with the combined list of events or factors and asked to estimate the levels of each.
- round 3: the panelists are presented with the events or factors, statistical description of panel estimates, and summaries of arguments.
- round 4: the panelists are again given a list of events, statistical description of the estimates, and arguments on either side. They may or may not take these into account in the process of making a new forecast. They may or may not be asked to provide new arguments, depending on the needs and desires of the director.

The Delphi technique can also be used in a condensed version. This proves to be useful when participants are very pressed for time. The four step procedure is collapsed into two rounds by providing the list of events beforehand to the panelists so they could proceed directly to two rounds of forecasting. In this second condensed version, the panelists are asked to give a "confidence rating" to their expertise on each question. This is done on a scale from 0 ("this is a sheer guess") to 3 ("I would be prepared to defend this opinion before a professional audience"). The resulting "vote" of each panelist is weighted by 0, 1, 2, or 3 rating respectively. This approach provides more credence than a verbal comment to the estimates supplied by panelists with such a wide variety of backgrounds and experience as applied to the wide variety of questions. The methodology for this consolidation technique was established in a study for the Rand Corporation in 1973 by L.T. Thompson (Dickey & Watt, 1978:217-233).

The Delphi technique is especially useful in the examination of a problem such as the one at hand. The incorporation of quinoa into the formal economic sector requires the expertise of individuals from a variety of disciplines, plant genetics and systems science, for example, that do not share material or problems. However, with this technique, the expert opinion of a variety of disciplines is necessary for the sound and successful incorporation of new element in a nation's economy.

Due to the explosive growth in the total store of human knowledge we have had to divide, sub-divide and further divide the specializations into which we package our knowledge. Few people are experts in even one field of science or technology; no one is master

of all. In forecasting for technology we must widen our considerations to include many related areas of economics, politics and sociology, each with its own group of specialists possessing detailed knowledge about one or a few areas of expertise. The new element introduced by systematic forecasting is that the very real contributions of experts can be structured in a way that enables the user, inevitably a layman in much of his activity, to forecast within the broader perspectives of his study. Thus the forecaster must establish the sources of knowledge and expertise and use this knowledge and the judgments of the experts in such a way that the forecast reflects their many and complex mutual interactions (Jones, H. & Twiss, B.C., 1978:225-226). The Delphi technique is very flexible, thus it can be applied in a wide variety of situations without changing its original purpose, which is to elicit current levels of knowledge from the respondents in order to make projections for future use of a given commodity. In the present study the Delphi technique was used as an exploratory technique in one round. This was done in order to get a fast overview of the range of knowledge of institutional decision-makers with regard to HPEC's.

The Delphi technique is not without problems. Some of these are: inadequate representation; deference to authority; sociological factors such as: persuasiveness, reluctance to modify views previously expressed, and the bandwagon effect. These problems however are not unique to the Delphi technique. Despite its limitations, it is particularly useful when the data for the application of quantitative techniques are lacking.

In view of the subjective nature of the inputs, the Delphi technique should be used only where objective data are unobtainable or

as a cross-reference to forecasts obtained in another way. Delphi is more useful when it forms part of a more detailed study directed to a specific problem; in such cases it will be used in conjunction with other techniques as a reinforcing technique (Jones, H. & Twiss, B.C., 1978:227-228). There are no data on the extent of knowledge, value or value-free, among decision-makers concerning HPEC's. The Delphi technique is used to obtain data from a select group of persons. The data gathered will be analyzed along with data obtained by participant observation and library/archival research.

Given the possibility that permission was not given for open-ended interviews in some cases, the Delphi technique was uniformly applied in order to obtain the necessary consideration of the current decision makers.

2. The Empirical Model

The empirical model consists of a decision function for agricultural policy. The conceptual model suggests the variables that should enter this function. The empirical specification of the decision function is expressed as indices and each is positively correlated with the others.

$$I \quad ECI = a_0 + a_1 QKI + a_2 QEI + a_3 QRI$$

$$II \quad QKI = b_0 + b_1 QEI + b_2 QRI + b_3 ECI$$

$$III \quad QRI = c_0 + c_1 QKI + c_2 QEI + c_3 ECI$$

$$IV \quad QEI = d_0 + d_1 QRI + d_2 QKI + d_3 ECI$$

where: QKI=knowledge index; QEI=environmental index; ECI=economic index; QRI=research index; a's, b's c's, and d's are parameters to be estimated.

The indices are the total means of the responses to the questionnaire. Each index is composed of all of the questions that have a direct relationship to quinoa knowledge, environment, economics and research. The indices are meant to represent and thereby elicit both positive and normative knowledge.

The predominant assumption in the problem statement of this dissertation, Chapter I, is that lack of knowledge of the agricultural potential of HPEC's by the participants in the formal sector in Ecuador, and by the international scientific research community, has prevented innovative exploration and experimentation with these agricultural commodities in Ecuador.

3. Hypotheses

The previous section identified the variables. The following hypotheses are developed to look at the theoretical relationship between one or more independent variables and the dependent variable.

I Greater knowledge of HPEC's by the international scientific community effects higher production and marketing of HPEC's.

II Greater knowledge of HPEC's (QKI) by the international scientific community influences agricultural economic (ECI) decisions in developing nations.

III Greater knowledge of the Andean environment (QEI) influences knowledge about HPEC's.

IV Economic considerations have greater salience than knowledge about HPEC's for agricultural policy formulation in LDC's.

V Lack of knowledge of HPEC's by the international scientific community decreases research initiatives in developing nations.

4. The Model

A simple model of decisions on the influence of the international scientific community on third world planning of agricultural policy is summarized. The model emphasizes the role of relative influence of the international scientific community for determining the agricultural planning policy in a developing nation.

The international scientific community employs a stock of decision-making skills obtained from schooling and past experience, a stock of accumulated information, and a flow of new information. The major sources of new information can be grouped as (a) academic journals that supply information specific to HPEC's, (b) mass-media: radio, TV, newspapers and magazines, (c) other scientists (Huffman & McNulty, 1985:761-762).

This section presents details on: the sample design; the data collection instrument; and the statistical analysis.

5. The Sample Design

Data were collected by survey from a group of professionals consisting primarily of scientists, consultants, and administrators, i.e. the "internationalists". The individuals contacted in this survey constitute an elite population. They were selected by virtue of the position they hold in their respective agencies.

The ability to contact prospective respondents who are members of elite populations needs further exploration. What research does exist indicates that elites such as political figures, lawyers, Nobel Prize winners, and so forth are more amenable to interviews in a face to face context than by either mail or telephone (Dexter, 1970; Dentitch, 1972; Zuckerman, 1972; Becker and Meyers, 1974; in Frey, J.H.,

1983:43). Requests by mail or telephone often end up diverted by "gate-keepers" or others who guard the time and schedule of the potential respondent. Those who have conducted this type of research assert that it is often better to "appear" at the respondent's office without an appointment. Once the respondent grants the interview, he or she will usually readily answer questions. Apparently, the best role for a mailing and/or a telephone call with these populations is to arrange appointments. As stated above, mail and telephone appeals may be very practical for research on elites (Frey, J.H., 1983:43). The Delphi technique is especially useful for work with small elite samples.

The responses of these individuals constitute "expert opinion". The judgments and estimates made by people who have spent much of their time working with a particular subject and who have gathered much general information that has been filtered through their minds and stored in their memories. Expert opinion is indispensable when the judgment involves human values. The ultimate judgment of value has to be made by noted scholars in various fields; what they judge as valuable is, by definition. Human bias, on the part of the researcher, expert opinion, in the sample exists. Bias can be both consistent and variable. Bias is a systematic tendency to deviate from the true value in one direction (Simon, J.L., 1969:83-84;274).

6. The Data Collection Instrument: The Questionnaire

The design selected for this portion of the study is a cross-section survey with voluntary participation that uses the Delphi technique. Seventy questionnaires were mailed on June 19, 1986. (See Appendix C). A total of thirty-four were returned by September 23,

1986. The data, for the Delphi portion of the research methods were analyzed at one time.

The questionnaire was divided into three parts: biodata, grain preference and a group of questions that dealt with research, environment, economics and general knowledge that relates to quinoa and other high-protein endemic cultigens. The biodata were requested in order to determine the individual and institutional profile that makes decisions. Grain preference was obtained to determine if personal grain preference had any influence on the knowledge base that relates to HPEC's. One intention of the Delphi survey was to determine how much, if any, effect personal grain preference or knowledge of HPEC's had on the knowledge of a select group of scientists in reference to the economic aspects of HPEC's and its use as a commodity in LDC's. It was initially assumed that personal grain preference would affect both awareness of HPEC's and the economic aspects of the commodity that had to be addressed in order to stimulate use of HPEC's. Questions that related to knowledge about quinoa and other HPEC's were gathered in order to see if knowledge in any of the four knowledge areas influenced individual proposal approval or the direction of institutional policy with reference to the nations that cultivate these crops.

For this survey the range of responses used is: 1=strongly disagree, 2=disagree, 3=indifferent, 4=agree, 5=strongly agree. An exploratory preliminary survey was conducted in one round. This is the first attempt to do this and to compare the results with the findings in current literature and the results of this author's fieldwork.

The questionnaire was designed to elicit the extent and nature of the respondent's knowledge about HPEC's. Most important was to see if the group profile and their own assessment of their ability to influence policy in the developing world is at all related to their specific knowledge on HPEC's. This portion of the study focuses on the following general factors as the independent variables:

Knowledge about HPEC's

Economic knowledge

Research knowledge

Knowledge of the Andean environment.

The dependent variable in this study is: the extent to which the international scientific community can influence policy formulation in the developing world. For the purpose of operationalizing the theoretical concepts, this study specifies empirical observations that may be used as predictors for future use of HPEC's in the economic formal sector of Ecuador.

Indices were developed from the answers provided by the respondents to facilitate analysis and to limit multicollinearity. Questions included in each category index are presented below:

Indices of Knowledge

QKI=Quinoa knowledge index

2. Quinoa is resistant to frost and drought.
3. Quinoa grows in nutrient poor soils.
4. Quinoa grows in high altitude soils.
5. Quinoa is insect resistant.
6. The protein quality of quinoa is comparable to whole cow's milk.
7. Wheat, quinoa, potatoes and rice are native to the Americas.
8. It is generally agreed by animal scientists that saponins retard growth in animals.
9. Highland Quechua and Aymara speaking populations obtain the

- majority of their calories from tubers and chenopods.
10. *Chenopodium quinoa* is high in lysine.
 13. Wheat, corn and barley are nutritionally inferior to quinoa and canihua.
 20. The higher the protein content of a grain the lower the yield.

QEI=Environmental knowledge index.

11. High altitude soils in the Andes are characterized as low in phosphorus.
14. The great variability and general poor quality of Andean high altitude soils require crops of comparable adaptability.
21. In regions characterized by poor soils, poor farmers and limited acreage per farmer, quinoa could provide income comparable to soy beans.

ECI=Economic knowledge index

12. Current wheat production in Andean nations can meet local demand.
16. Use of chenopodaceae in livestock feeds would provide an incentive for local farmers to increase current crop production of chenopods.
17. It is easier to develop a market for chenopodaceae in the developed world than in the developing world.
18. Increase in the market value of quinoa should generate interest in the production of the crop.
19. The use of quinoa by-products should significantly decrease the need for importation of industrial detergents and pesticides.

QRI=Research knowledge index

15. Long term research investment on high protein endemic cultigens benefits both developed and developing nations.
22. Research already exists on the agronomic characteristics of the Chenopodaceae.
23. The material on Chenopodaceae is not widely disseminated.

There is a statistical relationship (correlation) but one cannot firmly ascertain that one set of variates is predictable from another set of variates (Hammond, R. & McCullagh, P., 1980:247). The use of indices allows all related variates to be grouped and thus allows for more accurate prediction of change due to a specific variate that is not due to chance.

Ordinary least squares was used to estimate the equations on page 60. The TSP computer programme will be used to do the estimations.

The use of ordinary least squares has two distinct advantages:

1) It is possible to predict the value of one variable from a given value of the other by using the equations directly; it is not necessary to draw lines or measure anything on a scattergram.

Similarly, residuals can be calculated rather than measured. Results are consequently more accurate.

2) The way in which 'least squares' regression lines best fit the data is known exactly: they are calculated to minimize the sum of the squares of residuals, and therefore the total variance of actual data about the regression line. It is in terms of 'least squares' regression lines, and only these, that the amount by which one variable is said to be 'statistically explained' by the other can be determined precisely (Hammon, R. & McCullagh, P., 1980:260).

7. The Statistical Analysis

a) Data Analysis Approach

Data analysis measures degree relationships among variables. The focus is the relationship between the independent variables and the extent to which knowledge of HPEC's by the international scientific community may affect policy concerning these commodities in the Andean developing nations, as stated in the hypotheses.

b) Regression by the ordinary least squares method

The most widely used technique for deriving regression lines from data on an interval scale is the ordinary least squares method. It is more rigorous than the semi-averages method although it involves more

lengthy calculations. TSP (Time Series Program), is a computer program which was used for purposes of estimation, testing hypotheses, predictions and providing descriptive statistics such as correlation coefficients, standard errors, and means. The use of TSP (Hall, B., & Hall, R., 1980) program, is an excellent technique to use with a limited number of observations. It is an econometric computer program which uses ordinary least squares. As an analytical technique, TSP, complements the Delphi technique. Both are used to predict future values. Least squares has two main advantages: 1). It is possible to predict a value of one variable from a given value of the other by using the equations directly; and 2). the way in which least squares regression lines best fit the data is known exactly. It is in terms of these least squares regression lines that the amount can be determined precisely by which one variable is said to be statistically explained by the other. The amount of explanation can be determined easily: it is simply the square of the correlation coefficient (r^2), and is called the coefficient of determination (Hammond & McCullagh, 1980:260).

There is a direct relationship between r^2 and F:

$$F = \frac{r^2 / (k-1)}{(1-r^2) / (n-k)}$$

The larger the r^2 , the greater the F value.
 k = # of parameters
 n = # of observations.

A change of one unit in the independent variable will change the dependent variable by the current value in the independent variable and in the same direction.

C. 1. Participant Observation: Overview

Another research method used in this investigation is participant observation. It is most useful if the investigator immerses himself in the community under study. The researcher normally learns the local language and develops close associations with the population. This author already spoke Spanish and learned Quechua during her stay in Ecuador (1977-1978; 1982). In short, the researcher becomes a "participant" in the community and observes the manifestations or socio-cultural characteristics of the people (Rhoda, R., 1983:42).

The advantage of participant observation is that it allows the researcher to develop a range of simple questions that can be administered in the form of informal conversations with primary producers, retailers and farmer-retailers in the highland markets of Ecuador. Most of these individuals belonged to the indigenous communities of the Ecuadorian highlands.

2. The Sample

The indigenous population of the High Andes has been subjected to a variety of "project groupies". This has created in the highland population a great distrust for anything that reminds them of government, national or international intervention into their local affairs (Luna, Jose. Personal communication, 1982). They are most likely to trust individuals who take time to understand their concerns, rather than comply to someone else's research priorities. Participant observation allows the researcher to experience those values, that are perceived to be right or wrong, from the perspective of the target population. If local beliefs are in conflict with national policy as stated in the national plan the goals of the plan

will not come to fruition. This may be to the disadvantage of both nation and individual in the long run. Values that are important to the local population should constitute a component of any scheme that is devised to represent the Andean region. (Value and value-free knowledge are discussed in Chapter 1.) More important is the ability of the researcher to see and experience how values are expressed in the informal and the formal agricultural economy.

Initial field work indicated that Ecuadorian institutionally-affiliated researchers, i.e. participants of the formal sector, felt that increased interest in HPEC's in Ecuador would be stimulated by the scientific community external to Ecuador. As a result, a group of international scientists with institutional affiliation were selected in order to determine: 1. Does this community feel that it influences policy and projects in developing nations and 2. Does their knowledge of HPEC's influence their decisions?

The fieldwork period, July 18, 1982 - September 18, 1982, in Ecuador was divided between participation in meetings in INIAP with Nestle International, strategy meetings with the endemic crop research group and field trips with the researchers at INIAP that dedicated their time to HPEC's. The HPEC research group included an exchange scientist from Bolivia who had dedicated his research efforts to endemic cultigens in Bolivia. This team was formed as a result of a research initiative in Canada and FAO-Rome.

The informal sector described in Chapter I, is that part of the economy that has no formal relationships with the formal sector. The formal sector constitutes government, banking, and large commercial enterprises (Bor, W., 1982; Rhoda, R., 1982; Hernandez, S., 1982). Participant observation allows the researcher to include important

data of the informal sector. Ordinary research methods that rely solely on official government data do not allow such an inclusion. The reason is quite simple: most governments do not keep statistics on the activities of the informal sector. As a result these communities are represented by a set of data that bear little if any relationship to the daily activities of the highland population.

3. Participant Observation: Another Information Technique

The remainder of the research period in 1982 was spent in the highland markets. A portion of the market visits was dedicated to the identification of market retailers that marketed quinoa and other HPEC's.

A large portion of the time spent in the highland markets was dedicated to the identification of those individuals who cultivate and market HPEC's. To these individuals the same range of questions was posed. The questions were presented orally in a combination of Quichua and Spanish. Usually, the women had less familiarity with Spanish than the men. Women, however, were the the majority of the agricultural-retailers in the markets.

These questions were:

1. Where do you grow your crop?
2. Are there more persons in that region that also grow the crop?
3. What is the price of quinoa? Washed? Unwashed?
4. Do you sell quinoa?
5. Do you consume quinoa?
6. Why did you stop growing quinoa? (If they indicated that no longer grow the crop for market.)

Another aspect of the market visits was the identification of grain wholesalers that dealt in quinoa.

D. Library & Archival Research

Library and archival research was carried out in Quito, Ecuador and East Lansing, Michigan to provide background material on the colonial urban context and on the agronomic characteristics of quinoa. These two research methods lend historical continuity to the problem from a colonial to a contemporary urban perspective (the concept of urbanism) and from a positivistic perspective, the agronomic.

E. Summary

The research methods used in this study, the Delphi technique, participant observation, and library research, were used to reinforce each other. Participant observation is particularly useful for work with the Quechua community and with the scientists in INIAP, who did research on HPEC's. In both instances, informal conversations and observations lessened or eliminated the threat from an outsider. The Delphi technique allowed the researcher to gain rapid access to the knowledge base of an elite group. Library research supported and in many cases confirmed field observations.

Chapter IV

Results and Discussion

A. Introduction

The results and discussion of the three research methods, the Delphi technique, participant observation, and library/archival research are presented in this chapter.

B. The Delphi Technique: the questionnaire

1. Biodata Profile.

Part of the survey consisted of a series of questions designed to gain insight on the institutional affiliations of the respondents as well as profile of the respondents. The results are in Table 4.1.

2. Grain Preference

It was initially assumed, by the author, that personal grain preference would affect both awareness of HPEC's and the economic aspects of the commodity that had to be addressed in order to stimulate use of HPEC's. Personal grain preference had a negligible effect on any of the knowledge indices (see tables D.1-D.6 in Appendix D; Table 4.2 in this chapter). The results indicate that personal grain preference has no effect on either awareness of HPEC's or the knowledge of economics needed to augment the research of HPEC's. The

results of the survey of the individual respondents indicate that knowledge in one area has a positive significant effect on another area of knowledge.

3. General Knowledge on HPEC's

Consistent in the regressions is explanatory effect of Q5 (quinoa is insect resistant) on all of the knowledge indices. This may indicate that specialized knowledge in one area contributes to generalized knowledge in a specialized topic such as HPEC's. Q16 (use of chenopodaceae in livestock feeds would provide an incentive for local farmers to increase current crop production of chenopods) is another response that followed the same pattern of Q5.

The respondents, as a group, did not have much knowledge in any of the areas. There were, however, individuals within the group that were highly knowledgeable in all areas. Initial perusal of the questionnaire indicated that knowledge in one area was indicative of knowledge in the other questions. As a group the scores indicate which area of knowledge, quinoa, environment, economic or research has to be targeted in a communications strategy in order to facilitate accessibility to information. More specific analysis will follow in this chapter in Tables 4.3-4.6.

Table 4.1

PROFILE OF THE DELPHI RESPONDENTS

		%
Degree	Ph.D.	94.1
	Other	5.9
Degree Obtained	USA	97.1
	Foreign	2.9
Country of Origin	USA	85.0
	Foreign	15.0
# Years in Developing Nation	<3	29.4
	4-6	23.5
	7-9	2.9
	>9	35.3
	No response	8.9
# of Years in Position	<3	40.6
	4-6	21.9
	7-9	18.8
	>9	18.7
Male		100.0
Determine Proposal Approval	Yes	76.5
	No	23.5
Influence Policy of Developing Nations	Yes	70.6
	No	29.4
Sources of Budget	Public	61.8
	Private	5.9
	Both	32.3
Agency	Governmental	35.3
	Non-govern. for profit	11.8
	Non-govern. non-profit	50.0
	No response	2.9

Table 4.1 shows that the characteristics of this group are individuals in a decision making capacity who feel that their decisions influence policy in developing nations. Key features of

their profile are: forty percent have held their position less than three years; thirty-five percent have lived in developing countries for more than nine years; twenty-nine percent have lived in developing countries less than three years; seventy-six percent feel that they determine proposal approval and seventy percent feel that they influence policy in developing nations. The predominant agency profile is one that is non-governmental non-profit (50.0%) that obtains most of its budget (61%) from public sources. One hundred percent of the respondents were male.

Table 4.2 shows the results of the correlation coefficients between grain preferences and the knowledge indices. Thirty one coefficients out of thirty six have values less than .6. That is the majority of the correlations are low, indicating that there is no strong association between grain preferences and the knowledge indices. This conclusion is in agreement with the previous discussion in the beginning of this chapter. That is that personal grain preference has no effect on either awareness of HPEC's or any of the knowledge indices.

**Table 4.2 The Association Between Grain Preference and the
Four Knowledge Indices (Correlation Coefficient)**

Knowledge Index	QKI	ECI	QRI	QEI
Grain Preference				
Wheat (Q1A)	.588	.563	.565	.593
Rice (Q1B)	.344	.340	.298	.352
Corn (Q1C)	.721	.704	.668	.727
Rye (Q1D)	.717	.707	.681	.715
Quinoa (Q1E)	.768	.755	.657	.748
Oats (Q1F)	.643	.603	.640	.644
Millet (Q1G)	.512	.477	.419	.474
Sorghum (Q1H)	.534	.508	.437	.518
Amaranth (Q1J)	.586	.575	.493	.529

In the following tables 4.3-4.6 the four dependent variables are derived from the four indices of knowledge. These variables are: quinoa knowledge (QKI), environmental knowledge (QEI), economic knowledge (ECI) and research knowledge (QRI). Indices are a good way to avoid or limit the problems of multicollinearity. Multicollinearity is not a condition that either exists or does not exist in economic functions, but rather a phenomenon inherent in most relationships due to the nature of economic magnitudes. There is no conclusive evidence concerning the degrees of collinearity which, if present, will affect seriously the parameter estimates (Koutsoyiannis,

A., 1978: 233). So far the results have not proven to be sensitive to changes in sample size, therefore multicollinearity in this case should not be a major concern. Multicollinearity is the high degree of correlation among some of the independent variables in the regression equation. It leads to inefficient estimates of the parameters and it makes the parameter estimates very sensitive to small changes in the model specification or in the sample size. If independent variables are correlated but not too much, then including them both in the same multiple regression will provide unbiased estimates of their regression coefficient that are superior to the estimate provided by simple regression which suffers from specification bias. Specification bias is the bias that results from any specification error such as including irrelevant variables in the model, omitting relevant variables from the model, using the wrong mathematical form, or misspecification of the number of equations in the model. Specification bias can usually be overcome by incorporating the heretofore excluded variable in a multiple regression (Krueckeberg, D. A. & Silvers, A. L., 1974:186). Most economic or social variables are correlated to some degree.

Tables 4.3-4.6 represent the results of the four knowledge indices.

Table 4.3

Estimates of Multiple Regressions

Expected Change Given Decision
Based On

#	Dependent Variable	Constant	Independent Variable		R^2	F
1	ECI	= .052 (.391)	+ .634QKI (3.257)	+ .208QEI (1.191)	+ .019QRI (.186)	.918 113

#Numbers in parentheses are t statistics

ECI=economic index

QKI=quinoa index

QEI=environmental index

QRI=research index

The multiple regression analysis, equation 1, Table 4.3, indicated that quinoa knowledge (QKI), environmental knowledge (QEI), and research knowledge (QRI) explain 91.8 percent of the changes, at 1 percent level of significance, in economic knowledge (ECI). The constant term, in each of the equations, is the value of the dependent variable when all independent variables are set equal to zero. r^2 is the coefficient of determination, it shows the percent of change in the dependent variable that is explained by the changes in the independent variable. The F statistic tests the significance of the combined effect of the independent variables on the dependent variable. The F statistic (113) indicated that this effect was not due to mere chance.

Equation 1, Table 4.3 indicates that QKI, QEI, and QRI have a statistically significant effect, at .05 level of significance, r^2 91.8 percent, F 113, on ECI. The effect is positive and it varies from one independent variable to another. QRI (.019) has the smallest effect on ECI, while QKI (.634) has the largest effect on ECI. R^2 shows that 91.8 percent of the changes in ECI are explained by the

changes in QKI, QEI, and QRI. 8.2 percent of the changes in ECI are due to other variables not included in the model.

In Table 4.3 the F statistic shows that the effect of the three indices on the ECI index is not due to chance, so that an increase in QKI, QEI, or QRI will have a predictable positive effect on the ECI index. Research (QRI), environmental (QEI), and quinoa knowledge (QKI) indices have varying explanatory effects on the economic knowledge index. Of these only the quinoa knowledge index (QKI) has a significant ($p \leq .05$) predictable effect on the economic knowledge index (QKI).

This shows that if the group, in its decision making capacity, is well informed on quinoa knowledge, the likelihood that it will make an appropriate decision that involves quinoa and other HPEC's will be the right decision. This is indicative of the nature of prescriptive knowledge. This also shows that a right decision also requires knowledge in environmental and research knowledge. If a communications strategy were designed using this equation the emphasis would be placed on information dealing with the environment and research.

Table 4.4

Estimates of Multiple Regressions

Expected Change Given Decision
Based On

#	Dependent Variable	Constant	Independent Variable		R ²	F		
2	QKI	=	.090 (.837)	+ .432QEI (3.586)	+ .163QRI (2.111)	+ .412ECI (3.257)	.957	227

 *Numbers in parentheses are t statistics
 ECI=economic index
 QKI=quinoa index
 QEI=environmental index
 QRI=research index

The multiple regression, equation 2, Table 4.4, indicated that environmental, research, and economic knowledge explain 95.7 percent of the changes in quinoa knowledge. The F statistic (227) indicated that this effect was not due to mere chance.

Equation 2, Table 4.4 indicates that QEI, QRI, and ECI have a statistically significant effect, at .05 level of significance, r^2 95.7 percent, F 227, on QKI. The effect is positive and it varies from one independent variable to another. QRI (.163) has the smallest effect on QKI while QEI (.432) has the largest effect on QKI. R^2 shows that 95.7 percent of the changes in QKI are explained by the changes in QEI, QRI, and ECI. 4.3 percent of the changes in QKI are due to other variables not included in the model.

In Table 4.4 the F statistic shows that the effect of the three indices on the QKI index is not due to chance, so that an increase in QEI, QRI, or ECI will have a predictable positive effect on the QKI index. Research (QRI), environmental (QEI), and economic (ECI) indices have varying explanatory effect on the quinoa knowledge index.

Of these the economic and the environmental indexes have a significant ($p \leq .05$) predictable effect on the quinoa knowledge index (QKI).

This shows that if the group, in its decision making capacity, is well informed on the environment (QEI) and the economic status (ECI) of Ecuador, the likelihood that it will make an appropriate decision that involves quinoa and other HPEC's will be the right decision. This is also indicative of the nature of prescriptive knowledge. Prescriptive knowledge is knowledge about what ought or ought not to be done. Solutions to problems require prescriptive knowledge. The solution to a problem can be prescribed as an action which "ought to be" put into effect. Once a solution is found, we also have prescriptive knowledge about "what ought not to be done" in order to solve a problem (Johnson, G.L., 1986:16).

If we want to increase awareness of quinoa knowledge (QKI) the best way to do that is to increase awareness in QEI (environment), QRI (research), and (ECI) economics. We know from our sample that if the group is knowledgeable in QEI, QRI, and QRI, these areas have a measurable predictable influence on QKI.

Table 4.5
Estimates of Multiple Regressions
Expected Change Given Decision
Based On

#	Dependent Variable	Independent Variable		R ²	F
		Constant	Variable		
3	QRI	= -.007 (-.033)	+ .791QKI + .266QEI + .060ECI (2.111) (.850) (.186)	.856	59

 *Numbers in parentheses are t statistics
 ECI=economic index
 QKI=quinoa index
 QEI=environmental index
 QRI=research index

The multiple regression, equation 3, Table 4.5, indicated that environmental, research, and economic knowledge explain 95.7 percent of the changes in quinoa knowledge. The F statistic (227) indicated that this effect was not due to mere chance.

Equation 3, Table 4.5 indicates that QKI, QEI, and ECI have a statistically significant effect, at .05 level of significance, r^2 85.6 percent, F 59, on QRI. The effect is positive and it varies from one independent variable to another. ECI (.060) has the smallest effect on QRI, while QKI (.791) has the largest effect on QRI. R^2 shows that 85.6 percent of the changes in QRI are explained by the changes in QKI, QEI, or ECI. 14.4 percent of the changes in QRI are due to other variables not included in the model.

In Table 4.5 the F statistic shows that the effect of the three indices on the QRI index is not due to chance, so that an increase in QEI, QKI, or ECI will have a predictable positive effect on the QRI index. The constant term is negative but not significantly different from zero. This indicates that QRI is zero if QKI, QEI, and ECI are set to zero. Quinoa knowledge (QKI), environmental (QEI), and economic (ECI) indices have varying explanatory effect on the quinoa research index. Of these only the quinoa knowledge index has a significant ($p \leq .05$) predictable effect on the research index (QRI).

This shows that if the group, in its decision making capacity, is well informed on quinoa knowledge in Ecuador, the likelihood that it will make an appropriate decision that involves quinoa and other HPEC's will be the right decision. This is also indicative of the nature of prescriptive knowledge.

Table 4.6

Estimates of Multiple Regressions

Expected Change Given Decision
Based On

#	Dependent		Independent		R^2	F
	Variable	Constant	Variable			
4	QEI	= -.017 (-.125)	+ .088QRI (.850)	+ .693QKI + .216ECI (3.586) (1.191)	.933	140

#Numbers in parentheses are t statistics

ECI=economic index

QKI=quinoa index

QEI=environmental index

QRI=research index

The multiple regression, equation 4, Table 4.6, indicated that quinoa, research, and economic knowledge explain 93.3 percent of the changes in environmental knowledge. The F statistic (140) indicated that this effect was not due to mere chance.

Equation 4, Table 4.6 indicates that QEI, QKI, or ECI have a statistically significant effect, at .05 level of significance, r^2 93.3 percent, F 140, on QEI. The effect is positive and it varies from one independent variable to another. QRI (.088) has the smallest effect on QEI while QKI (.693) has the largest effect on QEI. R^2 shows that 93.3 percent of the changes in QEI are explained by the changes in QKI, QRI, or ECI. 6.7 percent of the changes in QEI are due to other variables not included in the model.

In Table 4.6 the F statistic shows that the effect of the three indices on the QEI index is not due to chance, so that an increase in QKI, QRI, and ECI will have a predictable positive effect on the QEI index. The constant term is negative but not significantly different from zero. This indicates that QEI is zero if QRI, QKI, and ECI are

set to zero. Research (QRI), quinoa knowledge (QKI), and economic (ECI) indices have varying explanatory effect on the environmental index. Of these only the quinoa knowledge index has a significant ($p \leq .05$) predictable effect on the environment knowledge index (QEI).

This shows that if the group, in its decision making capacity, is well informed on quinoa in Ecuador, the likelihood that it will make an appropriate decision that involves quinoa and other HPEC's in the environment will be the right decision.

Table 4.7 Summary of Probabilities of Tables 4.3-4.6

Dependent Variable	Independent Variable	SLS		R ²	F [‡]	F	Tests			
		t	t				t	t	t	t
		.95	.99				.95	.99	.95	.99
ECI	QKI	+	+	.918	113	2.92	4.51	1.69	2.44	3.25
	QEI	-	-							1.19
	QRI	-	-							0.18
QKI	QEI	+	+	.957	227					3.58
	QRI	+	-							2.11
	ECI	+	+							3.25
QRI	QKI	+	-	.856	59					2.11
	QEI	-	-							.85
	ECI	-	-							.18
QEI	QRI	-	-	.933	140					.85
	QKI	+	+							3.58
	ECI	-	-							1.19

 ECI=economic index
 QKI=quinoa index
 QEI=environmental index
 QRI=research index
 + =significant
 - =not significant
 ‡ =estimated
 SLS=statistic level of significance

The tabulated $F_{.05}(3,30)=2.92$. Since calculated F statistics in Table 4.7 are greater than 2.92, we conclude that there is a regression relation between QKI and the independent variables (QRI, QEI, and ECI). Thus, the p-value for the test is less than 0.001 because $F(.999;3,30)=7.05$.

According to the results, hypotheses I Greater knowledge of HPEC's by the international scientific community effects higher production and marketing of HPEC's, IV Economic considerations have greater salience than knowledge about HPEC's for agricultural policy in LDC's, and V Lack of knowledge of HPEC's by the international scientific community decreases research initiatives in developing nations are not statistically testable. However, their validity is arguably correct in light of the field work and archival/library research. Hypotheses II and III are acceptable since the influence of QKI on ECI and QEI on QKI are statistically significant.

Field observations in highland Ecuador have indicated that quinoa production and knowledge is declining. If there is to be a communications campaign that can capture and address the decrease in awareness with regard to HPEC's, the areas to be targeted for mass media information campaigns, in order of importance, are: knowledge about the environment, then economics and finally research. We conclude this because these were the three areas that were statistically significant at .05.

C. Participant Observation

The results of the field work period are divided into three sections. These are: 1) visits to formal agencies-INIAP, CESA (Riobamba), Banco Central, and radio stations in Latacunga (Julian Tucumbi, Personal communication, 1982); 2) site observations made on the road to formal agencies or on the way to markets or market towns and 3) market visits. The purpose of these trips was to note where quinoa and other HPEC's are grown in either cultivated or uncultivated fields. The author uses the term uncultivated rather than wild quinoa

in this context. Wild varieties of quinoa exist in highland Ecuador. This is indicative that the crop is endemic to the region and was probably domesticated in the Andean highlands. Nearly ten million peoples are permanent residents of high altitude regions, at elevations of 3600-5300 meters in the world. Almost eighty percent of these peoples live on the Peruvian and other parts of the Andes in South America. The greatest altitude, at which human beings live permanently at present, is 5334 meters in the mining town at Aconquilcha on the Andes (Mani, M.S. & Pardo, A., 1980d:161). Recent work in Guitarrero cave in highland Peru located at 2580 meters (8500 feet) above sea level was inhabited from 10,610-5,730 B.C. (Kautz, R.R., 1980:50-51). In the southern half of the Callejon de Huaylas, woodlands may have dominated grass formations at approximately 3200-4000 meters, due to slightly greater rainfall, lesser evaporation, and flat-lying and deeper soils. Nevertheless, on a modern ranch in this zone Masias (1963) identified 24 pasture grasses belonging to 16 genera, only two of which were introduced. Wild varieties of Chenopodium, closely related to the Andean domesticates of quinoa and canihua, also grow at these altitudes, as do tuber-setting potatoes (Solanum) and oca (Oxalis), some surely wild rather than modern feral varieties (Lynch, T.F., 1980a). The native Andean plants most commonly cultivated in the Callejon de Huaylas are the common "Irish" potato (Solanum andigenum), the oca tuber (Oxalis tuberosa), olluco tubers (Ollucos tuberosos), the oil-and protein-rich seeds of the leguminous tarwi (Lupinus mutabilis), and quinoa (Chenopodium quinoa), whose small but numerous seeds are especially rich in lysine and five other essential amino acids (Tapia, M.E., 1977). It is interesting that the present range of cultivation of these varieties corresponds in

altitude to the zone of pre-ceramic sites are located (as low as 2400 meters for tarwi, to as high as 400 meters for quinoa. Oca and olluco, grown at intermediate elevations today, are, perhaps not surprisingly identified tentatively in the archaeological remains at Guitarrero cave (Lynch, T.F., 1980a). Quinoa noted in uncultivated areas is indicative of the ease for the plant to introduce itself and grow in totally unattended fields. The palynological (pollen analysis) pattern shows that a shift from a hunting-gathering economy to one dependent upon agricultural products produces a concomitant realignment of the natural vegetation due to human intervention and subsequent manipulation. This effect is characterized ecologically by the fact that agriculture is a simplifier of ecosystems which replaces complex natural biotic communities with less complex, man-made ones (Kautz, R.R., 1980:53). The fact that chenopodium pollen is present in consistently significant quantities from the most ancient to the most modern times may be due to the fact that wild chenopodium and amaranth are attracted to areas of human disturbance and often show up as a weed in field systems. In the past seeds from both families were used as grain crops. Chenopodium quinoa was a staple that replaced maize at higher elevations whereas Amaranthus caudatus (bledos or sangoracha) provided a seed crops and is used as medicine (Altschul, 1973:63; Hernandez, S., 1982:Field notes; von Reis, S. & Lipp, F.J., 1982; Soukup, 1970:18, 77-79; Towle, M. A., 1961:36-37). Cultivated quinoa or quinoa noted growing close or next to homes is indicative of a purposeful desire to grow the crop. Quinoa that was seen cultivated next to homes shows that the crop is very important to the agriculturalists in the informal sector. The archaeological

literature and field observations corroborate the antiquity and continuity of use of Chenopodaceae in the Andes. In some instances, quinoa was noted growing in the surrounding countryside, but the grain was not found in the local markets; 3) Market visits. The last group of observations were made in the highland markets. The only market where quinoa was not seen growing in the approach to the market nor in the market was in Cuenca. The guinea pig market is still held in Cuenca. Cuenca is the only market where I observed live guinea pigs for sale. Guinea pigs (cui) contribute animal protein to the native diet. In many visits to Indian homes, I saw guinea pigs running around the house. This is not unlike raising chickens for eventual consumption. Guinea pigs in the high Andes are not pets, they are food. Guinea pigs are usually prepared for festive occasions (Hernandez, S., 1977;1982; Field notes).

The following tables 4.8-4.10 represent a summary of the 1982 field periods.

Table 4.8 Visits to Formal Agencies—Ecuador
July 18 – September 15, 1982

Date	Province	City	Affiliation	Name	#Visits	Remarks*
July 19	Pichincha	Cutuglagua	INIAP	Oleas	1	a
July 26	"	"	HPEC group	Nieto	1	b
July 27	"	"	INIAP	Oleas	1	c
July 29	Chimborazo	Riobamba	CESA	Calle	2	d
July 30	Pichincha	Cutuglagua	INIAP	Nieto	1	e
Aug. 2	"	"	Nestle	VaRutte	1	f
Aug. 3	"	"	Bolivia	J. Rea	1	f
Aug. 3	"	"	Nestle	VaRutte	1	g
Aug. 4	"	"	Bolivia	J. Rea	1	h
Aug. 23	Cotopaxí	Latacunga	Radio	Tigasi	1	i
Aug. 24	Pichincha	Quito	Banco Cental	Tigasi	1	j

Notes:

- a—Introduced by T. Oleas to Andean Cultigen Researchers (HPEC's).
- b—CONACYD; INIAP; AID loan; Conade be convinced of the value of HPEC's.
- c—Initiated site visits from INIAP offices.
- d—CESA official did not provide much information.
- e—Turned in quinoa samples collected on trip.
- f—Mestle, Inc. is interested in possible mass production of quinoa.
- g—Field prospects, food value of quinoa; 500 kilos of quinoa needed.
- h—Field prospects of quinoa discussed with J. Rea.
- i—Contacted J. Tucumbi Tigasi on indigenous culture broker, folklorist and musician.

Table 4.9 SITE OBSERVATIONS--SIERRA
July 18 - September 15, 1982

Date	Province	City or Road	# Visits	Crops	Harvest	Remarks
July 23	Pichincha	Quito	1	Q-		HFS
July 24	Pichincha	Quito	1	Q-		HFS
July 25	Pichincha	Quito	1	Quinoa		•
July 27	Chimborazo	Chukipollo AI	2	QW-		
July 28	Chimborazo	Cajabamba	1	Q+HPEC		Locales
July 28	Chimborazo	Panamericano→	2	Quinoa	July 28	Juanita
Aug. 3	Pichincha	Quito	1			J. Rea
Aug. 5	Pichincha	Quito	1	Q-		HFS
Aug. 8	Tungurahua	Ambato	1	Quinoa		Road
Aug. 10	Chimborazo	Riobamba	1	Quinoa		Sacha
Aug. 10	Chimborazo	San Juan→	1			
Aug. 16	Azuay	Cuenca	1	Quinoa✓		
Aug. 16	Azuay	→	1	••		
Aug. 18	Pichincha	Quito	1			
Aug. 19	Cotopaxi	Latacunga	1	Quinoa		
Aug. 20	Cotopaxi	Latacunga	1	Quinoa		Tucumbi

Notes: Site observations include visual inspection in markets for

HPEC's, conversations with market-retailers of HPEC's, road

and hacienda collections of wild HPEC's, visits to health

food shops and supermarkets in Quito.

Legend:

→indicates a road.

✓=Locales in this region say that they have not seen quinoa in the markets in the last ten years. They all commented that they enjoyed it as a food, yet they feared that the crop was virtually lost in the region.

••=Quinoa was seen growing next to native huts in the province of Azuay but none was seen for sale in the markets of the province.

QW=No wild or cultivated quinoa seen. Sacha is the Quichua term for wild.

Table 4.10 Visits to the Markets of Highland Ecuador
July 18 - September 15, 1982

Date	Province	City	Market	#Visits	Remarks
July 22	Cotopaxi	Saquilli		1	Quinoa, ocas, mellocos
July 28	Chimborazo	Riobamba		1	Major market day
Aug. 6	Pichincha	Quito		5	Supermarkets, dirty HPEC
Aug. 7	Pichincha	Quito		1	Ataco from Cuenca
Aug. 9	Tungurahua	Ambato	Ipiiales	1	Salasaca cuchinilla 3
Aug. 11	Chimborazo	Riobamba		1	Ataco from Guano
Aug. 12	Azuay	Cuenca		1	No quinoa for 15 yrs.
Aug. 13	Azuay	Cuenca		1	Amaranth=ataco*
Aug. 14	Azuay	Cuenca		1	Quinoa-, HPEC's+
Aug. 15	Azuay	Paute		1	Quinoa-, achira, jicama
Aug. 21	Cotopaxi	Latacunga		1	Quinoa+, sisters**
Aug. 22	Cotopaxi	Pujili		1	Quinoa+, sisters**
Aug. 26	Cotopaxi	Saquilli		1	Quinoa+, sisters**
Aug. 28	Bolivar	Guaranda		1	Quinoa-, HPEC's, llamas

Legend

+ = item present

- = item not present

** = these two sisters, Indian tribe not identified, went on a market cycle, they cultivated and sold quinoa and other HPEC's.

There is little or no movement of individuals between the formal and the informal agricultural sector, but there is movement of agricultural commodities. HPEC's are commodities which move, at various times, within the informal agricultural sector to the marketing cycle (informal to formal). This is done by middlemen. These middlemen (mayoristas) will travel to highland markets with large trucks and purchase potatoes, corn, beans, wheat, barley and quinoa. The commodities are then stored in warehouses and sold at a later date. On other occasions, the indigenous producer may bring his commodities to the mayoristas for sale.

Initial marketing of quinoa occurs mainly in the rural markets where the vendors are comprised of members of indigenous family groups that are both growers and retailers. In these markets, the indigenous vendors pay rent for their market spot. Commodity prices are set by the government on a daily basis. Needless to say, prices for those commodities that are within the informal agricultural sector are not set by the government.

There is a market for quinoa in Ecuador. It is served as part of a variety of dishes in many of the more elegant restaurants in Quito. These restaurants cater to the tourist trade and to an increasing number of Quitenos who seek authentic Ecuadorian cuisine.

I did not see any quinoa on my visits to health food shops in Quito. When the owners were asked why they had no quinoa, the response was that it was very difficult to get or they did not know anything about quinoa. Most HPEC's are available in supermarkets in Quito. The quinoa comes prepackaged in two-pound (1 kg.=2.2 lbs) plastic bags. The grain is always highly contaminated with soil, small stones and other unidentifiable objects. Price ranged from six

to eight sucres per pound. The 1982 United States dollar equivalent real effective exchange rate for unwashed quinoa was \$.06 and \$.08 for washed quinoa. In general the quinoa purchased from Indians in open markets is less contaminated and is often sold prewashed in two-pound plastic bags. Washed quinoa in the market is eight sucres per pound, unwashed is five sucres per pound. Unwashed quinoa is presented in the out door markets in shigras the contain about 5kg or 11 pounds of grain (a shigra is a bag sewn out of finely spun sisal). In 1982-1983 the real effective exchange rate for the sucre was approximately 137.15 sucres per one dollar. Table 4.11 shows the exchange rates in Ecuador during a six year period.

Table 4.11 Exchange Rates in Ecuador 1981-1987

Exchange Rate	Annual Average per Year						

Official rate (national currency units /US \$)	1981 25.0	1982 30.03	1983 44.12	1984 62.54	1985* 69.56	1986** 90	1987 120
Real effective exchange rate (index 1980=100)	93.8	97.2	177.1	135.4	129.2	145	147

*Preliminary estimate

**Post inflation rates (computed by Hernandez, S., 1986)

Source: Compiled by The Inter-American Development Bank, 1986:260.

The real effective exchange rate is used for the dollar equivalents because this represents the actual internal buying power of the sucre in Ecuador. The difference between the official and the real effective exchange rate is a reflection of the lack of foreign exchange.

In 1981 the official exchange rate for the price of quinoa (eight Sucres for washed) was \$0.032 and \$0.085 at the real effective exchange rate. In 1985 the official exchange rate for the price of quinoa (eight Sucres for washed) was \$0.11 and \$0.006 at the real effective exchange rate.

Table 4.12 Price of Quinoa in US Dollars 1981-1986

Exchange Rate	Price= 8 Sucres for washed quinoa					

Official rate (national currency units /US \$)	1981	1982	1983	1984	1985*	1986**
	.32	.26	.18	.12	.11	.44
Real effective exchange rate (index 1980=100)	.085	.082	.045	.005	.006	.28

*Preliminary estimate						
**Post inflation estimate						

Source: Derived from a table compiled by the Inter-American Development Bank, 1986:260.

In 1985 there was a 65% decline in the price of quinoa, official exchange rate, and 92% decline in real terms. From this simple example we can say that quinoa is underpriced in both official and real effective exchange rates.

D. Library/Archival Research

Library/archival research was conducted to clarify two points of contention posed by scholars. The first is that quinoa and other HPEC's are not mentioned by early chroniclers, neither Indian nor Spanish, because these crops were never grown extensively in the Inca Empire. Second, that European cultigens displaced endemic cultigens. A reading of the early chroniclers, both Indian and Spanish indicate that it is not a simple matter to determine why some authors took note of cultigens, native and exotic, and others did not. The general

belief has been that those chroniclers who were in the service of the crown took note of the exotic cultigens and those who were not took note of both native and exotic cultigens. This distinction does not stand upon reading the texts. Pedro Cieza de Leon, an early chronicler, at the service of the crown, made very astute and accurate notes of the ecological zones in which endemic cultigens grew and the lowland and coastal markets where these were exchanged for lowland products that could not be produced at high altitude. For our purposes, it is assumed that taking note of endemic and exotic cultigens and the patterns of indigenous and Spanish land tenure is due basically to the powers of observation of the individual chronicler. Therefore, it is necessary to read the work of more than one chronicler. Other students of Andean history attempted to group the chroniclers. Some of these students are: Clements Markham, 1910, The Incas of Peru; Philip A. Means, 1928, Biblioteca Andina; Louis Baudin, 1928, El Imperio Socialista de los Incas; Ake Wedin, 1966, El concepto de lo incaico y las fuentes; Marcos Jimenez de la Espada, 1881-1897, Relaciones geograficas de indias; others that have created their own classification of the early chroniclers include: Jacinto Jijon y Caamano, 1941; Hans Horkheimer, 1947; John V. Murra, 1955;1977; Raul Porras Barrenechea, 1962. Classification of the early chroniclers does not specifically help the researcher in his quest for particular material. In this study the search was for material that relates to Inca and Spanish agricultural production for the same time period. Early chroniclers did not organize material for the current scholar, nor is this expected. In order to gain insight on the urban and agricultural scenario during the late Inca and early

Spanish colonial period, the student must read through the entire text, extract the relevant material, and then recreate the appropriate scenario.

Pedro Cieza de Leon is of particular importance to us. In 1544-1545, he made a trip to northern Ecuador, then the northernmost extension of the Inca Empire. Today, this roughly corresponds to the provinces of Carchi, Imbabura, Pichincha, Cotopaxi, Tungurahua, and Chimborazo in Ecuador. The northern boundary that exists today between Colombia and Ecuador did not exist then. References to pastos are to the native inhabitants in a region that today includes portions of southern Colombia.

It is known that Cieza de Leon was fluent enough in Quichua to carry on simple conversations, however, for in depth interviews he used interpreters. As a result of this we know that as late as 1550 Quichua had not displaced all of the local languages in Ecuador. To this day neither Quichua nor Spanish have replaced all indigenous languages in Ecuador.

Cieza de Leon is a very important source because he cites the sources of his information, Indian or Spanish, and he tells where he was when the material was obtained (Wedin, A., 1966).

Present day Ecuador, was part of a fully-evolved urban state. The terms city and town are used within the context of urbanism, defined earlier in this text. With this definition in mind, when Cieza de Leon refers to "pueblos", we understand this to be a concentration of people with an urban affiliation as opposed to a dispersed rural population. These population concentrations took the names of their leaders.

The colonial province was an administrative unit that never bore any relation to land holding it appears to have been adopted from the Inca administrative system by the Spanish conquerors with little modification (Spalding, K., 1984:47). Another aspect of community structure in the central Andes is the essentially historical character of the groups composing the larger society. The series of nested units to which people belonged cannot be defined as segmentary lineages, groups were regarded as permanent and unchanging. Andean society was intensely hierarchical and concerned with power and status. In one myth..., a female deity impregnated without her knowledge by a male wak'a threw herself into the ocean when she discovered that the father of the child she bore was a "potato-eater," or wak'cha, who went about in rags and tatters (Spalding, K., 1984:53). Myths continue to provide supporting evidence that indicates that the current low status which quinoa has today was not the same during the pre-Columbian period. Spalding also cites a myth that potato-eaters were people who did not have high status (Spalding, K., 1984:53).

The high Andes represent a region of highly varied ecological zones. This has been clearly stated by the ethnohistorical and anthropological work of Murra. His classification of the use of multiple ecological zones is termed "verticality". Ecuador comprised the northernmost extension of the Inca Empire. The seat of the Inca Empire was in Cuzco, Peru. Yet, the reader must bear in mind that imperial conquest of a similar environment does not allow us to assume that it was an identical environment. This point is illustrated by the ethnohistorical work of Udo Oberem. In large regions of the Ecuadorian sierra there exists the phenomenon known as micro-

verticality (Sick, 1963:158-159 in Oberem, 1978). This is distinct from macro-verticality described by Murra (1975) as a system of archipelagoes, described for the Peruvian-Bolivian altiplano, for which agricultural and other commodities from the tropical lowlands to the Andean highlands were traded. Ecuador's micro-verticality is defined primarily by the lack of archipelagoes, characteristic of verticality, these micro-regions were accessible in a twenty four hour period. This allowed the traders to return to their cities by evening. The essential difference between verticality and micro-verticality is that there was no need, in Ecuador, to establish long term permanent trading settlements. Traders, merchants or mindala held a high status in their towns (Visita, 1567; Paz de Leon, 1582) and were only required to pay tribute in gold, cloth and chaquiras. That is they were not required to give labor as tribute. In Quito mindala performed as merchants and lived in the parish of San Sebastian, where many noble Indians had their houses. It is important to know of the existence of the mindala primarily because their function was to trade agricultural commodities from one ecological zone to another. We must also note that these commodities were traded from multiple ecological zones. The Spanish, upon their arrival in Andean cities and markets, made note of their superb organization and the incredible variety of food and goods in the Indian markets. This abundance and variety was no doubt due to the work of the mindala.

In these areas there was always the exchange of agricultural commodities from one climatic zone to another. Cieza de Leon mentions a lake with no fish. This may be one of many lakes in the province of Imbabura: Mojanda, Cuicocha or Yaguarcocha. He also mentions that

corn did not grow in this region (1553/1853). We know that the uppermost limit for corn in the north is 3,000 meters. Up to 3,600 meters tubers grow such as oca (Oxalis tuberosa), melloco (Ullucus tuberosus Caldas), mashua (Tropaeolum tuberosum R. et Pav.), and potatoes (Solanum tuberosum). Among the Chenopodaceae, quinoa (Chenopodium quinoa) cultivation starts at 2,600 meters. These crops are still cultivated today at the same altitudes in and around Otavalo province of Imbabura (Acosta-Solis, M., 1962).

Later in the text, Cieza de Leon again states that corn was not produced in the region of the pastos (1553/1853). With the concept of verticality or micro-verticality of agricultural production as practiced in Ecuador we can assume that the pastos produced sufficient highland agricultural commodities to exchange for lowland products such as corn, cotton, and fruit. The commodities that the pastos exchanged were those grown at altitudes between 2,800-3,300 meters. Other crops that were traded from the highlands included: chochos or tarwi (Lupinus mutabilis), cabuya (Fourcroeia spp.), white carrots (Aracachia esculenta D.C.), jicama (Polinnia edulis), and ajipa "yambean" (Pachyrrhizus tuberosus) (Gade, D.W., 1970; Heiser & Nelson, 1974; Heiser, 1985; Sauer, C.O., 1963).

According to Cieza de Leon, quinoa was important enough to the Incas that they felt the need to obtain more land in order to get even more quinoa to supply to their armies. Corn and potatoes were incorporated into the Spanish diet very early during the colonial period. As early as 1545, Cieza de Leon noted that barley, wheat, melons, sheep, and cattle, all introduced by the Spanish, were grown and raised alongside native plants and animals.

There has been much speculation as to the reasons for the decline in the production of endemic cultigens in the high Andes. Some of these are: they were never popular among the Indians or the Spanish, the crops never adapted to European soils, nor adopted by the European palate. If one reads the early chroniclers, there were more reasonable explanations. Some of these are: many highland Indians left their places of origin in order to escape the Spanish encomienda system. The encomienda or reducciones made virtual slaves of the Indians. In those places where the Indians remained as landowners or were still cultivating their own plots of land in usufruct from the hacienda owners, HPEC's continued to be cultivated. As greater portions of land went to the Spanish, there may have been a gradual decrease, by the Spanish, of the planting and the consumption of HPEC's. It took many years for European crops to become established in the highlands. The Spanish did not abandon all native crops. Potatoes, corn, and beans contributed to the Spanish diet. Much of the land that was acquired from the Indians was dedicated to livestock: cattle and sheep (Moreno Yanez, S.E., 1981). There was a multitude of other kinds of claims to land, however, that were recognized in Spanish colonial courts as derived from preconquest forms of land tenure. These claims, pressed in the courts on the grounds that they dated "from time immemorial" and were therefore part of the local traditions were to be respected by the authorities, involved both individual and group tenures (Spalding, K., 1984:45-46).

Although barley (Hordeum sativum) introduced by the mid sixteenth (1545) century, can grow at an altitude of 3,400-3,500 meters; barley requires more care than quinoa or canihua. It makes more sense to continue to grow crops that require little or no care, that are well

adapted to the environment, than to grow crops that require attention and that are not well adapted to high altitude soils. Today in Otavalo, as in the time of Cieza de Leon, quinoa replaces corn in the diet among high altitude populations. Examples of micro-verticality are still in evidence in Ecuador. Otavalo Indians sell washed and unwashed quinoa in the markets in and around Quito (Hernandez, S., 1983:Field notes).

E. Discussion

Problem solving cannot be adequately discussed unless we recognize that the application of knowledge in problem solving is a creative enterprise requiring objectivity (Johnson & Zerby, 1973:222)

The Delphi method in this study is used as a survey technique. The responses are analyzed by using regression analysis. That is regression analysis is our technique for forecasting and policy analysis in this study. The TSP computer program is used to estimate the regression equations.

A country should encourage production of agricultural commodities that enjoy a comparative advantage in the local agro-climatic environment. There are groups of crops that grow well in high altitude environments, although these regions are known for their erratic and extreme daily weather fluctuations. High altitude countries in Latin America, specifically the Andean nations; Africa-Ethiopia, Tanzania, and Kenya; and Asia-the Himalayas and the Pamirs, are all regions that share similar climatic and environmental characteristics. They also have crops that are unique to these regions. Crops of these areas have not received due attention within

the context of national development planning nor from the international research community. Much is known about these crops with regard to their genetic make-up and botanical characteristics. What is not known is the role of these plants in the present day social context. Chenopodium quinoa, a plant domesticated in the high Andes, is one such crop. The outstanding nutritional value of the plant has long been established. However, to my knowledge, there has not been a systematic, nor a successful attempt to incorporate endemic agricultural resources, with the characteristics of a plant such as quinoa, within the context of a national development plan or an agricultural sector plan.

In an experimental computer run (Appendix E), to determine at which point quinoa would be a viable alternative or substitute for layer (poultry) feeds, quinoa replaced soy beans, in a corn-soy based layer feed mix. The outcome of this simple experiment falls within the current grain pricing policy of Ecuador. "Current policy involves the government directly in price determination for the purpose of stabilizing prices within the year and strengthening commodity prices to producers to raise farm incomes over the longer term. It is also viewed as a means of influencing resource allocation decisions (encouraging the production of one commodity relative to others) to meet objectives such as import substitution" (AID, 1985:82-83). This statement, taken at face value, should automatically include those crops identified, in this thesis, as HPEC's, however, official documents of the formal sector, with very limited exceptions, do not include crops such as quinoa in the development of agricultural policy statements.

The inability of nations to produce sufficient food for their populace is one of continuing concern for the nations that are most severely affected by food shortages and periodic famines. Yet, many of the solutions for their problems stem from environments that do not have the specific environmental constraints of the equatorial Andes. Imported schemes are often inadequate for the problems they hope to improve. Plants and animals, domesticated by indigenous populations, represent an underexploited resource of the Andean region. Plants and animals are well integrated in the social fabric of the indigenous population of the country, but this knowledge is not included in national plans. Incorporation of these sectors, the formal and the informal, would benefit these nations in a number of ways, a few of which: are extension and intensification of land use for agricultural production; development of small scale agro-chemical industries; and a decreased dependence on imported food staples. For the development of agro-chemical industries involving HPEC's, originality and creativity on the part of the decision makers are musts. A person who is "original" is one who first of all is willing to turn from an accepted behavior to a new mode of behavior. Originality means the overcoming of inertia-an effort must be exerted to do something and to do that something differently (Johnson, G.L. & Zerby, L.K., 1973:227).

International research has had a measurable positive impact on third world agriculture. The bulk of this research has focused on the introduction of high yielding varieties (HYVs) also known as modern varieties (MVs). The available data on the adoption of the HYVs of wheat and rice by third world nations are elusive (Dalrymple, D.G., 1985). National research centers are influenced by international research centers in the areas of research that national research

centers expand upon. The data on budgetary allocations on national research centers are not available. Evenson, Pray, and Scobie (1985) developed an ingenious scheme to determine national monetary allocations to research. The authors assumed that the proportion of research expenditures allotted to specific commodities in a given country can be derived on the basis of data on the number of published articles reported by the Commonwealth Agricultural Bureau (Barker, R., 1985:1085).

Anderson, Herdt, and Scobie present a summary of their findings on the contribution of international agricultural research to world agriculture. An attempt was made to identify the perceptions that are held about the Consultative Group on International Agricultural Research (CGIAR) system among partner countries and institutions. The more knowledge the individuals in the national centers had about the CGIAR the more favorable their response. Enthusiasm for different products varied according to individual knowledge, experience, discipline, and job responsibility (1985:1081).

In these three studies the authors recognize that more research has to be directed at crops that do well in poor soil environments. There is no indication of which crops they might be. An important element surfaced as a result of institutional influences on the national centers they were either responsible for or with which they were closely involved: the new professional respectability perceived for working on "humble" nonexport crops (Anderson, Herdt, and Scobie, 1985:1084).

The research findings noted above have several implications for the results of the Delphi survey. The knowledge that the authors

described can be termed value-free knowledge. The Delphi questionnaire requested both value and value-free knowledge from the respondents. Part of the questionnaire asked a series of questions that were essentially of a true or false character. The purpose of those questions was to obtain value-free information.

The relationship between prescriptive knowledge and the two kinds of knowledge (about values and value-free) on which prescriptive knowledge depends is expressible as a decision rule:

$$\text{Prescriptive knowledge} = F(\text{value-free knowledge, value knowledge})$$

In the above equation, "F" is a decision rule. If we abstractly assume perfect knowledge, the decision rule is simple. It is one of simply subtracting badness from goodness for all possible actions and then selecting that action for which the excess of goodness over badness is greater than for any alternative or, conversely, selecting that action for which the excess of badness over goodness is less than for any other alternative (Johnson, G.L., 1986:17).

The problem statement posed the question of how to attract attention to quinoa. The problem as stated assumes a multi-disciplinary orientation to problem solving. In order to arrive at the right decision "the problem solving processes indicates that public decision makers are crucially concerned with the generation of prescriptive knowledge to solve problems. In order to generate prescriptive knowledge, they need both value-free and value knowledge. In order to be able to deal with these three kinds of knowledge, public decision makers need to be philosophically general and eclectic enough to work objectively with all three. Knowledge of various power distributions and covenants is required in converting value and other

value-free knowledge into prescriptions" (Johnson, G.L., 1986:18).

The Delphi and participant observation results reinforce the work of Anderson, Herdt, and Scobie as well as the proposed applications of Intriligator (1978). The informal conversations with the researchers at INIAP showed that they felt that their research initiatives were dictated by funding sources outside the country.

"Policy evaluation is closely related to forecasting, and just as in the case of forecasting, it is assumed that the policy choice is quantitative, explicit, and unambiguous. In fact, forecasting and policy evaluation are interrelated in a feedback system: A forecast must be based, in part, on assumptions concerning the actions of the relevant decision makers. Conversely, policy evaluation must be based, in part, on forecasts of the effects of policy choices. The forecaster and decision maker are indeed often combined in the same person (or agency or office), responsible for both forecasting and policy evaluation (Intriligator, M.D., 1978:538).

Expert opinion is the traditional approach to forecasting and it is also the traditional approach to policy evaluation. Indeed, in most areas of policy, the responsibility for the selection of a particular policy alternative is assigned to particular individuals selected on the basis of their expertise. The individuals in these organizations are chosen on the basis of their expertise, and their judgments influence, to a significant extent, the policies of the nation. Policy decisions in other areas are also based on expert opinion. Thus major corporations, municipalities, and nonprofit organizations frequently have planning departments staffed by experts responsible for policy evaluations.

A modern variant of the method of expert opinion, the Delphi method, pools the judgments of a panel of experts in order to obtain forecasts. Each of the experts is consulted and then their forecasts are presented, in summary statistical form, to all. This presentation of responses is usually done anonymously and without face to face contact (e.g. via mail questionnaire) in order to avoid problems of small group interaction, which might create certain biases in the outcome. The experts are then asked to revise their forecasts on the bases of the summary of all the forecasts and perhaps additional information. This process is repeated until the group of experts reaches a consensus. The Delphi method can be employed for policy evaluation, using an approach similar to that used for forecasting (Intriligator, M.D., 1978).

Another implication lies within the sphere of the development of a persuasive communications strategy directed at national and international decision makers. Once the target group is identified and their range of knowledge of QKI (quinoa knowledge index), QEI (quinoa environmental index), QRI (quinoa research index), and ECI (economic index) is established, a campaign can be devised to increase information on the specific area which the group lacks. Since all groups will have varying degrees of information, by using the Delphi survey technique, and regression analysis, we can estimate the range of information that needs augmentation.

As a group, the 34 respondents scored very low on their indices. The indices, based on the mean response, are: quinoa research index (QRI) 2.731; quinoa environmental index (QEI) 2.421; and economic knowledge index (ECI) 2.175. The original response range was: 5=strongly agree, 4=agree, 3=undecided, 2=disagree, 1=strongly

disagree. The author decided that a response of 3 indicated that the respondent had some knowledge of the statement but had not taken a firm stand on the extent of his knowledge.

A score that is close to 3 would indicate that the respondent had some notion of the crop and associated material. The score that came closest to 3 is the quinoa research index (QRI=2.785), the next closest is the quinoa knowledge index (QKI=2.528), then the quinoa environmental index (QEI=2.464), and finally the economic knowledge index (ECI=2.223).

There are individuals within the group that are highly knowledgeable in all areas, however, these high scores were subsumed due to the greater number of individuals that had little or no knowledge.

Chapter V

Summary, conclusions, and suggestions for further studies

To render our knowledge of man
useful, we must synthesize it
and we must reject the belief
in the supremacy of the
quantitative over the qualitative
and of matter over spirit (Carrel, A., 1935)

Summary

The research carried out for this dissertation sought to explore the knowledge base of decision makers in international and national research institutes with regard to HPEC's. Results indicated that neither international nor national research institutes harbor knowledge about HPEC's. These cultigens constitute a strong and potentially viable resource for the development of collateral industries and jobs in agro-industry. The knowledge base of HPEC's lies within the informal agricultural sector of Ecuador. Neither planning agencies, the ministry of agriculture nor national research institutes, to date, have developed agricultural projection estimates which include HPEC's.

In accordance with the basic suppositions of this thesis and supported by the results of the Delphi questionnaire, the pervasive lack of knowledge, as a group, of institutional decision makers with

regard to HPEC's, positively influences agricultural research and policy in a developing nation. An illustration of assuming away HPEC's in international research is exemplified in a document published in 1985 by Economic Perspectives, Inc., in collaboration with the Sigma One Corporation for the Ecuadorian Ministerio de Agricultura y Ganaderia: Unidad de Analisis de Politicas Agricolas (AID, 1985). It appears that the decisive voice with regard to the commodities that were considered in the grain pricing policy in Ecuador was the United States Agency for International Development Mission to Ecuador. In the entire text there is no mention of endemic cultigens by name or inference. As mentioned earlier endemic cultigens are those other than corn and beans. Of the four crops mentioned in the paper only corn is native to the Andean region; the other three, rice, sorghum, and soybeans are exotic to the Andean region and to Ecuador in general. The one element that these three crops have in common is that they are recognized by the international agricultural community and by individuals who influence decision making on a local and international level. The fact that these crops have attained international recognition does not necessarily intimate economic nor environmental supremacy, as an agricultural commodity, in the Andean region, for human or animal consumption.

Planning and Power: Prescriptive Recommendations

Planning is a means to the attainment of certain desired social goals and therefore it is difficult to see what a theory of planning should embrace. What is required is a theoretical framework which relates to the concept of planning which is associated to the concept of power for it is this concept which provides planning with its role,

its motivation and its justification. It is curious that the study of power relationships has been a neglected area of investigation in planning. Inquiry has focused on a narrow definition of power rather than using power as the central concept in the explanation of planning policies and outcomes (Blowers, A., 1982:140).

Throughout this thesis the overriding concern is to examine how institutional decision-makers, power brokers, influence planning policy in a developing nation that has particular interest in agricultural sector planning. Decision-makers need very specific data in order to make informed decisions that affect proposals and that may eventually influence policy in a developing nation. "Planning cannot be seen as a disinterested, technical, politically neutral and consensual activity protecting the public interest. It is necessarily and inevitably involved in a social context in which power relationships have to be recognized and understood. We must understand the operation of the market and the interests at work within it. And we must not assume that all we see is all there is to see, but recognize that the exercise of power relies on hidden as well as overt action" (Blowers, A., 1982:142).

There are three power bases that are considered. The first is the pluralist conception of power of a 'socio-political system in which the power of the state is shared with a large number of private groups, interest organizations, and individuals represented by such organizations' (Presthus, R., 1971:331 in Blowers, A., 1982:143). This group is represented by the individuals in the Delphi pool of experts. The group is also an elite group, so that the second conception of power, elitism is also applicable to this group. Elitism is a 'system in which disproportionate power rests in the

hands of minority of the community' (Presthus, R., 1971:331 in Blowers, A., 1982:143). This suggests that participation is limited and resources and information are concentrated in a few hands. Power of the elites is concentrated, but it is by no means cohesive. Those who possess power are competing and changing, a definition that lies somewhere on the pluralism-elitism continuum which constitutes the third definition of power (Blowers, A., 1982:143).

M.J. Rossant in his forward to The New Economics of Growth noted that Mellor argued for development based on measures to increase food supplies, the need to undertake changes in other sectors of the economy as well as in institutional arrangements if growth was to be more sustained and broader than in the past. Mellor stresses that neglect of the rural sector has impeded growth and has led to internal strain and conflict in developing countries.

Mellor selects the agricultural sector to lead an employment-oriented strategy for economic growth. "The strategic choices are real and involve major differences in the processes of planning and the allocation of resources. The shift in development strategy can be implemented only by decisions involving major political and institutional changes that affect the distribution of power and therefore require attention at the highest levels of government" (Mellor, J.W., 1976:xi).

The cooperation of the planning agency at the ministerial level is essential for the success of Mellor's recommendations. He sees agriculture as the foremost employer of the rural sector. The agricultural surplus produced can engender the development of rural and urban industry. He recognizes that a shift from capital goods

production to agricultural based employment generation is complex, however, the current practice of single factor production reinforces the neglect of the agricultural sector.

Throughout his treatise, Mellor assumes a pragmatic approach to planning. "A pragmatic planning process does presume learning by doing, and thus, evaluation according to the standards of an explicit set of objectives". This approach would allow the most basic employment and food consumption to be mitigated (1976:291).

Mellor's approach requires agricultural innovation and research. In addition to a shift in international priorities toward (1) relaxation of tensions so as to dissuade low-income countries from short-run pursuit of the capital intensive requisites of national defense and self-sufficiency; (2) provision of relatively open trade situation with short-term credits for financing raw materials and capital intensive intermediate products; (3) increased technical aid, particularly for agriculture; and (4) renewed capital assistance for those minimum capital intensive investments still essential to the labor intensive strategy (1976:293). He feels that failure on the agricultural front will occur due to lack of administrative desire to foster success in research and lack of political impetus to allocate sufficient resources to irrigation, power, and transport (1976:293).

Ecuador's indigenous population has always had a strong entrepreneurial spirit that predates Inca times. Today these populations continue their efforts, however, this is not considered a contribution to the gross national product. The government still views these populations as a national burden rather than a national resource. "The political atmosphere must be oriented away from past ineffective forms of redistribution toward encouragement of

entrepreneurship by the peasant farmer and the small businessman" (Mellor, J.W., 1976:293).

Mellor bases his thesis on increased production of foodgrain that require fertilizer and irrigation in order to succeed. Grain HPEC's are an unusually sturdy crop; with appropriate techniques, they can be planted in inhospitable high altitude soils and produce grain without the need of irrigation or fertilizer. Of course with adequate credit and agricultural extension, fertilizer and irrigation could be gradually introduced. Seasonal rains provide sufficient water. Bumper crops have been reported when the Nino current produces droughts in the coastal lowlands, flooding in the midlands and only slightly increased rainfall in the highlands. This was the case in 1982 in Ecuador and Peru. Lowland crops were destroyed, but the highlands had very high yields of HPEC's. The use of HPEC's could limit the need for increased food imports due to the vagaries of the Nino current. In the highlands, farmers obtained bumper crops of quinoa or showed no loss in Bolivia and Peru. This despite the fact that it was grown in drought areas where the potato harvest perished (Barber, R.T., & Chavez, F.P., 1983; Cave, M.A., 1983; Cusack, D.F., 1984:27; Kendall, S., 1985:3; Kerr, R.A., 1983; Rasmussen, E.M. & Wallace, J.M., 1983).

These are only some examples of the heartiness of HPEC's, nonetheless, in order for a deliberate incorporation of such crops into the formal economic sector both Blowers (1982) and Mellor (1976) recognize that the current governments must be willing to relinquish power. This may be facilitated by persuasive techniques in a communications strategy. The impetus for the initiation of such a

strategy may well come from the international research institutes that are increasing the amount of scientific inquiry into HPEC's.

Market Potential: Agro-Chemical and Agro-Industrial

A project that involves increased production of the grain should consider investigating the commercial value of quinoa by-products, specifically saponins and crop residues. The use of saponins in biochemistry has been long established; however, the use of crop residues for use as feed for gastric and monogastric poultry and livestock has been examined in Ecuador only with reference to maize and cane. The 1985 compendium, which is considered the state of knowledge, uses FAO statistics. FAO does not present data on crops that have been classified in this dissertation and in other material, as part of the informal agricultural economic sector, i.e. quinoa and amaranth. Nonetheless, it is conceivable to substitute crops such as quinoa or amaranth and make use of their residues and chemical by-products in the development of an agro-industry in the Andean region that would make full use of locally grown and available agricultural commodities. The report mentions use of pulses and sorghum. Quinoa and amaranth could be successfully substituted for both pulses and sorghum in the development of an agro-chemical and agro-industrial enterprise in the Andean region.

The nutritional value, for humans and animals, of both these crops, grain and dry matter, has been shown to be superior to both pulses and sorghum. In the study of the potential use of crop residues as animal feed Kossila (1984) indicated that forages constitute some 85-94% of the metabolizable energy intake of grass eaters (cattle, sheep, horses, asses), 17.7% of that of pigs and 8.6%

of that of poultry on average in the whole world. The review indicated that about two thirds of crop residues were derived from cereal crops. In developed as well as developing countries crop residues account for about 24% of the total feed energy suitable for ruminant livestock while agro-industrial by-products account for only about one percent.

Quinoa cannot be consumed by humans or animals unless the bitter substance is removed. The development of collateral industries with quinoa by-products could provide an additional source of revenue for Ecuador and other quinoa producing countries. Saponin based antifedants could be an economic, nationally produced antifedant that could replace petroleum based naphta. The seed coating contains a substance called saponin, commonly present in other plants. The saponins are plant glycosides found both in the leaves as well as in the seed coating. There are two types of saponins: steroids and triterpenoids. The saponins isolated from quinoa may be a triterpene. The triterpene contains three units of terpenes or monoterpene. Hydrolysis of plant glycosides (saponins) with mineral acids give a sugar, and a hydroxylic compound, which is known as aglycon. The aglycon can be an alcohol or a phenol. The phenols are more acidic than the alcohols. Aglycon is also known as sapogenin.

Quinoa is a potentially rich source of saponins. Synthetic saponins are very costly. Quinoa producing countries could provide an inexpensive supply of natural saponins to the chemical industries of the developing world. In general, saponins are important in neurochemistry and biochemistry. Among the biological and metabolic functions of saponins are as a hemolytic agent. Saponins are also necessary to hemolyze the red blood corpuscles, which is of prime

importance for the action of acetylcholinesterase enzyme. This enzyme is normally required, in the human body, to hydrolyze acetylcholine into acetic acid and choline. Saponins are also used as an agent in gastro-enterological studies; it can also be used as an experimental drug to exhibit hypersalivation (Gupta, R., 1982).

A crucial element for the future development and commercialization of quinoa and its by-products depends on cost-effective separation of the seeds from their bitter coating. Sundstol (1984) notes that before starting a research project the following should be known: 1) amounts, quality and distribution of materials; 2) alternative uses of the materials; 3) alternative feeds and feed supplements; 4) level of technology in the agricultural sector; 5) potential improvement due to treatment; 6) availability and cost of chemicals and equipment; 7) adverse effects of chemicals; 8) possibility of government support. What is already known about quinoa would facilitate the development of such an industry in the Andean nations.

Future commercialization of quinoa and its by-products, specifically saponins, needs further substantiation, on the availability of organic and inorganic material. As a result of several conversations with Dr. Rashik H. Raythatha, (1982), in which I informed him of the bitter elements of quinoa, he agreed to conduct several chemical procedures which resulted in the elementary extraction and separation of saponins and other materials from the seed coat of quinoa.

The particulars for establishing a quinoa processing plant would of necessity be left in the hands of an agricultural engineer and

others. Much of the technology for processing quinoa has been developed for Peru and Bolivia. Yet the use of machinery often increases the cost of the grain to the consumer, although increase in volume production may act as a balance and serve to limit consumer cost. Paramount in the development of a plant is that it be cost effective and appropriate for the population and the environment. The participation of the planner in this context is to provide the agricultural engineer with all the information pertinent to quinoa and its role in the agricultural sector. The re-use of abandoned buildings in the quinoa growing regions in Ecuador, and other Andean nations could be a likely start to use as regional research stations, grain storage, and as a point of origin for the marketing and for the general commercialization of the grain in the international commodities markets.

The establishment of an International Quinoa Board would contribute to the timely dissemination of information that deals with quinoa and other food crops throughout the world that have comparable qualities to quinoa. The Quinoa Board could centralize and systematically disseminate information on quinoa and other HPEC's. Dalziel (1984) presents a summary of marketing boards in developed and developing countries. The establishment of a Quinoa Board, based on an adapted model of boards in the developed world would avoid the problems of parastatals. To date, promulgation of details on quinoa has been a scattered endeavor on the part of individuals who are interested in these agricultural commodities. At the initiation of this research in 1982 there was virtually no news of HPEC's in the daily mass media, radio, T.V., magazines or newspapers. Since that time quinoa has appeared in all of those media. Specifically,

Newsweek, The New York Times, and on National Public Radio "All Things Considered" (Copeland, J.B., 1985:83; Fabricant, F., 1986:25,27; Hernandez, S., 1986: Fieldnotes).

In 1982 quinoa was not available in New York City's health food stores. As of 1982 to date (19 December 1986), quinoa is available in Nature Food Centers, one of which is located on 84th Street and Second Avenue on New York's east side. This is one of the nuclei of New York's gentrified 'yuppiedom'. Cusack and others have noted in their articles that the route to increased consumption of quinoa in the Andes is through New York or a city similar to New York.

The wholesale distributor is Arrowhead Mills located in Hereford, Texas. The quinoa that they distribute is most likely grown in Colorado, since there is no indication of the country of origin on the package. Their packaging notes 16% protein and 403m lysine. A two ounce serving has nine grams of protein. Fourteen ounces (397 grams) retails for \$4.99. In New York City, the price of one pound of quinoa, \$5.70, is comparable in price to one pound of t bone steak.

The price of quinoa per pound in the highland markets of Ecuador was eight sucres if washed; five sucres for unwashed quinoa. At 1982 official exchange rates that is \$.16 (5 Sucres) for unwashed and \$.26 (8 Sucres) for washed quinoa per pound. The price at the real effective exchange rate was \$.082 (8 Sucres) washed and \$.05 (5 Sucres) unwashed.

Conclusions

To recapitulate, any project in the developing world must have a multidisciplinary perspective. A planner is well equipped to work within governmental confines and simultaneously contact national

private chemical industries to stimulate interest in quinoa saponins. In order to effectuate a successful campaign and project, the planner must deal with government officials, the private sector, and at the grass roots level. Working from the bottom up will never work if your plans are aborted by the powers that exist.

Communications and Planning

Planners and communications specialists could provide ideal complements to each other in developing a strategy directed at increasing knowledge and use of quinoa. Planners tend not to plan with a strategy in mind and a communications specialist does not know how to work without one. A strategy is meant to be updated and refined in accordance to the needs of the identified target populations. If we understand a "strategy as the science of mobilizing resources towards goals", then a large portion of our problem is on the road to closure. A significant part of my research was dedicated to determine the amount of information that institutional decision makers had with reference to quinoa. The answer was very little, however, I also discovered that among my sample there were individuals that had a great deal of knowledge with regard to quinoa. Therefore, part of the strategy goal is to increase knowledge of the institutional decision makers and by extension use of quinoa and its by-products in both the developed and developing nations of the world.

In order to set goals and priorities, identify issues and constituencies, an international conference should be convened in a politically neutral country, this would avoid the general accusations made by developing nations of "first world" manipulation of the problems of "third world" nations. A conference is a comfortable and

non threatening forum were ideas, no matter how controversial or innovative can be presented to the widest possible audience at one time. It is understood that the invited speakers would be representatives from both the formal and informal economic sectors of all nations involved. This would start a precedent to initiate and continue a dialogue among participants of both the formal and informal sectors.

For an increase in the awareness of and eventual increment in the consumption of quinoa to occur in the Andean countries, there are a number of events that should occur concurrently. Permission should be secured from the appropriate radio stations, whose range extends to the rural areas. A series of jingles or announcements should be broadcast. The aim of these jingles is to manipulate the demand (Soruco, G., 1984) for quinoa among the indigenous population. Most of the Indians have small portable battery or transistor radios. These jingles should be in Spanish and in Quichua. The population in the outermost rural sector is monolingual Quichua speaking. The men are often minimally bilingual.

A note of caution: the advertising schemes of multinational corporations are becoming increasingly similar to those used by planners and change agents. A common feature of both strategies lies in the recognition of the wants and needs of the target population. A clear understanding of the culture of the specific population is also needed. There is no inherent danger in a policy that seeks to understand the desires of the target population. However, the planner cannot dismiss the fact that change within the context of persuasion is inevitably perceived as manipulative. Manipulation connotes the

negative use of power. The intent of the present communication is not to be equated with that of multinational public relations firms, a planner has to be aware of the international connections of any agency, mission or project that is chosen to implement the proposed campaign. In order to convince the government of the merit of a quinoa project, emphasis should be placed on the selection of national firms that have a reputation for having the well being of the country among their priorities. When the proposed campaign is presented to the national government for initial clearance, the planner should appeal to the government's fervent nationalism.

There is a growing concern among developing nations in regard to foreign control of national policy. A project to encourage production of endemic cultigens may seem innocuous, however, whatever concerns the national government must be assuaged. Any initial rejection would be based upon prior experience based upon years of encroachment and infiltration of national enterprises.

There is a political element to advertising (Mattelart, 1976:235-282). The planner is not a-national. He is representing someone's self interest. The likelihood that he is perceived in this manner is not unrealistic.

Step one in the process of persuasion, therefore, is to establish the interest of the nation as your primary concern. In order to achieve this, interpersonal channels are best utilized. Here the planner is playing the role of the stimulator (Rogers and Shoemaker, 1971:277).

Within the context of development, a planner is akin to the change agent. The abovementioned political caveat should not deter the planner from pursuing his ultimate goal. Recognition of the

political atmosphere should enhance the saleability of the planner's

Suggestions for Further Studies

In order to promote research and eventually increase the consumption of quinoa and other HPEC's it is crucial, in the future, to study the possible effects of income, prices, household characteristics, cultural traditions, and occupation as they relate to the quinoa agricultural and marketing practices. It might be possible to encourage locals to consume more quinoa if the prices of substitutes such as wheat and rice are increased. Of particular import would be to observe public reaction if wheat subsidies were eliminated. If the government is interested in improving the nutritional status of the poor, the elimination of wheat subsidies may prove to be the most expedient way to create a demand for quinoa. Given that wheat prices are artificially low, due to the subsidies, quinoa would compete in accordance to actual market prices.

Formally, one can study the relationships between quinoa and wheat on one hand and total caloric intake on the other. Studies of the nature have been carried out by anthropologists, but again the dissemination of the results tend to remain within the confines of anthropology as studies that relate only to remote and unacculturated populations in the high Andes. The generalizability of these studies to other highland populations appears not to occur in the literature nor in practice.

There is a need to create formal local markets for quinoa in the urban areas of Ecuador and other Andean nations. This would enhance the economic well being of quinoa farmers. It might be possible to

convince urban consumers in Ecuador to consume more quinoa if they know that quinoa is becoming a highly regarded commodity by the urban elite in major cities in the United States such as New York City.

APPENDICES

APPENDIX A

QUINUA: Agronomic and Chemical Characteristics

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Agronomic and Chemical Characteristics

Quinoa (Figure A.1) is apparently a hispanicized form of the original Quechua word kinua and today even the Indians use the corrupted term. The Aymara people call the plant huppa but the Spaniards first noted the crop among the Quechua and so adopted their name for it. The taxonomical name is Chenopodium quinoa Willd. The spelling of the cultigen varies in the text between quinoa and quinua. Andeanists will write quinua, most English speaking writers will select quinoa. As a result of this both spellings are found throughout the literature review. There are other closely related Chenopods that are mentioned in the text, these are: canihua (Chenopodium palidacuales), known as kaniwa in Peru and huauzontle (Chenopodium nuttalliae), which was grown by the Aztecs of Mexico and which can still be found today in southern Mexico.

Chenopodaceae: agronomic characteristics

Chenopodium quinoa is a domesticated herbaceous plant, attains a height of two meters, and has broad leaves increasing in size and number toward the base of the stalk. The root is simple, generally braided and easily pulled up. The inflorescence is a panicle and the fruit is an achene which encloses only one tiny seed, the cuticle surrounding the seed contains saponin and this must be washed away before the seed is palatable. Saponins are glycosides obtained from many varieties of plants. Saponins are used as a base for foam baths,



Quinoa in Flower
Source: Jose T. del Granado, 1931

Figure A.1

detergents, and as stabilizers, due to their frothy qualities, saponins serve to protect plants from insects and contain at least one class of compounds which may be commercially valuable as a biodegradable insect repellent or anti-fedant. Chemical analysis at Michigan State University's department of Chemistry has shown that saponins in this form could be commercially valuable.

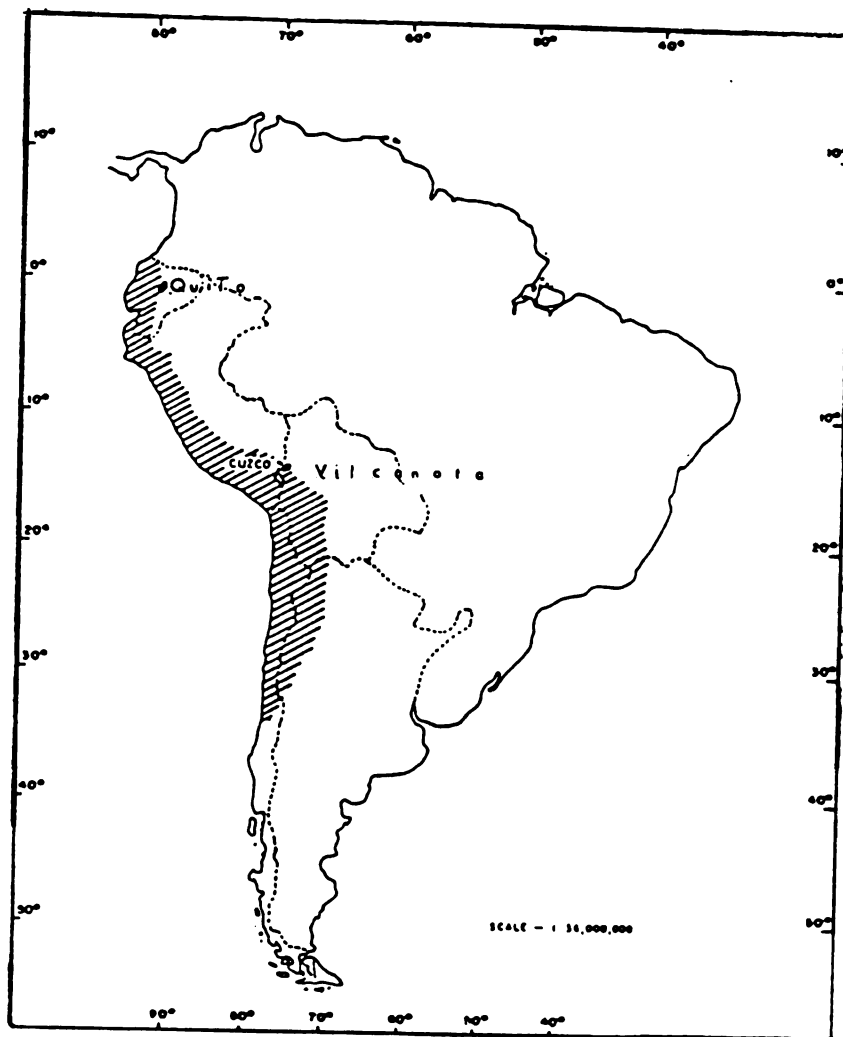
The quinoa under consideration was grown at an altitude of 3,000-4,500 meters. Our observations (INIAP, 1982), point to the fact that the protein content of quinoa depends on climatic conditions and altitude. The higher the altitude the greater the protein content. Cultivation at high altitude consistently produces quinoa with higher protein content than soybean grown under the most favorable climatic conditions. Since the protein content of any grain is one of the most important factors for selling, it is logical to argue in favor of marketing quinoa over exotic grains (Chaudhuri, A.P., 1981; Oleas, T., 1981; Raythatha, R., 1981-1982).

The young leaves of the quinoa plant are rich in trichomes. These are epidermal accessories which play an important role in plant defense mechanics by secreting some substances, as yet not fully identified, which act as insect antifeedants. The greater the number of trichomes, the better the defense against insect predation. This presents an interesting point for the continuation of traditional planting techniques and usage of quinoa plants. Quinoa is the only grain which is still sown according to the Inca technique. Quinoa was planted to defend corn plants from insect predation. It is still a common practice to surround corn plants by quinoa plants. Phaseolus vulgaris was also noted in the field to be surrounded by quinoa plants (Hernandez, S., 1983, Field notes).

Recent scientific experiments corroborate that the young leaves of Chenopodium quinoa are highly resistant to insect predation. "Some plants are relatively free of insect and fungi attacks, e.g., quinoa, anu, and manioc; others such as potatoe, cacao, broad bean, and wheat are plagued with pests" (Gade, D.W., 1975:49). The exact chemical composition of the trichomes that resist insects is still not known (Gade, D.W., 1976; Garcilaso de la Vega, 1609; Guertin, S., 1981; Leon, J., 1964). Once the exact composition of the trichomes is known, it can be marketed as an insect antifeedant. The saponin that occurs in quinoa may be a triterpene in the form of a glycoside since it does not contain phosphate.

The Vilcanota valley of Cuzco in Peru (Figure A.2), is one of the few places in Andean America where systematic research has been conducted on quinoa and its use among the indigenous population. The valley has a similar climatic range, physical environment, and indigenous population to that found in Andean Ecuador. The inhabitants of the Vilcanota valley classify quinoa on the basis of seed color and size. The kinds of quinoa grown in the Vilcanota valley are: yurak with large white seeds; kami with yellow seeds and yellowish stalk, leaves and fruit, and puka with red stalks, fruits and yellow seeds, according to Gade (1974:5), the latter two kinds are said to contain a higher percentage of saponin than does the first which explains why yurak is preferred. Yurak, kami, and puka are Quechua words which refer to the colors white, yellow, and red.

Quinoa is sown broadcast, in Peru and Ecuador, in the months of September, October, or November, when the plants reach a height of 6-10 centimeters they are already resistant to drought, so moisture is



Vilcanota, Peru
Source: Edward P. Lanning, 1967

Figure A.2

critical only during the germination stage. Few pests bother quinoa and farmers give little attention to weeding it. The crop is harvested 150-180 days after sowing. The stalks are often pulled out the ground by hand rather than cut at the base with a sickle. One apparent reason for the survival of the pre-conquest harvesting method is that, unlike most grains, quinoa seed shatters readily when ripe, and pulling jars the stalk less than cutting it. By extirpating the whole plant, very little of the plant remains in the field to provide organic matter to the soil, the stalks and panicles are dried in the sun for several days before being threshed by flailing sticks, rarely, if ever, is quinoa threshed by animal hooves.

Quinoa responds best to indigenous planting, management, cultivation, and harvesting methods, fertilizers have been used with highly favorable results, without fertilizer quinoa will yield 400-800kg of grain per hectare; with fertilizer it will yield as much as 4,400 pounds per acre (Tapia, M. et al., 1979; Tapia, M., 1982). Yields up to 1,700 or even 2,000kg per hectare (1,400-1,700 lb/acre) under harsh dryland conditions and 3,500kg per hectare (3,000 lb/acre) with irrigation or ample rainfall are not uncommon. Increasing yield is a function of improved agronomy, breeding and improved cultivation techniques. Due to the lack of capital of the indigenous population, the use of ordinary fertilizers is not recommended, the native population may use the grain as insurance against famine, and as a source of additional income. The concept of food bank has yet to be fully explored on a larger scale of national development planning. Because the grain ripens at various times, the native population is assured of a steady supply of the grain. By planting several varieties of quinoa: red, yellow, and beige, the Indians insure hybrid

vigor (high variability) in the grain. These are observations of the native planting methods, it is not known if, with such primitive techniques, F1 crosses are controlled (Oleas, T., 1981, Personal communication). Quinoa will grow and give high yields in those areas where no other grain will grow (Gade, D.W., 1975; Baker and Osborne, 1952:93; Garcilaso de la Vega, 1609;1617). The critical point with regard for the ability of quinoa to produce high yields under ideal conditions is not as important as its ability to produce under less than ideal conditions. These conditions include extreme drought in heavily alkaline or saline soils where other crops cannot grow. Production per unit of land in a marginal area is a meaningless measurement, the only valid indicator being production compared to other crops under similar conditions. Yields per hectare on traditional Andean farms are low because: 1. little effort was ever made to improve yields, and 2, among small farmers whose primary concerns are subsistence and security, dependability under adverse weather conditions is more important than high yield per land unit (Cusack, D.F., 1984:29). Those areas in the upper slopes of the Andes that are now uncultivated could be planted to quinoa.

The distribution of quinoa among altitudes is wide: from 2,770 meters to 3,800 meters. In no place in the Vilcanota valley is it grown as a mono-crop; it is intercropped in mixed fields. Curiously, quinoa is seen least in the harsh microthermal environment of southern Canchis, in the department of Cuzco, where one would expect to find it cultivated, the most common reason given for its scarcity here is that the people do not know how to prepare it for consumption; this suggests that wheat and barley have replaced it here in recent

generations. Farther north in the valley, in the maize growing section, quinoa is often sown as a living fence around a maize field, a planting pattern which goes back to Inca times (Garcilaso de la Vega, 1609; 1617; 1966:227). This pattern may also be seen in Ecuador (Hernandez, 1977; 1983, Field notes). The Indians claim this 'defends' the maize from winds, frost, and animals. Quinoa may also be sown in clusters within a maize field or individually dispersed among corn plants. Additional patterns that were noted in Ecuador included quinoa plantings within a few yards of the main house or right next to the house. This is often indicative of the importance accorded to a plant (Hernandez, S., 1983, Field notes).

Uses of Quinoa

Only where wheat and barley do not thrive, as on the altiplano, south of La Raya pass in Vilcanota, is quinoa the basis of subsistence, the altiplano, the high plateau, presents an environment similar to but not identical to the paramo of Ecuador. The loss of quinoa as a significant crop in the Vilcanota valley is lamentable in view of the advantages of this plant. It has few pests, high food value, a variety of uses for most of the plant, and the ability to produce despite low rainfall, low temperatures, and poor soil conditions.

The severe drought conditions brought on by the exceptionally strong Nino current of 1982 did not significantly affect the production or yield of quinoa and other endemic cultigens. Table A.1 presents crop production for Bolivia and Peru.

Table A.1 1983 Crop Losses in Bolivia and Peru due to drought. (As of June 30, with 1982-1983 season harvests completed.)

	Tons Lost	Dollar Value (millions)	% of Total Nat'l Production
Bolivia			
Potatoes	587,378	180.5	66
Maize	112,476	19.4	25
Barley	33,286	6.3	54
Wheat	28,706	11.1	44
QUINUA	1,065	.4	7
Rice	25,095	6.3	29
Cassava	91,932	17.0	34
Veg & Fruit	147,918	28.7	40
Other	78,368	8.0	
Total	1,100,000	277.7	
Peru			
Potatoes	491,000	94.3	27
Maize	24,000	5.5	6
Barley	34,000	4.7	26
Wheat	5,500	1.0	
QUINUA	no loss	---	--
Olluco	16,500	3.8	48
Other		8.5	
Total	578,800	120.8	

Source: Latin America Weekly Report, 26 August 1983, WR-83-33, p. 9 (USAID estimates 30 June 1980).

The importance of maintaining quinoa and other hardy native crops has been further dramatized by the devastating altiplano drought of 1982-1983, the worst in Bolivia's history. As shown in Table 3, quinoa production was the least affected of Bolivia's major crops, even though much of it is grown in the hardest hit areas. In some parts of Peru, the drier-than-normal weather even produced bumper yields of quinoa (Cusack, D.F., 1984:27). There is no comparable data for production in Ecuador for the same period.

Experiments have shown that the protein quality of quinoa is equal to that of whole dried milk (Cardozo, A. and Bateman, 1961;

White, Alvistur, Dias, Vinas, White, and Collazos, 1955). This is particularly important for the indigenous population prone to be lactose intolerant. Not only does quinoa have a higher protein content than grain (White et al., 1955:534), but the quality of the protein is very high (Cardozo & Bateman, 1961). After the seeds have been thoroughly washed, the seeds are made into a mush, first by toasting and then boiling the seeds. Often sugar is added. As late as the mid-nineteenth century (Gonzalez, 1833:61), quinoa mush (api) was important in the diet of Cuzco town dwellers and rural folk alike. Another way to prepare quinoa was to grind the seeds and to make them into a dough which was allowed to harden into a cookie, [known as kispino]. This was a common food taken on long journeys because it would last several months without spoiling. Quinoa chicha, a beer like brew, was formerly made regularly, but now it is prepared in the Vilcanota valley only for certain ceremonial occasions, for example the feast of Corpus Christi (Gade, D.W., 1975; Hernandez, S., 1977). Before the plant matures the tender leaves are eaten as a salad (llipecha), furnishing vitamins. Quinoa stalks are also macerated, dried, and burned; the ashes are then collected and formed into a ball, the size of a golf ball, a bit of which is chewed with coca leaves to extract the alkaloid in the coca leaf. The stalk is also valued as a fuel which produces a quick, hot fire in an area where fuel of any kind is scarce.

The plant seems to do best when left to its own devices. There is really very little that could be done to improve the genetic makeup of the plant. Saponins, which cause the greatest problems for palatability may prove to be a blessing in disguise (National Academy of Sciences, 1975). Insects dislike saponins as much as the human

population dislikes them. In order to make the grain palatable to both humans and animals, the saponins must be removed. This is done by an extremely easy process. The grains are washed several times in water.

Other Important Endemic Cultigens

Kaniwa (Chenopodium pallidicaule Aellen), is much smaller (30-50 centimeters) and more branching than quinoa. Kaniwa is grown sparingly above 3,800 meters beginning at the lower edge of the puna and extending to La Raya Pass (4,340 meters). It commonly grows in small patches on a garbage heap or in an abandoned llama pen, land that has been fertilized by the llama droppings, of all cultivated plants in the valley, kaniwa requires the least amount of heat for successful growth. Planted in the months of November, December, and January, it matures within 120 days. It is threshed like quinoa, with a stick, and the seeds are used in much the same way as quinoa (Gade, D.W., 1975). Kaniwa has an even higher protein content (White, et al., 1955:532) than does quinoa, but less calcium. This may explain the preference for quinoa ashes as the accompanying lime for coca chewing. Paik'o (Chenopodium ambrosioides L.), an herbaceous plant with a very strong odor which grows as a ruderal, at elevations above 2,600 meters. Ruderals are plants that can grow in excessively poor soil conditions. Paik'o has long been a part of native medicine (Cobo, B., I:179; Hernandez, S., 1977:154). The seeds are used against intestinal worms in humans and the leaves are used to cure stomach disorders. Llipecha (Chenopodium petiolare L.) a weed in grain fields is valued for its edible leaves that are consumed boiled.

APPENDIX B

REVIEW OF COLONIAL PERIOD

REVIEW OF THE COLONIAL PERIOD

The early inhabitants of the newly established colonial cities in the Americas had also enjoyed urban environments on the Iberian Peninsula. The city in Spain and Portugal were the centers of intellectual activity, artistic innovation, and production. These cities were unique given that health codes were enforced and there were many public recreation areas. The antecedents of these particular urban forms were provided by the Arab and Roman colonizers of the peninsula. Crouch, Garr, and Mundigo (1982: xvi) note that the Islamic impact on Spanish urban planning is poorly dealt with in the literature; consequently it is not treated extensively in their text. They mention further that the effects of the Moslem occupation were both subtle and profound. A brief overview of the current literature clearly confirms that the Spain of the fifteenth century was the most urbanized country in Europe.

There was no feudalism in Spain. Morse (1974:144-145) has argued that classical feudalism based on a manorial system never existed either in Spain or in Spanish America because of the strong urban tradition and the subjugation of culturally and ethnically distinct populations. In both places, he points out, there was considerable latitude for the achievement of status and material wealth that was largely absent in the classical feudal societies of Northern Europe.

Perfumed gardens, canals and bridges, internationally renowned universities and schools of medicine, exquisitely tiled public baths; the cities of southern Spain (al-Andalus) were known for their intellectual environments and their unique beauty. Spain was the most urbanized country in Europe from the ninth to the fourteenth centuries (Nutini, H.G. in Telkamp, G.J., 1978:24). Spanish colonial urbanization was partly an expression of urban Renaissance ideology (urbanidad) and partly a set of techniques of political, cultural, and territorial control (Telkamp, G.J., 1978:24). The physical evidence of the Spanish presence in the Americas is the indelible city, the urban form. However we chose to analyze the settlement of the American continents, this had at its base the city, it cannot be understood in any other way, for the policy of the Spanish crown was to establish cities from whence the crown could dominate and control the newly discovered territories and thence continue its civilizing mission of religious and political indoctrination of the indigenous population (Dominguez Company, F., 1984:9). The configuration of the American city and urban planning both owe a strong, although often unacknowledged, debt to its Iberian antecedents.

The task of urban creation, initiated by Spain in the new world, from the XV-XIX centuries, was enormous. No other nation has completed, in this aspect, anything that remotely resembles or is comparable to this achievement. The founded city confirmed the conquered territory, and at the same time, gave institutional form to the colonizing policy of the Spanish crown (Dominguez Company, F., 1984:8; Ramirez, S.E., 1986).

With the founding of Santo Domingo de Guzman in 1496 by Capitan Nicolas de Ovando on the island of Hispanola, today the countries of

the Dominican Republic and Haiti, planning in the Americas was initiated. The founding charter of Quito exemplifies the importance with which the crown viewed a new city. The following text is a literal transcription of the charter of Quito.

FUNDACION DE LA VILLA DE SAN FRANCISCO DE QUITO

(28 de agosto de 1534)

En la cibdad de santiago A veyente e ocho dias del mes de agosto ano del nascimiyento de nuestro saluador hiesu xrispo de myle E quinyentos e treyenta e quatro anos el magnyfico senor don diego de almargo mariscal de su magestad en estos rreynos de la nueva castilla por su magestad y lugar tenyente general de gouernador e capitan general en ellos por el muy magnifico senor el comendador don francisco picarro adelantado gouernador e capitan general en ellos por su magestad etc. En presencia de my gonzalo diaz scriuano de su magestad e escriuano publico y del concejo desta dicha cibdad el dicho senor mariscal dixo quo por tanto el en (nonbre) de su magestad e del dicho senor gouernador en su rreal nonbre A conquystado e pacifficado esta probincia de quyto e otras a ella comarcanas e a plazido a nuestro senor que los mas senores e prencipales e yndios dellas. estan pacifficos e deaxo del yugo e obidencia de su magestad y para mas verdaderamente vengan a las pazes y se conbiertan a nuestra santa ffe catolyca con la conversacion e buen ejemplo e dotrina de los espanoles basallos de su magestad que en estas partes poblaren. El en nombre de su magestad ffundo e poblo (vna) esta cibdad de santiago y por que conbyene al seruicio de su magestad y a la paz y sociego destas provyncias y conversion de los natural(es) dellas que se funde e pueble otro pueblo de mas desta dicha cibdad por que dello su magestad sera muy seruydo por tanto quel en nonbre de su magestad y del dicho senor gouernador don ffrancisco picarro en su rreal nonbre e por virtud de los poderes que de su senoria tiene come su thenyente general de gouernador e capitan general ffundava e fundo otro pueblo. en el sytio e asyento (de) dondesta el pueblo que en lengua de yndios aora se llama quyto questara treynta leguas poco mas o menos desta cibdad de santiago, al qual puso por nonbre (a) la villa (a) de san ffrancisco. la qual dicha ffunacion dixo que hazia e hizo en (nonbre) de su magestad e del dicho senor gouernador con tal condicion e aditamy(ento) que (el dicho sen) su megestad o el dicho senor gouernador en su rreal nonbre lo aprueve e que paresciendole a su senoria o a el en su nonbre que la dicha (pueblo) vil(la) de san ffrancisco se deve mudar o poner en otro sytyo en su comarca lo muden e pongan en el lugar e sytio mas bonbynie(n)te por que al presente A

cabsa de ser la tierra nuevam(ente) conquistada e pacifica no se a visto ny tiene espye(ncia) de los sytios donde mejor pueda estar la (dicha villa) para en lo que toca al seruicio de su magestad e a la conversion de los naturales e byen e pro de los vezinos e moradores que en la dicha villa se avezindaren e poblaren e andando el tiempo podrya haber espyencia de todo e convenyr quel dicho pueblo se mudase en otro cabo mejor e que mas convenga e done se ayan mejor las calidades que se rrequyeren para ffundacion e poblacion de pueblo.

E luego el dicho senior mariscal en el dicho nonbre de su magestad y del dicho senior governador aviendo fecho la dicha ffundacion segund e de la manera que dicha es dixo que por que la dicha villa sea vien rregida y la justicia de su magestad admynstrada en ella como conviene a su rreal servicio que el en nonbre de su magestad e del dicho senior governador en su rreal nonbre nonbrave e nonbro por alcaldes hordinarios de su magestad el capitan juan de ampudia e diego de tapia e por rregidores a pedro de puelles e juan de padilla e rrodrigo nunez. e pedro danasco e alonso hernandez e diego martyn de btrera e juan despinosa e melchyor de baldes.

Que son personas abiles e suficientes y en quien concurren las calydades que se rrequyeren en semejantes officios a los quales e a cada vno dellos nonbro a los dichos officios hasta tanto que el dicho senior gouernador don ffrancisco picarro o el en su nonbre otra cosa proveen confforme a la horden que se suele tener en semejantes helecciones y en nonbre de su magestad e del dicho senior gouernador dixo que les dava poder tal qual de derecho en tal caso se rrequiere a los dichos alcaldes. para que puedan traer vara de justicia en la dicha cibdad e sus termynos e oyr e determynr en los casos de justicia ansy (eviles come crimynales y en las otras cosas tocantes a los dichos officios anexos e pertenescentes e snsy mysmo a los dichos rregydores en lo tocante a sus officios los puedan vsar y exercer en las cosas e casos a los dichos officios para lo qual como dicho es. dixo que les dava poder conplido tal qual de derecho en tal caso se rrequyere con todas sus yncidencias e dependencias e por (que) el dicho senior mariscal e por su mandado lo ffirmo juan de espinosa scriuano de su magestad e alcalde mayor en estas provyncias de quito por su magestad

juan de espinosa

E despues de lo suso dicho en este dicho dia e mes e ano suso dicho el dicho senior mariscal mando parescer ante sy a los dichos alcaldes e rregydores de suso contenydos e rescibyó dellos juramento por dyos e por santa maria e por las palabras de los santos evangelyos e por la senal de la cruz en que se pusyeron sus manos derechas corporalmente que como ffieles cristianos temiendo a dios nuestro senior e guardando sus conciencias bsaryan de los dichos officios fielmente cada bno conforme a lo que hera oblygado myrando primeramente el seruicio de dios nuestro senior el el de su magestad e byen pro comund de los vezinos e moradores de la dicha villa e que obedesceryan las provysiones e cedula de su magestad e los

mandamientos del dicho señor gouernador don ffrancisco picarro e de
sus tenyentes y en todo haryan aquellos que buen(05) alcaldes o
rregydores heran oblygados en semejantes cargos los quales asolbyendo
el dicho juramento dyxeron si juro e amen e que ansy lo conplyryan en
todo lo a ellos posyble e el dicho señor mariscal (los l) dixo que los
abya e obo por rescebydos a los dichos officios en nonbre de su
magestad e del dicho señor gouernador en su rre (al) nonbre e les dava
poder conplydo como dicho es en el dicho nonbre (para) e lo firmaron
de sus nonbres testigo juan despinosa alcalde mayor e el capitan
sabastian de benalcacar

diego de tapia

alonso hernandez

pedro de puelles

pedro danasco

rrodrigo nunez

juan de padylla

diego martyn

Planning in the Americas has been practiced for 490 years. The
institutions established by the Spanish were not abandoned with the
advent of the independence of the Spanish provinces in the New World.
The practice of colonialism, as practiced by the Greeks and Romans in
Spain was markedly different from the concept of provincialism as
practiced by Spain in the New World. "In the ancient world the city
as a symbol of conquest was that of the polis. The polis was an urban
nucleus for the ruling Greeks and was independent of the precinct
destined for the native population. The city of Emporium as described
by Titus Livy consisted of two cities separated by a wall. One part
was inhabited by Greeks, the other by Iberians; but the Greek city
faced the sea (abierta hacia el mar) had only a small walled portion,
while the Spanish were far from the sea and were surrounded by a wall
4km. long. At night a third of the citizens watched the walls..." no
Spaniard was admitted in the city nor did the Greeks leave the city
without a special purpose...". Clearly we are dealing with a factory
whose sole purpose was commerce with the distant metropolis.

On their behalf, the Roman culminated their expansionist policy within a rigid criteria of military occupation for the exclusive benefit of the Roman citizen. The typical procedure consisted of reserving a third of the occupied territory for themselves, leaving the remainder under the power of the defeated. The origin of the purely Roman colonial city was always the military camp (castra) which, occasionally, attained stability until it became a city (urb) (Zendequi, G. de., 1977:s-9).

Spanish urban policy from its inception in the New World was to create extensions to the Spanish crown. Documents which consist of a group of letters to Christopher Columbus from Ferdinand and Isabel, compiled by Antonio Rumeu de Armas, confirm that the new cities of the New World were indeed extensions of the Crown. Another group of documents published in 1984 by Francisco Dominguez Company, which consist of the original founding charters of the cities, provide reinforcing documentation of the actual intention of the Spanish crown with regard to the New World. Clearly, the unstated policy of the crown was to obtain wealth. By conceiving of the new found lands as an extension of the crown, the quest for wealth was justified within the socio-political aims of the crown.

Cities were founded as centers of acculturation. The indigenous population was considered as subjects of the Spanish crown. These cities were truly sociological experiments where seeds were sown that would foster the essence of the creole movement, the formative stage that would engender future nations of the Americas.

From an urban perspective, the enormous building enterprise that Spain completed in her dominions implicates a true revolution, that

anticipated by many years, the advantage, today generalized, of planning for urban growth which conforms to a rigid concept of order, which signaled the development of modern urban science (Zendequi, G. de, 1977:s-9).

Various Spanish and Latin American scholars have published excellent monographs concerning the urbanization of important capitals in that ultramarine empire [the Americas]. There are several recent "works" thanks to the Anglo-Saxon pen, some of considerable value, that capriciously elude the name of Spain when they study urbanization of what they call Latin America. Such a minor oversight would not be permissible if it were the consequence of an involuntary lack of knowledge, however, since it is the result of systematic propaganda, the act, in addition to being irritating, is scientifically, a scandal. Torres Balbas and Chueca hope to establish, once and for all, that the Spainards did "something" in America in the subject of urbanization (1981).

Laws of the Indies

There is a fascinating argument in the literature regarding the relevance and importance of the planning ordinances of the Laws of the Indies. Crouch, Garr, and Mundigo (1982:xxi) assert that in terms of their application, the city planning (emphasis added) ordinances of the Laws of the Indies are the most influential body of urban law in human history. Hardoy states that only occasionally an attempt was made to introduce an overall urban plan into a city of any importance (1978:217). This argument is reflective of the continuing controversy in regard to the importance of Spanish planning legislation. It is

imperative to interpret the significance of planning legislation in light of the European temper of the fifteenth and seventeenth centuries. No one was planning. Spain was the only nation that was taking risks, with the possible exception of Portugal; all other European nations followed in the footsteps of the Spanish and tried to overcome them. Of foremost importance is the recognition, by the Spanish, of the need to have legal and political acceptance of their colonizing efforts. Indeed, the colonization and conquest of the Americas was an eminently practical undertaking (Hardoy, J.E., 1978:217). It is curious that Hardoy does not see the critical relationship between the planning ordinances and Spanish urbanization in the Americas. The connection was clearly established, irrespective of the later codification of the laws, during the reign of Charles II in 1681. The compilation or Recopilacion de Leyes de los Reynos de las Indias, compiled and reorganized by Antonio Leon Pinelo and Juan de Solorzano Pereira represented a reduction from the original 100,000 royal edicts to 6,500. The final work was published in four volumes with a total of nine books. Book IV incorporates the city planning ordinances of 1573 and Book VI incorporates the New Laws of the Indies of 1542-1543. All of the Laws were issued by the Council of the Indies in Seville.

Present day planners often lament that their plans cannot be implemented without political support. Spanish planning ordinances had the full political support of the prime political arbiter, the Pope. In 1493, Alexander VI, a Borgia and a native of Valencia, was the Pope. He divided the world between Spain and Portugal. By so doing he gave primacy to Spain in the New World. In 1493 Ferdinand and Isabella issued the Royal Order Concerning Indians, where it is

clearly stated that the Indians were to be well treated and of course converted to Christianity. In the years 1512-1513, royal ordinances were encoded in Spain for the good government and treatment of the Indians. The corpus was known as the the Laws of Burgos. This action acknowledges the possible effect of change on the populations that were encountered, without engaging in a moral debate, which was more than adequately handled by Las Casas in the process of building a city. This is very important because the New Laws of the Indies of 1542-1543 restated and reinforced the good treatment of the native population. Thus, it is of no surprise that the planning ordinances of 1573 state that the native settlements were to be respected. Ordinances 5, 32, 110, 136-148 all insist on the respect and good treatment of the Indians and their property. The Laws of the Indies, which were first consolidated in 1573 during the reign of Philip II represent the first planning legislation in the Americas (Reps, J.W., 1980:27). These Laws of the Indies were expected to govern the planning of all subsequent settlements in what was an extensive colonial empire. This vast overseas domain could not have functioned without an intricate urban network composed of ports, mining towns, military communities, administrative centers, religious complexes, viceregal and provincial capitals (Reps, J.W., 1981:7). The Laws of the Indies represent a unique combination of town planning doctrines and prescribed practices (Reps, J.W., 1965:32).

Most authors concur that the laws are representative of some of the views on the form and function of the city in the fifteenth century. In practice the local authorities often maintained native custom even when it conflicted with decrees emanating from Spain or

from Lima (Spalding, K., 1984:45). Spanish colonial law recognized native tradition and custom as binding in cases involving members of Andean society, unless the custom specifically conflicted with the laws of Spain or the dictates of the Catholic religion ("'Real Cedula' claramente injustos (Peru),' Badajoz, 23 de Septiembre de 1580," in Konetzke, vol. 1, doc. no. 394, pp. 529-530). Not all of the early documentation concurs, however, we may assume that when expedient local custom was honored. The Spanish added another dimension that is still to be explored in the literature. This was the incorporation of the indigenous urban center. The classical Roman work, Ten Books on Architecture by Vitruvius was originally written in 30 B.C. and republished in the fifteenth century. Two other works which may also have influenced the Laws of the Indies with regard to the urban form were the Treatise on Architecture and Planning by Leon Battista Alberti published in 1485 and Machiavelli's Arte della Guerra (Crouch, et al., 1982; Reps, J.W., 1965; 1980; 1981).

The Spanish colonial experience was a planned enterprise. The reader must remember that Spain had recently emerged from the colonial subjugation of the Arabs. Iberians were aware of the need to be recognized as a permanent entity in the Reconquest. In order to re-establish themselves on the peninsula they had to build cities. The course of empire was to build a series of planned cities with royal approval and sanction.

Spanish urban policy had 330 (1492-1822), 490 years if we were to consider that there has not been a drastic departure in basic urban planning in the Americas since the advent of the Spanish, to develop in what is now the United States, the Caribbean, Central and South

America. Codification of these laws took place from the fifteenth to the seventeenth centuries in Spain. The Spanish definition of a city was the urban area plus the neighboring hinterland (emphasis added), (Beyer in Crouch, Garr, and Mundigo, 1982:27) eliminates the urban-rural distinction that is commonly discussed in the planning literature. If you accept the Spanish definition, there is no distinction in planning for the urban or rural sector. This allowed the planner to apply his skills in both. Planning in America was eminently urban, however, it was not unheard of to build a city in the middle of the wilderness. The critical point was to build a city and establish yourself. The ideal place to live was in the city (Mauro, F., 1978:250). Thus, if cities were built in rural or wilderness areas, their ultimate purpose was to suit the urban aristocracy. The rural-urban distinction in Spanish-America was not that of the isolated farmhouse of Anglo-America, if there was a difference, it was of scale not purpose.

Another influence on Spanish city planning and laws concerning urbanism comes from the Middle East. Spain was invaded by Arabs in 711. The Arabic architectural tradition was continued in Spain by the mozarabes (Catholics living among Moslems) and mudejares (Moslems living among Catholics). The term "mudejar" (stemming from the Arabic dajana, which has the double meaning of "settling somewhere" and of "submitting") has been used to indicate the work of Moslem artists who, although the Christian reconquest of Andalusia had made them vassalos moros, were prepared to put their Moorish-Islamic aesthetic traditions at the service of the Christians. This art survived the fall of Granada by some three hundred years. The true Mudejar style-the continuation of Hispano-Moresque art-is properly speaking a court

art (Scerrato, U., 1976:180). This architectural style is known as the hispano-moresque (Chejne, A., 1974:316-341). The hispano-moresque as an architectural and decorative style was solely in the hands of the mudejar. The mudejar influence in the architecture and planning of American cities persisted from the XV-XVIII centuries. Mudejar architecture is best preserved in Catholic ecclesiastical buildings. The homes of the urban elite were designed and decorated to conform to the mudejar style.

It is not uncommon to see exquisitely decorated church facades and ceilings that freely employ this style. These occur throughout Spain and in the early colonial cities of the Americas. It is not only the beauty of the decorative motifs that tantalize the eye, but the realization that there are few studies which acknowledge the Arabic presence and contribution to planning in the Americas. The Islamic impact on Spanish urban thought was both subtle and profound. This is being studied by Auguste de Montequin (Crouch, Garr, and Mundigo, 1982:xvi). Individuals who were practitioners of this art form came to the New World with the Spanish conquistadors. Mudejar artists were either secret Moors, Moors converted to Catholicism, or Christians who were fully conversant with Islamic art forms (Toussaint, M., 1946). Perusal through the literature that does exist reveals that planned cities, as initially manifested in the New World were an amalgam of both eastern and western traditions. The contribution of the pre-Columbian urban planners is another area that has not been incorporated into the picture of urban America. Of note is the idea among empire builders that the city is the instrument of conquest.

The situation for the urban scholar is magnificently compounded if he is unaware of the urban tradition in the Americas before the European conquest. Spanish explorers encountered wondrous cities. For the Spaniards, the existence of a city was the sign of civilization. When they arrived on American shores they stumbled upon cities. From the Pueblos of the American southwest to the cities of the Incas, the Spanish saw urban networks that were similar to those of Moorish Spain (Mauro, F., 1978). Tenochtitlan and Cuzco were as dynamic as any European city of the time. The American southwest provided the Spanish with a sedentary population that lived in multiple storied buildings. This looked very similar to the "Pueblos" of Spain, hence, the name of Pueblos for the habitation of the indigenous population of the region.

Scholars generally agree that for an urban center to exist three major processes must occur together. These are population growth, tens of thousands for cities; nucleation-growth of internal population density within a single settlement relative to its sustaining area, and population differentiation. Two other factors must also exist within the context of the above. These are social stratification and socio-economic differentiation, with a large part of the population freed from full-time food production (Price, B., 1978:52). The existence of a city in history assumes the pre-condition of a state form of organization (Schaedel, et al., 1978:34).

Now that the pious myth of the founding of the United States only by the Puritans at Plymouth and Cavaliers at Jamestown is questioned, the time is ripe for an examination of this other major strand in the history of the Americas (Crouch, Garr, and Mundigo, 1982:xix).

The myth has more serious implications. It involves the tacit

denial of the existence of a Spanish Catholic political philosophy and its influence on American urban thought. Thomism is representative of the ultimate fad in the early socio-political thought in the founding of American cities. It persisted at least six hundred years in the Americas unlike the inclination of modern Catholicism toward the rural population and its specific Ethos, it is solely the city that St. Thomas takes into account. In his view man is naturally a town dweller, and he regards rural life only as the result of misfortune or of want (Morse, R.M., 1972:77). It now becomes easier to see why the rural-urban distinctions are generally not valid in Spanish America. The Spaniard of the colonial period was a totally urban person both in philosophical outlook and practical orientation. A problem immediately develops when attempting to do research in this area. There are a number of related issues that are not adequately handled in the literature. Specifically, the relationship between Moor and Spaniard in Iberia, pre-Hispanic urban patterns, and the influence of the concepts of city planning of both on the American scene. Given that these are areas in which the present day researcher must make assumptions that reflect on their final recommendations it is necessary to realize that the historical development of urbanism in Spanish speaking America is conceptually different from the conceptual development of urbanism in English speaking America. The rural-urban continuum is an issue that will be addressed in the next section, with an emphasis on agriculture.

Food Crops in the Early Andean Colonies

A significant amount of work on the technical, botanical, and genetic aspects of Andean cultigens exists; Chenopodium quinoa has received sporadic intense attention in both Europe and North America (Acosta Solis, IBRD, Tapia, Vietmeyer, and White). There have been few if any attempts, other than in the archaeological literature (Towle, M.A., 1961) to understand the persistence of quinoa and other high altitude cultigens among the Andean plant and human population (Hillman, G.C. et al., 1983:1235-1236; Kautz, R.R., 1980; Lynch, T.F., 1980ab). There has been a limited amount of work done on the importance of these crops during the early colonial period. Gade, Antunez de Mayolo, Lynch, and Ramirez, S.E. make sporadic mention of the importance of these crops during the early colony, 1500-1700. With the current proclivity for multisectoral planning it is essential to understand how these plants were and are used in the Andes. Prior to 1550, the effect of growing interest in land, by the Spanish, did not seriously affect the indigenous population. During this time the two major harmful effects were depredation of Indian fields by Spanish livestock and Indian labor lost the aura of being an almost sacred duty to a master and became an almost undisguised economic exchange. The encomenderos could not employ Indians (had there been a surplus) after Bartolome de las Casas and other humanitarian-minded priests barraged the king and the council of the Indies with propagandistic writings describing the exploitation of the Indians by the Spanish (Ramirez, S.E., 1986:61;82). In order to do this, the nature of the interrelationships of the agricultural and health sectors as part of the informal sector and within the cultural arena of the Indian

population is needed. The individuals who devised the Laws of the Indies expressed a need to gain knowledge of the native population with respect to these sectors, which they considered essential if an urban center was to be efficient.

The compilation of lists from botanical garden archives (von Reis, S. & Lipp, F.J., 1982) give recent scientific recognition to these ancient crops. The seemingly obvious connection that nutrition and agriculture are critical to present day socio-economic development is receiving renewed attention (Hunter, J., 1982; Roldos Aguilera, J., 1981). The problem is recognized, but there is no attempt to note how the colonial pattern has persisted among the indigenous and Iberian inhabitants of the Andes.

As the local Spanish established their power through land allocations given by the crown or purchased outright from hacendados and local political activities they were able to ignore the wishes of the crown with regard to the treatment of the indigenous population; the Indians became increasingly powerless to assert their rights. The Indians were helpless. Personal friends of corregidores were immune to their complaints and civil suits. Corregidores, like the encomenderos who they replaced, used their authority to remove recalcitrant and uncooperative Indian leaders (Ramirez, S.E., 1986:143-144).

Indigenous dietary practices of the highlands may have greater nutritional integrity than those diets that are based on introduced crops such as wheat and barley. The crown was fully aware of the need to learn more about the indigenous population. In 1569 Viceroy Francisco de Toledo sponsored a visita (a fact finding mission) to obtain more information on Indian history and customs, to count the

native population, to review the Indians tribute obligations, and to relocate the Indians in more accessible places (Ramriez, S.E., 1986:72). A diet of native cultigens provides 2,428 calories as opposed to 2,183 calories for a diet composed of both native and exotic crops (Antunez de Mayolo, R., 1978; Antunez de Mayolo, R., personal communication, 1982; Frisancho, R.A. & Baker, P.Y., 1980; Mazess, R.B. & Baker, P.T., 1964). This is better than the national intake for Ecuador which was 1,820 calories in 1961 and 2,040 calories in 1970. Only Haiti is lower in Latin America with 1,820 calories in 1961 and 1,720 calories in 1970. This makes Ecuador on a national scale one of the most malnourished nations in the western hemisphere (Handleman, H., 1980:14,19).

National average caloric intake for Ecuador is not uniformly reported. It must be assumed that these data are derived from highly divergent samples. The general increase in income has resulted in an improvement in average caloric intake. This intake increased from 1,750 per day in 1968 to 2,000 by 1974, reasonably close to the 2,300 calories recommended by the Instituto Nacional de Nutricion. The difference between actual and recommended calorie intake declined from 24.0 in 1968 to 14.0 percent in 1974. However, a substantial nutritional deficit persists in proteins. The availability of proteins per day has decreased from 41 grams in 1968 to 37 grams in 1974, compared to the recommended intake of 62 grams. The deficit is on the order of 40 percent (World Bank, 1979:20-22).

APPENDIX C

Cover Letter and Questionnaire

Cover Letter and Questionnaire

May 29, 1986

Dr. Edward Vickery, Executive Director
South-East Consortium for International Development
400 Eastown Drive, Suite 207
Chapel Hill, North Carolina 27514

Dear Dr. Vickery:

The attached questionnaire is part of a survey of the views of persons responsible for programs in international agriculture. Your name was selected as a result of the research activities of your organization. The survey focuses on new food sources.

We are writing you at this time because some persons prefer being informed in advance about a request for participation in a Delphi survey. This survey will consist of two rounds.

The questionnaire should take only ten minutes to complete. Naturally, all of your responses will be confidential, and your participation voluntary.

Your participation in this important study will be greatly appreciated. If you have any questions, please call or leave a message at 517-355-3157 or 517-355-0174.

Sincerely,

Sandra Hernandez
Graduate Assistant

Dr. Kim A. Wilson
Assistant Director

1. What is the highest academic degree you hold? BA/BS ()
MA/MS ()
Ph. D ()
Other ()
2. In what country did you obtain this degree? ()
3. What is your country of origin? ()
4. How many years have you lived in any developing nation? < 3 ()
4-6 ()
7-9 ()
> 9 ()
5. What is your position (title)? ()
6. How long have you held this position? (years) < 3 ()
4-6 ()
7-9 ()
> 9 ()
7. Are you male or female? M ()
F ()
8. How many individuals do you oversee? < 3 ()
4-6 ()
7-9 ()
> 9 ()
9. What is the name of your organization?
10. How many others in your organization have the same title? 0 ()
1 ()
2 ()
3 ()
11. How many others in your organization have a position higher than yours? < 3 ()
4-6 ()
7-9 ()
> 9 ()
12. A decision that you make determines whether a proposal is approved or not? Y ()
N ()
13. Where are your organizations headquarters located? Please indicate city, state and country.
14. Is your agency (1) governmental 1 ()
(2a) non-governmental for profit 2a ()
(2b) non-governmental not for profit 2b ()

15. What are the sources of your budget?
- | | | |
|-------------|---|-----|
| (1) public | 1 | () |
| (2) private | 2 | () |
16. Do you feel that your agency influences policy in developing nations?
- | | | |
|--|---|-----|
| | Y | () |
| | N | () |

Concern to ensure a reliable source of high quality non-animal protein has created renewed interest, by the scientific community, in the high protein endemic cultigens of Andean America. The chenopodaceae are representative of some of these crops.

The purpose of this questionnaire is to illustrate what you consider salient characteristics for future research and use of chenopodaceae.

Using the following categories select the response that best matches your opinion for the next question.

- 5. My favorite
- 4. Like
- 3. Indifferent
- 2. Dislike
- 1. Strongly dislike

1. Please rank each of the following:

- a. wheat() b. rice() c. corn() d. rye()
- e. quinoa() f. oats() g. millet() h. sorghum()
- i. amaranth()

Please use the following categories in response to statements 2-23.

- 5. Strongly agree
- 4. Agree
- 3. Undecided
- 2. Disagree
- 1. Strongly disagree

- 2. Quinoa is resistant to frost and drought. 5 4 3 2 1 ()
- 3. Quinoa grows in nutrient poor soils. 5 4 3 2 1 ()
- 4. Quinoa grows in high altitude soils. 5 4 3 2 1 ()
- 5. Quinoa is insect resistant. 5 4 3 2 1 ()
- 6. The protein quality of quinoa is comparable to whole cow's milk. 5 4 3 2 1 ()
- 7. Wheat, quinoa, potatoes and rice are native to the Americas. 5 4 3 2 1 ()

8. It is generally agreed by animal scientists
that saponins retard growth in animals. 5 4 3 2 1 ()
9. Highland Quechua and Aymara speaking
populations obtain the majority of their
calories from tubers and chenopods. 5 4 3 2 1 ()
10. Chenopodium quinoa is high in lysine. 5 4 3 2 1 ()
11. High altitude soils in the Andes are
characterized as low in phosphorus. 5 4 3 2 1 ()
12. Current wheat production in Andean
nations can meet local demand. 5 4 3 2 1 ()
13. Wheat, corn and barley are nutritionally
inferior to quinoa and canihua. 5 4 3 2 1 ()
14. The great variability and general
poor quality of Andean high altitude
soils require crops of
comparable adaptability. 5 4 3 2 1 ()
15. Long term research investment on high
protein endemic cultigens benefits both
developed and developing nations. 5 4 3 2 1 ()
16. Use of chenopodaceae in livestock
feeds would provide an incentive for
local farmers to increase current
crop production of chenopods. 5 4 3 2 1 ()
17. It is easier to develop a market for
chenopodaceae in the developed
world than in the developing world. 5 4 3 2 1 ()
18. Increase in the market value of
quinoa should generate interest
in the production of the crop. 5 4 3 2 1 ()
19. The use of quinoa by-products should
significantly decrease the need for
importation of industrial detergents
and pesticides. 5 4 3 2 1 ()
20. The higher the protein content of a
grain the lower the yield. 5 4 3 2 1 ()
21. In regions characterized by poor soils,
poor farmers, and limited acreage per
farmer, quinoa could provide income
comparable to soy beans. 5 4 3 2 1 ()

22. Research already exists on the
agronomic characteristics
of the Chenopodaceae. 5 4 3 2 1 ()
23. The material on Chenopodaceae
is not widely disseminated. 5 4 3 2 1 ()

Please use this space to indicate any further comments or
observations.

APPENDIX D

Data Tables

Data Tables

Table D.1 Estimates of Multiple Regression
Expected Change Given Decision
Based On Environmental Knowledge

Dependent Variables	Constant	Independent Variables			R ²
q22	.026 (.083)	.521q6 (2.672)	.446q16 (2.493)		.717
q5	.218 (1.289)	.659q21 (7.034)	.169q23 (2.445)		.879
q4	.213 (.776)	.855q14 (2.305)	.121q15 (.465)	.169q16 (.553)	.862
q17	.144 (.613)	-.059q18 (-.494)	.933q19 (5.742)		.761

 *Numbers in parentheses are t statistics

Q9 and Q4 have a significant positive effect on Q2. Q3 has a positive effect on Q2, but it is not statistically significant. R indicates that 90% of the changes in Q2 are explained by changes in Q4 and Q9.

Q15 and Q16 have a positive effect on Q4. Q14 has a significant positive effect on Q4. R indicates that 86% of the changes in Q4 are explained by changes in Q14.

Table D.2

Estimates of Regression Equations

Expected Change Given Decision
Based On Quinoa Knowledge

Dependent Variables	Constant	Independent Variables	R ²
q11	.379 (1.111)	.725q10 (6.815)	.615
q13	.140 (.635)	.695q15 (10.768)	.799
q14	.159 (.909)	.856q15 (16.719)	.906
q14	.554 (1.798)	.887q21 (8.100)	.693
q14	.317 (1.500)	.859q9 (13.135)	.856
q15	.671 (1.936)	.947q8 (7.746)	.674
q15	.425 (1.479)	.914q9 (10.275)	.784
q19	.142 (.764)	.751q14 (12.576)	.845
q20	.725 (1.871)	.621q16 (4.771)	.439

*Numbers in parentheses are t statistics

Table D.3

Estimates of Regression Equations

Expected Change Given Decision
Based On Personal Preference & QKI

#	Dependent Variable	Constant	Independent Variable	R ²	F
1	QKI	1.043 (3.860)	.655Q1E (6.801)	.591	46
2	QKI	1.350 (3.847)	.471Q1I (4.098)	.344	16
3	QKI	.620 (1.227)	.545Q1A (4.117)	.346	16
4	QKI	1.283 (3.155)	.516Q1H (3.578)	.285	12
*5	QKI	.741 (2.955)	.733Q1I (8.449)	.697	71
6	QKI	1.362 (4.448)	.843Q12 (4.841)	.422	23
7	QKI	.198 (1.548)	.851Q14 (21.027)	.932	442
8	QKI	.284 (1.731)	.740Q15 (15.886)	.887	252
9	QKI	.282 (1.800)	.867Q16 (16.647)	.896	277
10	QKI	.691 (2.694)	.905Q17 (8.495)	.692	72
11	QKI	.460 (2.244)	.710Q18 (11.828)	.813	139
12	QKI	.333 (1.732)	.995Q19 (13.250)	.845	175
13	QKI	.449 (2.214)	.862Q21 (12.019)	.818	144
14	QKI	.840 (3.316)	.717Q22 (8.066)	.670	65

Table D.3 (cont'd.)

15	QKI	.838 (3.251)	.568023 (7.854)	.667	64
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 #Numbers in parentheses are t statistics
 ECI=economic index
 QKI=quinoa index
 QEI=environmental index
 QRI=research index

Table D.4

Estimates of Regression Equations

Expected Change Given Decision
Based On Personal Preference & QRI

#	Dependent Variable	Constant	Independent Variable	R ²	F
1	QRI	1.266 (3.323)	.670Q1e (4.934)	.432	24
2	QRI	1.599 (3.547)	.474Q1i (3.209)	.243	10
3	QRI	.589 (.956)	.627Q1a (3.883)	.320	15
4	QRI	1.566 (3.025)	.505Q1h (2.750)	.191	7
5	QRI	.403 (1.338)	.817Q2 (9.212)	.726	84
6	QRI	.407 (1.242)	.824Q3 (8.396)	.687	70
7	QRI	.262 (.936)	.759Q4 (10.447)	.773	109
8	QRI	.192 (.730)	1.102Q5 (11.418)	.802	130
9	QRI	.476 (1.825)	1.032Q6 (10.509)	.775	110
10	QRI	1.679 (4.515)	.648Q7 (3.942)	.326	15
11	QRI	.670 (1.961)	.866Q8 (7.304)	.625	53
12	QRI	.458 (1.508)	.832Q9 (8.972)	.715	80
13	QRI	.423 (1.540)	.863Q10 (10.135)	.762	102
14	QRI	1.518 (3.900)	.916Q12 (4.138)	.348	17
15	QRI	.441 (1.496)	1.048Q13 (9.313)	.730	86

Table D.4 (cont'd.)

16	QRI	.314 (1.095)	.954Q16 (10.011)	.757	100
17	QRI	.789 (2.178)	.983Q17 (6.525)	.570	42
18	QRI	.379 (1.388)	.826Q18 (10.343)	.769	106
19	QRI	.359 (1.162)	1.099Q19 (9.110)	.721	82
20	QRI	1.037 (2.440)	.733Q20 (4.857)	.424	23
21	QRI	.364 (1.349)	1.003Q21 (10.504)	.775	110

*Numbers in parentheses are t statistics

EI=economic index

QKI=quinoa index

QEI=environmental index

QRI=research index

Table D.5

Estimates of Regression Equations

Expected Change Given Decision
Based On Personal Preference & ECI

#	Dependent Variable	Constant	Independent Variable	R ²	F
1	ECI	.913 (3.669)	.578Q1e (6.515)	.570	42
2	ECI	1.185 (3.722)	.415Q1i (3.983)	.331	15
3	ECI	.582 (1.256)	.468Q1a (3.855)	.317	14
4	ECI	1.159 (3.115)	.441Q1h (3.340)	.258	11
5	ECI	.336 (1.777)	.648Q2 (11.633)	.808	135
6	ECI	.282 (1.480)	.673Q3 (11.822)	.813	139
7	ECI	.268 (1.447)	.588Q4 (12.223)	.823	149
8	ECI	.189 (1.212)	.864Q5 (15.042)	.876	226
9	ECI	.597 (2.562)	.727Q6 (8.292)	.682	68
10	ECI	1.313 (4.952)	.533Q7 (4.548)	.392	20
11	ECI	.484 (2.310)	.712Q8 (9.790)	.749	95
12	ECI	.355 (1.948)	.668Q9 (12.008)	.818	144
13	ECI	.498 (2.231)	.630Q10 (9.108)	.721	82
14*	ECI	.658 (2.762)	.646Q11 (7.831)	.664	61
15	ECI	.417 (2.036)	.808Q13 (10.347)	.769	107

Table D.5 (con't.)

*16	ECI	.172 (1.179)	.753Q14 (16.147)	.893	260
17	ECI	.250 (1.471)	.651Q15 (13.471)	.850	181
*18	ECI	.217 (1.430)	.781Q16 (15.323)	.883	234
19	ECI	.898 (2.835)	.556Q20 (4.939)	.432	24
20	ECI	.414 (2.011)	.749Q21 (10.283)	.767	105
21	ECI	.740 (3.117)	.630Q22 (7.561)	.641	57
22	ECI	.782 (3.118)	.485Q23 (6.950)	.601	48

*Numbers in parentheses are t statistics

ECI=economic index

QKI=quinoa index

QEI=environmental index

QRI=research index

Table D.6

Estimates of Regression Equations

Expected Change Given Decision
Based On Personal Preference & QEI

#	Dependent Variable	Constant	Independent Variable	R ²	F
1	QE1	.997 (3.510)	.64801e (6.393)	.560	40
2	QE1	1.385 (3.716)	.43101i (3.533)	.280	12
3	QE1	.511 (1.00)	.55701a (4.173)	.352	17
4	QE1	1.239 (2.970)	.50701h (3.430)	.268	11
5	QE1	.296 (1.504)	.74402 (12.849)	.837	165
6	QE1	.249 (1.217)	.76803 (12.538)	.830	157
7	QE1	.256 (1.227)	.66404 (12.232)	.832	149
8	QE1	.109 (.778)	1.00005 (19.357)	.921	374
9	QE1	.657 (2.418)	.80806 (7.896)	.660	62
10	QE1	1.477 (4.814)	.57807 (4.267)	.362	18
11	QE1	.571 (2.193)	.77508 (8.580)	.697	73
12	QE1	.392 (1.770)	.74109 (10.975)	.790	120
13	QE1	.390 (1.915)	.758010 (11.986)	.817	143
14	QE1	1.343 (4.172)	.810012 (4.424)	.379	19
15	QE1	.467 (1.894)	.893013 (9.495)	.738	90

Table D.6 (con't.)

16	QEI	.242 (1.223)	.732Q15 (12.964)	.844	168
17	QEI	.270 (1.333)	.847Q16 (12.557)	.831	157
18	QEI	.735 (2.466)	.851Q17 (6.875)	.596	47
19	QEI	.285 (1.697)	.748Q18 (15.226)	.878	231
20	QEI	.247 (1.240)	1.005Q19 (12.887)	.838	166
21	QEI	.874 (2.574)	.667Q20 (5.530)	.488	30
22*	QEI	.349 (1.688)	.872Q21 (11.897)	.820	141
23	QEI	.812 (2.960)	.702Q22 (7.287)	.624	53
24	QEI	.748 (2.899)	.577Q23 (8.034)	.668	64

 *Numbers in parentheses are t statistics
 ECI=economic index
 QKI=quinoa index
 QEI=environmental index
 QRI=research index

APPENDIX E

Quinoa Valuation in Corn-Soy Based Layer Feeds

Quinoa Valuation in Corn-Soy Based Layer Feeds						
Variables in the Optimal Solution						
Range in the C(J)'s over which the solution remains Optimal						
Variables	Value	C(J)	C(J) LB	NV	C(J) UB	NV
1	6.22202	0.08820	0.08530	39	0.10663	2
3	1.59820	0.07720	-9999.99999	0	0.07919	39
4	0.50921	0.18740	0.18641	39	0.19298	28
5	0.72507	0.18740	0.17360	28	0.18976	39
6	0.00849	2.64600	2.26809	39	4.74095	28
7	0.41305	0.02870	-0.03491	39	0.31239	28
8	0.41305	0.05510	-0.00851	39	0.33879	28
9	0.02381	0.24800	0.24149	39	0.27971	28
10	0.70305	0.23400	0.22654	28	0.23558	39
11	0.01705	0.03310	0.00585	28	0.54311	18
12	0.02700	0.83780	-9999.99999	0	9999.99999	0
Variables Not in the Optimal Solution						
C(J) at which variables would enter solution						
2		0.17640	0.14887			

Notes:

No. of Iterations: 40

Objective Function: 1.15414

NV=New Variable

LB=Lower Bound

UB=Upper Bound

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